Breaking the Learning Curve: Assessing Flintknapper Skill at the Epipalaeolithic Site of Kharaneh IV, Jordan

By

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Abstract

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Learning is a fundamental aspect of the human condition. It allows us to interact within a world of socially constructed meanings and to create individual and group identities (Jarvis 2012; Lave and Wenger 1991; Wenger 1998). My research investigates knowledge transmission during the Epipalaeolithic Period at the hunter-gatherer site of Kharaneh IV (≈20,000 BP) (Maher and MacDonald 2013) and argues that stone tool production (flintknapping) can be viewed as a practice that reflects normative rules guiding the interactions of flintknapping communities in the ancient past.

Evidence of the practice can shed light on an ancient *habitus* related to learning and participating within a community of practice (Lave and Wenger 1991; Cole 1996; Weisner 2002; Rogoff 2003; Maynard and Greenfield 2006; Joyce 2008; Wallaert 2012; Takakura 2013). The study of education in archaeology primarily focuses on ceramics as it is an additive process where each step is identifiable through microscopic analyses. While these studies have proven useful for understanding how novices learned practices in the past, in most regions ceramics only extend back to about 8,000 years BP and studies on apprenticeship and learning rarely extend past the Bronze Age (Hasaki 2012). To examine a reductive technology like flintknapping one must take a different approach than previously established ceramics studies on apprenticeship (Gosselain 2000; Wallart 2012; Hasaki 2012). The waste products, debitage, are the basis for analysis rather than the final tool form as each removal of flint during the production process preserves prior removal scars and indicates how an individual piece was removed.

The knowledge of where to find raw materials, how to 'correctly' reduce a blade core, and what constitutes a tool is circumscribed by the community (Ortner 2001; Joyce 2008; Pea and Cole 2019). Therefore, lithic artifacts may represent normative practices of flintknapping during the Epipalaeolithic. New materials or techniques can reflect changing dynamics within a community as the establishment and continuity of traditions are reliant upon ongoing apprentice/master relationships (Lancy 1980; Lave and Wenger 1991; Wallaert-Pêtre 2001; Greenfield et al. 2003; Milne 2012; Takakura 2013). By studying how unskilled flintknapping events are spatially related to skilled flintknapping events we can begin to reveal the *habitus* of a community of practice. Applying Lave and Wenger's (1991) legitimate peripheral participation to lithic artifacts and flintknapping education during the Epipalaeolithic, I pose a fundamental question: Can learning and evidence of a sociotechnological practice be used to understand the

habitus constructed around flintknapping at the Epipalaeolithic hunter-gatherer site of Kharaneh IV?

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Chapter One
Introduction

The communities we learn in are integral to our understanding of the world and significantly shape our perceptions, choices, and perspectives. Cultural values, shared meanings, environmental knowledge, production methods, food acquisition and cooking are all influenced by the communities within which we learn and are enculturated (Lemonnier 1992; Wenger 1998; Wallaert 2012; Malafouris 2013; and Arnold 2018). The process of enculturation allows individuals to interact within a community through shared histories, language, experiences, and perspectives, as well as 'known' pasts and imagined futures (Vygotsky 1978; Bourdieu 1977; Wenger 1998). Becoming part of a community is learned. Learning these histories and cultural norms and, thus, how to become an active member of a community, is the *goal* of apprenticeship, with some community members acting as teachers or 'masters', and others as apprentices, peers, or 'novices' (Greenfield and Lave 1982; Lave and Wenger 1991; Wenger 1998; Kamp 2001; Baxter 2005; Wendrich 2012).

The evolutionary origins of educational practices are not yet known, and current research depends on primate studies and the archaeological record in an attempt to reconstruct the history of education and learning as we know it today (Roffman et al. 2012; Grimm 2001; Takakura and Naoe 2019). Learning and teaching through cultural traditions and norms is a fundamental aspect of human existence in a world full of social meanings and knowledge (Schaik et al. 2019). We learn from a young age how to live within our community, using its social knowledge and cultural tools to cook our food, build and furnish our houses, organize or daily lives, teach our children, and interact with others or, in other words, live meaningful lives (Vygotsky 1978; Wenger 1998).

There is a long history of investigating technology to understand learning within a community and, more recently, learning within communities of practice (Lave and Wenger 1991; Wenger 1998). Technology can be viewed as the distillation of traditional knowledge, physical environments, social and cultural values, histories of practice and habitus, and individual skill. With this social approach to technology, it is possible to investigate the *praxis* and *habitus* involved in learning and the enculturation processes of past societies (Bourdieu 1977; Dobres and Hoffman 1994; Gossalian 2000; Dobres 2000; Arnold 2018).

Knowledge and, ultimately, technology is a fluid aspect of life that is necessary to understand past technological and social choices. Noam Chomsky wrote, "No discipline can concern itself in a productive way with the acquisition or utilization of a form of knowledge, without being concerned with the nature of that system of knowledge" (1979, 43). My research is uniquely situated to explore the social aspects of learning to flintknap within a community of hunter-gatherers. Through analysis of stone tools and debitage, experimentation with modern flintknappers, and highly detailed spatial analysis from site excavations, I strive to illuminate both the *habitus* and embodiment of flinknapping practice at the Epipalaeolithic site of Kharaneh IV, eastern Jordan. To identify a body of knowledge, detailed understandings of the *chaîne opératoire* (including approaches to tool production and error correction) and individual skill level are necessary as these components are negotiated aspects of a community of practice (Lave and Wenger 1991; Wenger 1998). My research approaches these interdependent aspects of the flintknapping repertoire to gain a more holistic understanding of the communities of practice that interacted with the site of Kharaneh IV and the knowledge they produced and transmitted (Wenger 1998).

The *chaîne opératoire*, or chain of operations, is necessary for understanding the general approach to making blade cores at Kharaneh IV (Karlin et al. 1991; Sellet 1993; Chazan 2003; Schlanger 2005; Tostevin 2011). Through refitting lithic artifacts from caches and across an occupation surface, in combination with previous techno-typological analysis at Kharaneh IV (Wilke and Quintero 1994; Macdonald et al. 2018; Barket et al. In Press) the general *chaîne opératoire* of blade core reductions is reconstructed in Chapter 8. With the *chaîne opératoire* outlined, expected patterns of reductions are established and thus variation from the pattern can be identified (Shelly 1990). This allows for exploration of both the established repertoire of the community of practice and for investigating how skill is expressed through a reduction sequence.

Individual skill is difficult to determine in lithic analysis as all flintknappers make mistakes and produce errors while producing stone tools (Torres and Preysler 2020). The experimental work conducted and discussed in Chapters 5 and 6 has advanced the common experiential approach (Thomas 1986) to determining the skill of a flintknapper by using morphological, metric, and aggregate data to establish the level of skill an individual expresses from novice to intermediate to master practitioner. Previous experimental work on skill has focused predominantly on biface production and has been able to differentiate skilled from unskilled individuals (Dibble 1997; Ferguson 2008; Eren et al 2011; Eren et al. 2016). With a clearer resolution of the skill level of a flintknapper during the process of making blade cores it is possible to use skill level data and articulate it with a *chaîne opératoire* approach to the analysis of stone tools and their associate debris to determine if notable variations in reduction sequences are due to individual skill or different learned repertoires. Identifying traditions for making stone tools signal different aspects of communities of practice in the archeological record, while exploring individual experiences and idiosyncrasies allows us to reconstruct aspects of the process of learning stone tool production as a social technology. The reconstruction of skill in the archeological record and identification of communities of practice will be discussed in Chapters 8 and 9.

Role of Stone Tool Production at Kharaneh IV

Set in the backdrop of the Epipalaeolithic landscapes, changing environments, and complex social dynamics, life at Kharaneh IV would have been shaped by the dynamic interactions across social and environmental spheres (Prucel 2006; Bauer and Kosiba 2016). A key junction of these two spheres is stone tool production. Raw material for flintknapping was predominantly sourced from local outcrops (de la Torre et al 2019) and brought to Kharaneh IV to make the tools required for daily activities (Macdonald 2013; Maher and Macdonald 2013; Macdonald et al. 2018). Other tools frequently associated with flintknapping like hammerstones, billets, pressure flakers, leather, and abraders would also need to be sourced from the environment. Flintknappers would require knowledge of the raw materials like locations, quality, quantity, and seasonality (Rockman 2012) and the knowledge of the process to produce stone tools, making supplemental tools (i.e., billets, pressure flakers, hafts, or leather), and the negotiated meanings within the flintknapping community (i.e., these pieces we can use for this type of work and those pieces we use for that kind of work) (Wenger 1998; Högburg 2008; Finlay 2015). Knappers would likely have learned how to make tools at a large aggregation site with easy access to good quality flint outcrops and would have taught others how to make them (Milne 2012).

Lithic technology can be viewed as the distillation of traditional knowledge, physical environments, social and cultural values, histories of practice, *habitus*, and individual skill. With this social approach to technology, it is possible to investigate the *praxis* and *habitus* involved in the learning in the ancient past (Dobres and Hoffman 1994; Gossalian 2000; Arnold 2018). Through techno-typological analysis of debitage, investigations of source material, a flexible knowledge of the *chaîne opératoire*, and an understanding of expressed skill it is possible to situate the practice of flintknapping at Kharaneh IV within its social and environmental contexts.

My research investigates the presence of skilled and unskilled flintknappers at a Kharaneh IV to better understand the process of flintknapping at Kharaneh IV, distinguish between variability and skill, and explore the presence of novice flintknappers.

In Chapter 2, I explore the current paleoclimatic and archaeological research from southwest Asia. Climate and environment play active roles in the technologies that people choose to engage with thus connecting environment, traditional knowledges, and social connections (Chakrabarty 2019). Chapter 3 expands on archaeological research from southwest Asia and focuses on the history of lithic research, major debates within lithic analysis, and discusses the current approach to lithic analysis taken by researchers at Kharaneh IV. Chapter 4 details the four major theoretical paradigms that structure this research. First, Lave and Wenger's (1991) influential notion of communities of practice is used to conceptualize groups of Epipalaeolithic flintknappers and the process of becoming a skilled master flintknapper through legitimate peripheral participation. This approach compliments the genetic processes model by Saxe (1994, 2002, and 2014; Saxe et al. 1996; Saxe et al. 2009). This approach expands on the processes of change. How actions, behaviors, and practices can change by a single individual (microgenesis), through interactions with others (sociogenesis), and throughout one's lifetime (ontogenesis). Practice theory compliments both of these approaches as it is focused on the social components of a practice and fundamentally centers daily practices as a means to approach *habitus* (Bourdieu 1977). *Chaîne opératoire* allows for fine scale analysis of daily practices — here flintknapping— for archaeological analysis and interpretation (Audouze et al. 2017; Schlanger 1994; Schlanger 2005; Chazan 2009). Combined these four theoretical approaches compose the base of this research to better understand the social aspects of learning to flintknap within an Epipalaeolithic hunter-gatherer community.

In Chapter 5, I review the lab methods used to analyze both lithic artifacts from Kharaneh IV and the experimentally produced lithics. Fundamentally, the techno-typological approach used here aligns with current research carried out by researchers at Kharaneh IV (see Maher and Macdonald 2013; Macdonald et al. 2018; and Barket et al. In Press). Some additional methods were added to capture glimpses of skill acquisition such as platform preparation (Bamforth and Finlay 2008), blade regularity (Pelegrin 1990), core trimming element and blade metrics collection (Andrefsky 1998), and refitting (Laughlin and Kelly 2010).

Chapter 6 outlines the flintknapping experiment with novice flintknappers, data collection of all participating flintknappers, and the parameters of the experiment. The experiment was conducted to determine commonalities among the debitage of novice, intermediate, and master flintknappers. Twelve novice flintknappers participated in ten flintknapping sessions where they observed blade core reduction and attempted to produce blade cores (N=127 unique blade cores) with minimal instruction. Ten skilled individuals produced a total of 39 blade cores. One novice flintknapper participated in a knap-in with the skilled flintknappers of the Puget Sound Knappers (PSK) and produced two blade cores, these were analyzed separately from both the skilled flintknappers and the novice experimental flintknappers.

Chapter 7 consists of the statistical analysis completed o the experimentally produced lithic assemblage. Skill level was initially assessed based on multiple common skill indicators as thoroughly discussed by Bamforth and Finlay (2008), Ferguson (2008), Apel (2008), and Bleed (2008). After analysis of the experimental debitage, K-cluster analysis and two-step cluster analyses was used to assign skill level to the participating flintknappers. Statistical analysis determined that there were three distinct skill levels, novice, intermediate, and master. When compared to a 2-step cluster analysis, novices were always classified as novices, masters were always classified as masters, however intermediate flintknappers were grouped with either skilled or unskilled clusters. Analysis of the experimental assemblage determined that blade regularity, the frequency of blades, the frequency of prepared platforms, average platform thickness, core trimming element frequency, and the diversity of error correction techniques can be used to determine the skill level of a flintknapper through debitage. These characteristics of skill were verified through a longitudinal study where three blade cores produced by myself were analyzed. The blade cores were produced during different periods of my flintknapping trajectory (a novice blade core from 2017, an intermediate blade core from 2020, and a master blade core from 2022) and were analyzed using the same methods as the experimental blade cores. The longitudinal test blade cores were clustered within the coordinating group (novice, intermediate, and master respectively). The data acquired during the experimental phase was mobilized to create a quick assessment tool for skill level analysis that was later used in the lithic analysis of three Early Epipalaeolithic caches and two lithic concentrations to assess the skill level of ancient flintknappers at Kharaneh IV.

Chapter 8 investigates an Early Epipalaeolithic flintknapping area at Kharaneh IV using techno-typological analysis. Seven lithic concentrations (three of which are caches) were fully analyzed (techno-typological analysis, refitting, and skill level analysis) while the flintknapping floor (Locus 043) only underwent techno-typological analysis. Findings from the analysis of the Early Epipalaeolithic assemblage suggest that a highly skilled flintknapper was situated on the flintknapping floor with lesser skilled flintknappers likely situated around them. Chapter 9 expands on this analysis and discusses potential educational structures that the archaeological record suggests. Furthermore, I reflect on assumptions I made as a flintknapper and lithic analyst and how these assumptions affect the way I approached flintknapper skill assessment. Termination types, error correction methods, platform preparation, and blade regularity are all notably major contributors to skill level analysis and are prone to unique biases. Overall, this chapter discusses, the *chaîne opératoire* of the Early Epipalaeolithic flintknappers who produced the caches, concentrations, and flintknapping floor deposit that are generally similar to one another. With both skill level analysis and techno-typological analysis this research was able to distinguish between variability caused by learning and variability caused by different communities of practice.

Chapter Two
Epipalaeolithic Background of Southwest Asia

Background

Twenty thousand years ago Southwest Asia was a dynamic region of trade, complex hunting and foraging strategies, regional responses to environmental challenges, and extensive knowledge systems (Goring-Morris and Belfer-Cohen 1997, Martin et al. 2010; Maher *et al.* 2016; Henton et al. 2017; Bode et al. 2022). In order to contextualize this dynamism, this chapter discusses the evidence for paleoenvironmental parameters, subsistence practices and mobility patterns of Epipalaeolithic hunter-gatherers, and will conclude with the role of stone tool production in Epipalaeolithic lifeways.

Southwest Asia encompasses the modern-day countries of Turkey, Syria, Jordan, Israel, Palestine, Lebanon, western Iraq and northern Saudi Arabia. Epipaleolithic research has been predominantly focused in the southwest, an area historically referred to as the Southern Levant[1], due to persistent geo-political unrest in much of the rest of the region. Jordan is particularly attractive for archaeological research as it has remained largely politically stable and safe over the last century, allowing for reliable access to permits and an operational Department of Antiquities conducive to long-term research projects, (Garrard and Byrd 2013:2). The Epipaleolithic is a term used to denote the period after the Upper Paleolithic and before the Neolithic[2]. The dates for the Epipaleolithic vary by region but in the southern Levant the accepted time span is *ca.* 23,000 – 11,500 cal BP (Goring-Morris and Belfer-Cohen 2017). Compared to the Upper Paleolithic, evidence suggests that humans were increasingly territorial and took advantage of the diverse environments within the Levant to hunt, gather, forage, and fish in wetlands, steppe, highlands, coastal plains, dense woodlands, park woodlands, and deserts. A classic "core-periphery model" uses the parallel technological changes from inhabitants on both sides of the Rift Valley, caused either by environmental adaptation or geographic proximity, to determine cultural affinity and, thus, territoriality (Clark 1968). In the past, researchers have pointed to the shift from geometric microliths to Early Natufian technology, and finally Late Natufian technology during the Epipaleolithic to support the core-periphery model. Continuities and discontinuities of the lithic technologies vary by the amount of technological innovation as technology is thought to have diffused from the 'core' to 'peripheral' regions. In this model, the 'core area' or Mediterranean zone was composed of more sedentary groups along the Mediterranean coast while the 'periphery' or arid zone was thought to be composed of mobile hunter-gatherers who logistically exploited the various ecological zones across the Irano-Turanian steppe and Saharo-Arabian lowland (Henry 1995: 15-19, Goring-Morris 1987, Garrard and Byrd 2013:10-16; Goring-Morris and Belfer-Cohen 2013: 563; Goring-Morris and Belfer-Cohen 2017).

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[1] Levant is a historical term that began in the 15th century and persists in Southwest Asia today. The name is derived from the Italian word *levante* which means rising and was used by the Venetians to describe the lands to the east- where the sun rises (Gagarian 2009).

[2] The Neolithic or 'New Stone Age' was termed the 'Neolithic Revolution' by Gordon Childe. This period was first named for the polished stone axes found on sites from the period but soon grew to encompass a 'package' of lifeways including pottery, megalithic structures, larger and more permanent settlements, and domesticated plants and animals. Childe described the Neolithic Revolution as a shift from a hunting-gathering lifestyle to a food production lifestyle (Childe 1935).

Paleoenvironment

Global Paleoenvironments

The Pleistocene-Holocene transition was characterized by climatic changes that shaped the modern landscape and is summarized in Table 2.1. Approximately 2.6 million years ago the onset of the Pleistocene was experienced throughout the world as a period of predominantly glacial conditions interspersed with sporadic warmer interglacial phases, ending around 11,500 BP. The most recent glacial maximum, known as the Last Glacial Maximum (LGM), started around 25,000 BP (at the end of the Upper Paleolithic) and peaked globally around 18,000 BP leaving most of Europe, Asia, and North America glaciated or in permafrost conditions (albeit with localized fluctuations) for 8,000 years (Donder et al. 2018, Lindgren et al. 2016, Maher et al. 2011, Nemhe et al. 2015, and Shackleton 1987) (Table 1.1). Conditions ameliorated for a short period of time before the rapid cooling event, known as Heinrich Event 1 (H1 Event). The H1 Event was caused by the rapid influx of fresh glacial water into the Atlantic Ocean that disrupted the thermohaline circulation patterns of ocean currents (Bar-Matthews et al. 1997; 1999; Heinrich 1988; Maher et al. 2011; Rohling 2013; and Robinson et al. 2006). This brief period was experienced globally from 16,800-16,500 cal BP as a cold and dry phase that is preserved in speleothem data as increased δ18O levels. The Bølling-Allerød, a rapid warming phase, soon followed with an increase in precipitation from 14,670 cal BP (Bar-Mathews et al. 1997; 1999; Bar-Matthews et al. 2003; Bar-Matthews et al. 2017; Frumkin et al.1999; Weaver et al. 2003). Temperatures rose 4-5ºC (Maher et al. 2011) during this period of climate amelioration and lasted approximately 1,800 years before a return to glacial conditions. From 12,900- 11,600 cal BP glacial conditions returned leaving the region arid and 6ºC cooler (Maher et al. 2011) than during the Bølling-Allerød. The phase known as the Younger Dryas, was a short dry and cold period comparable to the LGM in many regions of Southwest Asia (Bar-Matthews et al. 1999; 2003; Maher et al. 2011; Robinson et al. 2006; Vaks et al. 2006; Weaver 2003). Researchers point to the conditions of this time period as a driving force in increased sedentism, domestication, and social complexity as the rapid cooling during the Younger Dryas caused glaciation across much of northern Europe (Moore 1982; Bar-Yosef and Belfer-Cohen 1989, 1991, and 2002; McCorristen and Hole 1991). This brief cold period cannot be seen globally, as the data is derived from the ice cores in Greenland, but much of Europe lost forested ecosystems and transformed into arctic steppe. This environmental shift is also supported by the faunal record, in northern Eurasia, arctic adapted species like reindeer, arctic foxes, and pika were present while species that require warmer temperatures like pond turtles and insects disappeared. The perceived increase of environmental stress is linked to the beginning of the Pre-Pottery Neolithic A (PPNA) (Grosman and Belfer-Cohen 2002; Sommer et al. 2011) and marks the transition between the Pleistocene and Holocene. The Pre-Boreal phase (11,570- 10,070 cal. BP) is considered to represent the onset of the warmer and wetter Holocene (Bar-Matthews et al. 2003, Frumkin et al. 1994; Robinson et al. 2006, van der Plicht et al. 2004). The regional and local expressions of these global climatic oscillations, however, show a different pattern of environmental changes in the Levant. Starting from the southwestern point and working to the northeast, these variations from global climate patterns are discussed below and summarized in Table 2.1.

Event	***Duration cal. BP (Error ±)***	***Global Peak***	***Climatic Conditions***
Last Glacial Maximum	25,000- 18,000 (±500)	22,000	Cold and dry
Heinrich 1 Event	16,800- N/A (±150)	16,600	Rapid cooling
Bølling-Allerød	14,670- 12,870 (±35)	N/A	Warm and humid
Younger Dryas	12,900-11,600 (±120)	N/A	Cold and dry, return to glacial conditions
Pre-Boreal	11,570- 10,070 (±10)	11,400	Rapid warming

Table 2.1: This table shows the major climate oscillations globally experienced from 25,000 cal. BP to 10,000 cal. BP. (Modified from Bar-Matthews et al. 1997; Enzel et al. 2008, Heinrich 1988; Maher et al. 2011)

Regional Paleoclimates

The Sinai Peninsula is a triangular tract of land that connects northern Africa and Asia, separates the Mediterranean Sea and Red Sea, and is part of the northern extension of the African Rift Valley. This region is today dominated by desert landscapes and the Red Sea mountains which is vastly different from the environment during the LGM (Roskin et al. 2014 and Goring-Morris and Goldberg 1990). Compared to the modern climate, the Sinai was cold and humid during the LGM. Carbonate deposition from spring tufa deposits suggest that there was substantial groundwater present to produce the concretions. By 19,000 cal BP, before the end of the LGM, tufa deposition ceased, indicating that there was no longer enough rainwater to feed the local springs until the Bølling-Allerød (Roskin et al. 2014). As a period of pronounced aridity followed the LGM, sand dunes encroached upon the region covering watersheds and blocking wadis[3] as the winds blew them from west to east. As the warmer and wetter Bølling-Allerød set in, precipitation gathered in dammed up wadis creating shallow lakes and playas (Goring-Morris and Goldberg 1990). The presence of these playas and lakes were short-lived as the Younger Dryas brought a short but distinct era of cool and arid climates that gradually became more arid throughout the Holocene (Hamdan and Brook 2015; Robinson et al. 2006; Roskin et al. 2014).

The Negev is bordered on the west by the Sinai Peninsula and to the east by southern Jordan. The Negev comprises roughly 55% of the landmass of present-day Israel and is today a vast semi-arid steppe and desert of sand dunes, deeply incised canyons, and wadis (Hertzog et al. 2010). During the LGM it was not significantly different, a cold and semi-arid climate prevailed as sand dunes began to move into the region from the west. As the LGM progressed and the H1 Event began to take hold of the region it became hyper-arid (Goring-Morris and Goldberg 1990 and Roskin et al. 2014). Sand dunes were created by sand blown from the Sinai into the Negev by the west-eastern prevailing winds during the H1 Event and blocked wadis with aeolian sands throughout the desert. Seasonal storms potentially caused fluvial events that filled the dammed

[3] Wadis are seasonal channels, streams, or valleys that are dry throughout the year except during the rainy season.

wadies resulting in standing water around 15,700 cal BP (Roskin et al. 2014). This warm and wet period continued through the Bølling-Allerød and is supported by the presence of aeolian sands (dams) that helped slow the seasonal water flow and created natural reservoirs, silts and clays suggesting low-velocity water movement through wadis, and the formation of calcareous palaeosols. A proposed model suggests a pattern of west-east moving seasonal Mediterranean cyclones that provided much of the precipitation during the period (Roskin et al. 2014: 187-189). The climate quickly changed around 12,900 uncalibrated BP as a new arid phase began in the region. Globally, the Younger Dryas here was significantly cooler and drier than the Bølling-Allerød. However, in the Levant there was a notable decline and, ultimately, termination of sand dune incursion during this period. Less frequent seasonal water flow events continued to be slowed by the dammed wadis, the low-velocity flows intermittently created small lakes and playas. By 11,000 uncalibrated BP fluvial activity was dramatically reduced and a pattern of increasing aridity continued through the Holocene (Goring-Morris and Goldberg 1990; Roskin et al. 2014:189).

Further to the north the coastal plain is greatly impacted by the Mediterranean Sea. Today, the area receives 500-600 mm of precipitation annually and is a Mediterranean climate zone with seasonal precipitation from October to April. Comparatively, the climate was colder and drier during the LGM (Kadosh et al. 2004). Sediment and palynological analysis suggest oscillations between wetter and drier periods within the LGM. Paleosol formation in the Carmel Coastal Plain suggests the presence of a dry Mediterranean steppe environment that became more arid between 25,000 and 17,500 cal BP (LGM peak) and then experienced warmer and moister conditions briefly from 17,500 to 16,800 cal BP (Kadosh et al. 2004:151). This date correlates with the onset of the H1 Event and an erosional unconformity within the sedimentary record that suggests a different depositional environment to the previous stages (Kadosh 2004). During this period, a combination of low evaporation rates due to cooler temperatures and seasonal Mediterranean cyclones transformed the steppe environment around Mount Carmel into a marshy wetland (Kadosh et al. 2004; Rohling 2013). Organic-rich clay deposits and palynological analysis suggest the presence of a marsh until the onset of the relatively mild Younger Dryas. Analysis of the clay deposits and the reduced presence of arboreal pollen support the hypothesis that the region briefly returned to a Mediterranean steppe environment. By 10,250 cal BP wetlands returned as a result of increased precipitation and cool temperatures that reduced evaporation rates (Kadosh et al. 2004; Rohling 2013). Kadosh suggests that the area only remained a wetland for a few hundred years before reverting to steppe, with the gradual aridity of the Holocene.

The Judean Mountains make up most of the southern Levant's western highlands. With an average elevation of 1000 m, the mountain range effectively creates three distinct environmental subzones. The Mediterranean Coast gives way to gentle foothills that lead up to a small limestone mountain system, or central hill country. These small mountains grade into the larger Judean Mountain system while broad valleys that transect the mountain range allow for easy human passage across the range to the Dead Sea (Golden 2002:295-296). Each of these environments would have been affected differently by the LGM. This is reflected in the speleothem data taken from Soreq Cave in Israel and the lithology of Lake Lisan (Ghazleh and Kempe 2009; Rohling 2013). Speleothems are a localized reflection of evaporative processes, temperature, $\delta^{13}C$ of soil, water availability, and vegetation near a cave system that provide a fine-grained proxy record of local paleoclimate (temperature and precipitation) through the deposition of precipitated isotopes that form incrementally over time. Oxygen-isotope ratios are used as proxies for the environment during deposition. A higher ratio of oxygen-16 suggests a warmer and wetter deposition environment while a higher ratio of oxygen-18 is interpreted as a colder deposition environment (Robinson et al. 2006: 1525-1526). Researchers found that the LGM was the coldest and driest period over the last 25,000 years (Orland et al. 2012) with an average temperature between 8-12ºC (Robinson et al. 2006:1533). One brief period of slight warming occurred around17,000 cal BP but the amelioration was short-lived as a return to cold and dry conditions is suggested by the small but noticeable oxygen-isotope excursion; higher relative presence of oxygen-18 suggests a warmer climate as it is heavier and precipitates out at higher temperatures than oxygen-16 which suggests colder climate as it condenses and precipitates out of the atmosphere at lower temperatures (Bradley 1999 and Bar-Matthews et al. 1999). This warming phase quickly gave way to the H1 Event marked by higher $\Delta^{18}O$ values in the speleothem layers (Bar-Matthews et al. 1999). Orland (2012) proposes that the region may have experienced regular snow cover and/or a change in vegetation during the cooling event. By 15,000 cal BP the climate again experienced increases in temperature (averaging 18ºC during summer months) and moisture (Robinson et al. 2006:1536). Stable isotope data from Soreq Cave suggest increased temperatures and more C_3 plants within the watershed of the cave (Bar-Matthews et al. 1997, 1999, 2003). Palynological analysis from the Ghab Valley in modern Syria suggest that the Bølling-Allerød was a period of increased precipitation as evidenced by the presence of oak forests that require at least 50 cm of water annually (Rossignol-Strick 1995). This data corroborates the estimates from Bar-Matthews' (1997), where speleothem data suggests annual precipitation was between 500 and 750 mm. A perceivable drop in temperatures occurred during the Younger Dryas to approximately 13ºC (Bar-Matthews et al. 1999, Robinson et al. 2006 and Orland et al. 2012). Stable isotopes suggest that precipitation was reduced to approximately 150 mm/year (Robinson et al. 2006) but water availability within the cave, while diminished, remained consistent year-round (Orland et al. 2012). The Pre-Boreal and the onset of the Holocene mark a transition towards a climatic regime more like today. Warmer winters and wetter summers, increased precipitation, and distinct wet/dry seasons are reflected in the negative values from speleothem data (Bar-Matthews et al. 2000 and Orland et al. 2012). An increase in *Pistacia* and *Quercus* pollen in Ghab and Hula (Rossingnol-Strick 1995) indicate a rise in precipitation. Robinson (2006) suggests that the annual temperature increased to 16ºC with an average precipitation of 550-700 mm annually. Carbon and oxygen isotopes from snail shells suggest a warmer and wetter environment during the early Holocene (Goodfriend 1990). Carbon isotopes from Peqi'in Cave were used to verify the oxygen isotope values from Soreq Cave as fluctuations in carbon isotope ratios reflect changes in local vegetation. As C_4 plants become stressed through drought, high temperatures, and/or low atmospheric CO_2 they process CO_2 more efficiently and deposit more carbon into the soil. Bar-Matthews (2003) found a notable localized excursion of positive values for carbon-isotopes dated to the late Holocene that was interpreted as an increase in aridity that persists with minor fluctuations into the Anthropocene (Robinson et al. 2006).

Lake Lisan is the ancient predecessor to the modern Dead Sea that fills the valley created by the northern extension of the African Rift. The lake's catchment area extends from the western highlands to the eastern desert and from the Gulf of Aqaba to southern Syria and, thus, provides a broad view of environmental changes than the areas directly surrounding the lake (Rohling 2013). Geomorphological analysis and paleoclimate models suggest that during the LGM the lake was filled to its highest point from 24,600-24,000 cal BP due to decreased evaporation and increased precipitation (Bartov et al. 2002: 19; Ghazleh and Kempe 2009).

Rohling's model (2013) found that increased windiness, evidenced by an increase in windblown loess deposits across the northern Negev, and seasonal storms that produced ±500 mm of precipitation annually (Enzel et al. 2008) may have led to the increased lake levels. By 20,000 cal BP lake levels had dropped dramatically and remained relatively low until the onset of the BA. The H1 Event is only represented geologically through the sharp drop in lake levels attributed to increasingly intense winds and regional cooling (Bartov et al. 2002; Rohling 2013), but is also visible in pollen changes, speleothems, and marine sediment cores as a cold and dry phase (Maher et al. 2011). The Bølling-Allerød brought about a new wave of increased lake levels. Laminated marl deposits suggest deep water deposition thus higher lake levels. From ~15,000-13,000 cal BP warmer and wetter climatic conditions are considered to be a partial cause. Overlying the laminated marls are beach gravels and braided stream deposits that indicate high-energy shallow water deposition. A sand layer was OSL dated to 10,000 uncalibrated BP ±800 years and is thought to represent the receding of Lake Lisan during the Younger Dryas arid phase and exacerbated by wind erosion (Ghazleh and Kempe 2009). Above this layer is another deep-water deposition with silts and laminated marls. Wetter conditions returned to the area as it requires a minimum of 30 m (Frumkin 1997; Ghazleh and Kempe 2009: 261) of water to create the laminated marls seen in the lake deposits. Throughout the Holocene the lake generally continued to recede to its modern extent (Frumkin 1997; Ghazleh and Kempe 2009).

The Eastern Desert of Jordan, specifically the Azraq Basin, is a 12,000-km drainage basin located to the east of the Dead Sea and in the rain shadow of the northern extent of the Rift Valley. During the Paleolithic, the Azraq Basin experienced extreme fluctuations between a lake environment (around 150 kya cal BP), marsh lands, and drier steppic/parkland environment dominated by dicots and grasses. During the LGM the climate was cold with little precipitation (Cordova et al. 2013; Maher et al. 2021); however, the earliest Epipaleolithic deposits from Ayn Qasiyya suggest that a marshy environment had already taken root in the region. Reeds, sedges, and dicots were common in the phytolith record and increased quantities of charcoal suggest human utilization of the basin's vegetal resources (Ames et al. 2014; Ramsey et al. 2016). The endorheic basin was marshy despite reduced precipitation, as it was fed by wadis, aquafers, and springs that created standing water and ultimately oases. Low evaporation rates during the LGM also aided in the continued presence of the marshes as surface water pooled and marsh vegetation took hold (Jones and Richter 2011). Additionally, seasonal cyclones provided the region with seasonal precipitation (Cordova et al. 2013). By the end if the Early Epipaleolithic reeds, C3 plants, and woody dicots were common in the phytolith assemblage and were extensively utilized by the people in the region for housing and fuel for fires (Ramsey et al. 2016 and 2018). Immediately after the LGM a period of flooding, increased precipitation, or higher spring discharge was noted in the geomorphological analysis of the basin and was followed by a period of aridity. The lack of deposition at springs near Ayn Qasiyya from 16,000 to 10,500 cal BP suggests that the springs had dried out and a steppic environment returned to the region (Jones and Richter 2011). The Younger Dryas is ill defined in this region but evidence of dry lake beds and playas and the change of human behavior, a switch from large aggregation sites to small more mobile groups, suggests that the region was less hospitable than it had been during the Bølling-Allerød (Cordova et al. 2013). The transition into the Holocene saw increased aridity that was maintained into the late Holocene. Aurochs and wild boar, water dependent species, became virtually non-existent in the region after the Holocene began suggesting that there was not enough surface water available to support their presence on the landscape (Martin et al.

2016). This pattern of increased aridity continued into more recent times until the marshes returned ~2,000 cal BP (Cordova et al. 2013).

The Jordan Plateau is the hyper-arid region east of the receives less than 50 mm of precipitation annually. Qa'al-Jafr is a dry playa basin within the plateau region and acts as a catchment for some of the plateau's water. The remaining water runs north into the Dead Sea (Rech et al. 2017) During the LGM the western Qa'al-Jafr was once thought to have been a paleolake (Davies 2005; Enzel et al. 2008; Huckriede and Wiesenann 1968; Rech et al. 2017; and Mischke et al. 2015). Little is known about the east, but the lack of marl deposits and lake deposits that show past lake levels suggest that it was not as wet as the western part of the basin (Rech et al. 2017). Ostracods and charophyte algae from sediment samples support the hypothesis that the area was not a lake, but rather, a large wetland that spanned the western basin. By 25,000 cal BP the wetlands began to dry up (Mischke et al. 2015; Rech et al. 2017). Except for sporadic and short wet events evidenced by alternating aeolian and alluvial sequences deposited during dry conditions, the region remained arid through modern times (Davies 2005; Rech et al. 2017).

The northern extent of the southern Levant experienced a consistently wetter paleoclimate than many of the more southern regions. The region, only 10º south of the permafrost region (Lindgren 2016) was markedly wetter prior to the LGM with braided channels and abundant downstream sediment transport indicating the presence of a consistent water supply (Oguchi et al. 2008). Excavations and geomorphological analysis at the site of Dederiyeh Cave have shown a consistent presence of water prior to the LGM then cold and dry conditions set in until the H1 Event (Frumkin et al. 2011). During the LGM the climate was cold enough to reduce the evaporation speed of surface water. Climatic changes after the LGM are not as distinct and only records of trends of increased/decreased precipitation are available for the region (Iriarte et al. 2011 Oguchi et al. 2008, and Rossingnol-Strick 1995). Despite reduced precipitation, surface water remained present through the early Holocene evidenced oncoids (spherical sedimentary structures that form in warm freshwater) found along the terraces of the Khabur River. These onicods suggest that shallow water was present during the early Holocene as they only form in shallow water environments and could not have been moved by the low gradient Khabur River (Oguchi et al. 2008). Human intervention caused the displacement of onicods from the riverbed as they were used for construction material at the site of Tell Seker al-Aheimar, a PPN site (Oguchi et al. 2008). During the early Holocene, increasingly strong seasonal storms amplified fluvial activity, reflected in the deposition of fluvial sediments throughout the Khabur River terraces. The Bouqaia Basin to the west of Dederiyeh Cave reflects the climate patterns of central Syria (Iriarte et al. 2011). By the late Holocene both regions had become progressively more arid, evidenced by ephemeral wadi activity, eventually leading to the modern arid climate (Iriarte et al. 2011, Oguchi et al. 2008, and Robinson et al. 2006).

Palaeoclimate Reconstructions of Southwest Asia				
	Sinai Peninsula	**Negev Desert**	**Mediterranean Coast**	**Western Highlands**
Location & Type	Gebel Maghara, Egypt Wadi	Nahal Sekher, Israel Wadi	Carmel Cave, Israel Cave	Soreq Cave, Israel Cave
Type of Analysis	Geomorphology and marine cores	Geomorphology	Speleothems, geoarchaeology, and palynology	Speleothems
Scale of Analysis	Regional	Regional	Localized to catchment	Localized to catchment
Last Glacial Maximum	Cold and hyper-arid. Palaeolakes begin to recede.	Cold and dry. Sand dune incursion begins	Cold and dry. Paleosol formation during drier conditions.	Cold and moist. Year-round supply of drip water available in topsoil.
Heinrich 1 Event	Cold and dry. Pronounced aridity, sand dune incursion.	Cold and arid. Peak of sand dune incursion.	Cold and wet. Clay deposits suggest wetland environment.	Cold and moist. Spring meltwater contributes to water table, water available in topsoil and in cave.
Bølling-Allerød	Warmer and moister. Increased precipitation creates small lakes. Wadis blocked by sand dunes, playas and small lakes form.	Warmer and moister. Wadis blocked by dunes, playas and small lakes form.	Warmer and wet. Clay deposits suggest wetland environment.	Drier. Decrease in seasonality (wet/dry) and increase in aridity.
Younger Dryas	Cool and dry. Arid phase.	Cool and drier. Seasonal and/or episodic fill of low velocity water in dammed wadies.	Dry. Unconformity in stratigraphy, possible dry period.	Drier. Decrease in seasonality (wet/dry) and increase in aridity.
Pre-Boreal	Warmer and moister. Increased precipitation creates small lakes.	Warmer and dry. Arid conditions return.	Warmer and wet. Newly formed marshland.	Warmer and drier. Decrease in seasonality (wet/dry) and increase in aridity.
Citations	Hamdan & Brook, 2015; Robinson et al. 2006; Roskin et al., 2014	Goring-Morris & Goldberg 1990; Roskin et al. 2014	Kadosh et al. 2004	Bar-Matthews et al. 1999; Bar-Matthews et al. 2000; Orland et al. 2012

Table 2.2: Regional climatic conditions in Southwest Asia of the Pleistocene-Holocene Transition. The major effects global changes had on regional hydrology and climate during each period were collected from geoarchaeological, geomorphological, marine core, palynological, and speleothem research conducted at one or more sites from each region.

Palaeoclimate Reconstruction of Southwest Asia			
Rift Valley	**Eastern Desert**	**Jordan Plateau**	**Southern Syria**
Lake Lisan, Jordan Palaeolake basin	Azraq Basin & Druze Marsh, Jordan Endorheic basin	Qa'el-Jafr, Jordan Endorheic basin	Dederiyeh Cave & Bouqaia Basin, Syria Cave and alluvial fan
Geomorphology	Geomorphology, geoarchaeology, sedimentology, faunal and palaeobotanical analysis	Sedimentology and micropalaeontology	Geomorphology and geoarchaeology
Regional	Regional	Regional	Localized to catchment & Regional
Cold with West-East seasonal cyclones (±50mm of precipitation). Large lake present.	Cold and wet. Marshy but began to dry up around 25,000 cal BP.	Cool and wet. Wetlands present on landscape begin to recede by 25,000 cal BP.	Cold and dry. Surface water present due to reduced evaporation.
Cool and arid. Increased wind and hyper salinity of lake.	Cold and wet. Marshy but progressively drier, springs provided localized water source	Cool and dry. Water tables dropped and brief wet/dry cycles occurred.	Cool and wet. Wet conditions and fluvial activity present.
Warmer and moister. Lake levels rise dramatically.	Cool and dry. Possible damming of wadi induces localized marshes.	Cool and dry. Water tables dropped and brief wet/dry cycles.	Warmer and wet. Wet conditions and fluvial activity present.
Cool and dry. Lake levels decrease.	Cool and dry. Dry lakebed with eolian activity.	Cool and dry. Water tables dropped and brief wet/dry cycles.	Cool and dry. Arid phase.
Warmer and dry. Lake levels continue to decrease.	Warmer and dry. Dry lakebed with eolian activity.	Warm and arid. Ephemeral and sporadic playas	Warmer and wet. Wet conditions and fluvial activity present.
Ghazleh & Kempe, 2009; Rohling 2013	Cordova et al., 2013; Ames and Cordova 2015; Jones and Richter, 2011; Jones et al. 2016; Jones et al. 2017	Davies, 2005; Enzel et al., 2008; Huckriede and Wiesenann 1968; Rech et al. 2017; Mischke et al. 2015	Iriarte et al. 2011; Oguchi et al. 2008

Subsistence and Mobility

During the Epipaleolithic (23,000-11,600 cal BP), mobile hunter-gatherers thrived in the mosaic landscapes of the Levant. As discussed above, the region is ecologically and geologically diverse with mountains, valleys, deserts, parklands, and wetlands that played a role in the development of the dynamic ways of life from social organization to resource utilization (Henry 1995; Richter et al. 2011; Garrard and Byrd 2013). The Epipaleolithic period spans the transition from the late Pleistocene into the early Holocene that ultimately led to a change in subsistence patterns that, as some researchers argue, laid the foundations for the intensification and domestication of plant and animal resources known as the Neolithic (Garrard and Byrd 2013; Bar-Yosef 1996, 2002; and Goring-Morris and Belfer-Cohen 2010). Other scholars argue that the Epipaleolithic was a period of pre-adaptations for food production that occurred in "fits and starts" that lead to the Neolithic revolution (Asouti and Fuller 2012; Ramsey et al. 2016). Faunal and botanical remains demonstrate Epipaleolithic people's vast knowledge regarding the resources available to them in these landscapes (Bar-Oz et al. 1999; Bar-Oz 2004; Ramsey et al. 2016, 2018; Richter et al. 2011; Maher et al. 2015; Maher 2019).

Furthermore, subsistence strategies are integral to understanding the motivations, choices, and behaviors taking place on a given landscape. Researchers can use subsistence as an interpretive lens to contextualize the various roles stone tool technologies play in daily life. Human-plant interactions can be seen archaeologically through use-wear analysis. Sickle gloss is a key example of how tools can be used to interpret behavior as sickle gloss is the buildup of silicon on the cutting edge of a stone tool used to cut silica rich plants like reeds or wheat (Semenov 1964; Akoshima 1987 and 1993; Yamada 1993 and 2000; Macdonald 2013; Chabot et al. 2017). Human-animal interactions can also be determined through use-wear analysis; scrapers, projectiles and blades are just a few of the tools studied to determine what types of activities they had been used for. The presence or absence of this residue can help determine if a tool was used in hut construction, hide processing, food preparation or other activities (symbolic or mundane) allowing for a more inclusive and holistic understanding of human-plant and human-animal interactions and how they change over time (Yamada 1993 and 2000; Macdonald 2014; Chabot et al. 2017).

Settlements and botanical use

Epipaleolithic settlements have a rich and diverse range of archaeological remains, including grinding stones, fauna, lithics, botanicals, and shells (Delage 2004; Goring-Morris 1987). Larger settlements are interpreted as base camps or aggregation sites that were reoccupied regularly and in some cases for thousands of years (Stutz 2004; Maher et al. 2012, 2016; and Richter et al. 2011). Base camps are thought to be long-term habitation sites where complex hunter-gatherers (or collectors) strategically harvested local resources. This change in their behavior may have resulted in less mobile groups living on ecotones (Henry 1985; Belfer-Cohen 1991; and Neeley 2004).

Botanical remains from across the southern Levant suggest a similar approach to plant use and management. Research at the sites of Kharaneh IV, Ohalo II, Wadi Madamagh, Tor Sageer, Yutil al-Hasa, Eynan, Hilazon Tachtit, el-Wad and Neve David have shown that ecotones between wetlands and parkland/ steppic environments may have been preferentially settled as a way to strategically exploit both ecosystems (Ramsey et al. 2015, 2016a, 2016b, 2018; Powers et al. 2014, Rosen 2014; Macdonald and Maher 2022). This highly resilient approach would have allowed for the people to buffer themselves from a changing environment with perennial and reliable sedges and reeds from the wetlands. They were also able to exploit parkland resources like wild grains that would have been a riskier investment of their time (Ramsey et al. 2016a). This approach would have been flexible as sites with smaller wetlands often have more steppic and parkland resources present while sites with larger wetlands have more wetland resources present. Using the diverse plant life available on the ecotones mobile groups could settle longer in one place and support larger aggregations of people (Ramsey et al. 2016a).

Hut structures, although rare in the Levantine Epipaleolithic, have been found at Ohalo II and Kharaneh IV. Ohalo II, a submerged site on the shores of the Sea of Galilee, has multiple hut structures with flint artifacts, faunal remains, gazelle horn cores, and pebbles deposited in the floors (Nadel et al. 2004). Kharaneh IV, an open-air site in the Azraq Basin, has the earliest known hut structures in the region with well-preserved floors, burnt superstructures, caches of blades, ochre, articulated and disarticulated faunal remains, shell, and potentially a burial below a floor (Maher et al. 2011; Maher et al. 2012; Maher and Macdonald 2013; Ramsey et al. 2018). The hut structures share a similar form and construction as they are kidney bean shaped or ovaloid, 2-5 meters in diameter, semi-subterranean, with a bowl-shaped profile (Nadel et al. 2004; Maher et al. 2016; Ramsey et al. 2018). Through phytolith analysis researchers have determined that the hut superstructures were constructed of parkland/steppic species such as tamarisk (*tamarix*), willow (*salix*), oak (*quercus ithaburensis*) as framing elements and wetland species such as reeds (*phragmites)* and sedges (*carex)* as thatching and flooring (Nadel *et al.* 2004; Ramsey et al. 2018, Goring-Morris and Belfer-Cohen 2003). In order to construct the huts, individuals needed to harvest vast quantities of reeds and sedges from the wetlands thus changing the local ecology. Ramsey (2018:95) argues that the removal of building material and food resources from the wetlands would have increased the local productivity of the landscape. The anthropogenic alterations to the marsh such as harvesting reeds, settlements, and fire would have affected the marshes and, in turn, affected the way people interacted with them and creating a dynamic where the landscape and people shape each other through daily interactions (Ramsey et al. 2018, Maher 2019).

Faunal Evidence

Faunal assemblages from Epipaleolithic sites suggest two different approaches to subsistence linked to the environments of their respective regions (highlands to the west and wetlands to the south-east). Hunter-gatherers in this region were highly mobile, traveling 10-15 km from their camps to acquire resources (Goring-Morris 2017:647). The sites of Hefzibah, Raqefet Cave, Neve David, Ein Qashish South, and Ohalo II share similar assemblages and patterns of use through time (Bar-Oz et al. 1999; Maher et al. 2012; Yeshurun et al. 2013; Munro et al. 2016; Yaroshevich et al. 2016; and Goring-Morris and Belfer-Cohen 2017). Early Epipaleolithic faunal assemblages from the region suggest that the mountain gazelle (*Gazella gazella)* and fallow deer (*Dama mesopotamica)* were the main species hunted. To a lesser extent aurochs (*Bos taurus*), equids, wild boar *Sus)*, hartebeests (*Alcelaphus)*, roe deer (*Capreolus capreolus*), hare (*Lupus)*, and tortoise are found with evidence of butchery or burning patterns consistent with cooking. Predators were also found in the faunal assemblages at some of the highland sites; both wolf and fox are present with evidence of butchery (Munro et al. 2016; Bar-

Oz et al. 1999; Yeshurun et al. 2013; and Yaroshevich et al. 2016). There is a notable change in subsistence patterns from the Early Epipaleolithic to the Late Epipaleolithic where hunters shifted from large prey to smaller game. This shift has been explained by some scholars as an over exploitation of gazelle (Stiner et al. 2000; Stiner and Munro 2002; and Maher et al. 2012).

Large aggregation sites and smaller sites in the wetlands of south-east Jordan, namely Kharaneh IV, Jilat 6, Wadi al-Hasa (and smaller sites from the Azraq Basin and the Kerak Plateau) share similar faunal assemblages (Munro et al. 2016; Maher et al. 2012; Richter et al. 2011; and Martin et al. 2016). Gazelle dominate the records at these open air sites, followed by equids, aurochs, wild boar, wolf, fox, hare, migratory birds, raptors, and tortoise. The major difference in the subsistence patterns between the western woodlands and eastern steppe is the sustained use deer in the woodlands and gazelle in steppic regions into the Middle Epipaleolithic. While western hunter-gatherers shifted to smaller game around 15,000 cal BP (Maher et al. 2012 and Martin et al. 2016).

It is in this environmental backdrop that hunter-gatherers in the Azraq Basin lived their daily lives, interacting with local climate, ecologies, and people. Their technological choices act as reflections of these interactions and the cumulative experiences and knowledge that produced their technologies (Bauer and Kosiba 2016). Understanding the roles that technological choices play in daily life can help construct a more holistic view of the ancient past and elucidate the complex social interactions related to learning technologies within communities of practice.

Chapter Three
History of Lithic Research in Epipalaeolithic Southwest Asia

Traditionally, lithic analysts have used final tool form and metrics to construct culturally specific typologies (de Sonneville Bordes and Perrot 1954; Tixier 1964; Bar-Yosef 1970; Close 1978; Goring-Morris 1988; Pelegrin 1990; and Pirie 2004). In the construction and use of the typologies two main approaches have been taken: 1) A deductive approach focuses on description and time-space organization and 2) an inductive approach focuses on interpretation (which will be expanded upon in the next section) (Henry 1995:3). The inherent differences between the two approaches clearly plays out in archaeological debates and literature, but recent research projects have proven that both approaches provide valuable insight to the prehistory of South-west Asia.

Lithic Research in Southwest Asia

Southwest Asia has a long history of research centered on the transition from Palaeolithic hunter-gatherer life ways to the 'neolithic revolution' as described by Childe (1928). Eurocentric terms and approaches have been used to discuss local and regional variability in southwest Asia, starting with functional approaches (focused on lithic technology) in the 1900's and shifted to more holistic social approaches in the 1980's. As lithic artifacts are durable and frequent finds at Epipalaeolithic sites, variability has been the focus of many researchers through functional and social approaches (Richter and Maher 2013). In Southwest Asia, deductive approaches have been used to identify the boundaries of past archaeological entities by comparing the attributes of an artifact to differentiate functional choices from stylistic ones. When compared to a broader range of artifacts of the same type, patterned variability of artifact attributes is noted. The attributes are then compared to a typology list, that is regionally specific (Pirie 2004), and placed in an 'appropriate' category based on the artifacts' attributes. If artifacts share substantial attributes through time and/or space, they are considered to be of the same 'ethnic origin' (Close 1989, Dunnell 1978, Bar-Yosef 1991; Henry 1995: 3).

Prehistoric Levantine research has conventionally used this framework to construct some of the most influential models regarding culture change through time and environmental interactions. Environment plays an elemental role in the establishment of cultural boundaries that researchers impose on the archaeological record (Childe 1953; Bar-Yosef and Belfer-Cohen 1992; Smith 1994; Bar-Yosef and Meadow 1995; Henry 1995; Goring-Morris and Belfer-Cohen 1997). Dorothy Garrod, the archaeologist responsible for naming the Natufian Complex based on her finds in the Wadi Natuf in 1932 (Garrod 1932), used stone tool form to identify and roughly place the Natufian 'culture' within the broader understanding of prehistory. She compared the similarities and differences of the stone tools, bone implements, and personal decorative items to differentiate the studied group, Natufians, from other cultural entities (Garrod 1932). This exceedingly difficult task was made even harder by the lack of chronological control available in the 1930's. Through stratigraphic control and inter-site comparison, Garrod placed the Natufians in a pre-farming period before the Early Bronze Age (Garrod 1932). Considering the resolution of data available to her at the time, Garrod's findings prove that the deductive approaches are a valuable means of acquiring data and interpreting it.

Other seminal works like those of Bar-Yosef (1970; 1980; 1996) and Tixier (1964), suggest that cultural differences are brought on through the variety of adaptations people made to their unique environments. Bar-Yosef states that, "the divergence of the environmental variability of Southwest Asia served as a background for the development of regional cultural entities, each characterized by its own adaptive strategy" (Bar Yosef 1980: 406). The framework for constructing these territorial models is based on type lists, where regional definitions of stone tool types were adopted from the Maghreb (Tixier 1964) and adapted for Levantine tool traditions (Bar-Yosef 1970). Lithic assemblages are then compared (often the metric attributes from tools and debitage) to determine the similarity of an assemblage to other sites (inter-site comparison) or other times (diachronic comparison) (Tixier 1964; Bar-Yosef 1970; Hours 1974). In order for this approach to be successful, natural (e.g., climatic and environmental changes) and cultural processes (e.g., adaptations, tools, and behavior) must be analyzed and interpreted in combination with evidence for subsistence strategies to identify the boundaries between different cultural entities (Bar Yosef 1980). This approach relies heavily on the environment as a designating feature for cultural entities. Mosaic environments like Southwest Asia then acted as a vector for social interactions, trade, and knowledge transmission as seasonal changes encouraged movement across the landscape (Goring-Morris and Belfer-Cohen 1997). Models like those produced by Henry (1995:16) suggest that people moved through the landscape seasonally, taking advantage of the resources available to them in the various ecological zones. When faced with changing climatic conditions during the Younger Dryas, namely rapid and large-scale aridity, people were forced to reorganize their social and economic structures to thrive in new climatic regimes. Within this theoretical framework, behavioral change was incited by climate change and the various choices people made to adapt to their environments.

These changes can be seen archaeologically through stone tool technologies, substance strategies, and settlement patterns (Bar-Yosef 1996). For example, the shift from non-geometric microliths to geometric microliths was interpreted as an expansion of the Geometric Kebaran cultural complex into steppe and desert areas as the environmental conditions ameliorated. Researchers suggest that the climate had improved enough for the group to "relax their [mechanisms of] population control" (Bar-Yosef and Belfer-Cohen 2010:159) and spread more extensively across the region, including into areas that the geometric microliths they produced had rarely been observed before archaeologically (Bar-Yosef and Belfer-Cohen 2010). During the Natufian period, when lunates—a form of geometric microlith that forms the hallmark of the Natufian—dominate lithic assemblages, another change in tool morphology was associated with climate change. Early Natufians appear to have preferentially settled in semi-permanent villages within regions with oak and pistachio trees but were not restricted to them as many ephemeral sites are found throughout Southwest Asia (Bar-Yosef and Belfer-Cohen 1989). A period of increased aridity occurred from ca. 10,800-10,300 ±200 which 'forced' changes within the Natufian cultural complex. Researchers suggest that during the Late Natufian period people were forced to defend their territories and a shift of subsistence strategies. Resource scarcity is thought to be responsible for a shift back to locally available foods and the improvement of hunting techniques represented by the "Harif Point" (Bar-Yosef and Belfer-Cohen 1989: 470-475). Variations of the above framework were common in Southwest Asia. Goring-Morris and Belfer-Cohen suggest that mosaic environments played a critical role in the formation of cultural differences between groups of people. Microclimates allow for "fine-tuned adaptation" of peoples to specific and often changing niches (Goring-Morris and Belfer-Cohen 2011:198). As the climate oscillated in the terminal Pleistocene, Epipalaeolithic groups were thought to have spread into previously inhospitable areas and retreated into refugia when climate deteriorated.

The mesic Mediterranean and semi-arid periphery zones are discussed as being influential for population size due to greater access to resources like large herds of gazelle and perennial water sources (often in the form of springs). The authors suggest that when the climate was ameliorated, previously constraining factors like ecology, were relaxed and resulted in a general population increase (Goring-Morris and Belfer-Cohen 2011). During the Natufian period the Younger Dryas is identified as a major cause of change (Kohn 2013), "this is reflected most obviously in more marginal regions, such as the Negev and Sinai… conditions in these peripheral settings deteriorated beyond a critical threshold, and continued occupation of the area simply became untenable" (Goring-Morris and Belfer-Cohen 2011:200).

Generally, Early Epipalaeolithic groups were thought to tend to live in small seasonal camps often located in caves or rock shelters in the Mediterranean Zone and near oases in Southern and Eastern Jordan. They hunted gazelle, wild ass, aurochs. wild goat, some birds, hare, and tortoises while their tools, mostly non-geometric microliths, were made predominantly on blade/let cores (al Nahar and Olszewski 2016). During the Middle Epipalaeolithic, there was a shift towards large open-air sites with evidence of seasonal reuse. Middle Epipalaeolithic peoples predominately hunted gazelle, deer (in highlands), and tortoises and used geometric microliths from blade/let cores (Martin et al. 2010; Maher et al. 2011). In the Late Epipalaeolithic, people in the Mediterranean zone tended to prefer cave and rock shelter sites again, however, open-air sites were still in use especially in the arid zones. Pit house-type architecture, incised stone objects increased bone and ground stone tools, animal figurines, and flake core technologies were all considered key (and common) characteristics of the Late Epipalaeolithic (Bar-Yosef 2002; Grosman 2013). Their explanations of culture change stresses the importance of environmental changes not only on culture (here identified by final tool form) and subsistence strategies, but also on population size and the behaviors and choices that accompany the changes.

Current Approaches for Interpreting Lithic Assemblages

To understand how prehistoric peoples organized their social groups and experienced life, archaeologists need a reliable way to identify socio-cultural groups and recognize their changes over time. Techno-typological approaches like those of Olszewski (2011), Pirie (2004), Maher and Macdonald (2013; 2018) use a combination of typological lists initially developed in the 1950's by Sonneville-Bordes and Perrot (1954) and adapted by Tixier (1963) for the Maghreb. It was later adapted by Bar-Yosef (1970) and Goring-Morris (1987) for Southwest Asia to become the most commonly accepted typologies in these respective regions (see Shea 2013 for a illustrative synthesis of the historical approaches to lithic analysis in the Epipalaeolithic period of Southwest Asia). Tradition and the maintenance of a practice over time signal not only group identity but also social boundaries (see Stark et al. 1999), thus providing researchers with robust data sets from which a narrative can be constructed (David et al. 1988). Recent approaches to understanding lithic assemblages of Southwest Asia use a more inductive framework where style and variability are interpreted to transmit information about group identity and affiliation (Stark et al. 1999; Wobst 1999; Sackett 1982; Close 1978; Conkey 1978; Wiessner 1983). In addition to typological analysis, researcher use technological attribute analysis, use-wear, and refitting to reconstruct stone tool production and use.

The aforementioned researchers focus on *chaînes opératoires*, or the sets of actions employed to make an artifact, from raw material acquisition and initial reduction to final tool use, reuse and deposition. This approach focuses on the stone tool technology rather than "index fossils" (Sillet 1993; Pelegrin 1990; Pigeot 1991; Soressi and Geneste 2011; Delage 2017(a); Audouze et al 2017; Bleed 2001, Chazan 2003, Schlanger 2005, and Bar-Yosef and Van Peer 2009). First introduced into the ethnographic literature by Leroi-Gourhan (1964) and later brought into archaeological literature (Bordes 1950; Tixier 1963; Karlin, Pelegrin and Bodu 1986; Pelegrin, Karlin, and Bodu 1988; Karlin, Bodu and Pelegrin 1991; Soressi and Geneste 2011; and Audouze et al. 2017), *chaînes opératoires* implicitly employs Bourdieu's (1977) notions of *habitus* and *praxis* to interpret the underlying cultural influences that structure many aspects of stone tool production. Habitus is the durable system of ingrained beliefs, within which social structure and daily practice that can be regulated and maintained through ingrained cultural rules. While *praxis* encompasses the structured activities regularly practiced by individuals within a society that reinforce ideological elements in social, cultural, and/or economic dimensions (Bourdieu 1977). By combining multiple approaches (morphology, technology, experimental archaeology, use-wear analysis, and refitting) researchers can demonstrate flintknapping sequences (Bleed 2009) and create more comprehensive classification schemes. Schlanger argues that this framework allows for lithic analysis to "appreciate the intersecting life histories of objects-in-motion as simultaneously social, technological, and symbolic accomplishments" (Schlanger 2005: 28). Although this approach creates a more comprehensive understanding of assemblages, it should not be equated with an emic perspective on the lives and motivations of prehistoric peoples (Bleed 2009). Recently, many researchers in Southwest Asia have taken on, at least in part, this typo-technological approach to lithic analysis that incorporates multiple lines of evidence to understand the knowledge and motivations behind stone tool production (Bar-Yosef and Van Peer 2009; Belfer-Cohen and Goring-Morris 2012).

Industries, Cultures, and Complexes in Southwest Asia During the Epipalaeolithic

The analysis of stone tools and debitage is quite similar to how one approaches a jigsaw puzzle. First, separating out the edge pieces, finding corners, and subdividing these distinct pieces by color. This allows a dissectologist to frame their future designations in a more meaningful light (i.e., knowing that a piece with blue and dark blue stripes is water while plain dark blue is an evening sky). These assumptions are not natural distinctions, rather, designations the dissectologist constructs to create meaningful and useful categories (Dunnell 1986: 151). Often, these categories are flexible as puzzle pieces are rarely homogenous in color and patterning, thus creating a need for a flexible approach that is also rigid enough for the categories to remain useful. Rules like, "a piece must be more than 50% blue in order to go into the ocean category" may be made to help with the consistent designation of pieces, but inevitably there are pieces that do not fall into a single category. What does a dissectologist do then? Adding new categories, shifting older categorical distinctions, or finding a "closest fit" solution are all possible ways to resolve the dilemma. At this point, any choice made by the dissectologist will affect past and future categorization.

Another issue with creating categories is that of communication; what if two individuals decide to work on the same puzzle together? The categories must be communicated and understood in similar ways for the categories to maintain their usefulness. Heuristic tools like named categories then become integral to maintaining continuity. These dilemmas of categorization are similar to those faced by lithic analysts. Unlike dissectologists, the categorical choices lithic analysts make influence the interpretation of an assemblage and ultimately the narrative constructed around the lithic analysis (Clarke 1968; Hayden 1984; Dunnell 1986).

In Levantine Epipalaeolithic literature, lithic analysts often use one of three types of categorical schemas: industry, complex, or culture. Industry refers to a mid-level categorization and is the most rigid of these approaches as it uses typological classifications of stone tools to determine the relatedness of assemblages. Often, industries share a high degree of similarity in technological and typological attributes (Garrod 1932; Bar-Yosef 1970; Henry 1995: 36; Pirie 2004) (See Table 3). Henry points to the Madamaghan as an example of an industry in Southwest Asia because it shares the tendency for the intensive use of microburin technique and has similar material culture with other Mushabian complex sites in the Negev, Sinai, and Southern Jordan (Henry 1995, 1997). The term culture implicitly uses environment, economy, temporal and spatial variables to distinguish one group from another. In the hierarchy, it is higher than industry but lower than complexes (Henry 1995:36). Culture and complex are often used interchangeably, however, culture is often inextricably tied to modern notion of ethnicity and has been used to determine basic site-types for recognizing inter-site patterns (Henry 1995; Goring-Morris 1987; Pirie 2004). The Early Natufian, for example, is considered a culture as Early Natufian sites have a high level of technological affinity. Early Natufian sites are known to use an industry focused on the production of wide bladelets, intensive use of microburin technique, and heavy use of Helwan lunates. Bedrock and portable mortars as well as shell ornamentation are common finds at Early Natufian sites which are preferentially located in open- air Piedmont locations (Henry 1995). Complexes utilize the broad array of material culture to determine similarity, they are also spatially limited and related temporarily (Henry 1995; Clarke 1968). Henry argues that the Mushabian complex is separate from the Kebaran-Geometric Kebaran complexes as it was previously only known in the Sinai and Negev but recently Mushabian sites have been found in rockshelter sites in Southern Jordan. The technology found at these sites in Southern Jordan is more like the technology found in the Sinai and Negev than Eastern Jordan and therefore was assigned a new industry, Madamaghan (for the eastern extension of the complex) (Henry 1995). Similar to the jigsaw puzzle, the way researchers choose to interact with categories effects how the "big picture" gets put together. Pirie (2004) notes that one must remain vigilant when accepting statistics as facts due to the arbitrary nature of typologies; any variation in the typologies chosen by researchers can cause miscommunication while conducting inter-site analysis particularly when site specific characterizations are added. In order to communicate with other researchers, I have chosen to use the term 'cultural entity' (Maher 2010) as a heuristic tool to discuss groups of Epipalaeolithic peoples and their various behaviors, choices, and adaptations while rejecting the implicit relationship between culture and ethnicity (Conkey 1978; Jones 1997; Stark 1999).

Levantine Epipalaeolithic cultural complexes are distinguished from each other by the proportion of microlithic to non-microlithic tools, the frequency of truncations, microlith form based on type and location of backing, microlith size, and the use of the microburin technique (Henry 1995; Goring-Morris and Belfer-Cohen 1997; Olszewski 2011; Garrard and Byrd 2013). Indeed, microlith form and their changes through time serve as chronological and geographical markers. Tixier's (1964) research in the Maghreb and then Bar-Yosef's (1970) research on Palestine were foundational works that continue to define the Epipalaeolithic (Richter et al. 2011). The variation in tool frequency was a key component in earlier works and was used to distinguish between the time periods of the Epipalaeolithic, cultural entities, and industries (Tixier 1964; Bar-Yosef 1970; Henry 1995) (Figure 3.1). Current research expands upon this approach through techno-typological analysis, refitting, and use-wear analysis to gain a more nuanced understanding of the stone tool making process. In the Azraq Basin, for example, during the Late Upper Palaeolithic, microliths comprise around 32% of the overall tool assemblage which increases to 88% in the Initial Epipalaeolithic (Garrard and Byrd 2013). As the Early Epipalaeolithic began, microliths remained an important component of the assemblages but at a slightly lower frequency of 72%. This long-standing pattern of heavily using microlith technology abruptly changed in the Middle Epipalaeolithic. While microlithic technology remained common, microliths only made up approximately 25% of the overall tool classes (Garrard and Byrd 2013: 330). By the Late Epipalaeolithic microliths again increased in frequency as they comprise approximately 65% of the total tools (Garrard and Byrd 2013). Although the data provided is from the Azraq Basin, the pattern interpreted in the Western Levant as a shift in reduction strategies through time. The Late Upper Paleolithic bladelets have less retouch compared to later Epipalaeolithic bladelets and were not as standardized morphologically (Ferring 1988). This trend is thought to represent a shift towards composite technologies during the Early Epipalaeolithic (Bar-Yosef 1970; Goring- Morris 1987; Ferring 1988; Belfer-Cohen and Goring-Morris 2008). By the Middle Epipalaeolithic, less standardization of bladelets and broader bladelets became more common (thus a change in the core reduction procedure). This is thought to be the response to a new hafting technology, potentially mastic or other hafting material (Kakan 1978; Wiseman 1993). Finally, during the Late Epipalaeolithic there is a continuing trend towards less standardization of bladelets. Researchers have interpreted this to be a response to increasing sedentism and, thus, an increase in efficiency and more flexibility in the tool making process (Bar-Yosef 1998; Belfer-Cohen and Goring-Morris 2008).

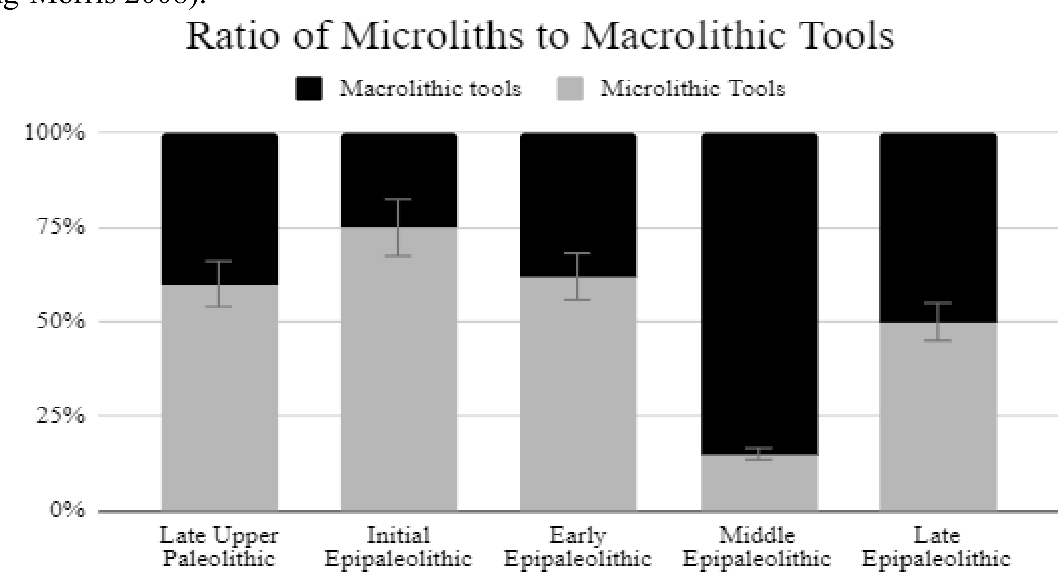


Figure 3.1: This graph illustrates the ratios between microlithic and macrolithic chipped stone tools during the Epipalaeolithic in the Azraq Basin (Tixier 1964; Bar- Yosef 1970; Henry 1995; Garrard and Byrd 2013: 330)

Although this method is useful for creating a general overview of broad trends over time, this approach has some serious problems for interpreting culture change and characterizing variability. First, is the idea that two separate cultural trajectories representing differing adaptations existed in the ‘core’ Mediterranean area and steppe/desert ‘peripheries’. This is reflected in the choices people made in tool production as regional tool ‘traits’ vary from the Mediterranean and Arid zones (Goring-Morris and Belfer-Cohen 1997). In conjunction with the morphological differences in tools, researchers also point to the differences in site size, occupation densities, raw material sources, and ground stone tools to distinguish between the cultural complexes (Bar-Yosef 1970; Henry 1996; Goring-Morris and Belfer-Cohen 1997). Secondly, there is no universal set of criteria to distinguish one cultural complex from another. Sites are the product of unique cultural systems that structure and organize the environment, fauna, and other humans. These are dynamic places that do not fit neatly into the etic categories researchers construct and therefore require a 'best fit' approach when determining one cultural complex from another (Binford 1982; Deetz 1990; Ingold 1993; and Anschuetz et al. 2001). Even if there were qualitative and quantitative criterion to abide by the inherent variability of lithic assemblages would simply be too diverse to create useful categories for cultural complexes.

Current approaches have attempted to negate some of these issues by focusing on site patterning, manufacturing techniques, reduction sequences, features, site function and stylistic choices for a more nuanced and holistic understanding of the past (Goring-Morris 1987; Wiessner 1989; Close 1989; Olszewski 2001 and 2011; Pirie 2004; and Maher 2010). By using cultural complexes as heuristic tools to convey a 'package' of lifeways, researchers can arguably more effectively communicate general patterns regarding tool use, time periods, and site types (Maher and Macdonald 2013; Maher and Macdonald 2020). Generally, most researchers have taken on a more comprehensive understanding of sites through the investigations mentioned above (Olszewski 2001 and 2011; Pirie 2004; Bar- Yosef and Van Peer 2009; Davidzon and Goring-Morris 2003; Richter et al. 2011; and Maher 2010).

Epipalaeolithic Archaeological Entities

Historically, archaeological entities during the Epipalaeolithic have been constructed based on inter-group similarity (and disparity) of characteristic tools, chronology, and subsistence practices (Goring-Morris 1988; Olszewski 2006). In this section, I will review the major archaeological entities (Maher 2010) of the Epipalaeolithic Levant as they are generally accepted in current literature focusing on the lithic industries associated with each respective entity.

Late Ahmarian or "Masraqan"

The Late Ahmarian entity, also called the Masraqan, dates to 24,000-19,000 cal BP. Steppe, Levantine desert and the Mediterranean Levant environments were frequently preferred for settlement with a proclivity for the terraces of rock shelters (Henry 1995; Belfer-Cohen and Goring-Morris 2014). The lithic industry is diverse with scrapers, burins on blades, and el-Wad points predominant. The use of diverse reduction strategies to produce blades and bladelets is common in earlier sites but reduction becomes increasingly standardized in other periods (Goring-Morris and Belfer-Cohen 2018). Microliths also become more common through time at Late Ahmarian sites. Microgravettes with bipolar retouch, retouched bladelets and *Lamelles dufour* bladelets are common. Microliths make up 10-60% of the tool assemblages. Notably, the microburin technique is not used at Late Ahmarian sites.

Nebekian

The Nebekian entity was first identified by Rust (1950) and is regionally restricted to the eastern Levant— predominantly in arid regions. Sites are relatively small compared to other Epipalaeolithic entities as they range from 50-200 m^2. Sites occur in both open-air and sheltered locations which date to 23,000-21,000 cal BP and are considered contemporary with the "Masraqan" (Henry 1995; Belfer-Cohen and Goring-Morris 2014). The lithic industry association with Nebekian sites are predominantly microlithic with habitual use of the microburin technique. Of the microliths, non-geometric microliths are most common, frequently with intensive backing. Large tools are also present and predominantly represented by truncations and non-standardized tools (Garrard and Byrd 2013; Belfer-Cohen and Goring-Morris 2014).

Kebaran

Kebaran sites expand across the Mediterranean coastal plains and through the central rift valley of Southwest Asia. With a clear preference for Mediterranean zones, sites are often small, ranging from 25-100 m^2 and rarely larger than 250 m^2. Lowlands near westward draining wadis atop aeolianite sandstone ridges are preferred site locations (Bar-Yosef 1980; Richter et al. 2011; Belfer-Cohen and Goring-Morris 2014). Kebaran sites date to 21,000-18,000 cal BP (Belfer-Cohen and Goring-Morris 2014). The lithic industry is bladelet oriented. Microliths make up at least 40% of the tool assemblages and non-geometric microliths comprise up to 90% of the microlithic assemblage. Microliths are produced on narrow bladelet blanks. Earlier sites frequently utilize an inverse and fine retouch, producing curved micropoints and microgravettes (Bar-Yosef 1980; Garrard and Byrd 2013; Belfer-Cohen and Goring-Morris 2014). At later Kebaran sites Kebara points become more common. The microburin technique is absent from Kebaran sites.

Geometric Kebaran

Geometric Kebaran sites are dispersed across much of Southwest Asia, from Northeast Syria to the Southern Sinai. While higher altitudes are preferred site locations, Geometric Kebaran sites can be found in the lowland plains, coastal plains, the Jordan Valley, and the southern deserts (Bar-Yosef 1980; Henry 1995; Belfer-Cohen and Goring-Morris 2014). These small occupation sites in steppic and semi-arid regions are commonly 75 m^2 but can be much larger— ranging from 320-650 m^2. Geometric Kebaran sites date to 17,500- 14,750 cal BP (Belfer-Cohen and Goring-Morris 2014). The lithic industry is predominantly microlithic. While there is evidence of variable approaches to blade and bladelet production, the microliths themselves are highly standardized (Bar-Yosef 1980; Goring-Morris 1987; Henry 1995; Belfer-Cohen and Goring-Morris 2014). Geometric microliths dominate the microlithic assemblages and trapeze rectangles are most common, comprising 55-97% of the microlithic assemblage. The microburin technique is used occasionally to truncate microliths (Garrard and Byrd 2013). Few macroscopic tools are noted at Geometric Kebaran sites, notably endscrapers on blades (Maher 2005; Garrard and Byrd 2013).

Mushabian

Mushabian sites are restricted to the Negev and Sinai and range between 25-150 m^2. Roughly contemporaneous with Geometric Kebaran entities, Mushabian sites date to 17,000-14,500 cal BP (Belfer-Cohen and Goring-Morris 2014). It is important to note that the Mushabian entity likely has a North African origin as the lithic industries share more similarities with North African Industries than Levantine ones (Bar-Yosef 1980; Garrard and Byrd 2013). Mushabian lithic assemblages are dominated by arch backed bladelets with the frequent use of the microburin technique. There is a later shift towards producing concave backed and truncated bladelets (Belfer-Cohen and Goring-Morris 2014). Non-geometric microliths dominate the tool assemblage with frequent production of la Mouillah points (Bar-Yosef 1980; Kaufman 1983; Garrard and Byrd 2013).

Ramonian

The Ramonian entity is split into two distinct periods, early (15,300 cal BP) and terminal (14,700-13,300 cal BP) (Garrard and Byrd 2013). Ramonian sites have only been found in the Negev and Sinai and likely represent a northern movement of hunter-gatherers from North Africa (Goring-Morris 1987). These small sites range between 100 m^2 (Goring-Morris 1987) The lithic assemblages associated with Ramonian sites are dominated by the Ramonian point -almost to the exclusion of other non-geometric microlith types (Goring-Morris 1987) and are made with the microburin technique (Garrard and Byrd 2013). Lithic diversity at Ramonian sites is low, burins, retouched and backed blades, truncations on blades, and scrapers are uncommon. Notches and denticulates are present in earlier phases but increase in frequency through the terminal period (Goring-Morris 1987).

Natufian

The Natufian entity has diverse material culture signatures. Spatially, the Natufian entity expands from Syria to the Sinai and from the Mediterranean coast through the eastern deserts (Goring-Morris 1987; Bar-Yosef 1990; Belfer-Cohen 1991). Natufian sites are believed to represent an increase in sedentism as the round semi-subterranean structures have stone foundations and are well-built, sites associated with cemeteries, an increase of sickle blades, and the onset of commensal fauna like the house rat, house mouse, and sparrows (Bar-Yosef 1980; Bar-Yosef 1990; Belfer-Cohen 1991; Goring-Morris and Belfer-Cohen 2013). Natufian sites are frequently located in rockshelters and caves and date to 13,000-10,000 BP (Goring-Morris and Belfer-Cohen 2003). According to Bar-Yosef (1980 & 1990) Natufian sites can be separated into three separate classes: small, medium, and large. Small sites range from 15-100 m^2 and are interpreted as ephemeral summer hunting sites. Medium sites range from 400-500 m^2 and are considered campsites. Large sites are over 1000 m^2 and are interpreted as base camps (Bar-Yosef 1980; Goring-Morris 1987; Bar-Yosef 1990; Goring-Morris and Belfer Cohen 2013). Ground stone tools are common and diverse. Mobile mortars, bedrock mortars, pestles, cup marks, bowls, and goblet basins commonly occur at larger Natufian sites and are predominantly made of basalt (Bar-Yosef 1980; Bar-Yosef 1990; Goring-Morris and Belfer-Cohen 2003; Goring-Morris and Belfer-Cohen 2013).

While the Natufian chipped stone tool assemblage is more diverse than the preceding lithic industries, it is defined by the omnipresent lunate. Lunates are considered to be the *fossile directure* associated with Natufian sites and are frequently made on bladelets and flakes. The lithic industry is predominantly bladelet based but flake and blade tools are common. The microburin technique is intensively used particularly in the production of Helwan lunates. Other microliths present at Natufian sites include trapeze rectangles, triangles, and parallelogram but microlith form becomes increasingly uniform in later periods shifting to the intensively retouched lunates (Bar-Yosef 1980; Goring-Morris 1987; Goring-Morris and Belfer-Cohen 2013). Macro-tools like scrapers, burins, denticulates, notches, borers, awls, sickle blades, and picks are abundant. Fine chalcedony is preferred for small and medium sized tools while more coarse flints and cherts are preferred to produce macro-tools (Goring-Morris and Belfer-Cohen 2013).

Harifian

The Harifian entity is found within the Negev and Sinai and dates to 12,800- 11,600 BP (Garrard and Byrd 2013). There is a preference to settle further south, likely due to environmental changes during the Younger Dryas (Bar-Yosef 1990; Goring-Morris and Belfer-Cohen 2013). Small semi-subterranean dwellings with hearths and cup marked work slabs are common at larger base camps (Goring-Morris and Belfer-Cohen 2013). The lithic assemblage is like that of the Natufian entity as small lunates and triangles made with the microburin technique are the predominate tool type. Tool forms became less formalized through time as non-standardized and multi-platform cores are more common at later sites. Fine chalcedony is preferred for small tools like points, microliths (microgravettes being most common in this category), scrapers with coarse denticulation, burins, and perforators. Coarse flint is preferred for large tools like backed knives and heavy-duty tools (Goring-Morris et al. 1998). A distinctive feature of the Harifian entity is the presence of the Harif point. This point is produced by retouching the distal end of a bladelet and removing the proximal end with the microburin technique (Henry 1974).

Debates in Lithic Analysis

The interpretation of assemblage variability is widely debated amongst researchers. In Southwest Asia, stone tools (especially microliths) have traditionally been interpreted as *fossil directeurs* of distinct sociocultural and/or ethnic groups; sites are often described by the type of microlith most found (Henry 1989). Neeley and Barton discuss the major Levantine cultural entities (Mushabian, Geometric Kebaran, and Natufian) to argue that variation in microlith form could be due to the recycling of microliths where different forms represent different 'life stages' of a microlith and that the use of the microburin technique to produce said microliths was employed universally. They argue that using the microburin technique is problematic for understanding cultural affiliation because flintknapping debris and finalized tools are rarely found together. Deposition of debitage and final tools rarely occur in the same place thus skewing the counts of a given assemblage. Furthermore, the authors cite raw material scarcity as a potential cause of variation stating that longer blades were common in Geometric Kebaran assemblages that could have been snapped in half thus producing two usable blanks, no microburins, and increasing efficiency (Neeley and Barton 1994). This hypothesis was strongly rejected by researchers for a variety of reasons. Kaufman (1995) argues that Epipalaeolithic peoples would not have expended the effort to recycle microliths because the composite tools (a technology widely believed to have been used) (Yaroshevich et al. 2013; Bar-Yosef and Kuhns 1999:331) would have been much easier to simply change out a microlith than to continually retouch and re-haft them. He also brings attention to the co-variance of technology and typology across sites that suggest a technique and mental template were chosen prior to the finalization of the tool (Kaufman 1995). Phillips (1996) elaborates on this idea and points out that the different core shapes at these sites suggest separate production trajectories that each have a unique set of debitage characteristics. Phillips argues that the mental templates used to produce different core types could be due to behavioral choices that cannot be explored by relying on an environmentally deterministic model of raw material acquisition rather, *chaîne opératoire* is necessary for understanding the culturally determined decision making processes (Phillips 1996). Goring-Morris (1996) argues that variability is both functional and stylistic. Here he describes style as the result of flintknapping traditions rather than the result of environmental restrictions (i.e., accessibility of raw material). While he acknowledges that there is variable use of raw materials, he states that the variability is indicative of people from different cultural entities utilizing the locally available flint to produce their tools, and selecting finer, higher quality material for the production of tools that require pressure flaking. Finally, Henry (1996) argues, similarly to Goring-Morris (1996) and Phillips (1996) that variability within Epipalaeolithic lithic assemblages can be attributed to both environment and behavior. Henry points to 'ethnicity' as the main driver of variation (here 'ethnicity' is equated with cultural complex) as the variability of scars on micoburins is the result of different technological systems. This is opposed to Neeley and Barton's (1994) view of variation of microlith scars as the result of different stages within the same technological system.

Stylistic variability is argued by many researchers to represent the behavioral choices within a tradition (Phillips 1996; Close 1978; Wiessner 1983; Shelly 1990; Wobst 1999; Olszewski 2001; Finlay 2008). The interpretation of stylistic variability has been the subject of multiple approaches. Close argues that using final tool form to identify cultures is a gross over-simplification of the cultural systems and choices made during the production process. In her 1978 article, Close investigated the premise of culturally-bound behaviors, knowledge, and individual ability (namely function, handedness, retouch type, the pointed end of a microlith, and style) as a way to study a culture system rather than a determining factor of the final tool form and tradition (Close 1978: 228-234). The study of twenty-three North African Epipalaeolithic sites suggests that self-conscious social groups would be localized and found that, by comparing stylistic variability across sites, one could support or oppose hypotheses regarding relative group size, seasonality of occupation, movement across a region, and flexibility of social structures to allow ebb and flow of members (Close 1978: 234). This type of research could help restructure the way researchers perceive cultural groups in the Epipalaeolithic period of Southwest Asia. Rather than using microlith form as a diagnostic characteristic of a cultural group, researchers can explore the communities of practice surrounding the flintknapping knowledge to further understand the *praxis* and *habitus* around stone tool production.

Style and variability are at the heart of the Epipalaeolithic dilemma. Where dos style end and variability begin? How do we distinguish between the two? What does this difference mean? I view style as an individual's idiosyncrasies (or microgenetic patterns) that an individual knapper accumulates through their flintknapping education- a social endeavor that occurs within a community of practice (Lave and Wenger 1991) and responses to their lived experiences as a knapper. While some decisions can be made by the knapper that are relatively unique to them (how to hold an abrader tool or having a "favorite" hammerstone or percussor) many decisions are culturally constrained (raw material selection, *chaîne opératoire*, or final tool form). These culturally constrained decisions thus fall into the variability category as they relate to a larger group with negotiated meanings, understandings, and shared processes known as communities of practice (Lave and Wenger 1991; Wenger 1998). By understanding the set rules negotiated by a community of practice we can approach the debate on variability through educational trajectories. These educational trajectories, or shared educational experiences bound in cultural knowledge, can be used as a proxy for archaeological entities as they are unique to a community of practice (Wenger 1998). Examination of c*haîne opératoires* through refitting work and techno-typological analysis can aid in understanding the choices made within an archaeological entity so the practices can be compared to other sites to determine affinity through shared educational experiences. Distinguishing between internal variability and external variability[4] can indeed be difficult, however, by identifying learners or those with less skill and comparing their approaches to tool production to the approaches of masters we can identify what was once considered important aspects of the flintknapping process within a community of practice. These shared meanings and practices within a community of practice can then be more readily compared to individuals of similar skill levels at other sites to gain a clearer understanding of lithic variability and distinguish between archaeological entities.

[4] Internal variation includes idiosyncrasies, style, traditions, and cultural values an individual expresses within a community of practice. External variation is the variation between two or more communities of practice. While the fundamental physics of flintknapping constrains the diversity of approaches possible, different communities of practice will have unique educational trajectories—even if some meaning or intentions may overlap (Lave and Wenger 1991; Wenger 1998).

Chapter 4
Theoretical Framework: Learning, Organization of Knowledge Transmission, and Practice Theory

Introduction

Learning is an integral part of human life. From language acquisition and handshakes to calculus and driving cars, learning (and teaching) occurs through a wide variety of social interactions. This chapter will discuss how learning and the cultural transmission of knowledge is perceived through social and situated theoretical perspectives. To further explore concepts of situated learning (Lave and Wenger 1991) and genetic processes (Saxe 2014), I will discuss a case study of ancient Greek potters from Attica (Hasaki 2005, 2012, and 2019) to highlight social transmission of knowledge and discuss the different forms that knowledge transmission can take.

In the following discussion, the terms apprentice and master are used to convey the relationships between individuals, but also express their roles in the learning process. The term apprentice refers to individuals who actively engage in remembering and replicating knowledge in any setting. Masters, on the other hand, model practices, operations, social behaviors, and language for the learners (Strauss 1984). I note here, however, that these categories can be held fluidly by individuals, such that an apprentice in one context (or within one community of practice) may be a master in another, and vice-versa. In the discussion of cultural change and learning I have chosen to use Lave and Wenger's definition where:

> [Learning is] neither wholly subjective nor fully encompassed in social interaction, and it is not constituted separately from the social world (with its own structures and meanings) of which it is part. This recommends a decentered view of the locus and meaning of learning, in which learning is recognized as a social phenomenon constituted in the experienced, lived-in world, through legitimate peripheral participation in ongoing social practice; the process of changing knowledgeable skill is subsumed in processes of changing identity in and through membership in a community of practitioners; and mastery is an organizational, relational characteristic of communities of practice. (Lave and Wenger 1991: 64)

These terms were adopted as they best organize the apprentice-master, apprentice-knowledge, and apprentice-community relationships discussed at length below.

Apprentices and Archaeology

Children are often ignored or overlooked in archaeological research. Archaeologists generally acknowledge that it is difficult to identify a 'ritual' object from a child's plaything especially as the features of each are modern constructs that may not be identifiable, applicable or mutually exclusive in prehistoric contexts. Around the world, children play; it is universal to the human condition (Gosso *et al.* 2005: 214; Langley and Litster 2018). It follows then that children play with 'toys' (or playthings with varying levels of modification to the raw materials that make up the 'toy') and toys would become part of the archaeological record. Play can be divided into eight main categories: exercise play, object play, exercise play with objects, social contingency play, fantasy play, construction play, rough-and tumble play, and games with rules (Parker 1984; Langley and Litster 2018). Play often mimics adult daily life and practices—it is repetitive, often miniaturized, and occurs in domestic and special locations. Therefore, play and, ultimately, learning could easily be mistaken for ritual when little other evidence is available (Bloch and Pelligrini 1989; Coşkunsu 2015; Nowell 2015; Langley and Litster 2018). Importantly for our discussion here, toys as the implements of play and its tangible material culture signature, can also be employed as tools for children to learn specific tasks or trades. In other words, a child learning a specific task or technology may do so within the framework of play and it is unclear how the implements of this type of play might (or do not) differ from an apprentice learning a trade. Indeed, this might be considered a form of play-apprenticeship.

Clearly, children and learners contribute significantly to the archaeological record in their efforts to learn the world around them and make sense of their physical and social environments. For children to become successful adults, they must learn skills and practices from skilled individuals (masters, parents, older kin) but also their peers (Coşkunsu 2015). These relationships vary by cultural phenomenon[5] and have the potential to be expressed uniquely in the archaeological record as learning is a historical process. Traditions and knowledge are learned and passed down from master to apprentice yet this process is not a direct transmission. Knowledge can transform even within a single generation to meet social, cultural, and environmental needs (Greenfield 2004). While the foundations of a particular knowledge set may remain unchanged the superficial aspects of a practice can change more easily. For example, the practice of weaving in modern Mayan communities is deeply ingrained in daily life (Greenfield 2004). Women are taught from a young age how to weave on a back strap loom. They start with toy looms at the age of three and become fully competent weavers by their teenage years. To effectively use the backstrap loom a stiff back and minimal arm movement is necessary. Weaving ultimately structures the way girls are taught to move in all aspects of their lives, including cooking, fire tending, weaving, even dancing (Greenfield 2004: 24-66). In a longitudinal study, researchers found that the foundational aspect of the practice of weaving had not changed (weaving on a backstrap loom with restricted torso and arm movement) with significant cultural and economic change in the community. What had changed was the patterns girls and women created and the thread used to make the woven products. The woven patterns and thread being superficial aspects of the practice diversified and changed to meet the needs of the community (e.g., sale to tourists).

This educational phenomenon was also found in communities of contemporary Cameroonian potters. The foundation of the potting practice, here preparation and initial pot construction, remained consistent through generations and yet the superficial practice of decoration was prone to change both regionally and temporally (Wallaert-Pêtre 2001; Wallaert 2012). The implications of these knowledge transmission practices for archaeology are clear. When learning a practice, masters encourage the transmission of skills that are deemed fundamental for a community. This is an expression of community values, shared meanings, enterprises, and repertoires (Wenger 1998:82-85). Archaeologically, if an aspect of a practice is maintained through time it can be inferred that the practice was culturally meaningful to a community. Furthermore, the contents of deposits can act as indexes for other places where the materials were derived and thus provide more context to the importance of such places in

[5] Cultural phenomenon refers to the social worlds people inhabit. Similar to 'a culture', cultural phenomena are a sum of material objects, social experiences, practices, behaviors, and interactions that create unique and shared histories and understandings within a group (Watson 1995).

particular practices (Joyce 2008; Joyce and Pollard 2010; Arnold 2017: 206-214). While changes through generations of learners can be expected for many social, environmental, cultural, or economic reasons the foundations of a practice tend to remain consistent over time. Evidence of learners must exist in the archaeological record as practicing a skill will use materials and leave traces of said practice (Milne 2012; Knight 2017).

In the following discussion, I frame knowledge transmission regarding the manufacture of blade cores at the Epipalaeolithic site of Kharaneh IV in the context of legitimate peripheral participation (Lave and Wenger 1991; Greenfield 2018), genetic processes (Saxe 2012), and practice theory (Bourdieu 1977). I posit here that children, young adults, and adults were likely active participants in flintknapping events, as learners and masters, either through mimicry and play, or more structured 'lessons'. The study of children in the archaeological record and in prehistory specifically has grown significantly since the late 1970's. Studies regarding how children learn skills, interact with communities of practice, and actively engage in the process of craft production are fascinating facets of archaeological exploration. Lithic production is a burgeoning area of study (for further discussion see Bodu et al. 1990; Babel 1997; Finlay 1997; Ferguson 2008; D'Errico and Banks 2015; Ember and Cunnar 2015; Finlay 2015; Högberg 2018). However, there remains minimal research that allows for the identification of children from adult novices, and we may never be able to make these distinctions in the material record. Therefore, I use the term novice to encompass both child learners and adult learners, as they are (so far) virtually indistinguishable in the lithic archaeological record). I recognize that there is the potential for developmental differences among these two groups. This research is instead focused on the apprentice writ broad and how they grasp learning socially constructed rules and physical tools to create 'ideal' knapped products (Vygotsky 1978: 52-57).

Organization of Knowledge Transmission

Formal vs Informal Learning: A False Dichotomy?

The separation of 'formal' and 'informal' education has influenced educational theory for over eight decades. The term 'formal education' is based on a systematic, structured, and organized models where deliberate "out of context" learning occurs in a special setting apart from daily life (Scribner and Cole 1973; Strauss 1984:195). The education of youth is considered a responsibility of the larger social group and presents rigid curriculums with specific objectives, subject matters, and methods clearly defined by the instructor. This system often involves three main components: the master, the learner, and the institution. Master-learner interactions tend to be of a punitive nature as obedience is preferred for the existing mono-directional teaching methodology. For example, education during the Victorian Era was focused on memorization of arithmetic, literature, and writing. Masters often used physical punishments to discipline learners but also used embarrassment as a tactic to maintain authority in the classroom (Kalman 1991). 'Formal' education allows for a master to be 'in charge of' and responsible for the learning of many learners (Zaki Dib 1988:300). Informal education is more broadly defined as education that takes place in the context of daily life (Scribner and Cole 1973; Strauss 1984: 195) which may or may not include objectives or subject material (Zaki Dib 1988). In short, western style education is often considered formal while everything else is considered informal education (Greenfield and Lave 1982).

Despite this coarse distinction, the boundaries between formal and informal education have long been debated. Some researchers choose to focus on power disparity, others on the process, and yet others on the nature of the learned material. Power disparity refers to the interrelations within the learning environment and the material that is being taught (Bourdieu and Passeron 1990). It is argued that "formal education is dominated by the values of social elites, and that its prime purpose is to preserve and reproduce their privileges" (Colley et al. 2003: 14). Thus, learning within a formal system empowers some individuals within a society and oppresses other individuals who are often historically disadvantaged. Learning in an informal system is often connected with 'everyday practices' and therefore not valued by social elites as a means of advancement (Colley et al. 2003). The process of learning is another way researchers have attempted to divide formal and informal education. The notion of formal learning that is commonly used has roots in industrial and colonial nations where the institutionalization of standardized and decontextualized knowledge (taught by teachers in schools) was mandated by the state. This is opposed to the idea of informal learning which is often organized on the family or community level and allows for more flexibility as the knowledge required for individuals to be successful is diverse and occurs during daily activities (Perry 1976; Colley et al. 2003). Finally, the nature of the learned material is used to divide formal and informal education as formal education is associated with knowledge acquired through insular academic pursuits while informal education is associated with amorphous daily practices that intersect with multiple aspects of daily life (Muller 2000; Colley et al. 2003).

Since the early 1980's there has been a shift away from the formal/informal dichotomy and towards a more pluralistic approach that captures the extreme variance of educational models around the world and through time. To approach the process of learning, from the nascent stages of novicehood to the mastering and sharing of knowledge after significant acquired experience, a wholistic and socially oriented approach, such as the one discussed below, is a better fit for understanding the effects of culture, knowledge transmission, and learning within a community of practice (Lave and Wenger 1991). This approach is ideal for archaeological research as it focuses on practices and the social constructions around them. Practices leave material evidence (assemblages) behind that can allow for detailed investigation of past interactions, knowledges, choices, and values. Research of the assemblages allow for interpretation of past practices and the roles they played within a community (Joyce 2008).

Culture, Change, and Learning

Cultural and educational structures are inextricably intertwined. Using a situated perspective, learners are always influenced by the socio-cultural structures and settings where learning occurs (Lave and Wenger 1991; Rogoff 1994; Greenfield 2018). Learning a practice is not simply the process of memorizing a set of facts or procedures. Rather, learning a practice requires interacting with an enterprise and a community of practitioners in a way that allows the learner to construct and negotiate meanings around the practice. Practices themselves are dynamic structures within a community that are both resilient and mutable (Wenger 1998).

Practices have three interrelated dimensions: 1) mutual engagement that involves participation of both learners and masters, 2) a joint enterprise where socially negotiated goals become integral to a practice, and 3) shared repertoires in the form of routines, language, habits, lore, gestures, symbolism, and ideas used to negotiate and construct meaning within the practice (Wenger 1998: 73-83). As the physical world around us is always changing, practices too must change. Even when a practice is perceived to be consistent with past practices, small changes or microvariables[6] occur, sometimes largely unnoticed (Wenger 1998:93-94). For example, in a lithic replication experiment performed to study the correlation between microvariables and the social group within which an individual learns a craft Creese (2012) found that individuals quickly develop and maintain their own microvariables and that on a group level, microvariables were affected by the context of learning. Two test groups were used in the analysis, and each had statistically significant differences between the final products produced by the subjects (Creese 2012: 56). Creese's study affirmed that communities of practice are dynamic entities which develop within historical, cultural, and social contexts and, importantly, they are mutable. Fluctuations in a practice can be maintained or changed with time and are reflections of both the practicing community and the broader system the community functions within (Wenger 1998: 78-79).

Situated Learning

Learning within a community of practice can take many forms and is culturally circumscribed. Communities of practice are flexible nexuses of knowledge and practice. Through the process of legitimate peripheral participation[7] novice members gain the social and practical knowledge to become more central members of the community. Through experience, practice, and social interactions individual members become holders of knowledge and eventually masters who in tern teach newcomers the numerous aspects of a practice. Part of this learning process is situated learning, where a novice learns 'in context'. They can actively or passively engage with a practice which allows them to gain different types of knowledge like language, values, beliefs, processes, or preferences of the community of practice (Lave and Wenger 1991; Wenger 1998).

In the situated learning model defined by Lave and Wenger, the mind, history, culture, and social interactions are intertwined processes that ultimately shape each other (Lave and Wenger 1991: 63). Learning within a community of practice has four main components: practice, community, identity, and meaning. Each component shapes the experiences of the learners (and masters) and influences their choices. Practices are mutual actions that occur in shared social and historical contexts. Practices share negotiated meanings, processes, language, values, and understandings (Wenger 1998) which can be seen as patterns of behavior. Communities are the social environments in which participation in practices can occur. Identity is the construction of personal meanings within the context and *doxa* of a community. Meaning is the internalization of experiences within a community and is constructed through processes of participation and reification. Participation and reification are viewed as dualities; participation includes experience, action, interaction, and membership within a community while reification includes the symbolic and physical aspects of tools, instruments, monuments, and artifacts that reinforce meaning. The interplay between the less tangible participation within a community and the

[6] According to Creese, a microvariable is physical evidence of a particular application of techniques by an individual that vary due to idiosyncrasies, body movements, learned behavior, and socio-cultural factors; they are thought to be unique to an individual (Creese 2012).

[7] Legitimate peripheral participation as defined by Lave and Wenger (1991) is the process of learning a practice through interactions with a community of practice. Novices are given peripheral tasks to build their skills, as novices become more skilled they are given more complicated tasks until they master the various tasks and become central members of the community.

tangible artifacts created or used by a community allows for the negotiation of meaning by its participants through experience (Lave and Wenger 1991; Wenger 1998: 4-7).

Meaning is fluid and contextualized within a community of practice and changes as the community itself changes. Old members create spaces for new members to participate in a practice both peripherally and directly. New members eventually gain enough skills and knowledge to become more central members through their own experiences and negotiated meanings. Practices cannot be stable or stagnant. Members of communities interact with practices both continuously and discontinuously. Continuous interactions like language use, shared enterprises, and shared meanings that affect community identity may remain relatively unchanged. Yet, the world is a constantly changing place and social, environmental, economic, and cultural factors can cause shifts in practices through time. For a practice to be maintained over space and time it allows for cumulative change. For example, due to a shift in economy the Maya weavers of the Chiapas transitioned from cotton thread to cheaper and more colorful acrylic threads to produce woven goods they could sell to the public (Greenfield 2004). The shift to acrylic thread allowed weavers to produce more woven goods cheaply, increased access to thread so children could ‘play’ more, and increased diversity in style and design as weavers were less constrained by color and cost (Greenfield 2004: 18). While the weaving practice remained continuous, discontinuity occurred within the practice as well. Changes can also occur on the individual level during the development of styles and repertoires through discourse with other community members. Learning is a dynamic experience that combines social interactions and experiences through the legitimate peripheral participation of a shared practice to produce shared meanings, identities, and enterprises (Wenger 1998: 93-95).

Learners start as peripheral members of a group and are often given minor responsibilities or allowed simply to observe the community of practice. Through regular interactions (observation, mimicry, imitation) and practice, learners become more skilled and less peripheral until they become central community members and masters in their own right. In this way, masters and learners are dependent on each other. Learners must gain experience and knowledge from masters and, for the practice to continue, masters must train their future replacements within the community of practice (Lave and Wenger 1991; Wenger 1998).

Change of practice is inherent in this model as Lave and Wenger note, where “[t]he construction of identity is also a way of speaking of the community’s constitution of itself through the activity of its practitioners. It further involves a recognition and validation by other participants of the changing practice of newcomers-become-old-timers” (1991: 73). Through these reciprocal relationships of practice, social interactions, and skilled experience, learners can become masters and ultimately core members of a community of practice while also changing the practices of a community (Lave and Wenger 1991; Wenger 2000).

Thus, the arena wherein learning takes place is the community of practice and it can be broadly described as the joint engagement of learners and skilled practitioners in an aggregated community where learners develop skills and skilled practitioners share accumulated practices and knowledge (Mayes et al. 2001). In these communities, learners start with a peripheral position within the community and through practice and participation, they take on a more central role within the community (Lave and Wenger 1991). Becoming a skilled practitioner is viewed then as the outcome of a learner’s ability to self-motivate in order to successfully participate in the community’s practice both physically and socially. A focus is placed on learning as the growth, maintenance, and creation of new relationships between learners and other community members through practice resulting in the full membership of a learner in the community of practice (Mayes and De Freitas 2007).

The experience of learning within the community shapes the learner's identity as they are observing and participating in routines and social interactions of the skilled practitioners. Identity is inseparable from practice and community as it is a way of creating meaning. Building an identity requires individuals to negotiate meanings based on their lived experiences as members within a social community (Wenger 1998: 145). To do this, community members explicitly or inexplicitly negotiate rules regarding how they engage with one another. Practices act to reify individual identities within a community as it is the interplay between the lived experience, community membership, learning trajectories, multi-membership, and the notion of 'belonging', both locally and in broader communities, that allow an individual to construct an identity (Wenger 1998: 150).

Genetic Processes Model

Another approach to learning and cultural change is through the investigation of small changes made to a practice by community members on both the individual and group level. Geoffrey Saxe discusses the ways that information can be created or learned through the processes of microgenesis, sociogenesis, and ontogenesis (Figure 4.1). Each genetic process is intricately connected to the other in an agent-centered web of personal growth, learning, accommodation, assimilation, and sharing of knowledge in a communal practice (Saxe 1994 & 2002; Saxe et al. 1996; Saxe et al. 2009).

The genetic model uses form in two different ways. Material forms are objects that guide their own use (Saxe 2014). For example, a round river cobble does not have an inherent use, however, in the hands of a flintknapper, the cobble can become a hammerstone or anvil for producing stone tools. The form of the cobble guides and affects the way the rock is used by an agent but does not determine it, especially since cobbles are selected for a pre-determined purpose and deemed to be of a suitable shape or size for a flintknapper's intentions.

Semiotic forms are more ephemeral, they can be thought of as mental templates (language, thought, or even numeration systems) that affect and afford a function[8] or behavior but do not determine the function (Saxe 2002, 2014). For example, the "thumbs up" gesture in the United States indicates that something is "okay". One may use this gesture to communicate with others from a distance that things are fine at their location. In Japan this gesture indicates the number five. Neither of these gestures inherently means "okay" or "five"; between the United States and Japan the same abstract gesture evolved into very different meanings that make sense in their respective communities. Material forms (objects that guide their own use) and semiotic forms (socially constructed mental templates) can be combined and applied to a situation in order to solve a problem, this is the act of creating a function. For example, a flint cobble is a material form as it has its own unique shape, internal and external properties, and life history. When combined with a semiotic form like the flintknapping knowledge of a community, a flint cobble can serve the function of a tool as it can be transformed into a variety of useful tools through the combination and application of both material form (flint) and semiotic form (flintknapping knowledge). This combination of material constraint and social construction allows room for change of practices on the individual level (microgenesis), group level (sociogenesis), and through time (ontogenesis) (Saxe 2014).

[8] Functions are a meaningful way in which forms can be used or applied to solve a problem.

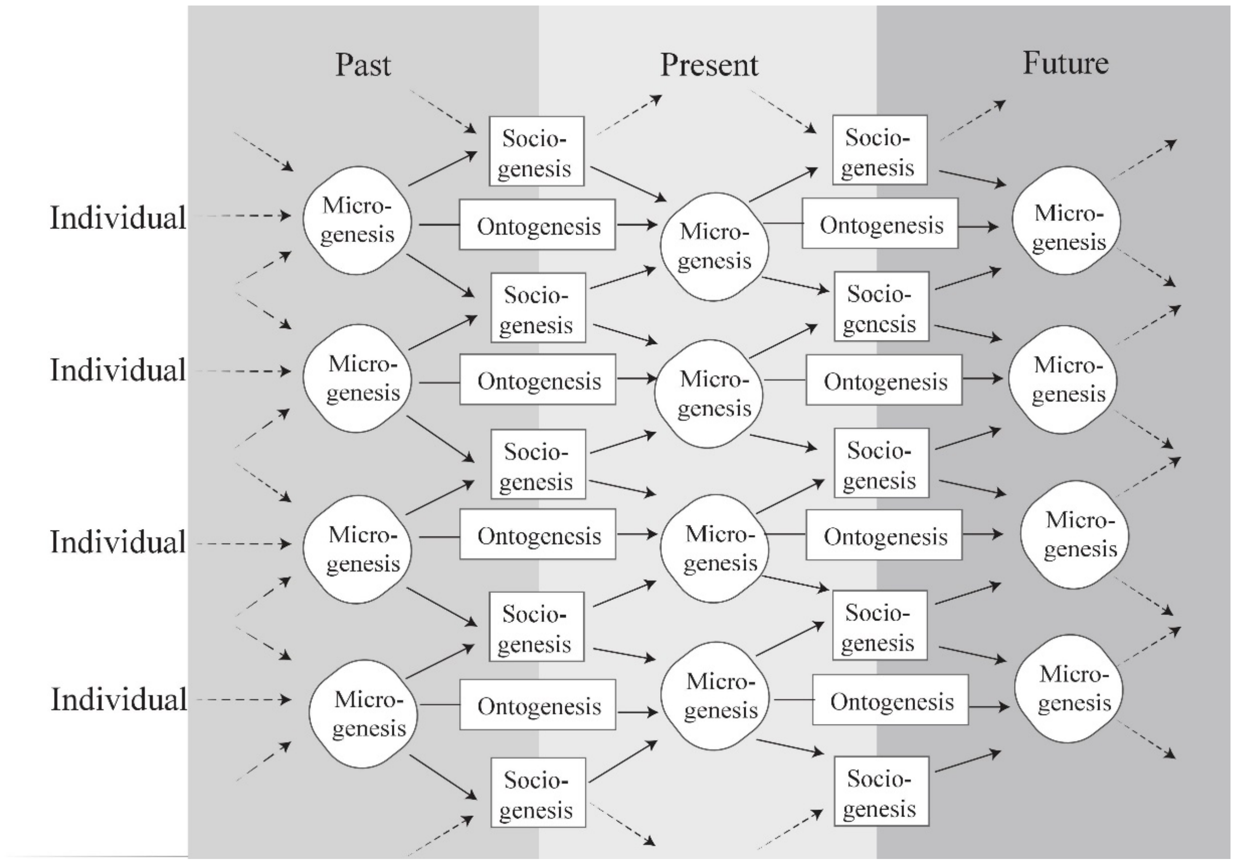


Figure 4.1: The relationship between the genetic processes proposed by Geoffrey Saxe (adapted from Saxe 2014: 33).

Microgenesis was originally used by Vygotsky[9], it is used differently in the genetic model. Microgenesis is the process whereby an individual gives meaning to a practice or activity. The individual takes forms and transforms them into functions thus creating a system with no inherent meaning to a broader community but is meaningful to the individual trying to solve a problem (Saxe 1991, 1994; Saxe *et al.* 2009). In archaeological terms, microgenetic acts can be discussed in relation to Creese's (2012) microvariables. Microgenetic acts would be decisions made during the production process that are unique to an individual, these decisions are made to solve problems that arise during the production process. An example of microgenesis would be an flintknapper abrading the platform of a blade core in an idiosyncratic way to help prepare for a blade removal. While this small change to the practice does not affect the community more broadly, by mobilizing their unique approach, the act is meaningful to the individual as they are now able to produce blades on a blade core. This microgenetic action would result in a microvariables as the change to a practice could be detectable in the material record.

Sociogenesis is the process of emergence, reproduction, and maintenance of ideas over time. An individual can share their personal understandings (microgenesis) by sharing their experiences; others can share their understandings of a practice as well. This allows for meanings to change and be negotiated between individuals as cultural forms get reproduced and altered

[9] Vygotsky uses the term microgenesis to denote the developmental process of creating schemas where individuals transition from a rough understanding to a clearer understanding over a short period of time (Saxe 2002).

through interactions with other individuals and through time (Saxe 2012). This process of sharing understandings and negotiating ideas and processes relates closely to Wenger's (1998) use of the term 'negotiation of meaning'. Here members of a community of practice continually interact with other members to participate in a practice and reify meanings through social and physical means (E.g., processes, tools, or final products). Saxe discusses the process of sociogenesis as a means for change through social interaction, where individuals gain insight from other practitioners, share their knowledge with others, and maintain ideas about their practice within an ever-changing world (Saxe 2012).

Ontogenesis is the change of functions throughout the lifespan of an individual. As an individual begins the learning process, certain forms may be applied more readily. After a practitioner gains experience, both with the social group and the practice, one may use different forms and functions through time. Each plays a role as the microgenetic process is replicated and altered by sociogenetic processes, which in turn get assimilated and accommodated through ontogenetic processes (Saxe 2012: 236). Ontogenesis is then the changes to a practice that an individual experiences through their lifetime as a practitioner. These changes could be due to environmental constraints, social or ideological changes, or even personal preferences. Masters do not see their practice exactly as they did when they were novices— ontogenesis accounts for these changes to worldview, practice, practicality, and social interactions within a community of practice.

Case Study: Attic Potters

In this section, I examine Attic potters of ancient Greece whose daily routines regularly include youth learning a technology within a community of practice. This case study is intended to depict the complex relationships between learning, culture, and change through the lenses of situated learning and the genetic model (Lave and Wenger 1991; Saxe 2014). In later chapters I will apply the takeaways of this case study to the identification of expertise in Epipalaeolithic flintknapping in eastern Jordan. Extensive research has been conducted on Attic potters and their apprenticeship processes (Hasaki 2012). Current research of the community of practice is diachronic, includes social network analysis, tends to focus on artisans at the individual level, examines change of a craft over a period of 150 years, and hones on a thirty-year span when innovation of decorations and style was unparalleled in Greek history (Shapiro 1995; Hasaki 2012 & 2019). The Attic potter community was large and highly visible within the broader community of ancient Greece, yet pot-making knowledge remained circumscribed within a small subset of highly skilled individuals (Hasaki 2012). This makes Attic potters a prime candidate for application of a social learning approach including the notions of communities of practice, situated learning, and genetic processes.

Multiple lines of evidence in conjunction with archaeological findings have been utilized by researchers to reconstruct the apprenticeship process of ancient Attic pot makers. Literary evidence from poets, philosophers, and encyclopedists provide insight to how potters were viewed within the society and how their trade was a central component of Athens' bustling trade centers of the time (Shapiro 1995; Langdon 2015; Hasaki 2012; Hasaki 2019). Iconography on Attic pots that depicts various aspects of pot making and apprenticeship is only known to have been produced in Attic workshops (Beazley 1956; Shapiro 1995; and Hasaki 2019). These vessels have long been considered by art historians as material depictions of the potter's perspective of the crafting process (Beazley 1956, 1963). Archaeological analyses of the pottery workshops and a social network analysis of the distribution of signed pottery, a common practice for masters and learners alike in Attic workshops, corroborates depictions of the pot-making process and, thus, the importance of these pots for illuminating many aspects of the learning process (Beazley 1956; Hasaki 2012).

Social network analysis of the signed pots found between 650 and 400 BCE suggest there were over 1000 individual potters active in Athens Potters' Quarter. Of these 1000 individuals, thirty-nine were found to have strong connections with each other and overlapped in time producing pots enough to be considered contemporaries. This is particularly important in determining the type of knowledge present within and around workshops at any one point in time. Using 'cohorts' of potters, researchers found that workshops tended to produce shape specific vessels; in other words, one workshop only produced a single vessel type/shape or a small selection of similar vessel types/shapes. Hasaki (2019) argues that this practice suggests highly specialized and technical knowledge was required to skillfully produce and decorate each type and shape of vessel in the Attic tradition.

In Athens' Potters Quarter individuals began their apprenticeships at a young age. Philosophers and artists only refer to boys as taking on the trade from their fathers or slaves (with no gender assigned) learning a skill from their masters, but little other information is provided regarding the beginning of an apprenticeship. Apprenticeship contracts (for weavers) have been found that discuss the length of time a child is to be apprenticed, the number of days off an apprentice has per year, and the number of hours they are expected to work per day. Apprenticeships were not freely offered by master craftspeople, the life of an apprentice was strenuous, often working from sunrise to sunset to help the master craftspeople and to perfect their skills. Among potters, children observed the master potter at work and started by aiding in menial tasks like carrying small vessels, gathering fuel and moving formed vessels to the drying area. Young apprentices are also depicted helping their masters spin the potter's wheel, potentially to help aid learners in learning appropriate speeds for vessel construction (Hasaki 2012). Plato commented on this process as he felt that it was important to master the beginning stages of a skill (specifically rhetoric in *The Republic*) before moving on to more complicated tasks: "Did you ever observe in the arts how the potter's boys look on and help, long before they touch the wheel" (Republic 5.476A). This scaffolded approach is also suggested by the ancient Greek proverb: "Is not this, as they say, to learn the potters craft by undertaking a pithos… and does this not seem to you a foolish thing to do?" (*Gogias* 514E; *Laches* 187B; and *Protagoras* 324E). This proverb highlights the importance of learning basic skills first before taking on complicated tasks; to do otherwise might lead one to botch the undertaking due to a lack of skill, finesse, or knowledge (Hasaki 2012; Langdon 2015).

Philosophers certainly saw the apprenticeship of a potter as requiring patience, persistence, and the gradual accumulation of skills through a long process of trial and error (Hasaki 2012). More skilled apprentices were expected to help draw templates for a vessel's final decoration, paint simple decorations and designs, and aid in the firing process. Taking a more central role in the community of practice, this stage allows for apprentices to learn specific aesthetic traditions like pattern, symmetry, and use of negative space in frames but also allowed them to refine their skills. The final stages of apprenticeship included teaching apprentices where and how to collect the raw materials for the vessels and slips[10] and painting decorations on vessels. Also, during the later stages, apprentices were expected to anticipate the needs of their

[10] Slip is a thin slurry of fine clay particles that is used to decorate pottery prior to the firing process.

masters and proactively prepare and compensate for the master potter's needs (Shapiro 1995; Langdon 2015; Hasaki 2012, 2019).

Here I explore the apprenticeship process of Attic potters in both the genetic model and situated learning model, overlapping the two theoretical approaches to build on the ideas of cultural phenomena like traditions of pottery making as both models explicitly discuss dynamic processes of change through a social lens. Microgenesis captures the constantly changing condition of people as they experience, assimilate, and adapt to novel situations (Saxe 2014). Microgenesis allows for a microscale analysis of change as it gives agency to independent actors who ultimately feed into a larger social system (Saxe 2014). Young Attic learners would come into a pottery apprenticeship with varying levels of education and knowledge regarding the pot making process (Langdon 2013). A learner then must engage in the communal practice of pot making, a sociogenetic act, in order to construct their own understanding of the pot making process through experience. They may learn the proper moisture content of the clay, the appropriate speed at which to turn the potter's wheel or how to handle leather-soft pots in need of further drying (Hasaki 2012, 2019). This peripheral participation allows the learner to construct a meaningful foundation of techniques and skills they will need as skilled potters. The process of forming this body of knowledge by an individual is microgenesis and is unique to each individual who participates within the community of practice (Saxe 2014; Hasaki 2012, 2019; Langdon 2013).

While in the workshop, apprentices observe the movements, actions, and decisions made by master potters (Langdon 2013; Hasaki 2012, 2019). This allowed the apprentices to construct an understanding of the pot making process that was clearly shaped by the masters around them. As masters only specialized in one (or a select few) vessel forms, apprentices too would have specialized in those specific vessel forms. Strict standards were applied to finalized novice work and it was not uncommon for a learner to receive corporal punishment for mistakes (Hasaki 2012). As learners became more skilled, they took on more central roles within the community of practice. Learners honed their motor and artistic skills by drawing templates, attaching handles to vessels, and other less central tasks for the master potter. The work was either accepted or rejected by the master. This process of submitting work with the intention of conforming to the communal practice is an act of sociogenesis. The learner and master are both reinforcing the communal practice. Each individual has their unique set of microvariables or idiosyncratic actions that cause recognizable differences between the products of two individuals (Creese 2012), yet the work itself conforms to the community norm. When the learner becomes a master, they will pass on their knowledge, gained from their perspective within the community of practice, to a new generation of learners, but also pass along their specific idiosyncracies. Sociogenesis thus allows for the accumulation of small changes in practice over time (Saxe 2014; Hasaki 2012, 2019).

There are other sources of variation too. Over their lifetime, Attic potters experienced changes in decorative styles, vessel shapes, raw materials, and technological innovation (other factors like warfare, trade, and climate also play a role in this process). As a young apprentice, the potter learned the rules of making pots from a master. This is not a direct transmission of all knowledge as multiple Greek philosophers noted that potters used a trial-and-error pedagogy (Langdon 2013; Hasaki 2012, 2019). Children who learn this way tend to have more random innovation than children who are taught in highly scaffolded environments (Greenfield 2000; Langdon 2013). This understanding is gradually constructed through time through experience and practice.

During the learning process meanings can change. For example, learners often experienced a shift in their approaches to painting vessel decorations. Masters and skilled apprentices prepare and paint fanciful scenes of mythology, history, war, politics, and feasts. It is thought that most craftspeople would not have had the social capital to attend lavish feasts or other events elites hosted (Sapirstein 2013). Potters, however, are believed to have transcended the barrier between elite and craftsperson. To paint the scenes elites wanted on their vessels, potters would have to have seen the events or received enough of an education to paint nuanced works of religious or political importance (Hasaki 2012; Langdon 2013). This is drastically different when compared to the work of children who often paint animals with misshapen bodies or geometric patterns that were not up to the aesthetic standards of the time. The ontogenetic shift is clear as learners understood that they needed to learn how to decorate pots and choose to decorate them with scenes that were known to them like horses, (stick-figure) people, boats, and simple shapes. Through their apprenticeship they learn that painting is much more than producing an attractive image, it conveys a message to an audience (Langdon 2013).

This case study highlights the flexibility necessary when approaching technologies through an archaeological lens. The practice of pottery making in Attic Greece was dynamic, included many phases of production as well as learning. Archaeological remains like whole or partial vessels and workshops provide both the materials and the context for understanding the ancient practice among Attic potters. Paintings on vessels are mobilized to show social interactions between members of the Attic potting communities, SNA of potter's signatures allows for the construction of Attic potting communities, while excavation of workshops and ethnoarchaeological research aid in the understanding of use of space, tools, and general practice (or *chaîne opératoire*). Practice theory acknowledges that the social world and the experiences that occur within it shape both knowledge and practices (Bourdieu 1977). Communities of practice allows for investigation of communities and comparisons between communities based on a history of traditions (Lave and Wenger 1991; Wenger 1998). These traditions can be material like making pottery and flintknapping or more experiential like pedagogy, lore, or oral histories. The less tangible aspects of tradition can be more difficult to understand as archaeologists we are often constricted to the tangible, the physical remains of traditions and practices. This simply means that more work must be done to contextualize the physical remains archaeologists have access to. A genetic processes approach can act as a middle range theory (Binford 1977) as it bridges practices, individuals, and communities through time. Microgenesis allows for investigation of individual actors within a community, sociogenesis contextualizes the microgenetic interactions within a broader social practice, and ontogenesis allows for investigation of how an individual changes their practices through time due to interactions both microgenetically and sociogenetically (Saxe 2014).

These three theoretical approaches work in unison to create a flexible approach to archaeological technologies. Methods like social network analysis, material analysis, experimental studies, and spatial analysis can aid in contextualizing the archaeological remains of practices to gain a more nuanced understanding of the social worlds within which practices occur. To further contextualize the practice of flintknapping at Kharaneh IV within its social contexts, I utilize practice theory, communities of practice, and genetic processes in conjunction with *chaîne opératoire* and lithic analysis to delve into the social world surrounding the practice of flintknapping.

Situating Learning within Social Contexts

Practice Theory

How then does one identify a practice when looking at archaeological remains? Practice theory, first outlined by Pierre Bourdieu (1977) suggests that by situating daily practices into context, archaeologists may be able to identify the *habitus*, or the durable system within which social structure and daily practice can be regulated through cultural rules of a learned skill or behavior and thus gain insight to the social lives of past peoples (Bourdieu 1977).

Universal generalizations and descriptions of behaviors cannot begin to capture the complexity and variety of the human experience (Hodder 1987); archaeologists are uniquely situated to study the daily routines of past peoples as the archaeological record predominantly consists of the remnants of mundane activities and behaviors. Archaeologists can then analyze repeated behaviors, activities, and events through spatial organization, ultimately allowing for the interpretation of artifact distributions and the creation of meaningful and often plausible narratives (Lightfoot et al. 1998; Ortner 2001). Repetitive behaviors and daily activities are not innate, rather, they are taught and learned within a community of practice. Children learn the culturally "appropriate" methods or *habitus* of tool production, food and resource acquisition, selection of settlement areas, and many other aspects of daily life through interactions with members of their social group (Bourdieu 1977; Wendrich 2012). To understand how the ancient peoples organized practices, archaeologists need to identify and analyze a community of practice. Tradition and the maintenance of a practice over time signal both group identity and social boundaries, thus providing researchers with a robust data set from which an interpretation can be constructed (Wiessner 1983; David et al. 1988; Wallaert 2012).

One of the most challenging aspects of applying practice theory to prehistoric societies is situating a practice within a social context. Ethnography can play a role in placing artifacts and remains within a socio-cultural understanding of the past (Edgeworth 1991) and allowing for a more holistic understanding of past human behaviors. Researchers should approach the application of ethnographic examples of behavior situated within a social context as an analogue for the past with caution. Behaviors such as butchering, pottery making, cooking, tool production (and many other aspects of daily life) are often culturally unique and formed over time through diverse experiences of the peoples and their relationships to the environment and other organisms within it. Ethnographic examples should not be used as direct comparisons but to give context to archaeological data and construct plausible narratives of daily life in prehistory bolstered by multiple lines of data (Dobres 2000; Soressi and Geneste 2011; Cipolla 2014).

Chaîne Opératoire Approaches

Practice theory is concerned with the presumptions of the researcher. Researchers are encouraged to recognize their roles as interpreters and to investigate their presumptions. To do this, Bourdieu argues that the studied culture itself should be used to situate interpretations. Activities provide observable and tangible evidence of *habitus* and *doxa* and therefore can be used to analyze and interpret cultural materials and cultural values (Bourdieu 1977).

Approaching technology as a social practice, c*haîne opératoire* allows researchers to expand from typological approaches and acts as an interface between technology and the mental templates which are shaped by cultural norms (Audouze et al. 2017; Schlanger 1994; Schlanger

2005; Chazan 2009; Soressi and Geneste 2011; Maher 2019). The concept of *chaîne opératoire* was originally adapted for archaeological use by Leroi-Gourhan as he aimed to understand a sequence of technical actions within a practice (Leroi-Gourhan 1964; Audouze et al. 2017). *Chaîne opératoire* incorporates far more than the sequence of actions that lead to the production of an object. It represents the application of knowledge (*connaissance*) and skill (*savoir faire*) during a dynamic process of production. Here knowledge is the information needed to carry out a process while skill is the physical ability of a practitioner to carry out a process (Chazan 2009:468). This approach to merging the body (skill) and the mind (knowledge) also accounts for the active role agents have in producing material culture. Ultimately c*haîne opératoire* recognizes the unique knowledge sets of practitioners which are compiled through long term engagements with a practice (Sellet 1993; Schlanger 1994; Phillips 2003; Chazan 2009; Soressi and Geneste 2011).

By viewing technology as evidence of a social practice (Lemonnier 1992; Dobres 2010) researchers can attempt to reconstruct the roles a technology played within a community of practice. This allows for further exploration of values within a particular community of practice through the community's approach to knowledge transmission (Maynard and Greenfield 2005; Greenfield 2016; Greenfield 2018).

Discussion

Learning is a dynamic process of change both on the part of the learner and the community of practice. Each change an individual makes to their practice is reflected, at varying degrees of intensity, in the communal practice. Over time, individuals' practices change to adapt to new situations or problems that cause a shift in the broader community of practice (Lave and Wenger 1991; Wenger 1998; Saxe 2014). These shifts accumulate overtime which can appear as new cultural phenomena or even the disuse of a practice (Wallart 2012). If a community of practice can be successfully identified in the archaeological record, a diachronic approach in combination with spatial analysis and detailed analysis of the *chaîne opératoire* should allow researchers to track the nuanced changes to a practice through time and space.

In this framework, children and learners are innovators. They come to a practice with new ideas, insights, and imagination that can be applied to an already dynamic practice. Through their growth within a community of practice and as an individual actor in the broader community learners become masters and gradually shape the communal practice they were taught (Lave and Wenger 1991; Langdon 2013; and Saxe 2014).

The following methods chapters, both laboratory and experimental, utilize the notions of communities of practice, situated learning, practice theory, the genetic processes model, and *chaîne opératoire* to identify evidence of flintknapping learners in the archaeological record at Kharaneh IV. Communities of practice, situated learning, and genetic processes are the overarching structures that shape the way I view learning in the ancient past. Practices, broadly speaking, are functional and yet are imbued with meaning from the community a practice is created and maintained within (Bourdieu 1977). Repetitive practices allow for the investigation of a practice, how it changes through time, and how practitioners interact with the practical, theoretical, and social knowledge of the community of practice (Ortner 2001). Learning within a community of practice through the processes of situated learning allows for the acquisition of knowledge that is both malleable and meaningful (Wenger 1998), while the genetic processes model aids in identification of change throughout the learning process (Saxe 2014). *Chaîne* *opératoire* is a means to view changes to a practice through time within a community, the community's *habitus* around making stone tools, or even investigate flintknappers understandings and skill in relation to other practitioners within a community of practice (Soressi and Geneste 2011).

I will explore skill as the ability of an individual to apply a c*haîne opératoire* and successfully produce tools or tool blanks. To do this, experimental work was completed that established the parameters for novice, intermediate, and master flintknappers when producing narrow faced blade cores on flint cobbles.

Chapter Five
Laboratory Methods

Lithic Samples

Activity areas, areas near or around combustion features and huts, as well as caches and concentrations were identified as likely locations for flintknapping to occur or the products of flintknapping episodes to be stored. Previous excavation revealed a high density of lithic artifacts in various loci that had been interpreted by excavators as potential floors due to the horizontal orientation of artifacts and artifact density. Initial techno-typological analysis of Locus 043 revealed two raw materials types occurred prolifically and consistently across the entirety of the locus. All reduction phases, from primary reduction to final tools, were present in Locus 043. The combination of a limited number of raw material types, a full range of debitage, and three lithic caches cut into Locus 043 (as well as two lithic concentrations within Locus 043 and one concentration nearby) suggested that Locus 043 was an active flintknapping area. Techno-typological analysis in Area B was completed on Locus 043, an activity area situated between two hut structures (Maher et al. 2012). The caches and concentrations within and near Locus 043 were selected for analysis and refitting due to their discrete boundaries, the large quantity of lithic artifacts from various stages of reduction, and distinct raw material units. This type of floor is ideal for understanding skill and the social interactions that are inherent in participating in a technological practice such as flintknapping.

Lithic debitage from two areas at Kharaneh IV were selected for further analysis. Early Epipalaeolithic activity areas are represented by lithic caches and concentrations. These tended to be located near or associated with the flintknapping floor of Locus 043 and include the following contexts: Locus 208 (a cache dug into Locus 043), Locus 213 (a cache dug into Locus 043), Locus 212 (a cache dug into Locus 043), and Locus 316 (a lithic concentration near Hut Structure 2). The final sample associated with Locus 043 is a concentration of translucent flint found predominantly across Locus 043 in Area B and thus represents an Early Epipaleolithic context. The second Early Epipalaeolithic area from which artifacts were derived for this study is Area E, Locus 014. This locus is located on a different part of the site, Northeast of Locus 043 and dates to 16,230 +/- 40 and 16,480 +/- 35 BP (uncalibrated).

Techno-typological analysis

My approach to lithic techno-typological analysis is modeled after the techno-typological approach at Kharaneh IV (Maher and Macdonald 2013; Macdonald et al. 2018; Barket et al. In Press). This approach prioritizes the *chaîne opératoire* of an archaeological reduction and utilizes experimental reductions to determine the goals of a reduction sequence, taking into account variable debitage caused by raw material variability, knapper skill, and flexible approaches to tool making (Wilke and Quintero 1994), as well as established typologies to determine lithic debitage groups (e.g., Tixier 1964; Bar Yosef 1970; Goring-Morris 1987).

Understanding the applied *chaîne opératoire* and error correction choices of flintknappers is essential for later analysis and interpretation of flintknapper skill level. One must distinguish between types of variation present in debitage to learn the various approaches and problem-solving techniques of ancient flintknappers. Variation in an assemblage is predominantly social, but the environment can affect the ways people choose to interact with different materials, including the choice to engage with specific materials and choices of knapping tools during the reduction process, and the final tool forms are socially constructed. (Sullivan 1987; Lemonnier 1992; Sellet 1993; Bauer and Kosiba 2016; Arnold 2018). For example, due to the sedimentary nature of flint, cobbles tend to be irregular in shape and size (Andrefsky 2005). However, flintknappers in the Azraq Basin show preference for making blade cores on cobbles of particular shapes and sizes (Garrard and Byrd 2013; Macdonald et al. 2018). Natural properties of the flint enable and constrain the actions of the flintknappers (Schlanger 1994; Lemonnier 1992; Chazan 2009; Bauer and Kosiba 2016). Raw material characteristics like texture, shape, and cortex thickness (also described as 'workability') can influence the flintknapper's choices during the reduction process (Knutsson 1988; Wilke and Quintero 1994; Olausson 2008; Olausson 2010; Eren et al. 2014).

The flint selected for reduction by flintknappers at Kharaneh IV is variable and ranges from high-quality, fine-grained and glassy flints to low-quality, coarse flints. As the flints originate from multiple outcrops and formations throughout the region the raw material comes in a variety of colors, shapes, textures, and types of cortex (Sánchez de la Torre et al. 2019). Some anthropogenic causes of variability can include individual flintknapper skill (here defined as a combination of *connaissance* and *savoir-faire* (Pelegrin 1990)), flintknapper intention, and flintknapper preferences (flint color, handedness, and flintknapping idiosyncrasies or micro-variables) all of which can be ascribed to the application of *chaîne opératoire* and can add to the significant variability within a single assemblage (Pelegrin 1990; Clarkson 2010; Creese 2012; Lycett and von Cramon-Taubadel 2015).

The techno-typological approach is well situated for interpreting the nuances of flintknapping and the intentions of the flintknappers. An understanding of the technology itself, the stages of production, the waste or by-products of the process, and the final tools produced can all aid in determining the intentions, abilities and skill of a flintknapper. The combination of replication experiments and refitting archaeological reductions can provide significant insight to the mind of the ancient flintknapper[11] and can reveal techniques regarding common reduction methods, error correction methods, tool production and, I argue here, the skill level of an individual flintknapper (Yerkes and Kardulias 1993; Wilke and Quintero 1994; Laughlin and Kelly 2010; Eren et al. 2016; Takakura and Naoe 2019). Replication experiments have done much to further our understanding of the *chaîne opératoire* and influence the techno-typological analytical system in use at Kharaneh IV.

The techno-typological approach breaks debitage down into categories that are related to their sequence in the *chaîne opératoire*, their intended purpose (i.e., to fix a bulge in a core face or prepare a platform), and their morphology (Flenniken and White 1985; Yerkes and Kardulias 1993). At Kharaneh IV the main chipped stone technological categories consist of debitage, core trimming elements, blades, cores, retouched tools, and microliths. These categories are

[11] While it may be possible to distinguish a single flintknapper through their skill expression and idiosyncratic choices (application of a specific *chaîne opératoire*), here, getting into the mind of an ancient flintknapper refers to the ability to understand their technological choices that reflect the social *habitus* and *praxis* that are constructed within a community of practice. Some refitting research suggests that it is possible to identify individual flintknappers and distinguish between multiple flintknappers working on an individual core (Takakura 2013; Takakura and Naoe 2019). I consider the community of practice the most prudent level of analysis and focus on clusters of skill levels as this allows for discussion of internal and external variability, but also an understanding of the social values constructed around flintknapping (E.g. "for a tool to be useful it should look like this", "this is a good/bad tool", "we use 'good' material for this type of work and 'bad' material for that type of work") (Wenger 1998).

subdivided based on morphological and technological features. Debitage broadly refers to flakes removed during the earlier phases of blade core reduction but is not restricted to early phase reduction. Debitage is highly variable as each cobble requires a different approach to produce a blade core (Wilke and Quintero 1994). Debitage includes primary pieces, secondary flakes, non-cortical flakes, secondary blades and bladelets, platform isolation elements, edge preparation elements, shatter (including burnt shatter), sectioned blade fragments, and chips (Maher and Macdonald 2013; Macdonald et al. 2018; Barket et al. In Press).

Core trimming elements are divided into two major categories, core preparation and core maintenance elements. Core preparation entails the shaping of a cobble to prepare it for blade production and includes lateral core trimming elements, initial core tablets, initial faceted core tablets, and crested blades. Core maintenance elements are removals that are intended to maintain or correct core shape (either on the platform and core face). These include angle correction elements, non-initial core tablets, non-initial corrective core tablets, core face rejuvenation elements, profile correction blades, partially ridged blades, and bottom partially ridged blades (Maher and Macdonald 2013; Macdonald et al. 2018; Barket et al. In Press).

Blades are removals with roughly parallel lateral margins and that are twice as long as they are wide. Blades and bladelets are commonly distinguished in Epipalaeolithic technologies regarding their dimensions (blades are longer than 5cm while bladelets are shorter than 5cm) (Tixier 1964; Andrefsky 2005). This is an arbitrary distinction as blades and bladelets exist on a continuum. The distinction is commonly used in Epipalaeolithic assemblages and can be useful in identifying inter-site variation (Olszewski 2001). At Kharaneh IV, blades are frequently used for producing geometric and non-geometric microliths through intensive retouch, making the size of the final tool more important for typological distinction rather than blank size (Maher and Macdonald 2013; Macdonald et al. 2018).

Blade cores are the predominant core type at Kharaneh IV and are crafted to allow for multiple blade removals to be removed sequentially. The blade cores vary in morphology and include single direction nosed cores, narrow faced cores, broad faced and sub-pyramidal cores, opposed platform cores, and change of orientation cores. An additional qualifying term of 'exhausted' is added to the core type if the core is deemed 'no longer workable' by the analyst. This can include factors such as a small platform size, shallow platform/core face angle, overall small core size, or accumulated errors like multiple hinges (Maher and Macdonald 2013; Macdonald et al. 2018; Barket et al. In Press).

As the focus of this research project is on debitage and the technological and social implications of the flintknapping process, final tool forms were assessed and assigned, however, they were not studied further. The tools were used as markers for flintknapper intention and considered to be the result of the interactions of the flintknapper, the raw material, the flintknapping tools, the culturally prescribed understanding of 'tool' or 'useful', flintknapping knowledge, *chaîne opératoire*, environmental knowledge, and the socio-cultural work environment the final tools would act within (e.g., hunting, butchering, reed cutting) (Renfrew 2004; Malafouris 2013; Arnold 2018). The tools are broken down into two major categories: microliths and a variety of other macro-scale tools. These categories and sub-categories were constructed based on previous research and adapted to the site of Kharaneh IV (Tixier 1964; Bar-Yosef 1970; Goring-Morris 1987). Tools include perforators, scrapers, burins, multiple tools, truncations, backed and retouched blades, notches and denticulates, heavy duty tools, and retouched pieces (retouched pieces can range from large macrolithic tools to microlith sized tools yet are classified separately given the regularity and location of retouch). The microlith category includes non-geometric microliths, geometric microliths, fragmented microliths, and microlithic points (Maher and Macdonald 2013; Macdonald et al. 2018; Barket et al. In Press). See Appendix A for details on categories and definitions of debitage, cores, and tools.

Refitting

The process of refitting debitage is akin to working on a 3-dimensional puzzle. Caches were selected for refitting as they are discrete and contain debitage that appears to be related to a small number of individual flint cobbles. Attempts at refitting artifacts from inside hut structures were not productive as many of the artifacts were partially burnt during destruction of the structures and, thus, unable to be matched back to a blade core.

The first step to refitting lithic artifacts in a large assemblage is to separate debitage into raw material units (RMU) (Roebroeks 1988; Bustillo et al. 2009; Vaquero et al. 2019). Six categories are used to distinguish between RMU's: color, translucency, grain size, luster, veins/patterning, and variability (Table 5.1). While these categories are subjective and qualitative, a macroscopic approach to categorizing flint has proven to reliably distinguish between different nodules of flint (Bustillo et al. 2009). As individual flint nodules can vary greatly in color it is necessary to approach debitage with a multifaceted approach to RMU creation (See Figure 5.1 for a sample RMU).

Color is first assessed by eye. Between one and six initial groupings are made per assemblage. Within each group, variation is noted and a Munsell chart is used to distinguish highly variable color clusters within the original groupings. For example, within the 'red' category, debitage with a 'yellow-red' value is separated from debitage with a 'red-purple' value. A miscellaneous category is then made to group the burnt pieces or rare colors within the assemblage.

Translucency is assessed by holding the flint over a piece of white paper with printed black lines. If the lines can be clearly seen through the flint it is categorized as translucent (See Appendix B). Debitage is categorized as either translucent or opaque. Translucent material is rare in the Kharaneh IV assemblage and is separated into a unique RMU based on color and luster.

Grain size is assessed by eye and through physical examination of texture. The four grain size categories are: coarse, medium, fine, and glassy. Coarse flint has a visible crystalline structure (≥0.031mm) and feels like sandpaper. Medium flint does not have a visible crystalline structure (≈0.015mm) and feels slightly gritty (similar to wet silt). Fine flint has no visible crystalline structure (≈0.008mm) and is smooth. Glassy flint has no visible crystalline structure (≈0.004mm) and feels wet or silky—similar to chalcedony which has a fibrous microstructure (Blair and McPherson 1999). Four geological samples were selected as reference pieces from the Geoarchaeology and Southwest Asia Prehistory Laboratory's comparative collection at the University of California, Berkeley, to maintain consistency when determining texture (See Appendix B).

Luster is determined by the reflective properties of the flint. Flint is categorized as matte or vitreous. Matte flint does not have a sheen when observed under florescent lighting. Vitreous flint has a sheen and reflects light when observed under florescent lighting (See Appendix B).

Veins and patterning are determined by using the table found in Appendix B. Some of the raw material has distinct patterning while others are plain and seemingly lack patterns in the flint (See Appendix B). Additionally, some pieces of raw material have multiple patterns which would be considered "variable" (see below). With enough pieces of debitage that provide cross sections of a flint cobble (core tablets and lateral core trimming elements are key debitage types here) the patterns in the raw material can be determined and even used to situate the individual removals during the refitting process. For example, if an initial core tablet is brown, opaque, fine grained, matte, has spots on one half of the initial core tablet and bands on the other half, we can then assume that pieces of debitage within the assemblage that are brown, opaque, fine grained, matte and have spots belong on one side of the blade core while pieces of debitage that are brown, opaque, fine grained, matte and have bands belong on the other side of the core rather than creating two different RMU's. Therefore, the category of variability is useful for creating RMU's. Variability allows for a researcher to determine if the initial flint cobble was highly variable, and if so, in what ways. This prevents multiple false RMU's from being constructed.

Variability is defined here as having more than one characteristic in a single category. For example, if a piece of debitage only expresses one color, one translucency, one grain size, one luster, and one pattern it would be considered homogenous. If a different piece of debitage had two colors, one translucency, two grain sizes, one luster and two patterns it would be considered variable. This category is used to help coalesce RMU's of variable color, translucency, grain size, luster, and veins/patterning values as many cobbles of flint have multiple colors, textures, and patterns.

Raw Material Unit (RMU) Categories						
	Color	**Translucency**	**Grain Size**	**Luster**	**Veins/Patterns**	**Variability**
Flint Classifications	Red, gray, brown, tan, orange, miscellaneous	Opaque or translucent	Coarse, medium, fine, glassy	Matte or vitreous	Stippling, dots, spots, inclusions, graded, stripes, bands, mottled	Variable or homogenous

Table 5.1: Categories suggested by Vaquero et al. (2019) and Bustillo et al. (2009) for the construction of RMU's with modifications for use in Early Epipalaeolithic assemblages at Kharaneh IV.

In Figure 5.1 an RMU was constructed to aid in the refitting of a Middle Epipalaeolithic blade core from Kharaneh IV. After typo-technological analysis, the blade core was pulled from the assemblage as it had the most visual cues regarding what would constitute a single RMU within the assemblage. The blade core is predominantly dark brown with a cream stripe that separates a light brown. The opaque flint is fine and vitreous. As the stripe is only present in some parts of the core and not others, it is a reasonable assumption that only some of the debitage will have stripes. Furthermore, the core has a light chalky cortex. This aids in determining where in the reduction sequence an individual piece of debitage was located. The refitted debitage is completely composed of core trimming elements (AP01-AP05), which is consistent with much of the refitting work completed in the Early Epipalaeolithic period. Core trimming elements tend to cross-cut parts of the core making them very useful for determining RMU's and their variability.

Previous refitting work and RMU construction that I have conducted in both Middle and Early Epipalaeolithic assemblages at Kharaneh IV suggests that there are three RMU creation categories that are more effective in finding RMU's and refits than the other categories: color, grain size, and pattern. First, color is a quick and effective way to separate out RMU's. Once one has an understanding of the range of colors one will find within an RMU (by looking at a blade cores or core tablets for instance) then creating groups based on color is relatively quick but imprecise. For example, in Figure 5.1, two main color groups were accepted as part of the RMU (dark brown and light brown). However, there was a large amount of debitage that was tan or reddish-brown that overlapped with the dark brown and light brown distinctions.

This is where grain size is most useful in RMU construction. Grain size can be used to distinguish between two pieces of debitage that are similar in color. While grain size can also be variable within a single cobble, again, reference to a blade core or core tablet can aid in determining how much variability is to be expected within an RMU and what types of variability. For example, one blade core has a light tan fine interior surrounded by a light brown coarse flint while the blade core in Figure 5.1 has an undulating fine light brown and fine dark brown flint throughout. One can then separate out the coarse light brown flint and place it in a separate RMU for further analysis. This can help distinguish debitage from another RMU that has the same coloring and separate two similarly colored RMU's. Knowing the potential for variation is key to RMU construction. In Figure 5.1 the grain size is consistent across all colors and patterns. The only significant difference were areas in which chalky inclusions were present.

Finally, patterning is an enormously effective way to distinguish RMU's. It is imperative to determine the level of variability in patterning early in the process of constructing an RMU. I found that using core trimming elements with cortex and blade cores were the most useful ways to determine the distribution of patterning throughout an individual cobble. Many RMU's are generally homogenous and have only one pattern or distinctive feature. For example, in Figure 5.1 a distinctive feature is the light stripe between the dark brown and light brown flint in most pieces of debitage. Other examples of distinctive features include orange bands between the cortex and the flint, thin stripes of translucent flint, or black stripes that occur near the outer surface of the flint. While these are all patterns and would be identified as such, they are also quick identifiers that allow for rapid identification of debitage and placement within an RMU. Some RMU's are variable and have more than one pattern. Any combination of veins and patterns can exist within a single cobble as these categories are not mutually exclusive. For example, stippling and spots can coexist throughout a single cobble but if the patterning is consistent then it would not be considered variable. If, however, stippling and spots existed on the cobble's interior while bands existed closer to the cortex (with no stippling or spots) then the cobble would be designated as variable. Lateral core trimming elements and cores are most useful here in determining the spatial relationship between patterns within a single core.

The process of separating the RMU categories occurs after techno-typological analysis is complete (Figure 5.2). Each piece of debitage within a techno-typological category is assessed using the RMU categories above and recorded separately by RMU (Appendix B, Table 5.1). I began with determining RMU's with cores, core tablets of all types, and lateral core trimming elements. After getting an idea of the variety in each assemblage and potential RMU's. I then analyzed the core trimming elements, unretouched debitage, and ended with tools to determine which RMU they fit into. The collected data is separated by techno-typological distinction then RMU. This allows for easier tracking of material types and identifying potential refitting material across multiple excavated units.

Figure 5.1: Sample RMU from the Middle Epipalaeolithic period at Kharaneh IV. This image shows the partially refit core from square AP37 and the lithic artifacts that were pulled from the same locus during the RMU construction process. Color in all of the pieces of debitage is dark brown (with some variability- light brown). All of the debitage is opaque. The grain size of all the pieces of debitage excluding cortex is glassy. The luster of this RMU is vitreous as it reflects light. Some pieces of debitage exhibit striping, particularly where the two colors meet, this can be most easily seen in the blades. Pictured here: A) geometric microliths, B) large blade with burin C) core trimming elements likely removed from the left side of the core based on removal curvature, D) core trimming elements likely removed from the right side of the core based on removal curvature, E) blades. For an image of the other side of this blade core and discussion of the removal sequence see Figure 5.3.

Working from the earlier removals within the *chaîne opératoire* (i.e., cortical flakes, secondary flakes, and initial core tablets) to core shaping removals (i.e., flakes, lateral core trimming pieces, faceted core tablets, and crested blades) and the inner reduced core to blade removals (i.e., blades, profile correction blades, core face rejuvenation pieces, platform isolation elements, and edge preparation pieces), debitage is inspected for the potential of refitting. Curvature, veins/pattering, cortex, shape, and position in the *chaîne opératoire* are used to identify likely refitting pieces (Davidzon and Goring-Morris 2003; De Bie 2007).

Figure 5.2: This image depicts an RMU that was constructed based on the RMU characteristics listed above. The outer bag is labeled with a photo of the core used to construct the RMU and Munsell color for quick identification.

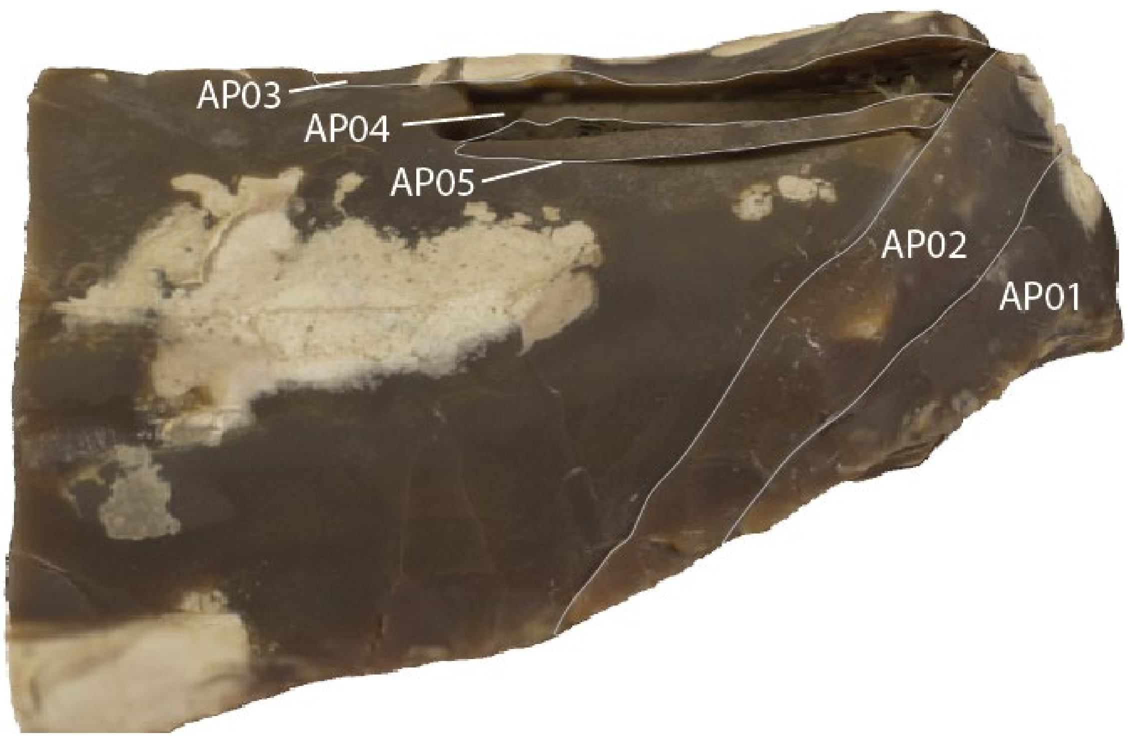


Figure 5.3: Partially refit core from the Middle Epipalaeolithic phase of Kharaneh IV. Here, the refit removals are labeled from the earliest in the sequence to the latest (the letters "AP" note which square the artifacts were excavated from). AP01 is a crested blade that was removed before AP02, a partially ridged blade. The flintknapper then removed a series of three core tablets, AP03 an initial core tablet, AP04 a non-initial corrective core tablet, and AP05 a non-initial corrective core tablet.

When a refit is found, the debitage earliest in the sequence is assigned a number. The later removal is assigned the next number in sequence (see Figure 5.3). The order of the refitting debitage is recorded in an earlier: later format (e.g., blade: profile correction blade). The debitage is labeled and adhered together with museum wax. Refit material is then held off to the side and matched against other pieces that would be near them in the *chaîne opératoire.*

Experimental research suggests that refitting success drops after 8 hours of analysis and that refits are less likely to occur if an assemblage is larger than 2,000 pieces (Laughlin and Kelly 2010). Given the large assemblage size at Kharaneh IV it was necessary to restrict the amount of time spent on refitting pieces of debitage (Table 5.2). Each square within a locus was restricted to 12 non-contiguous hours of refitting. After this point the artifacts were stored for at least a month. After one month, I returned to the previously refit materials for 2-5 hours depending on the success rate of refitting. After 14-17 hours of refitting attempts, any attached refits are pulled to the side and measured for skill level analysis.

Table Comparing Analyzed Loci and Number of RMU's							
	Early Epipalaeolithic Caches or Concentrations						**Area E Cache**
	Locus 208	**Locus 212**	**Locus 213**	**Locus 316**	**Locus 043 Cache**	**Clear Concentration**	**Locus 014**
Number of RMU's	1	1	1	3	1	1	1
Total Number of Lithic Artifacts (N=)	435	29	16	101	17	199	158
Number of Individually Refitting Flakes	30	0	0	0	2	5	32
Number of Refit Sequences	7	0	0	0	1	2	13

Table 5.2: Table of the caches and concentrations that underwent refitting and skill level analysis. The total number of lithic artifacts, number of refits, and number of refit sequences are reported after Laughlin and Kelly (2010).

Skill Level Analysis

Previous research on skill level analysis has made great strides in defining, outlining, and identifying skill in lithic production. Experimental approaches like those of Eren et al. (2011), Ferguson (2003), and Finlay (2008) explore aspects of skill expression in the hands of modern knappers. These experiments had modern knappers produce Levallois cores on flint, bifaces on obsidian, and blades on flint respectively. Eren et al. (2011) focused on the quality of raw material and its effects on skill expression. They found that an individual knapper's skill was the main cause of success while producing Levallois cores rather than raw material quality.

Ferguson's experiment (2003) approached the analysis of debitage through both qualitative and quantitative methods and found that basic skills are acquired quickly but the ability to problem solve requires significant experience or guidance from a master. Finlay's experimental work (2008) on blade production approached knapper skill through the consistency of debitage and cores produced by knappers of variable skill levels. Furthermore, it tested characteristic attributes of skill and the consistency of their expression. This experiment found that skill is variable within an individual and that even a highly skilled knapper can perform poorly. However, skilled individuals are able to conform to a *chaîne opératoire*— they are able to follow mental templates regarding stages of production. My approach to determining knapper skill level is similar to Finlay's and Ferguson's approaches as it focuses on a knapper's ability to make blades on flint cobbles and tests characteristics of skill both quantitatively and qualitatively. Here I view skill as the ability to mobilize a *chaîne opératoire* (and all of the knowledge embodied within) to produce blades with a consistent morphology. I studied the debitage of 12 novice flintknappers, each with less than 5 hours of flintknapping experience, over a period of 10 flintknapping sessions. These novices received minimal instruction and were encouraged to observe other flintknappers and experiment before asking for guidance when they struggled. This novice debitage was compared to debitage produced by skilled flintknappers (of reported intermediate and masterful skill levels). Qualitative aspects such as termination type, platform type, and platform damage were gathered. Aggregate experimental data from each reduction was collected and includes the total number of flakes, blades, and core trimming elements, the total number of single faceted platforms and multi-faceted platforms, the total number of hinged, step, *outrepassé,* and feather terminations, and blade regularity. Refitting of experimentally produced blades was conducted to determine if there were any sequential blade removals produced by the participants. Quantitative data including platform thickness, medial thickness, distal thickness, maximum length, maximum width, and mass were collected from each core trimming element and blade produced by all participants. The findings of the statistical analysis of this experiment (Chapter 7) were used to create a skill level questionnaire to determine individual knapper skill (Appendix C).

Analysis of knapper skill in the archaeological record at Kharaneh IV was conducted on each cache and concentration listed above. Metric data including platform thickness, medial thickness, distal thickness, maximum length, maximum width, and mass were collected from each core trimming element and blade within the respective locus. Morphological data including termination type, platform type, and platform damage were also gathered at this stage. Aggregate data regarding each whole cache and concentration was also collected and includes the total number of flakes, blades, and core trimming elements, the total number of single faceted platforms and multi-faceted platforms, the total number of hinged, step, *outrepassé,* and feather terminations, and blade regularity. Refitting was attempted in each of the loci and used to determine if sequential blades were present. The data was entered into the questionnaire to determine the skill level of the knapper that produced the cache or concentration. This approach assumes that a single individual was responsible for the production of the artifacts within a single cache or concentration.

Photogrammetry and 3D Modeling

Photogrammetry is a method of creating scalable 3D models. As the refitting process requires that pieces are adhered back onto the core (or to each other), analysists lose the ability to look at how the removals relate to each other in space. By making 3D models of the core reduction sequence one can preserve the spacing and manipulate the core reduction sequence as necessary to perform further analysis. Creating 3D models is beneficial as the models allow researchers to observe the relationship between debitage pieces after they have been hidden from view once a core reduction has been glued back together. This process allows for clear visualizations of the reductions and the choices made by the flintknapper. Models also provide a means of clearly communicating particular reduction strategies with other researchers as approaches to typology and technology are variable among lithic analysists (Olszewski 2001; Olszewski 2006; Maher and Macdonald 2013; Macdonald et al. 2018; Barket et al. In Press)

To produce a model, approximately 250-400 photos are taken of each core in a reduction sequence with a 50 mm lens and/or macro-lens (Figure 5.4). The camera remains stationary while the artifact is placed on a turntable and a photo is taken every 15 degrees until the entire object is photographed (a complete set of photos from around the artifact is called a circuit). Two additional circuits (and as many as four) are taken from differing angles (Figure 5.5). This allows the software program, Metashape, to stitch the photos together in three-dimensional space later in the modeling process. Once the photos are taken and input into Adobe Lightroom, initial processing of the images is conducted. This includes adjusting white balance, contrast, and conversion to uncompressed Tagged Image Format Files (.TIFF). To produce the model, photos are uploaded to Metashape and the process of stitching the photos together begins.

Metashape matches pixels from the photos and uses the overlapping nature of the photos to construct a 3D image of the artifact. Once the 3D model is produced, it is saved and uploaded to the Kharaneh IV database. The 3D modeling process adds the ability to observe removal patterns and compare stages of removals once a core has been refit. 3D versions of a core can be moved and measured to understand the stages. The similarity or dissimilarity of reduction stages across multiple cores can be observed simultaneously and errors or areas of low-quality flint can easily be accounted for during analysis. Furthermore, these models also aid in communication among researchers with different terminologies for a more precise communication of ideas.

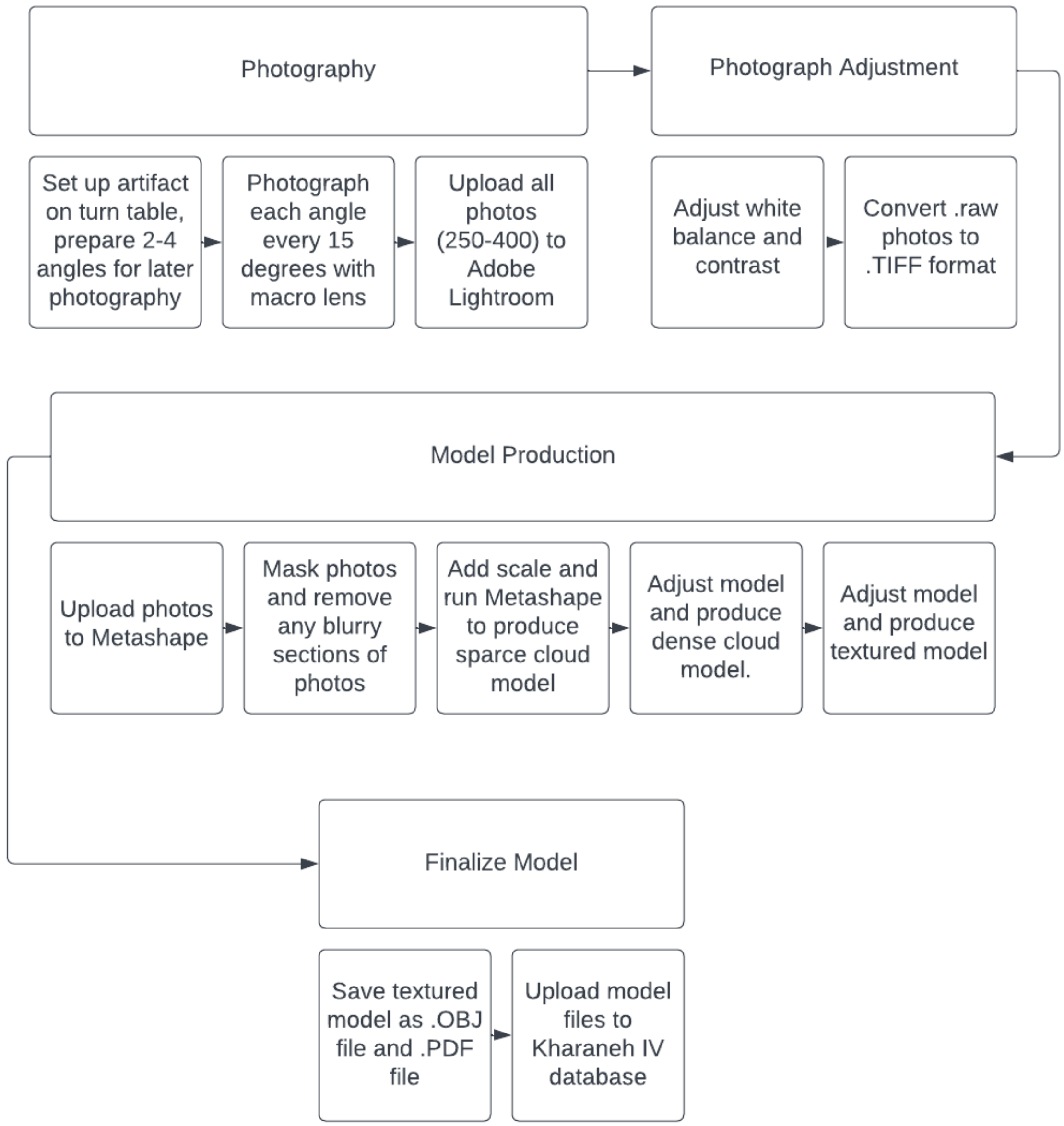


Figure 5.4: This flowchart depicts the workflow necessary to produce a 3D model of small archaeological artifacts.

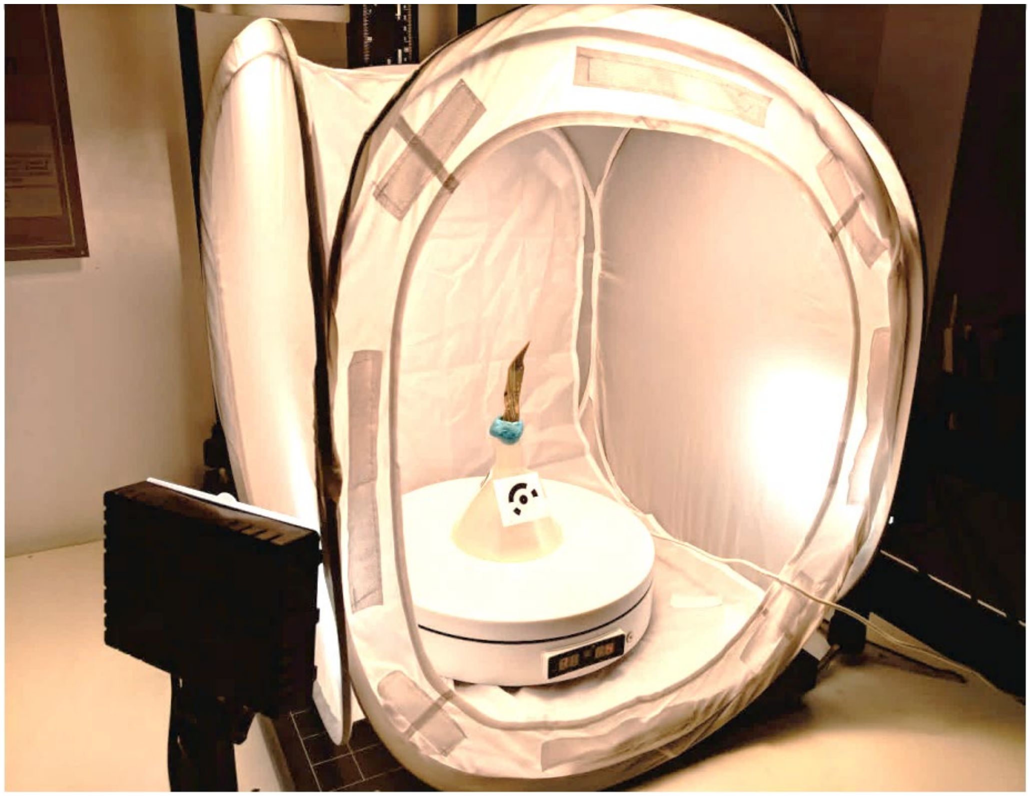


Figure 5.5: This image depicts the preparation of an artifact for photography on a turntable within a photography light box. Here, a partially ridged blade sits atop a funnel with printed identifier codes attached to aid in later model construction. The artifact is photographed from one angle, then will be adjusted so the opposite end will be in view of the camera for a second angle. The turntable stops automatically at 15-degree intervals to allow for photos to be taken. The white background aids in masking during the model production stage.

Chapter Six
Experimental Methods: Determining Skill Level Through Debitage

Introduction

Knapping[12] skill is a qualitative assessment of an individual's *connaissance* (knowledge) and *savoir-faire* (know-how) (Pelegrin 1990; Bamforth and Finlay 2008). *Connaissance* encompasses knowledge, memory, cognition, and mental templates while *savoir-faire* relates to the more practical aspects of knapping like motor skills, motivation, practice, and dexterity (Bamforth and Finlay 2008; Pelegrin 1990, 1993). Memory allows for a knapper to build up a repertoire of shapes, patterns, gestures, and sequences necessary to produce a tool. Pelegrin (1993) likens this to knowing the capabilities of each piece on a chessboard. Motor skills relate to the physical action of knapping; adapting movement to certain percussors, holding the parent material in certain positions, and the coordination to make contact between the percussor and parent material to remove the intended flake (Pelegrin 1993). Ideational know-how is the ability to analyze and evaluate the situation and plan for (or predict) what will need to happen in the next phases of reduction. This requires an understanding of what is possible (or impossible) with the current conditions of the parent material and one's own abilities in working with it. Experience is key to acquiring knapping skill. While learning to make complicated tools (which tools to use when, preparing platforms, understanding angles and fracture mechanics, learning the characteristics of certain raw materials, etc.) requires hundreds of hours of practice and training (Pelegrin 1993).

While learning to knap, I noticed that certain actions (and sets of actions) were more difficult to complete than others, a common experience for novices. So, what makes certain removals more difficult than others? Anecdotally, the experience of learning to knap led me to believe that it was a lack of experience, inability to predict removals, and a loose grasp of the *chaîne opératoire.* I decided to intensively study the acquisition of knapping knowledge among novice knappers and track their progress as the novices gained more experience. As experience is the driver for improving knapping skill (Pelegrin 1993) I expected to see increasing evidence of skill among novices.

To test the relationship between skill and experience I conducted a flintknapping experiment using raw flint cobbles and "traditional" tool kits (use of billets and hammerstones) with novice flintknappers and collected blade core reductions from experienced flintknappers to help delineate potential indicators of skill in blade technologies.

Skill Investigation and Parameters

Knapping skill is difficult to quantify as even master knappers produce errors. Other external factors including the quality of the raw materials (Porr 2005), the amount of time a knapper has or is willing to commit to a reduction (Winfrey 1990), inherent knapping talent (Olausson 2008), and even the knappers mood can affect the final product (Finlay 2008). Markers of a skilled knapper broadly reflect a mastery of both *connaissance* and *savoir-faire*. I identified commonly analyzed aspects of debitage that potentially identify skill level when conducting comparisons of archaeological materials and published archaeological records. Previously identified indicators of

[12] Flintknapping connotes producing stone tools specifically on flint or chert while the use of the term knapping broadly illudes to the process of producing stone tools on any raw material.

skill specific to blade core technologies include regularity of [blade] form (Pelegrin 2006; Finlay 2008), complex patterns and multistage reductions (Apel and Knutsson 2006; Bleed 2008; Pigeot 2010), planned removals and appropriate preparation for the removals (Pigeot 1990; Pigeot 2010), usage of appropriate tools to remove flakes and blades within the reduction sequence (Janny 2010), ability to fix errors or know when to stop after a terminal error (Arnold 1987; Bleed 2008; Pigeot 2010), long blade removals (Arnold 1987; Pigeot 1990; Olausson 2010), and consistency in removals (Finlay 2008). Indicators of less skilled individuals include irregular blade removals (Ferguson 2008), frequent errantly detached blades (Andrews 2006: 269), inability to fix errors (Bleed 2008; Pigeot 2010), inability to detach flakes or blades effectively thus causing damage to the platform (Shelly 1990), lack of or insufficient platform isolation (Tostevin 2012; Weedman-Arthur 2018) battering or stacked step terminations on flake platforms (Shelly 1990), and 'wasteful'[13] use of raw material (Weedman-Arthur 2018).

In this experiment, skill is assessed by the ability of a flintknapper to reliably produce blade cores (Finlay 2008), consistently produce blades on blade cores (Finlay 2008; Bamforth and Finlay 2008; and Bleed 2008), produce sequential blade removals (Bamforth and Finlay 2008; Bleed 2008), and the ability to create regular and consistent blades (Whittaker 1987; Apel and Knutson 2006; and Finlay 2008). Other aspects taken into consideration as markers of skill include the ability to correct errors on the core face or platform (Finlay 2008) and the preparation of blade and core trimming element platforms (Pigeot 1990; Sørenson 2006; Haug Røe 2015). The skill level experiment described below is focused on assessing the capabilities of unskilled flintknappers when compared to the capabilities of skilled flintknappers in shaping blade cores and, ultimately, producing blades. The fundamental questions addressed in the experiment are:

1. Do unskilled flintknappers make more mistakes—more visible errors that require fixing—than skilled flintknappers when producing a blade core? If so, what types of errors do they produce?
2. Do unskilled flintknappers produce less core trimming elements than skilled flintknappers?
3. Do unskilled flintknappers prepare platforms less frequently than skilled flintknappers?
4. Do unskilled flintknappers batter or crush platforms more frequently than skilled flintknappers?
5. Are unskilled flintknappers able to make blades from blade cores consistently?
6. Are unskilled flintknappers able to effectively utilize their flintknapping tool kits in order to make successful removals?

Experimental Work to Determine Skill Level:

In order to approach determinations of skill level (and its impact on blade production) through both quantitative and qualitative methods of analysis, experimental work was conducted to identify potential diagnostic features of the debitage of skilled flintknappers. I grouped the flintknappers into three distinct groups to allow for better resolution in skill analysis: novice, intermediate, and master (see Table 1). The three groups are hierarchical to provide measures of improvement but also broad enough to capture patterning within and among groups. Novice flintknappers have no previous experience flintknapping or have less than five hours of

[13] The term 'wasteful' is culturally relative and is different in each community of practice as value and meaning is negotiated and constructed within a community of practice (Wenger 1998).

flintknapping experience with minimal instruction. Intermediate individuals are experienced flintknappers often with years of experience, they may have limited experience producing blade cores or are not familiar with using traditional tool kits (i.e., hammerstones, billets, and bone rather than modern tools like copper). Master flintknappers have a significant amount of experience (generally +5 years), can reliably produce blades from blade cores, and are competent in traditional tool use.

Novice flintknappers were expected to increase their skill level or 'improve' over the experimental period. Novices started with minimal to no experience and therefore could either improve or remain consistent at their starting skill level. This is the base level of skill determination. Intermediate skill was introduced as a category that allows for the tracking of improvement of skill among novices or for skilled individuals (individuals with experience other than blade core technology or use of traditional tool kits). This category represents an intermediate phase (akin to an adept or journeyman) of learning where individuals are not yet experts; however, they have learned enough to be competent flintknappers. Master flintknappers are highly skilled and capable of producing blades and correcting errors efficiently. This is the highest level of skill within the spectrum. The three categories are not intended to categorize individuals as 'good' or 'bad' flintknappers, rather, each category acts as a heuristic tool to better understand the relationships between experience, *savoir-faire,* and *connaissance.* With a clearer understanding of how individuals progress through the process of learning to flintknap, archaeological interpretations of skill can be refined. Factors like individual style and variation can be distinguished from skill when working to understand variation in an archaeological assemblage.

Novice Flintknapping Data Collection

IRB Information

In the summer of 2020 I received IRB approval (CHPS Protocol Number: 2019-11-127552) to work with undergraduate students and campus members to perform the flintknapping experiment. Twelve novice flintknappers signed up to participate in the flintknapping experiment through the Undergraduate Research Apprentice Program or volunteered to participate. Each participant received three hammerstones (1 large, 1 medium, and 1 small), one medium sized billet (7-10 oz.), an antler tine/ pressure flaker, an abrader, eye protection, leather gloves, plastic bags to separate each core reduction attempt, tags (for labeling each attempt), core tracking forms (Appendix D for tags and forms), and a mixture of Georgetown flint and Edward's Plateau flint (Figures 6.1 and 6.2). None of the Georgetown flint or Edward's Plateau flint was heat treated therefore all participants worked with untreated raw material. All participants were instructed to inform me if they injured themselves, any of their tools failed (or were heavily damaged), if their flintknapping tools were not sufficient to produce removals, or if they required more flint.

In preparation for the experiment, the novices were required to read three chapters from John Whittaker's (1994) "Flintknapping: Making and Understanding Stone Tools". The chapters selected for reading including Chapter 2: Flintknapping: Basic Principals, Chapter 4: Raw Materials, and Chapter 5: Safety. For a full list of the mandatory and optional readings and videos see Appendix D. In addition to these chapters, novices were also instructed to watch three flintknapping videos that specifically address blade core reduction. These videos totaled 58.5 minutes.

Figure 6.1: Flintknapping kit provided to novice flintknappers. From left to right the kit includes leather gloves, eye protection, an abrader, one large hammerstone, one medium hammerstone, one small hammerstone, an abrader, and a medium sized billet.

Figure 6.2: This image depicts two representative pieces of flint utilized in this experiment. Georgetown flint on the left and Eduard's Plateau flint on the right.

The novices that participated in the experiment included 11 undergraduate students and one graduate student from the University of California, Berkeley. Novice participants attended a one-hour orientation that outlined the goals of the project, situated their participation within the larger research project, stated their responsibilities as participants, an overview of their traditional tool kits, and a discussion of mandatory safety gear and precautions. After the orientation novices were given consent forms and were asked to turn them in signed if they agreed to participate in the project. For their participation, the novice flintknappers were allowed to keep their flintknapping kits and safety gear.

Experimental Flintknapping Protocol

Novice flintknappers met with me via Zoom for instructed flintknapping sessions. Due to the Covid-19 pandemic we were unable to meet in person for these sessions. Each novice was required to attend a minimum of ten flintknapping sessions over a period of nine weeks. Three flintknapping sessions were held per week and participants were able to select the frequency with which they attended the flintknapping sessions. During the flintknapping sessions participants were instructed to ask questions only if they had tried and failed at making a particular removal. I then gave feedback regarding the participant's attempt and helped guide them towards more successful techniques or approaches within the purview of their personal goals (see Appendix E for protocols and suggested scripts).

Each flintknapping session was two hours long and broken down into three segments. First, there was a 10-minute set-up where participants prepared their flintknapping areas, selected the flint they would work on during the session, filled out their Core Tracking Forms by setting personal goals and predicting the issues they would have in carrying out those goals, and asked questions regarding their goals and approaches to flintknapping.

Then, there was a 100-minute flintknapping session. During this period, I flintknapped to produce blade cores, demonstrated various techniques for error correction and flake removal, answered questions that participants had, and noted when her own attempts were either notably successful or unsuccessful.

Finally, there was a 10-minute breakdown period where participants bagged their flintknapping products, filled out tags, filled out the Core Tracking Form with the goal of self-assessing their progress by noting their struggles, accomplishments, and their perceptions regarding the usefulness of watching others flintknap that session. Participants were also free to ask questions regarding their flintknapping attempts during that session or general flintknapping questions.

During the first two weeks of flintknapping sessions I focused on blade core preparation and flake production on large cobbles of flint. The majority of each flintknapping session was spent on setting up blade cores. After the first two weeks I aimed to prepare and exhaust blade cores, spall large cobbles to produce multiple blade cores from a single cobble and returned to earlier blade cores to reduce them further or exhaust them. This was an attempt to scaffold the novice participant's learning and to demonstrate the types of removals the novice participants would likely be working towards on their own blade core reductions (Ferguson 2008).

After all of the flintknapping sessions were completed, I collected the ten core reductions from each participant (some participants made up to 13 blade cores) and checked to ensure that all of the reduction sequences were labeled with the supplied tags and had coordinating Core Tracking Forms completely filled out.

Skilled (Intermediate and Master) Flintknapping Data Collection

Skilled flintknappers were contacted through personal communications and online flintknapping forums. All the skilled flintknappers except (SF1) and myself (SF10) were given identical information regarding the research project and blade production. SF1 and SF10 are both familiar with the lithic artifacts at Kharaneh IV. SF1 has worked with the Epipalaeolithic Foragers of Azraq Project (EFAP) since 2010. SF10 has worked with EFAP since 2016. Both flintknappers are familiar with the blade core types, the reduction sequences frequently found at Kharaneh IV, and the general *chaîne opératoire* and therefore were not provided the supplemental information regarding blade core size, shape, and production parameters. The skilled flintknappers were provided with background information on the project, given the parameters for blade production, and were supplied with photos of archaeological examples of blade cores from Kharaneh IV as well as drawings from previously published research at Kharaneh IV and other Near Eastern sites with similar core technologies (see Appendix D for a full list of instructional materials)

Skilled flintknapper one (SF1) is a highly skilled flintknapper proficient in blade core production on flint using traditional tool kits. SF1 has 14 years of experience in replicating Near Eastern stone tool technologies, including blade core production, and 10 years of teaching lithic production and analysis to undergraduate students. SF1 provided five blade cores on fine and medium quality flint for analysis. The provided cores were used in a pilot study to setup a list of possible indicators of skill. In the early phase of the project the following characteristics were identified as skill indicators: platform preparation, damage to the platform, number of complete corrective elements, consistent blade thickness, and flake termination type. These cores were also included in the final skill level analysis.

Two highly skilled flintknappers (SF2 and SF3) volunteered to participate by responding to a post on the flintknapping blog site PaleoPlanet. SF2 has four years of flintknapping experience and knaps four days per week. SF3 has 15 years of flintknapping experience and knaps three-five days per week. While they predominantly focus on biface technologies, they are a competent blade core makers and have produced approximately 30 successful blade cores prior to the experiment. Both flintknappers were provided with a mixture of Georgetown flint and Edward's Plateau flint and were asked to produce at least five blade cores for analysis using only traditional tool kits. Both flintknappers self-reported their skills as master regarding biface production; however, they reported having limited experience with flint, the use of traditional tools, and making blade cores. One of the skilled flintknappers produced ten blade cores (SF2), while the other produced five blade cores (SF3) for analysis.

The Puget Sound Knappers flintknapping group, an informal association of flintknappers in Washington State committed to promoting flintknapping, was contacted via email. Seven participants (SF4-SF9 and US14) of varying skill levels volunteered to participate in the research project. These flintknappers self-reported their skill levels as two master flintknappers (SF4 and SF5), three intermediate flintknappers (SF6, SF7, SF8), and two novice flintknappers (SF9 and US14). One of the self-reported novices had over a year of experience with flintknapping and was thus classified as a skilled flintknapper (within the intermediate skill level). The group of flintknappers were provided with the same background information and images as SF2 and SF3. Notably, the participants in this group were asked to produce two cores each as the sample sizes were increasing rapidly and I wanted to maintain a manageable sample size that could be analyzed by an individual analyst over the span of six months. The group met and knapped together during a 'knap-in'. Before beginning their flintknapping session, the group received an overview of the challenges of working with the Georgetown flint (this group did not receive any Edward's Plateau flint) by the most experienced member (SF4). Each participant then selected a nodule of flint (or two) and worked to produce blade cores and blades. The group was provided with flint, plastic bags, and tags for labeling the core reductions.

I am the last member of the skilled flintknapper group (SF10). I am proficient at producing blades and blade cores on flint using traditional tools. Notably, most of the advanced flintknapping knowledge and training I received was from SF1. I produced a total of 23 blade cores during the flintknapping experiment with the novice flintknappers. Five of the 23 blade cores were randomly selected for analysis. Each of the 23 blade cores were sequentially numbered during the flintknapping experiment (the first blade core produced was numbered ‘1’, the second numbered ‘2’ etc.). The cores I produced during week one were not included in the sample population as they were aimed at producing flakes and general core shaping rather than blade production. A random number generator was used to randomly select the blade cores for analysis. Blade cores 04, 15, 17, 19, and 21 were analyzed.

Analysis of Experimental Data to Determine Skill Level

I conducted two levels of analysis on each core reduction sequence. This approach was intended to capture reduction strategies, skill level patterning, and effectively analyze all debitage over 25 mm.

First, all experimental debitage was size sorted. Debitage smaller than 25 mm was removed from the sample. Prior research indicates that small flakes (under 30 mm) are more difficult to refit as they require more time and effort than larger pieces with minimal information gained. Refitting efforts frequently use size cutoffs that range from 10 mm to 40 mm depending on the lithic technology. Microblade technology requires a smaller flake cutoff size than biface technologies (Laughlin 2005; and Laughlin and Kelly 2010). As this experiment was focused on blade and bladelet production a 25 mm flake size cutoff was utilized for refitting flakes. Therefore, flakes below 25 mm were not measured or recorded. This allowed for the analysis of blades, bladelets, flakes, and core trimming elements but frequently removed chips, shatter, edge preparation elements, platform isolation elements, and small flakes.

Phase 1 of analysis is predominantly an attribute analysis based on previous replicative work and the techno-typological approach in use at Kharaneh IV and assessed each experimental core reduction as a single analytical unit (Quintero and Wilke 1995; Whittaker 1994; Maher and Macdonald 2013; and Macdonald et al. 2018). The specific attributes targeted for analysis can be found in Appendix G and directly relate to the research questions outlined above.

Flintknapper notes were annotated and used to explore the relationship between *connaissance* and *savior-faire* among novice flintknappers (Pelegrin 1990; Chazan 2008; Bamforth and Finlay 2008). All novices that participated in the experiment outlined their goals, their plan to reach said goal, and how they struggled and/or succeeded in reaching their goals. Some novices provided detailed drawings and discussions of their thought processes and how they planned to improve their techniques in the future. Additionally, many novices outlined their success or failure with particular materials from their knapping toolkit (i.e., hammerstones, billets, and abraders) and described how they planned to alter their approach to the tool kits in future flintknapping sessions.

In Phase 2 of analysis, blades and core trimming elements were analyzed individually. This analysis allows for a fine-grained investigation of skill indicators. For example, the category of Removal Type is techno-typological in nature and thus aids in expressing the *chaîne opératoire* mobilized by the individual flintknappers. It also provides insight to error correction techniques, application of the techniques, and determination of the success the flintknapper had in correcting the error(s). Other elements that directly relate to the previously outlined skill indicators include the completeness of individual pieces of debitage, platform types and preparation for removals, stacked hinged or stepped platforms, consistency of removals, and regularity of the blades. For more information regarding the recorded attributes see Appendix H.

Master blade core reductions were analyzed first. The analysis of the master blade core reductions allowed me to experience the variability and consistency of individual masterful flintknappers and across all of the flintknappers within the category. The novice blade core reductions were analyzed second to allow for contrast between the two groups on opposite sides of the skill level spectrum. This aided in pattern recognition and provided significant insight into the differences between novice and master reduction sequences. Finally, intermediate blade core reductions were analyzed. I believed that distinguishing between intermediate and novice reductions or intermediate and master reductions would potentially be more difficult than distinguishing between master and novice reductions as all flintknappers are prone to errors. By analyzing the intermediate blade cores last, I already had experience with master and novice reductions which aided in pattern recognition.

This experiment was structured to identify consistent and predictable variability within blade core reductions produced by flintknappers at varying skill levels. Novices had the most instruction and guidance while intermediate and master knappers received general guidelines and instructions. Everyone was allowed to utilize their own methods, tools, and understandings to produce blades on a blade core rather than conforming to a strict *chaîne opératoire*. Overall, the data produced was useful as debitage types, counts, metrics, novice notes, and debitage characteristics all aided in outlining skill levels through reductions sequences. Upon reflection of the entire experiment, I would change my approach in three ways. First, I would provide more instruction to the skilled knappers. While the intentional flexibility of the design allows for knappers to utilize their own *chaîne opératoires* a video or in-person flintknapping interaction could have helped to clarify the blade core types common in the Early Epipalaeolithic. Blade core form among skilled individuals were extremely diverse therefore with even a short period of in-person discussion could have helped standardize blade form. Second, finding more master knappers could have produced a more robust data set. Currently, only two knappers were assigned the skill level "master" and of these two knappers (who each produced five blade cores) a total of five blade cores were ascribed the skill level of master —all ten of the blade cores produced by these two knappers were ascribed a "skilled" skill level in the k-means cluster test with two variables (see Chapter 7 for further discussion). Therefore, with more blade cores from each intermediate and master individual (ASL respectively) and more masterful participants as a whole, a more thorough dataset could be collected. Finally, I would have collected data on sequential blade and core trimming element removals. For this experiment, I used sequential blade removals as an indicator of skill, after analysis of the experimental debitage I believe that the presence of sequential blade and core trimming element removals would also likely be an indicator of skill.

The strength of this research design rests in its flexibility as knappers were able to utilize their own *chaîne opératoires*, skills, tools, and knowledge. First, novices produced about ten core reductions (here I do not use the term blade core as many of the novice reductions ended as flake cores). This allowed me to define specific characteristics of improvement (see Appendix I). For example, Dingo was unable to produce blades on a blade core at the beginning of the experiment and by their eighth and ninth flintknapping event they were able to produce blades on a blade core. This change was associated with an increased frequency of prepared platforms and core trimming elements. Secondly, novices kept track of their thought processes on a core tracking sheet. This allowed me to see what their goals were, how they conceptualized problems and solutions, and what they struggled most with. This was useful because it allowed me to better see why they were struggling when analyzing the debitage. For example, Bobcat noted on one of their core reductions sequences that, "Initial flaking was easy but hitting an inclusion and not knowing how to make a platform was frustrating. I watched others more after this…". Here Bobcat struggled with both an inclusion and setting up platforms so rather than continuing to flintknap they decided to watch other people in the flintknapping session to gain insight to their problem. In another instance Eagle noted, "I finally made the right shape! I need to focus on thinning so that the ridge can maintain a steep enough angle. I also need to pause to assess my plan more". Here Eagle both identified what they considered to be their problem with the core, hastily making removals and thinning the core, while also identifying their strength in producing the core as having an ideal narrow faced blade core shape. In another example, Hyena explained a difficulty they had in producing a blade core, "After I set up my first ridge, I found a patch of difficult, flakey (like puff pastry) material underneath & didn't know where to turn". All of the problems novices expressed in their notes were clearly reflected in the debitage often as battering, lack of platform preparation, and a low frequency of core trimming elements. Overall, I believe that the freedom participating flintknappers had to utilize their understandings, *connaissance*, and *savoir faire* without strict adherence to a specific and limiting *chaîne opératoire* is a strength of this design. It allows for a wide range of variability similar to what we would expect to see in an archaeological context composed of multiple communities of practice— this could mean through time or space as communities of practice are dynamic and change with the members that compose them (Wenger 1998).

Chapter Seven
Statistical Analysis

Determining Skill Through Experimentation

Flintknapping skill is the dynamic interplay between practitioner, raw material, tool kits, experience, and acquired knowledge. Skill is not stagnant and thus the reflection of skill through debitage can change due to a variation in any of the above variables (Pelegrin 1990; Clark 2003; Andrews 2003; Bamforth and Finlay 2008; Bleed 2008; Finlay 2008; Ferguson 2008).

To identify indicators of skill level within experimental debitage assemblages, we must first recognize that all flintknappers—no matter their experience—make mistakes. This can occur as an aspect of human error or due to the nature of the raw material. Thus, the author hypothesized that the ability to fix errors, continue blade core reduction, and produce blades would act as indicators of skill level (Andrews 2003, 2006; Bamforth and Finlay 2008; Finlay 2008; Ferguson 2008; and Baena et al. 2019). Each of these abilities can be enacted in various ways with differing levels of success. The following discussion will outline the abilities, approaches to these abilities, and their relationships to skill level.

Two skill levels are frequently used for skill level analysis and roughly correlate to "skilled" and "unskilled" classifications (Andrews 2006; Ferguson 2008; Eren et al. 2011). Here the author attempts to create a third category—intermediate—to capture the nuances of the ongoing processes of learning a craft (for more discussion on the archaeological applications of intermediate skill levels see Pigeot 1990). Knowledge is gained through experience. Experience is gained slowly through hours of flintknapping practice, interacting with flintknappers, studying your own work and that of others, and producing (and correcting) many errors (Bleed 2008). Practice is a key component to the acquisition of flintknapping knowledge and skill and accumulated knowledge and 'improvement', leaves characteristic traces that can be seen morphologically and measured quantitatively (Andrews 2006; Bleed 2008; Olausson 2008; Högberg 2008; Takakura 2019).

The experimental sample is made up on a total of 189 blade core reductions. Of these, 150 blade core reductions were produced by novice flintknappers under the supervision of the researcher. Two novice blade cores were also provided by a PSK flintknapper. Experienced flintknappers of various experience and skill levels contributed the final 37 blade core reductions.

Debitage analysis consisted of a sample of 1158 individual removals. Specific debitage types were selected for metric analysis to assess skill (see Chapter 5 for more discussion). Novices (reported skill level) produced 336 removals. Intermediate flintknappers (reported skill level) produced 88 removals. Master flintknappers (reported skill level) produced 734 removals.

Hypotheses About the Expression of Skill

While debated, flintknapping expertise is considered by some researchers a combination of *connaissance* (acquired knowledge through experience and practice) and *savoir faire* (talent, motor ability, or genetic predisposition) (Callahan 1979; Olausson 1998 & 2008; Bamforth and Finlay 2008; Ferguson 2008; Audouze and Cattin 2011). With the variable of *savoir faire*, it was expected that some novice flintknappers would 'improve' and show evidence of increased skill with ongoing experience, while other novice flintknappers showed minimal or no improvement in their flintknapping capabilities. Novice flintknappers were expected to regularly produce flake cores (and an inability to produce blade cores), make many errors, display a minimal ability to correct errors, ineffectively work with lower quality raw material, and inconsistently produce blades.

Intermediate flintknappers were expected to display a combination of skilled and unskilled characteristics. They were expected to be proficient in some tasks and to fail in others. Intermediate individuals were expected to regularly produce blade cores, produce more consistent error types, using more diverse strategies to correct errors either successfully or unsuccessfully, ineffectively work with lower quality material, and inconsistently produce blades.

Master flintknappers were expected to perform consistently by regularly producing blade cores, effectively correcting errors, producing consistent error types, and consistently producing blades. As a result of consistent blade production and error correction, master flintknappers were also expected to produce sequential blade removals from a single blade core face.

To test these assumptions the blade core reductions were analyzed and tested as individual units. Broad trends and patterns were discerned during this stage of the analysis. The individual debitage was later analyzed and tested for identification of techniques used by individuals and characteristics of 'skill' within each skill level cluster.

Results of Assessing of Skill

Clusters by Skill Level

Using the self-reported experience level of the participating flintknappers (See Appendix F) in conjunction with their reported experience with blade core reductions and traditional tool kit use flintknappers were assigned a preliminary skill level (novice, intermediate, or master). Exploratory descriptive statistical analysis was completed using the self-reported skill level. During the exploratory analysis blades, core trimming elements, multifaceted platforms, irregular blades, regular blades, extremely regular blades, hinge terminations, step terminations, *outrepassé* terminations, battering damage on platforms, and crushing damage on platforms were frequently associated with individuals that reported being skilled (either intermediate or master). These variables were then used for clustering core reductions.

To determine if particular lithic characteristics (termination types, platform types, error types, and measured aspects of the lithics), abilities, and techniques clustered among skill levels a k-means cluster analysis of each core reduction was conducted. z-scores from the following variables were used to determine cluster affiliation (novice, intermediate, and master): blades, core trimming elements, multifaceted platforms, irregular blades, regular blades, extremely regular blades, hinge terminations, step terminations, *outrepassé* terminations, battering damage on platforms, and crushing damage on platforms. Of these variables only hinge terminations ($z= 0.341$) and platform battering ($z= 0.141$) where not considered significant in the creation of clusters (See Figures 7.1 & 7.2). Three distinct clusters formed: Cluster 1- Intermediate, Cluster 2- Master, and Cluster 3- Novice. These clusters are labeled "Assigned Skill Level" (ASL) and are distinct from "Reported Skill Level" (RSL) as the later was based on individual perception of ones' own skill.

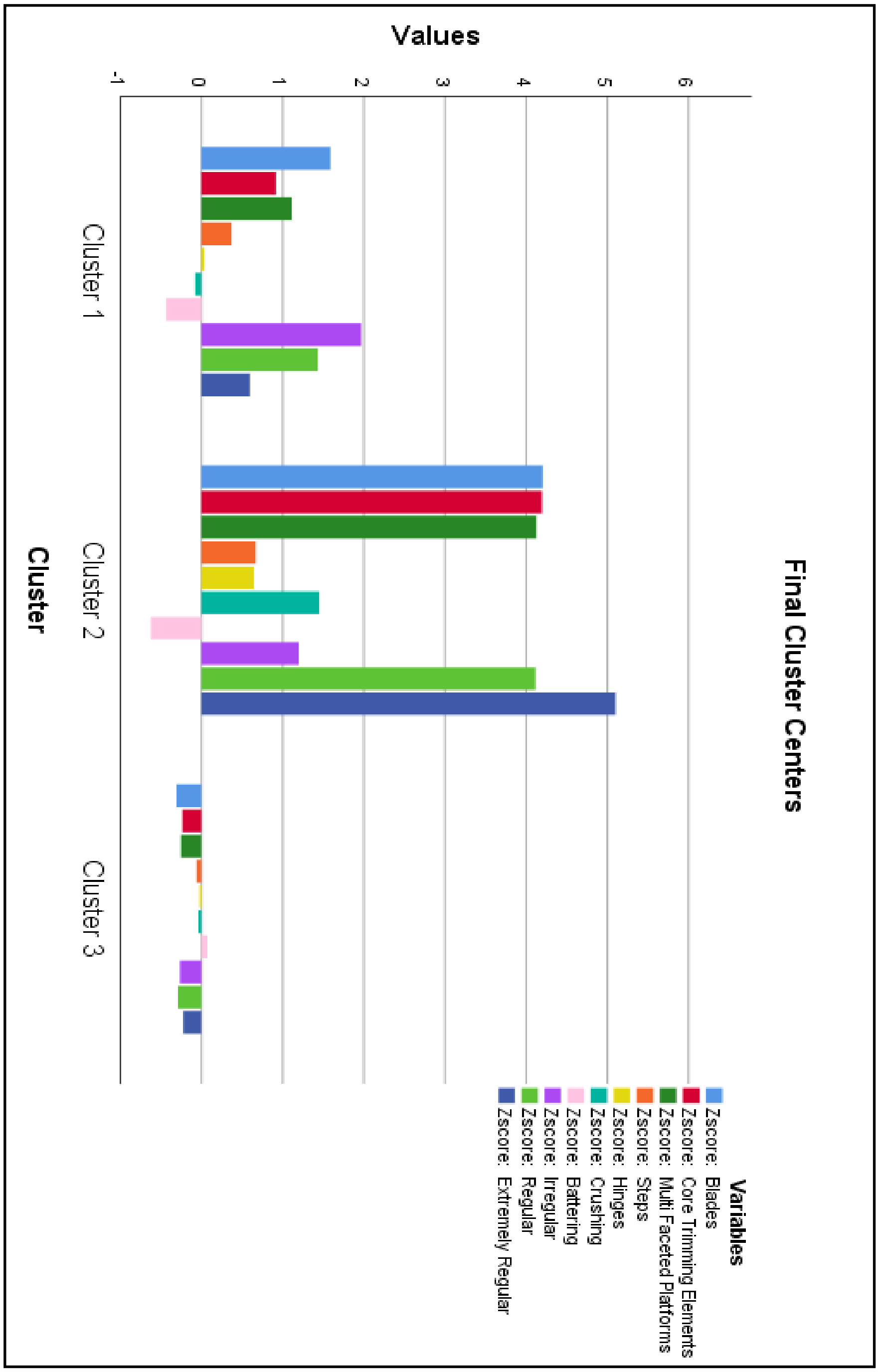


Figure 7.1: Three dependent variable k-means cluster analysis based on the quantity of blades, core trimming elements, multi-faceted platforms, irregular blades, regular blades, extremely regular blades, hinge terminations, step terminations, *outrepassé* terminations, battering damage, and crushing damage. Cluster 1 represents intermediate flintknappers, Cluster 2 represents master flintknappers, and Cluster 3 represents novice flintknappers.

Final Cluster Centers

	Cluster 1	Cluster 2	Cluster 3
Zscore: Blades	1.58870	4.20061	-.31212
Zscore: Core Trimming Elements	.91586	4.19247	-.23392
Zscore: Multi Faceted Platforms	1.10815	4.12445	-.25413
Zscore: Steps	.37042	.66797	-.06328
Zscore: Hinges	.03298	.64265	-.02341
Zscore: Crushing	-.08042	1.45066	-.03491
Zscore: Battering	-.43531	-.62258	.06941
Zscore: Irregular	1.96693	1.19387	-.26427
Zscore: Regular	1.42973	4.11348	-.29105
Zscore: Extremely Regular	.59526	5.10004	-.22445

Figure 7.2: Three dependent variable k-means cluster centers based on z-scores of debitage aspects within blade core reductions. Cluster 1 represents intermediate flintknappers, Cluster 2 represents master flintknappers, and Cluster 3 represents novice flintknappers.

To test the validity of the ASL two additional tests were completed: a k-means cluster analysis with two dependent variables and a two-step cluster analysis.

A k-means cluster analysis with two dependent variables (to determine clusters of unskilled and skilled individuals) was completed using similar variables (flake count and single faceted platform count were added to the analysis) (Figure 7.3). The skilled and unskilled categories supported the previous novice, intermediate, and master categories. Masters were consistently classified as skilled. Novices were consistently classified as unskilled. Intermediate individuals were classified as either skilled or unskilled.

A two-step cluster analysis was conducted using the frequency of blades, core trimming elements, multifaceted platforms, irregular blades, regular blades, extremely regular blades, hinge terminations, step terminations, *outrepassé* terminations, battering damage on platforms, crushing damage on platforms, and core type as variables (Figure 7.4). Masters were consistently clustered together in a skilled category. Novices were consistently classified in an unskilled category. Intermediate individuals were classified as either skilled or unskilled. There is some deviation among intermediate flintknappers between the k-means cluster analysis (of skilled and unskilled individuals) and the two-step cluster analysis (of skilled and unskilled individuals).

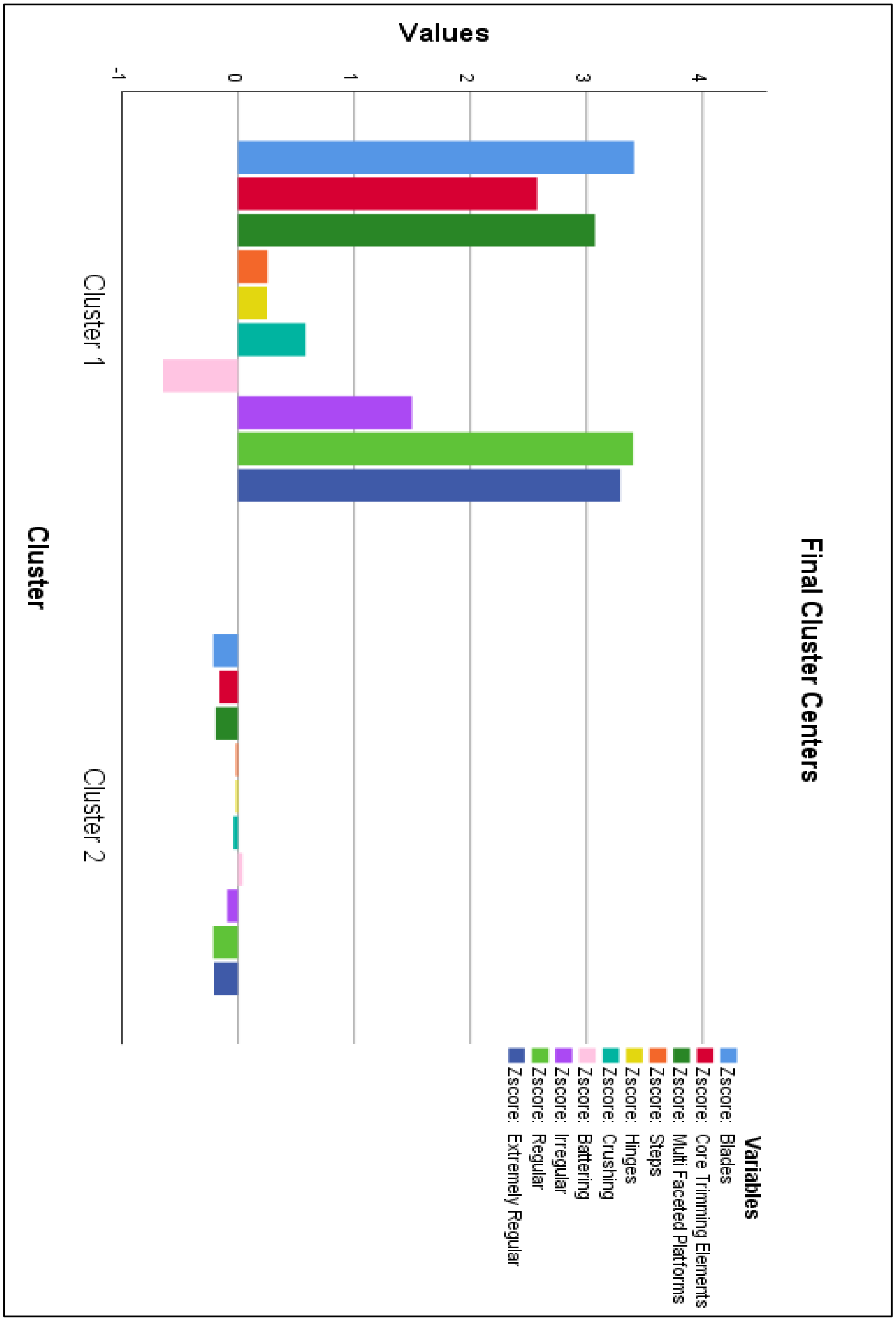


Figure 7.3: Two dependent variable k-means cluster analysis based on the quantity of flakes, blades, core trimming elements, single faceted platforms, multi-faceted platforms, irregular blades, regular blades, extremely regular blades, hinge terminations, step terminations, *outrepassé* terminations, battering damage, and crushing damage. The two dependent variables distinguish between skilled and unskilled flintknappers. Cluster 1 represents skilled flintknappers which have higher frequencies of blades, core trimming elements, multifaceted platforms, and irregular, regular, and extremely regular blades. Cluster 2 represents unskilled flintknappers which have below average frequencies of all removal types and multifaceted platforms.

Clusters

Input (Predictor) Importance

1.0 0.8 0.6 0.4 0.2 0.0

Cluster	2	1
Label		
Description		
Size	92.0% (172)	8.0% (15)
Inputs	Zscore: Blades -0.25	Zscore: Blades 2.89
	Zscore: Regular -0.24	Zscore: Regular 2.79
	Zscore: Extremely Regular -0.22	Zscore: Extremely Regular 2.55
	Zscore: Multi Faceted Platforms -0.21	Zscore: Multi Faceted Platforms 2.41
	Zscore: Core Trimming Elements -0.19	Zscore: Core Trimming Elements 2.23
	Zscore: Irregular -0.15	Zscore: Irregular 1.74
	Zscore: Outrepasse -0.05	Zscore: Outrepasse 0.59
	Zscore: Crushing -0.07	Zscore: Crushing 0.45
	Zscore: Battering 0.03	Zscore: Battering -0.45
	Zscore: Steps -0.03	Zscore: Steps 0.27
	Zscore: Hinges -0.01	Zscore: Hinges 0.21

Figure 7.4: Two-step cluster analysis using the z-scores of blades, regular blades, multi-faceted platforms, extremely regular blades, core trimming elements, irregular blades, core types, *outrepassé* terminations, step terminations, hinge terminations, battering damage and crushing damage.

The three dependent variable k-means cluster analysis (Figure 7.1) created three distinct skill level clusters. The novice cluster consists of 164 blade core reductions. The intermediate cluster consists of 19 blade core reductions. The master cluster consists of five blade core reductions.

Longitudinal Test of K-means Cluster and Two-step Cluster Analyses

To further test the novice, intermediate, and master clusters a longitudinal test was run on the clustering analysis. Three blade cores produced by the author were tested to see if the fit within the cluster models (cores DE01, DE02, and DE03). One blade core from the early phases of learning to knap blade cores (DE01 produced in 2017), one blade core from middle-late phases of learning to produce blade cores (DE02 produced in 2020), and one blade core after significant practice and experience with blade cores (DE03 produced in 2022) were processed for comparison to the experimental findings to test the rigor of the variables. Identical statistical tests were run on the three longitudinal cores as were completed with the experimental cores.

In the three-dependent variable k-means cluster analysis core DE01 was grouped with the novice cluster. Core DE02 was grouped with the intermediate cluster. Core DE03 was grouped with the master cluster. In the two-dependent variable k-means cluster analysis DE01 was grouped with the unskilled cluster while DE02 and DE03 were grouped with the skilled cluster. The two-step cluster analysis provided an interesting departure from the two-dependent variable k-means cluster analysis as DE01 and DE02 both grouped with the unskilled cluster and DE03 was grouped with the skilled cluster. The difference between the two-dependent variable k-means cluster analysis and the two-step cluster analysis proves to be the weight placed on the number of blades within the assemblage. In the two-dependent variable k-means cluster analysis the cluster center is 3.31 (based on z-scores of blades) while the two-step cluster centers the blade core z-score at 2.79. The main difference between the two tests is predominantly the weight placed on blade quantity, however, some differences in blade regularity is also noted as both tests use the z-score of regular blades as a heavily weighted factor in determining skill level.

The longitudinal test cores suggest that the three-dependent variable k-means cluster is representative of individual flintknapper skill level and can identify three distinct experience levels: novice (DE01), intermediate (DE02), and master (DE03). The two-dependent variable k-means cluster analysis and two-step cluster analysis that test for skilled and unskilled individuals correctly identified DE01 as unskilled in both tests and DE03 as skilled in both tests. DE02 was identified as unskilled and skilled in each test, respectively. This clearly identifies the number of blades and regular blades as being an important factor in determining skill.

Novice Assigned Skill Level

The novice cluster, Cluster 1, is defined by a low frequency of blade removals, core trimming elements, multifaceted platforms, irregular blades, regular blades, and extremely regular blades (Figure 7.2). On average, novices produced one blade per blade core. The low frequency of blade removals suggests that novices are less capable of creating and maintaining a blade core face that would allow for blade removals. This is supported by the reduced frequency of core trimming elements—a key component to shaping blade cores and maintaining core face profiles for blade removal. The low frequency of multifaceted platforms indicates that novices do not prepare the platforms prior to removal. Platform preparation is an important component of making successful removals and are integral for complex tool strategies like blade-making

(Whittaker 1994). Novices frequently produced incomplete or exhausted flake cores, many of which had extremely battered surfaces. Novices reflected in their journals that they had difficulty in setting up platforms that would allow them to prepare blade core faces and ultimately remove blades, they expressed frustration in their inability to remove the flakes they 'wanted' and lamented "smashing" platforms, removing "wasteful flakes", and "ruining" their angles. As a result of limited blade production, an inability to correct errors, a lack of blade core profile maintenance, and a lack of platform isolation, blades produced by novices are frequently irregular in form. Regular blades and extremely regular blades were not produced by novices at any point in the experiment (Figure 7.11).

The ASL of novice flintknapper reflected the RSL consistently. Most novice flintknapper maintained their novice ASL throughout the experiment, there was one exception to this group of flintknapper. One novice knapper produced two blade cores (D09 and D10) after eight previous flintknapping events. These two cores clustered among the intermediate individuals in the three dependent variable k-means cluster analysis, and among the unskilled individuals in the two dependent variable k-means cluster analysis and the two-step cluster analysis. This suggests that the individual had gained skills that were similar to other lesser-skilled intermediate flintknappers. Other skilled participants who had reported their skill levels as master or intermediate were clustered with the novices. Notably these individuals had significant experience with producing bifaces, working with obsidian, and working with copper tools but had little to no experience with blade core technologies, working with flint, or traditional tool kits. This suggests that this approach to analysis tests for both *connaissance* and *savior faire* of blade core technology and the findings are only applicable to blade core assemblages. More experimentation is needed to determine skill in biface technologies using this method although similar research on flintknapping bifaces and skill acquisition has been completed (Ferguson 2008).

Intermediate Assigned Skill Level

The intermediate cluster, Cluster 3, is defined by a moderate frequency of: blade removals, core trimming elements, multifaceted platforms, and extremely regular blades (Figure 7.2). Blade frequency in the intermediate cluster is higher than the novice cluster and lower than the master cluster. A significant difference between the novice and intermediate cluster is the quantity of blades produced per blade core reduction; intermediate flintknappers produce 17 blades on average (Figure 7.9). Core trimming elements are more diverse and more frequent among intermediate flintknappers than in novices (Figure 7.9). As a result of an increased ability to prepare platforms, correct errors, and maintain blade core profiles, blades are more common among intermediate flintknappers. These blades are, however, irregular in shape compared to those produced by masters (Figure 7.11).

The ASL of intermediate flintknappers diverges from most of the intermediate RSL's. First, in the three dependent variable k-means cluster analysis an intermediate skill level was clearly defined from novices and masters as discussed above. However, in both the two k-means cluster analysis and the two-step cluster analysis intermediate flintknappers were split into either 'skilled' or 'unskilled' clusters. The skilled and unskilled distinction remained consistent for each flintknapper in both tests. Thus, the intermediate category encompasses intermediate-skilled and intermediate-unskilled individuals. Individuals with an RSL of master who were assigned intermediate flintknappers clustered with skilled individuals while individuals with novice RSL's that were assigned as intermediate flintknappers clustered with unskilled individuals. Individuals with intermediate RSL's that also clustered with the intermediate ASL clustered with either skilled or unskilled individuals.

There is a significant amount of variability in the intermediate category. Novices can learn to become intermediate flintknappers quickly. Their skill acquisition reflected in their intermediate-unskilled categorization. Long term flintknappers that are highly skilled at producing bifaces on obsidian with copper tools made up a significant portion of the intermediate cluster as both intermediate-skilled and intermediate-unskilled suggesting that a robust knowledge of the *chaîne opératoire* and thus the *savior faire* is integral to interpreting skill level. Finally, both individuals that were frequently assigned as masters in blade production each have a blade core reduction that is assigned intermediate-skilled. This highly variable group aligns with current research on skill. Flintknapping skill is acquired slowly and through many hours of practice. Individuals who are highly practiced in one form of technology will likely have a grasp of the *savoir faire* but are perhaps limited by the *connaissance*. Individuals with less experience (like the novice who began producing intermediate cores) are in the process of acquiring both the *connaissance* and the *savoir faire*. While the RSL masters that produced the intermediate cores could have potentially been influenced by several factors like fatigue, motivation, or material quality (Pelegrin 1990).

Master Assigned Skill Level

The master cluster, Cluster 2, is defined by a high frequency of blade removals, core trimming elements, multifaceted platforms, regular blades, and extremely regular blades (See Figure 7.2). Blade frequency among masters is high on average they produce 38 blades per blade core reduction on average. This increase in blade production relates to the diverse approaches to core trimming and maintenance masters use during their blade core reductions. Masters produce a wider variety of core trimming elements and at higher frequencies than novices and intermediate flintknappers (Figure 7.9). Masters frequently prepare their platforms and therefore have a higher success rate for removing core trimming elements and blades. Masters produce irregular blades but produce regular and extremely regular blades at a significantly higher frequency than both novices and intermediate flintknappers (Figure 7.11).

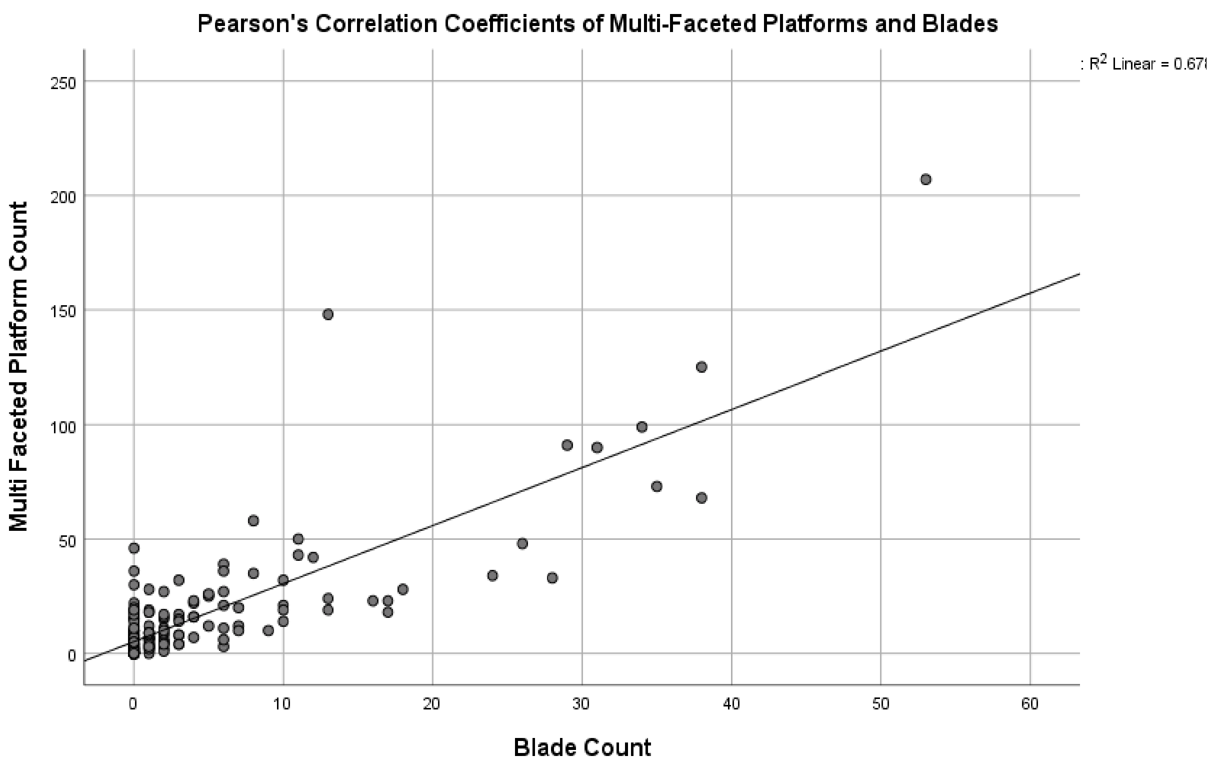
The ASL of master differs slightly from the RSL. Two individuals were clustered in the master ASL, both of whom specialize in making blade core technologies on flint using traditional tool kits. The notable difference in the RSL from the ASL is the clustering of individuals that reported a master level skill with biface technologies on obsidian using copper tools within the intermediate cluster rather than the master cluster as discussed above.

Correlations Within Blade Core Reductions

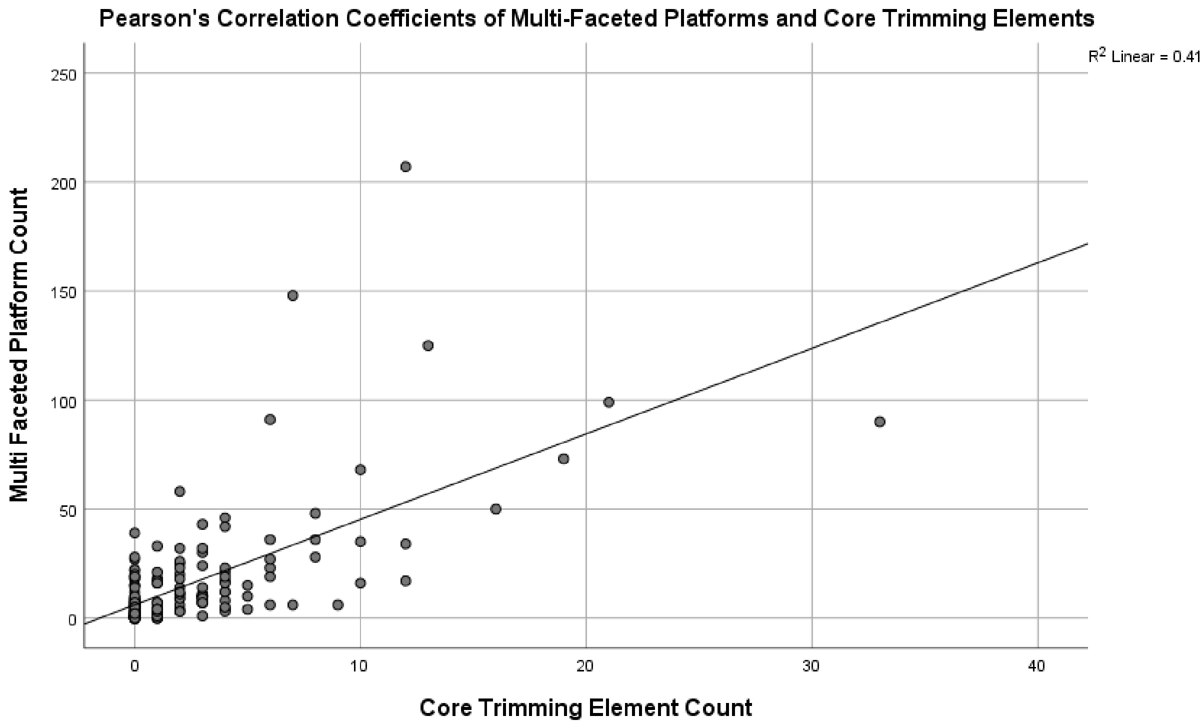
To further test the correlation between specific removal types, qualities, or frequencies the Pearson's Correlation Coefficient (r) was used to interpret the relatedness of the variables based on non-standardized counts of. The Pearson's Correlation Coefficient is a measure of the strength of the linear relationship between two sets of data. Coefficients where $r \leq 0.20$ are considered to have a "small effect", $r = 0.50$ a "medium effect", and $r = 0.80$ a "large effect" (Cohen 1988). Two sets of analysis were completed. First, multi-faceted platforms were tested for correlation with blades, core trimming elements, irregular blades, regular blades, and extremely regular blades. A similar test with single faceted platforms was then conducted. These tests were conducted to highlight the relatedness of platform isolation and blade production.

Multi-faceted platforms are positively correlated with the total number of blades, core trimming elements, irregular blades, regular blades, and extremely regular blades in the blade core reductions. A distinction here between blade count and blade regularity is necessary, the number of blades is the total number of blades of any type, while the type of blade refers to the number of irregular, regular, or extremely regular blades within a blade core reduction. Multi-faceted platforms had a large effect on the presence of blades and regular blades within a blade core reduction, suggesting that as multi-faceted platforms increase so does blade production. Multi-faceted blades had a medium effect on the presence of extremely regular blades and core trimming elements (Figure 7.5 plots A-E). Multi-faceted platforms had a low effect on the presence of irregular blades. All of the correlations are statistically significant (Table 7.1).

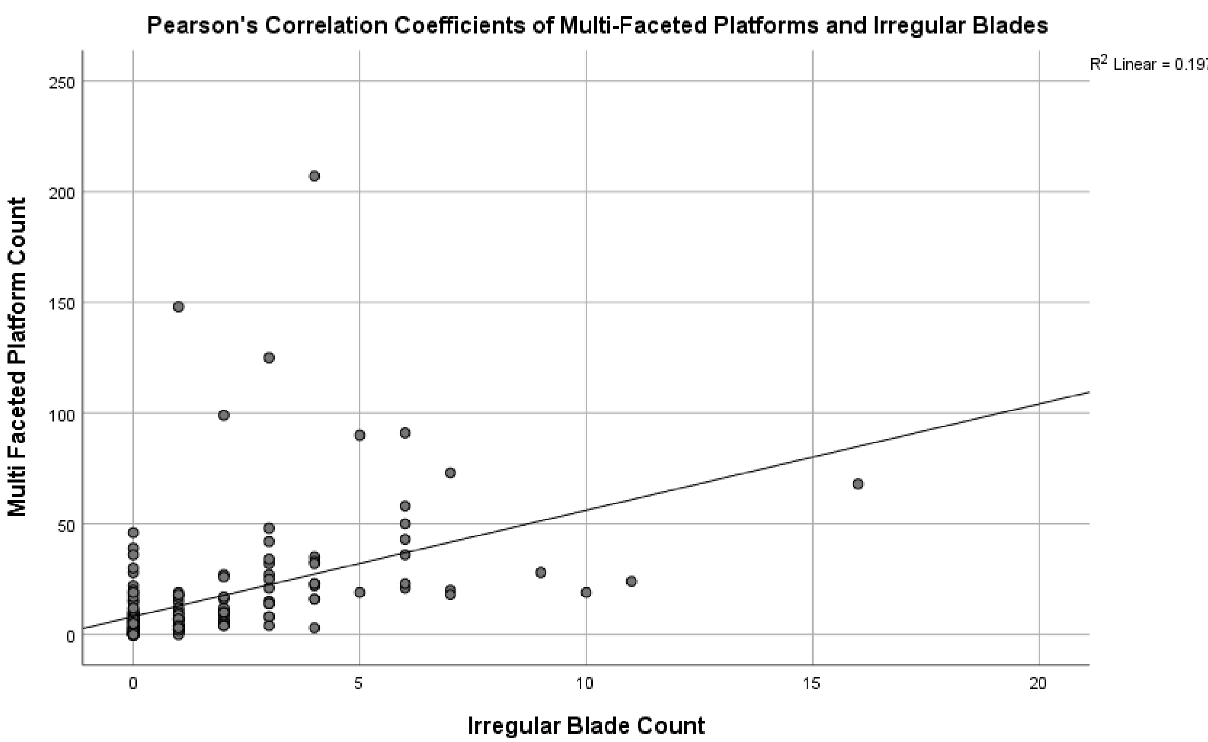
Single faceted platforms were not correlated with any removal type (Table 7.1). This supports the exemption of single faceted platforms as an indicator of skill and highlights the importance of multi-faceted platforms for blade production. Platform isolation is a significant process in the production of blades and thus the ability to produce, and knowledge of, platform isolation should be considered a significant aspect of skill.



A


Pearson's Correlation Coefficients of Multi-Faceted Platforms and Core Trimming Elements
R^2 Linear = 0.415
Multi Faceted Platform Count
0
50
100
150
200
250
0
10
20
30
40
Core Trimming Element Count

B


Pearson's Correlation Coefficients of Multi-Faceted Platforms and Irregular Blades
R^2 Linear = 0.197
Multi Faceted Platform Count
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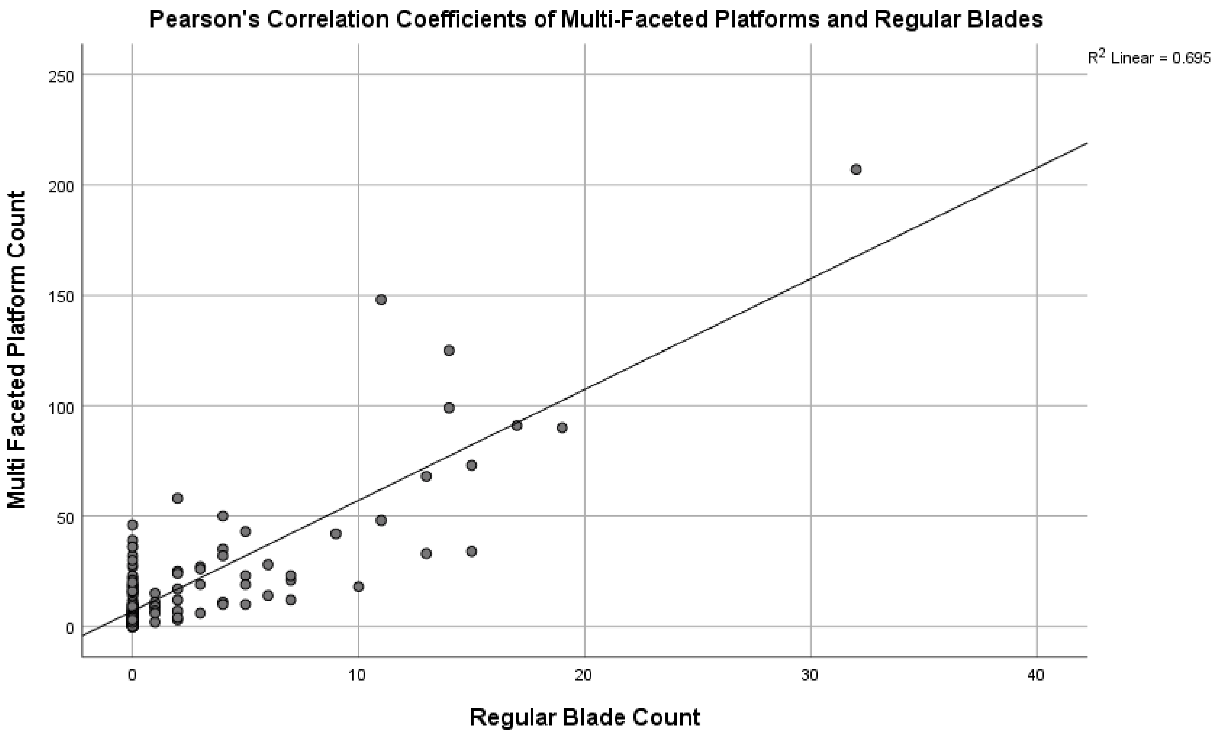
50
100
150
200
250
0
5
10
15
20
Irregular Blade Count

C


Pearson's Correlation Coefficients of Multi-Faceted Platforms and Regular Blades
R2 Linear = 0.695
Multi Faceted Platform Count
Regular Blade Count
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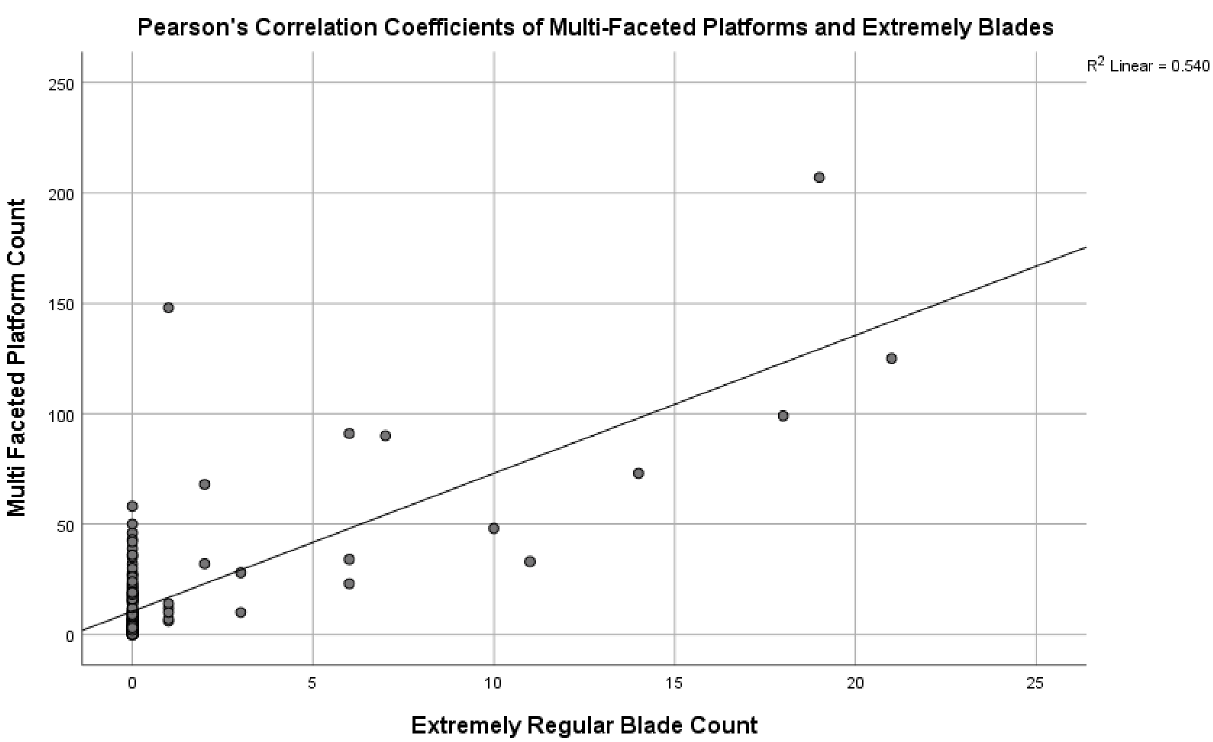
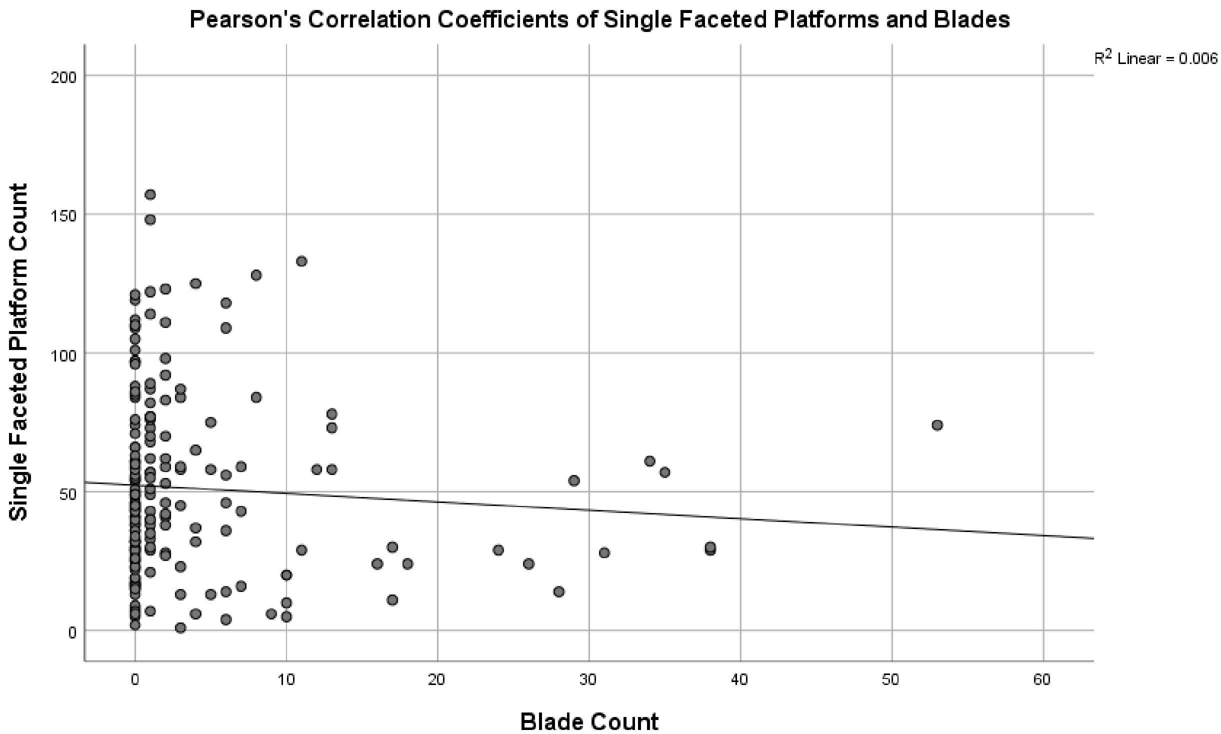
50
100
150
200
250
0
10
20
30
40

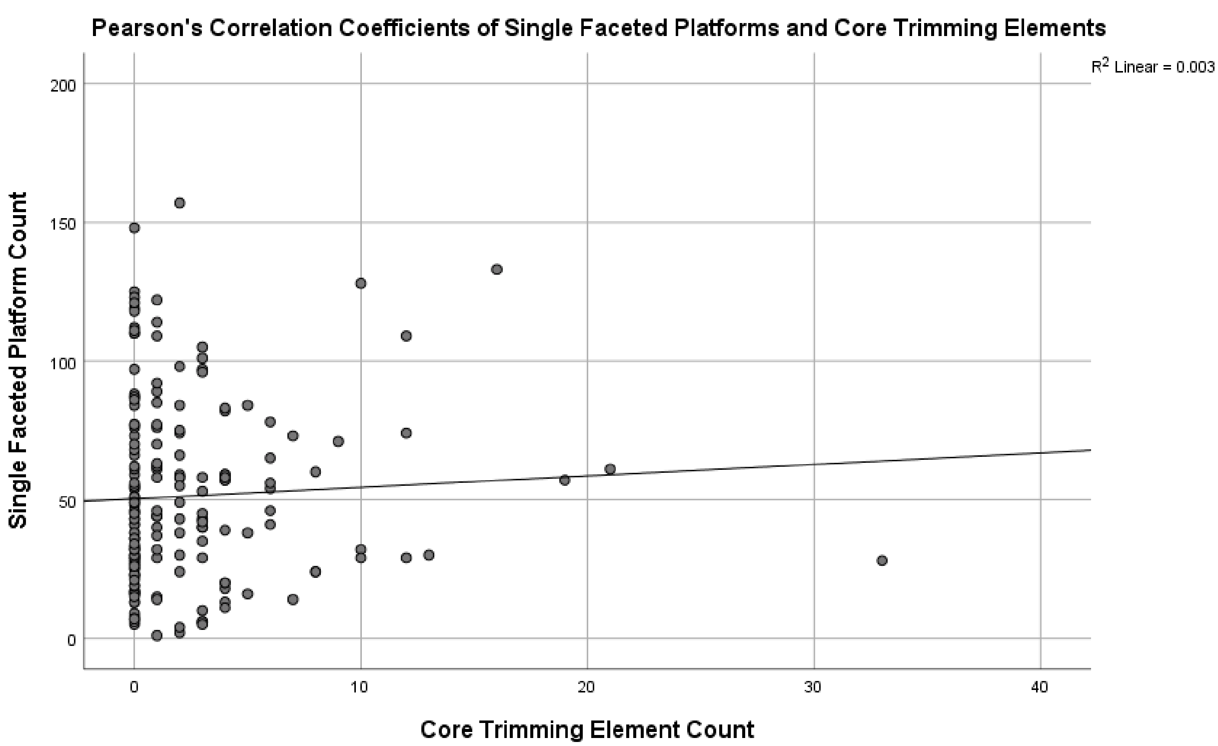
D


Pearson's Correlation Coefficients of Multi-Faceted Platforms and Extremely Blades
R2 Linear = 0.540
Multi Faceted Platform Count
Extremely Regular Blade Count
0
50
100
150
200
250
0
5
10
15
20
25

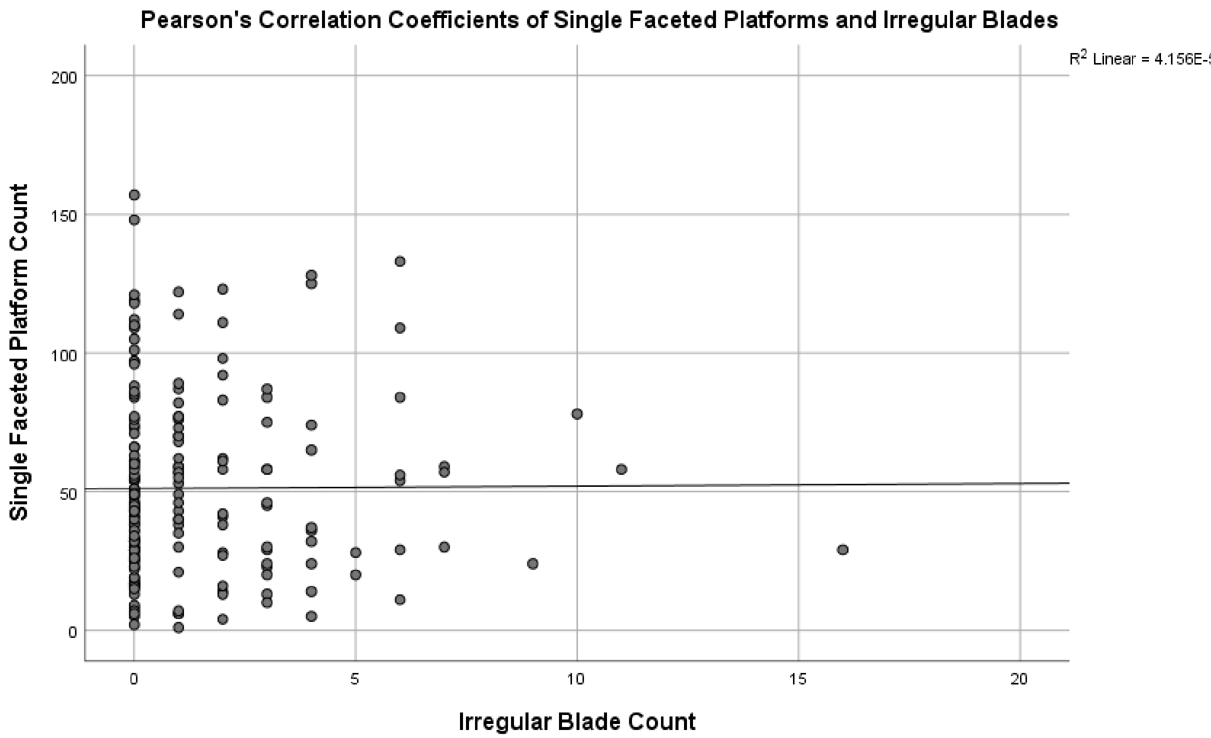
E


Pearson's Correlation Coefficients of Single Faceted Platforms and Blades
R2 Linear = 0.006
Single Faceted Platform Count
Blade Count
0
50
100
150
200
0
10
20
30
40
50
60

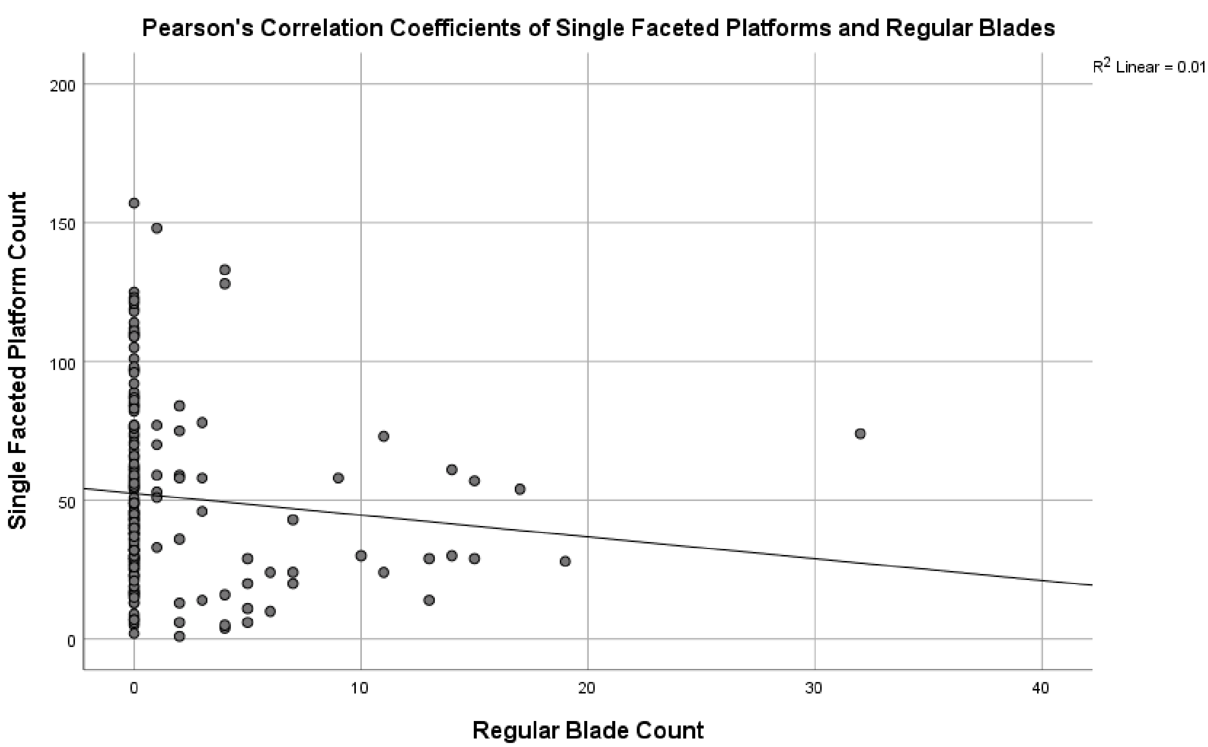
F


Pearson's Correlation Coefficients of Single Faceted Platforms and Core Trimming Elements
R2 Linear = 0.003
Single Faceted Platform Count
Core Trimming Element Count
0
50
100
150
200
0
10
20
30
40

G


Pearson's Correlation Coefficients of Single Faceted Platforms and Irregular Blades
R^2 Linear = 4.156E-5
Single Faceted Platform Count
0
50
100
150
200
0
5
10
15
20
Irregular Blade Count

H


Pearson's Correlation Coefficients of Single Faceted Platforms and Regular Blades
R^2 Linear = 0.010
Single Faceted Platform Count
0
50
100
150
200
0
10
20
30
40
Regular Blade Count

I

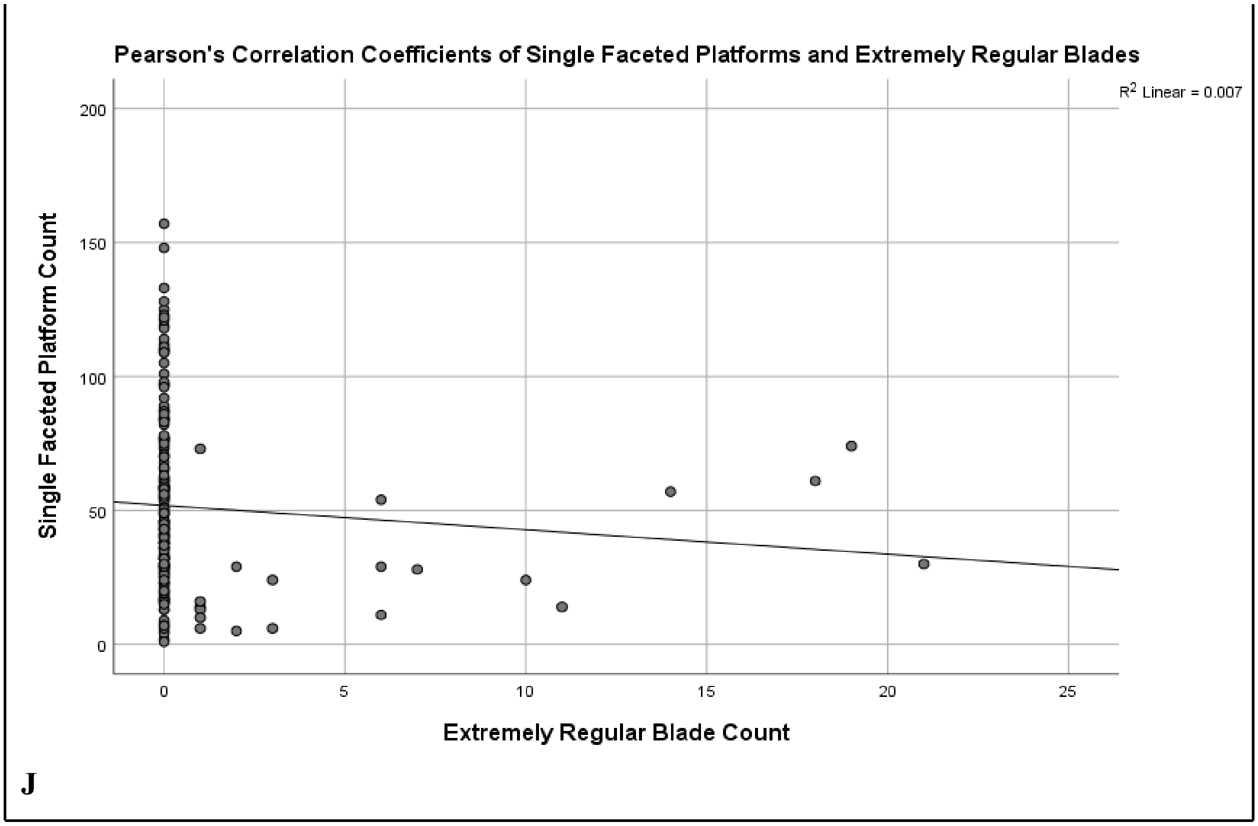


Figure 7.5: These scatter plots show the relationships between multi-faceted platforms and single faceted platforms when compared to blades, core trimming elements, irregular blades, regular blades, and extremely regular blades within each blade core reduction.

Correlations Between Debitage and Multi-Faceted Platforms and Single Faceted Platforms			
	Variable	**Pearson's Correlation Coefficient (r)**	**Statistical Significance**
Multi-Faceted Platforms	Blades	r = .824	p< .001
	Core Trimming Elements	r = .644	p< .001
	Irregular Blades	r = .444	p< .001
	Regular Blades	r = .834	p< .001
	Extremely Regular Blades	r = .735	p< .001
Single Faceted Platforms	Blades	r = -.075	p< .305
	Core Trimming Elements	r = .052	p< .478
	Irregular Blades	r = .006	p< .930
	Regular Blades	r = .100	p< .172
	Extremely Regular Blades	r = -.082	p< .263

Table 7.1: This table compares the Pearson's Correlation Coefficients of debitage with multi-faceted platforms and single faceted platforms. Multi-faceted platforms show a statistically significant relationship between debitage types and platform type while single faceted platforms do not show any statistically significant relationship to debitage types and platform types.

Effect of Skill Level on Blade Regularity- Eta Test		
	Eta Value	**Eta-Squared**
Irregular	$\eta = 0.701$	$\eta^2 = 0.492$
Regular	$\eta = 0.856$	$\eta^2 = 0.734$
Extremely Regular	$\eta = 0.880$	$\eta^2 = 0.776$

Table 7.2: This table shows the findings of the Eta test where assigned skill level is the independent variable and blade type was the dependent variable. Eta-Squared values over 0.26 are considered large and have a stronger correlation to the independent variable.

Eta Test of Blade Type

The Eta test is useful for correlating nominal and scale variables while eta-squared is used to measure the effect one variable has over another. Blade type was identified as the dependent variable in this test and ASL as the independent variable. A value of $\eta^2 = 0.20$ is considered a "small effect", $\eta^2 = 0.50$ a "medium effect", and $\eta^2 = 0.80$ a "large effect" on the tested variable (Cohen 1988).

The number of irregular blades per blade core reduction had a small effect on determining the skill level of a flintknapper. The Eta-Squared value (η^2) of irregular blades was η^2=0.492 meaning that 49.2% of the variation in the number of irregular blades per blade core reduction can by accounted for by the flintknapper's skill level.

The number of regular blades per blade core reduction had a medium effect on determining the skill level of a flintknapper. A flintknapper's skill level accounts for 73.4% of the variation in the quantity of regular blades produced per blade core.

The quantity of extremely regular blades had a medium effect on determining the skill level of a flintknapper. At 77.6%, most of the variation in the quantity of extremely regular blades per assemblage is dependent on the flintknapper's skill level.

Therefore, blade type is a useful signifier of individual skill and can act as a predictor of a flintknapper's skill level (Table 7.2).

Correlation Results

Using the ASL identified in the three dependent variable k-means cluster analysis and the weighted importance of variables identified in the two-step cluster analysis an ETA test for correlation between blade type (irregular, regular, and extremely regular) and skill level was completed. The findings verified that there is significant correlation between skill level and produced blade types (Table 7.2).

Combining the ETA test with the blade core correlation findings, it is clear that higher frequencies of regular blades, extremely regular blades, and higher blade counts are indicators of highly skilled individuals. High frequencies of multi-faceted platforms, core trimming elements, and irregular blades suggest skilled individuals indicate skilled individuals. While low frequencies of blades, core trimming elements, multi-faceted platforms, regular blades, and extremely regular blades indicate individuals with less skill.

Qualitative Analysis

Platform Preparation

Platform preparation is evidenced by multiple small removals around a platform and/or abrasion of the platform and nearby area. This preparation sequence occurs frequently among masters and is a significant contributor to the cluster formation (see Figures 7.1, 7.5, and 7.6). Single faceted platforms are unprepared and do not aid in distinguishing between skill levels. A high frequency of multi-faceted platforms suggests a high skill level.

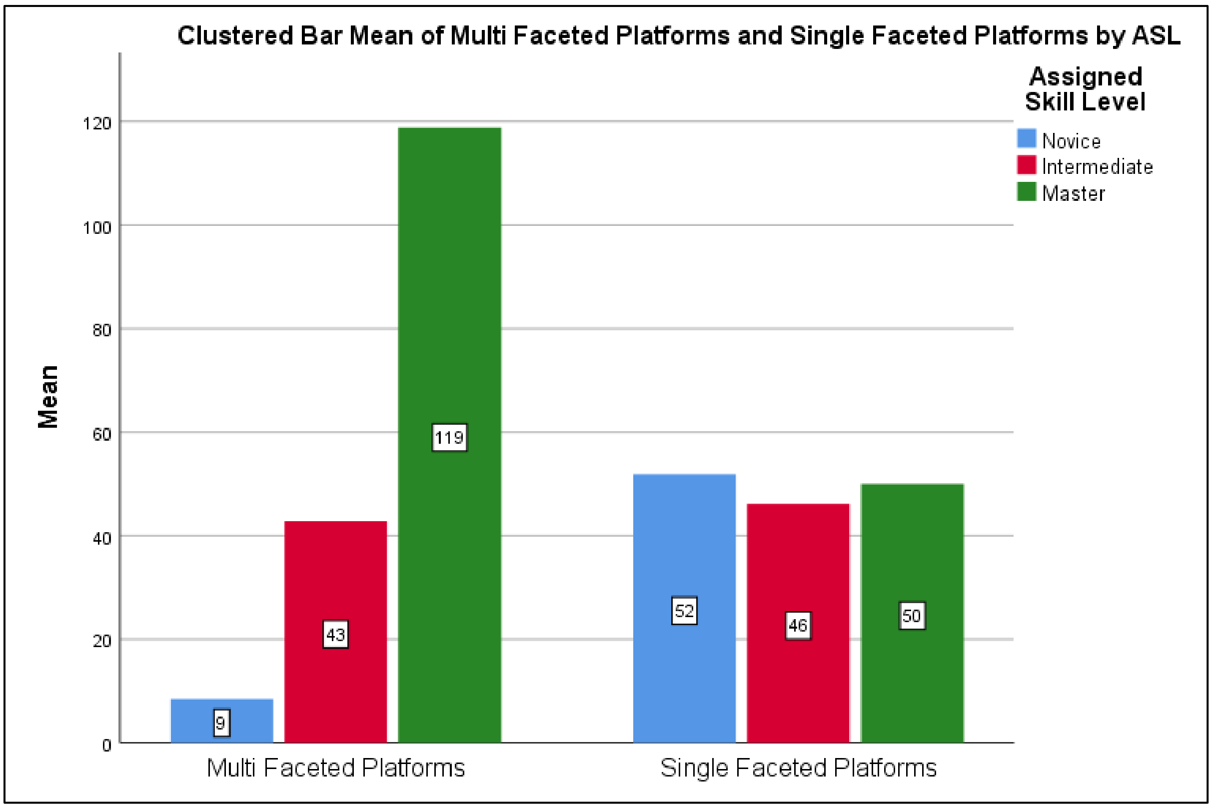


Figure 7.6: Platform preparation techniques. Average of single faceted vs multifaceted platforms in blade core reductions by assigned skill level.

Platform Damage Frequency

Platform damage has minimal relation to the skill level of an individual flintknapper. Battering is more frequent in novice blade core reductions but was not significant in cluster construction. Crushing was more common in master blade core reductions. The k-means cluster with three skill levels revealed crushing as a significant factor in distinguishing between novice, intermediate and master individuals. Both the k-means cluster (with two variables) and the two-step cluster did not find crushing to be a significant factor for clustering (Figure 7.7). Platform battering and platform crushing are both moderately useful in determining skill level as battering frequently occurs among novices and crushing frequently occurs among masters.

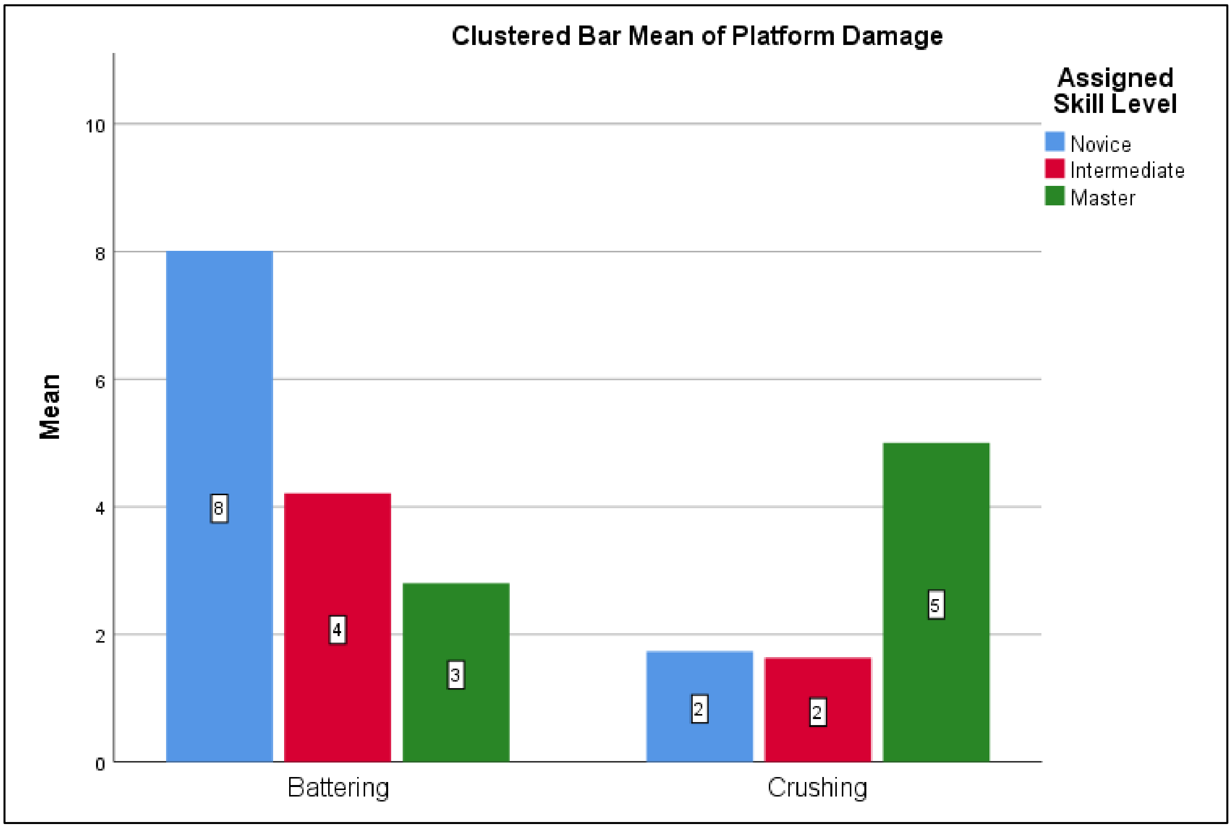


Figure 7.7: Average of platform damage types in blade core reductions by assigned skill level.

Termination Frequency

Termination type appears to have minimal relation to the skill level of a flintknapper. Feathered terminations were common throughout all skill levels. Hinge terminations were more common among master flintknappers than novices or intermediate flintknappers. This is particularly interesting as hinge terminations are often considered to be the result of a less-than-ideal platform angle and will be explored further in the metrics section below (Whittaker 1994). Step terminations and *outrepassé* terminations have no relationship to skill level (Figure 7.8).

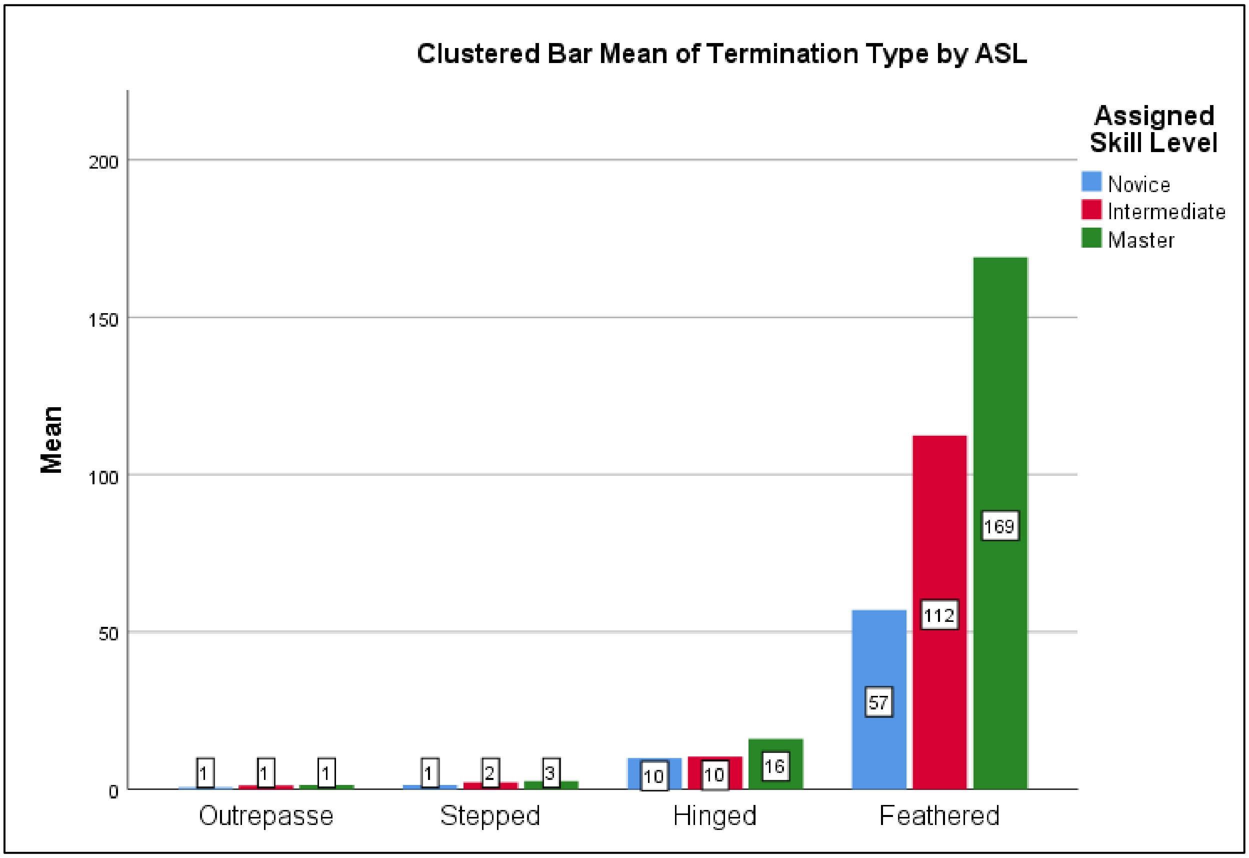


Figure 7.8: Average termination types in blade core reductions by assigned skill level.

Removal Types

Removal types are likely indicators of skill level with some exceptions. Flakes alone are unlikely indicators of skill as the number of flakes present in a blade core reduction is relative to the starting size of the raw material selected for the blade core. Characteristics of flakes like platform preparation are indicators of skill, but flake counts alone are not indicative of skill (Figure 7.9). Novices produced less flakes on average than intermediate or master individuals however, this is likely due to the novice's inability to produce removals. Novices often use material ineffectually (Shelly 1990; Ferguson 2008) and frequently left a large, battered flake core at the end of flintknapping events. Ratios representing the relationships between flake, blade, and core trimming production are a better measure of skill as it can help reduce a skewed flake count due to starting flint cobble size.

In contrast, blades are the strongest predictor of skill level. The production of blades requires both *connaissance* and *savoir faire.* A knowledge of appropriate angles for successful removals, which tools to use for specific purposes, the *chaîne opératoire* for blade production, and how to fix errors or work around flawed material is necessary to produce blades. On average, novices produce one blade per blade core reduction, intermediate flintknappers average 17 blades per blade core reduction, and masters average 38 blades per blade core reduction (Figure 7.10).

Core trimming elements are also strong predictors of skill level. Masters frequently use core trimming techniques to correct errors, modify core face profiles, and maintain the core face in order to produce successful blade removals. On average, novices produce one core trimming element per blade core reduction, intermediate flintknappers average six core trimming elements per blade core reduction, and masters average 20 core trimming elements per blade core reduction (Figure 7.9). Further analysis of the core trimming techniques utilized by the flintknappers suggests that masters employ a diverse approach to core trimming and frequently produce a wide variety of core trimming elements. Novices produce less core trimming elements and utilize less types of core trimming techniques than masters or intermediate flintknappers. This is likely due to the fact that novices make many mistakes and simply do not know how to fix them yet. This results in the novice's inability to produce core trimming elements. By the time novices are able to fix errors or work around flawed material they have acquired enough skill and knowledge to be considered intermediate flintknappers. Intermediate flintknappers produce a diverse array of core trimming elements but less frequently than masters (Figure 7.10).

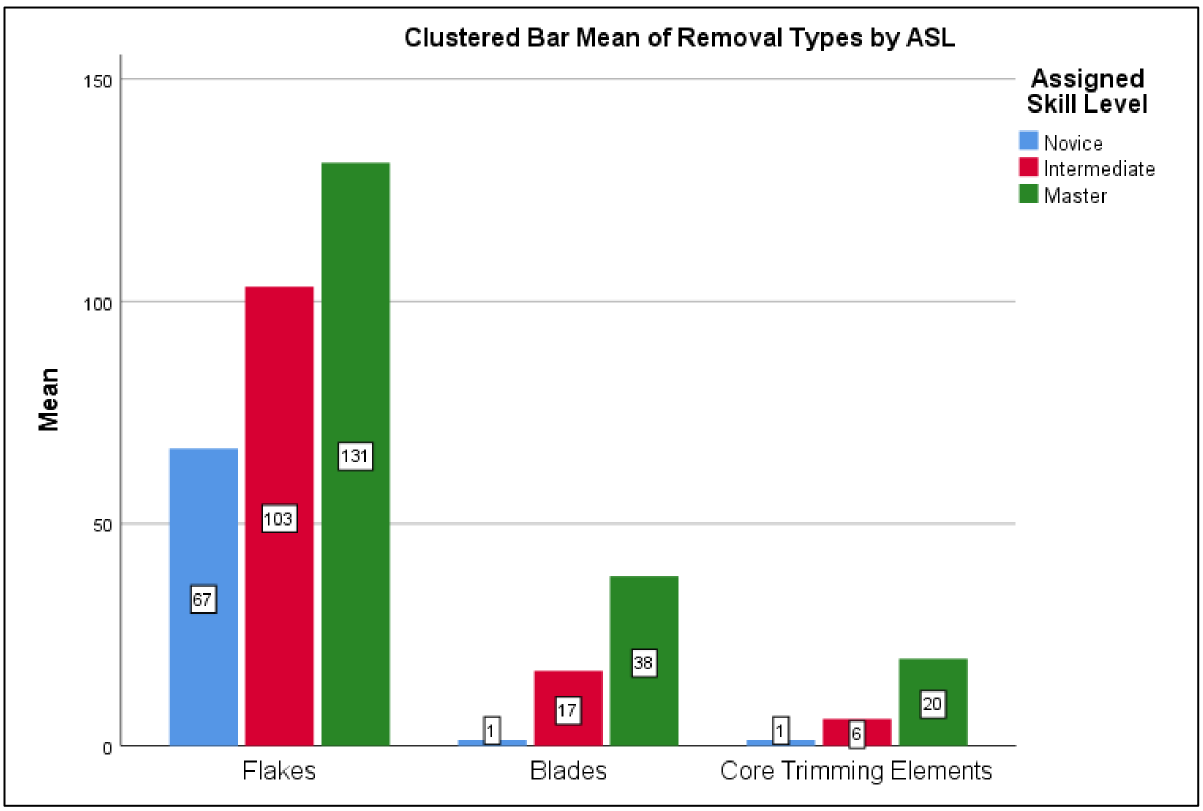


Figure 7.9: Averages of major removal types in blade core reductions by assigned skill level.

Figure 7.10: Average number of removals by type per blade core reduction separated by assigned skill level.

Sequential Blade Removals

The presence of sequential blade removals is indicative of highly skilled flintknappers. Among novices, sequential blade removals were unlikely as 91.8% of the blade core reductions lacked any sequential blades. Intermediate level flintknappers can frequently produce sequential blade removals. Of the 19 intermediate blade core reductions, 84% had sequential blade removals. Masters were consistently able to produce sequential blade removals, 100% of the blade core reductions had sequential blade removals (Figure 7.11).

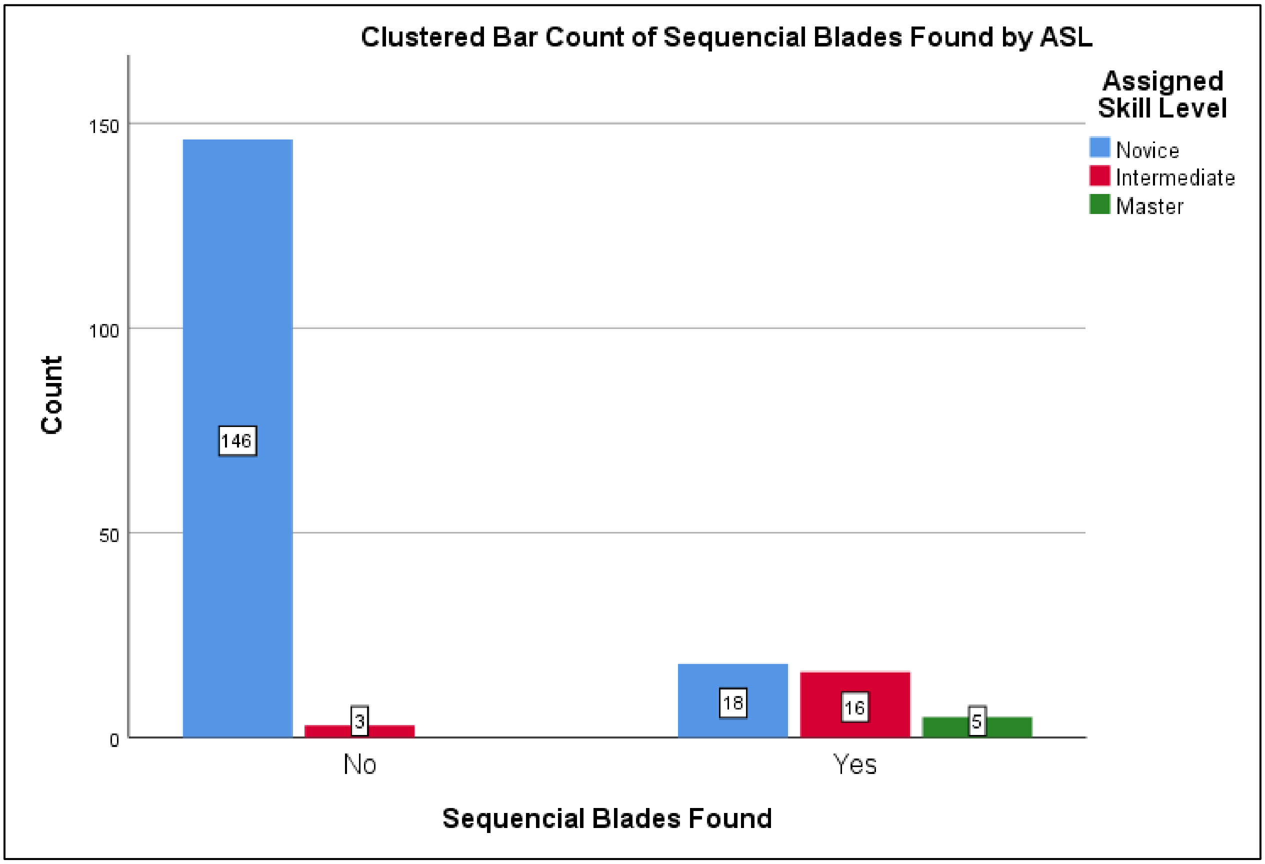


Figure 7.11: The total number of blade core reductions with sequential blades produced by assigned skill level separated by the presence or absence of sequential blades in the blade core reductions.

Blade Regularity

Blade regularity is strongly associated with skill level (Figure 7.12). Irregular blades are blades with non-parallel scar patterns on the dorsal surface indicating that prior removals were either flakes, not parallel to the blade removal itself, or irregular blade removals. Irregular blades are often produced early in a blade removal sequence where no previous blade removals have been made. For this reason, novices are most likely to produce irregular blades and they average 1 blade per blade core. Regular blades have dorsal scars that indicate previous removals were parallel with the removed blade but not consistently straight (either the dorsal scars or the lateral edges of the removed blade itself). Regular blades are frequently produced during the reduction of a blade core and are the most common blade type among intermediate and master flintknappers. Extremely regular blades have dorsal scars that indicate previous blade removals were parallel to the removed blade, the previous removal had straight consistent edges, and the removed blade has straight consistent lateral edges. Extremely regular blades require consistency in blade production and the ability to remove sequential blades, for this reason, extremely regular blades are produced most commonly by master flintknappers as they average about 16 extremely regular blades per blade core while novices were never able to produce extremely regular blades and intermediate flintknappers averaged about 3 extremely regular blades per blade core.

On average, novices were able to make a small number of irregular blades per blade core (0.8). They were rarely able to make regular blades (averaging 0.4 blades per core) and were never able to produce extremely regular blades. In any one reduction, it can be expected that a novice will produce 1 or less blades — the blade produced would most likely be irregular in morphology.

Intermediate flintknappers frequently produced irregular blades with a mean of 6 irregular blades per blade core. Regular blades were also common with an average of 7.6 regular blades per blade core. Extremely regular blades were uncommon among intermediate flintknappers as they averaged 2.5 extremely regular blades per blade core. In a single reduction, it can be expected that an intermediate flintknapper would produce about 17 blades, 6 of which would be irregular, 8 would be regular, while approximately 3 would be extremely regular in morphology.

Masters infrequently produced irregular blades and averaged 4.2 irregular blades per blade core. Regular blades were frequently found as masters averaged 18.8 regular blades per blade core. Extremely regular blades were only common among masters. Masters were able to produce 15.8 extremely regular blades per blade core which is vastly different from novices or intermediate flintknappers. In any single blade core reduction it can be expected that masters would produce approximately 39 blades— 4 irregular blades, 19 regular blades, and 16 extremely regular blades. To produce regular and extremely regular blades, flintknappers require error correction techniques, the ability to maintain a core face, consistent removals that result in sequential blade removals, and the knowledge and ability to isolate platforms, and competency in the *chaîne opératoire.* Due to this, the production of extremely regular and regular blades is associated with a high skill level.

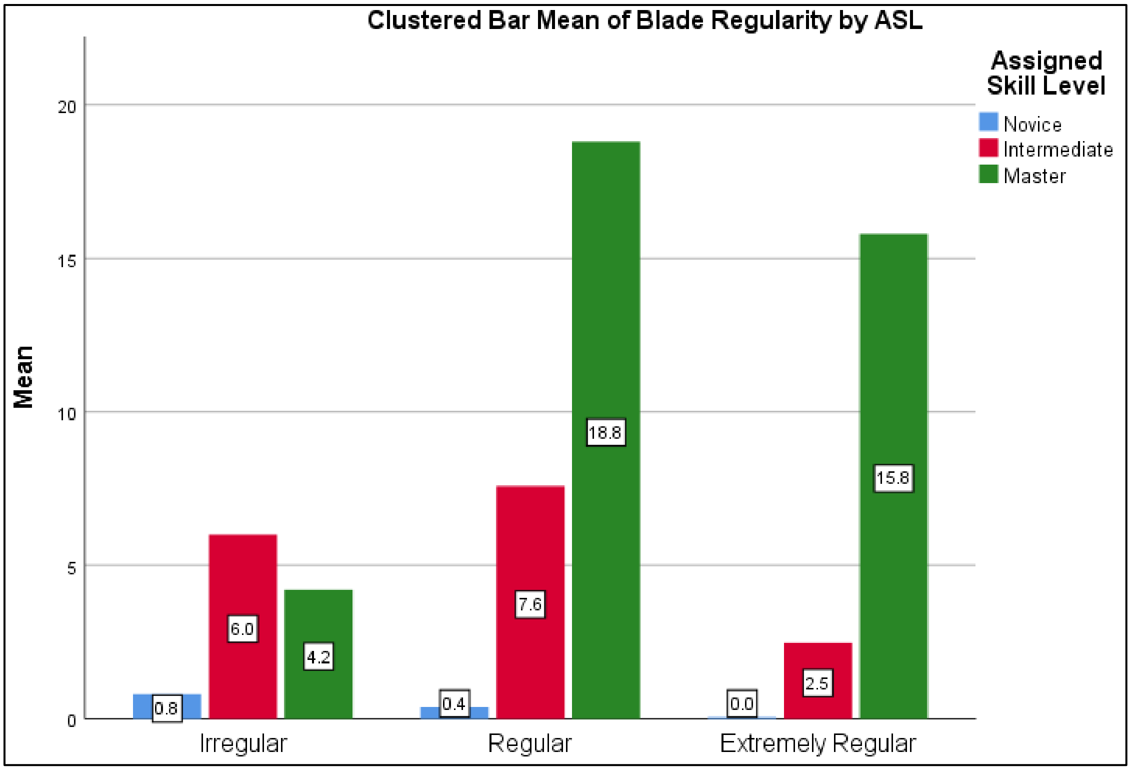


Figure 7.12: Mean number of irregular, regular, and extremely regular blades per blade core reduction by assigned skill level.

Flake: Blade Ratio (z-score)

The ratio of flakes and blades is also associated with skill level as novices produce significantly more flakes per blade than intermediates or masters; this is represented in the median number of flakes produced (Figure 7.13). Novices produce fewer blades and more flakes than intermediate flintknappers and masters this is due to the low number of blades produced by novices and the relatively higher numbers of blades produced my intermediate flintknappers and masters. Novices also produce a far more variable number of flakes while making a blade core (SD=27.70). Intermediate flintknappers have a lower flake: blade ratio (0.88) and more consistently produce blades (SD=1.70) than the novices. Masters produce the most blades in relation to the number of flakes produced (flake: blade ratio 0.34) and have the lowest sd (0.1) (Figure 7.13). This difference in flake: blade ratios likely reflect the effectiveness of the flintknappers' blade production methods and their familiarity with their respective *chaînes opératoires*, how to set up a core for blade removals, and fixing errors to continue producing blades. This suggests that the more skilled a flintknapper is, the more blades will be produced in a reduction sequence. Novices, with limited familiarity with *chaînes opératoires, connaissance*, and *savoir faire* are more likely to produce a large number of flakes in relation to blades. Related to the novice's propensity to produce large quantities of flakes is the standard deviation of flake production. Novices noted that they were unable to make further removals due to battered platforms or a lack of platforms from which flakes could easily be removed; novices frequently produced large, battered flake cores. In other instances, novices produced small flake cores and large numbers of flakes without producing any blades. This supports the wide range in the novice's flake: blade ratio as novices generally struggled to produce cores that would allow for blade production.

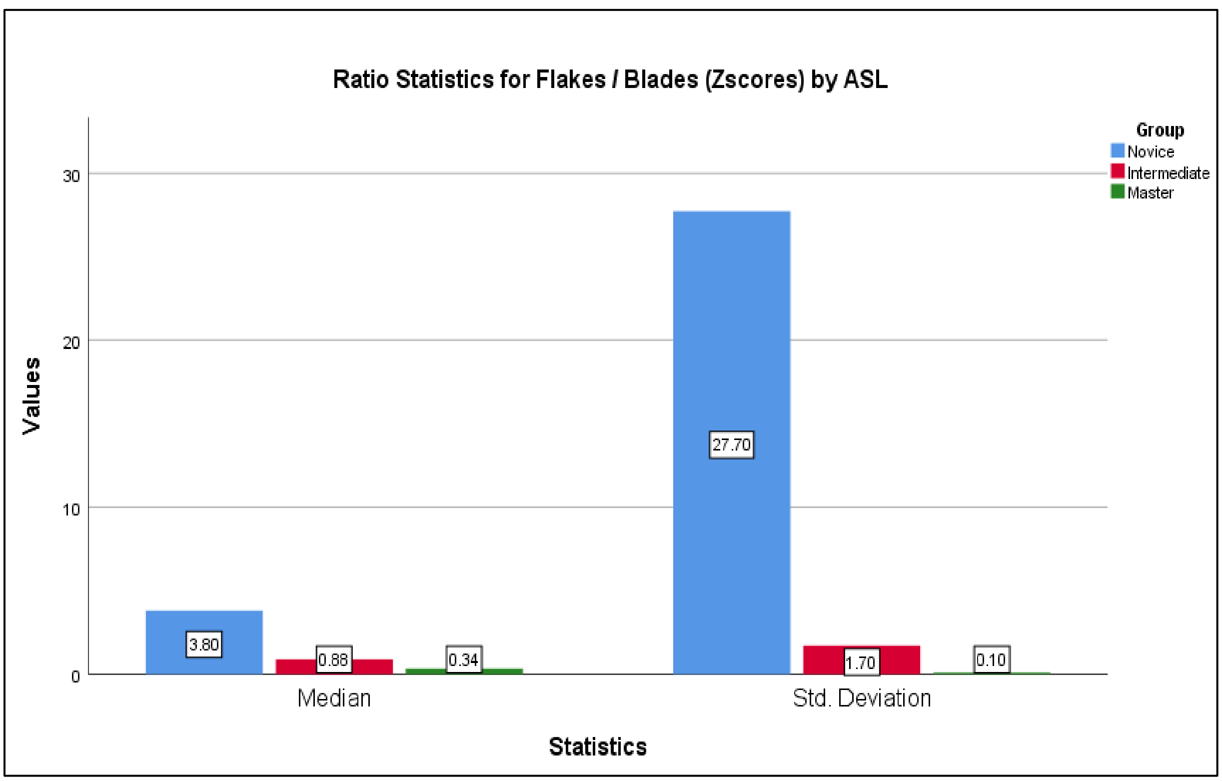


Figure 7.13: Flake/blade ratios based on z-scores of the aggregate analysis separated by assigned skill level.

Core Type

Core type is a moderate predictor of skill when specifically looking at blade core technologies. Novices produced incomplete flake cores (54.9%) and exhausted flake cores (23.8%) most frequently followed by prepared blade cores (0.07%) and exhausted blade cores (0.04%). Intermediate flintknappers produced exhausted blade cores (52.6%), and prepared blade cores (31.6%) most frequently, followed by incomplete flake cores (10.5%) and exhausted flake cores (0.05%). Masters consistently exhausted their core reductions and produced exhausted blade cores most frequently (80%) and an exhausted flake core (20%) (Figure 7.14).

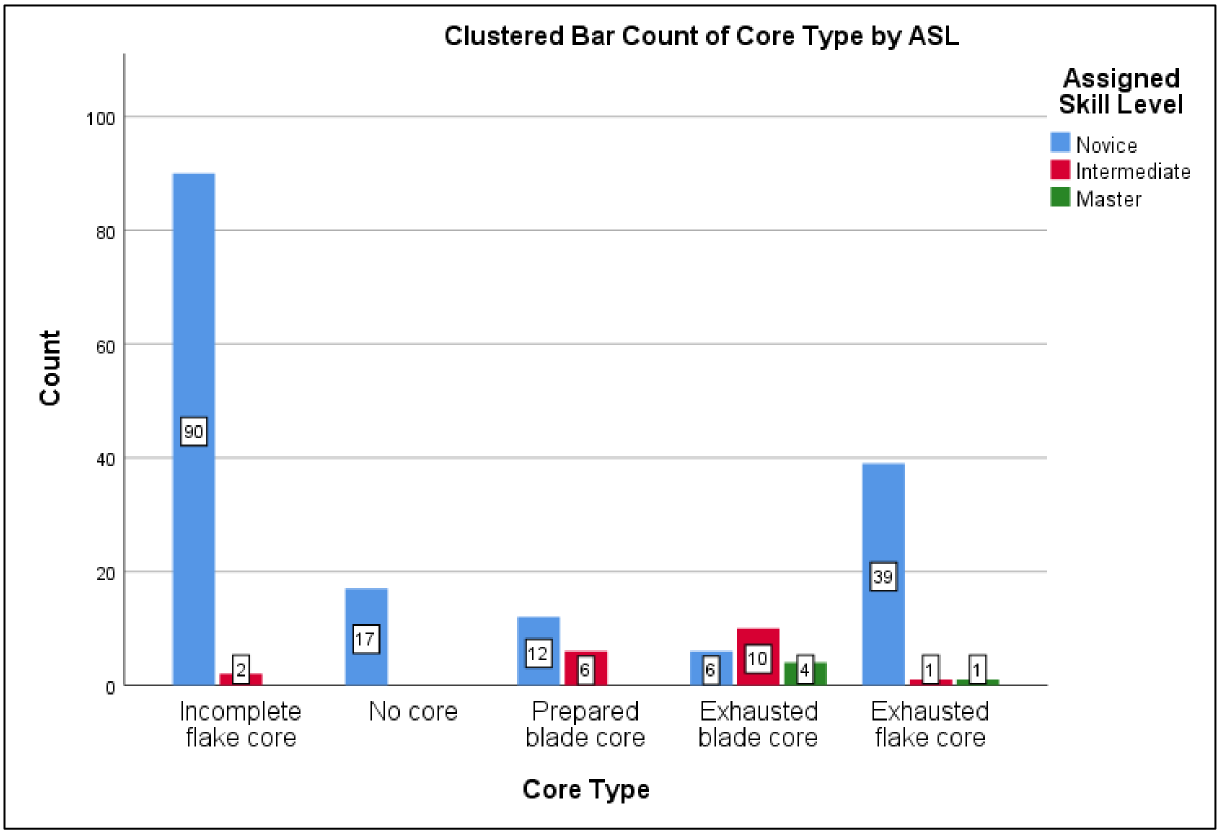


Figure 7.14: Average number of produced core types per blade core reduction by assigned skill level.

Error Types

Error types and error frequency vary greatly in their usefulness for determining skill level (Figure 7.15). All flintknappers produce errors no matter their skill level and experience (Shelly 1990; Finlay 2008), here, I test the hypothesis that master flintknappers are more capable of fixing errors than intermediate or novice flintknappers.

Battering is a moderately useful indicator of skill. Novices (z=0.06) batter platforms more frequently than intermediate flintknappers (z=-0.44) and masters (z=-0.62). Battering is often the result of multiple attempts to remove a flake and therefore suggests that intermediate flintknappers and masters are more successful in removing intended flakes on the first attempt. Battering is a indicator of skilled and unskilled individuals.

Crushing is a moderately useful indicator of skill level. Crushed platforms were less common among novices (z=-0.06) and intermediate flintknappers (z=-0.08) and frequent among masters (z=1.45). Previous experimental work suggests that crushing is a common occurrence when a flintknapper uses hard hammerstone percussion (Crabtree 1972). It is possible that this vast difference between novice/intermediate z-scores and master z-scores is caused by the preferences of the master flintknappers as both master contributors predominantly use hard hammer percussion in their blade core reduction. Alternatively, crushing may be useful to gauge the difference between skilled and unskilled individuals. More research is needed to effectively distinguish between the two possible explanations of this pattern.

Step terminations are a likely indicator of skilled and unskilled individuals. Novices (z=-0.07) produce step terminations less frequently than intermediate flintknappers (z=0.37) and masters (z=0.67). This is likely due to a combination of two factors. First, the use of direct percussion to remove blades from the blade cores is known to create step and hinge terminations more frequently than pressure blade removals (Crabtree 1968: 457). Skilled individuals were able to make more blade removals than unskilled individuals thus it is likely that skilled individuals, all of whom used direct percussion, were more likely to produce step and hinge terminations due to the nature of the fracture mechanics (Cotterell and Kamminga 1987).

Hinge terminations are a likely indicator of skilled and unskilled individuals. Novices (z=-0.02) produce hinge terminations less frequently than intermediate flintknappers (z=0.03) and masters (z=0.64). Hinge terminations tend to occur when a thin flake is removed from a flat surface and are common errors in core technologies (Cotterell and Kamminga 1987: 700). Masters consistently produce thinner removals than novices and intermediate flintknappers (see metrics sections on platform thickness, medial thickness, and distal thickness below for further discussion). A high frequency of hinge terminations in combination with a wide variety of corrective techniques suggests skilled individuals while near average frequency of hinge terminations in combination with minimal corrective techniques suggests unskilled or lesser skilled individuals.

Outrepassé terminations are an unlikely indicator of skilled or unskilled individuals. Novices (z=-0.08) produce *outrepassé* terminations less frequently than intermediate flintknappers (z=0.53) and masters (z=0.66). *Outrepassé* terminations occur frequently on blade cores due to the shape necessary to remove thin blades. Blade core shape often requires a narrowly angled bottom. These sharp corners can cause plunging to occur more frequently than in biface production (Cotterell and Kamminga 1987: 701). Intermediate flintknappers and masters are most likely to produce blade cores and therefore are more likely to produce *outrepassé* terminations as the termination type is closely linked to blade core production (Cotterell and Kamminga 1987: 701). Novices are less likely to produce blade cores and most frequently produce flake cores thus reducing the chances of producing *outrepassé* terminations. Alternatively, *outrepassé* terminations can be the intended target removal of skilled individuals as they can be useful for altering the profile of a core face or even as tools. Suggesting that skilled individuals are successfully producing this removal type that is considered an "error" by some typological standards (Crabtree 1968; Cotterell and Kamminga 1987).

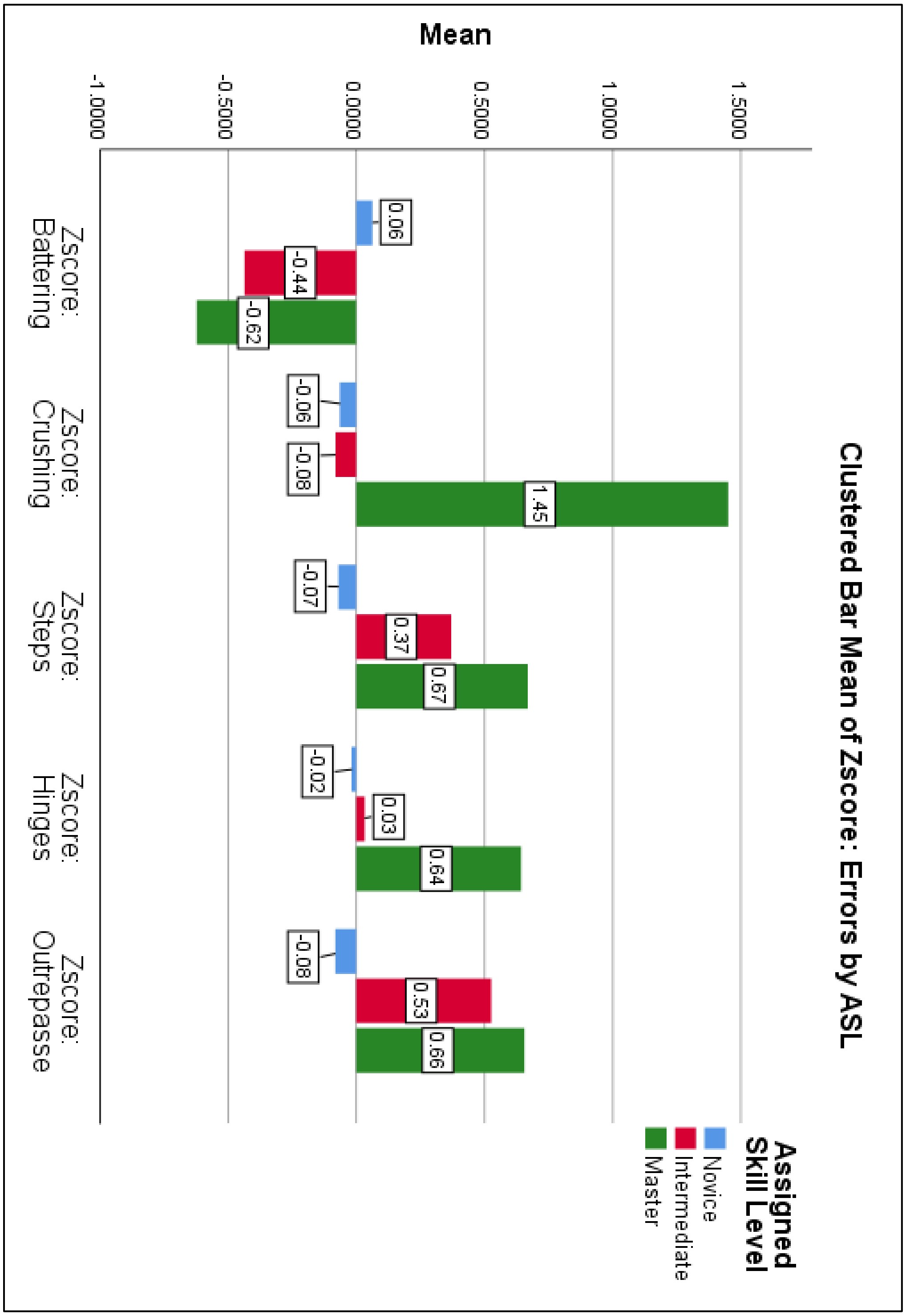


Figure 7.15: Z-scores of error types by assigned skill level.

Metrics and Quantitative Analysis

Metric analyses of lithics are a common approach to understanding the relationships within and across assemblages based on the conformity of a tool or a piece of debitage to previously established typological ranges (Andrefsky 1998). Common attributes used by lithic analysts include length, width, thickness, weight, wear, and completeness. Size and shape characteristics of debitage (e.g., length, width, thickness, and weight) are useful indicators of a flintknapper's approaches to reducing a nodule to a target tool type. Maximum length and maximum width ratios are a frequent measurement taken to explore variability vs. standardization of production and allow for identification of patterns within an assemblage (Whitaker 1994). Platform thickness and preparation are considered to be good discriminators of reduction trajectory (Odell 1989), identification of core reduction in relation to biface reduction (Andrefsky 1994), and identification of blade core reduction techniques (Quintero and Wilke 1995). Medial and distal thickness were explored here to understand the basic morphology of the flakes produced by individuals of varying skill levels. Whitaker argues that "debitage analysis should be conducted so that multiples lines of evidence are used to support various interpretations about production and reduction of objective pieces" (1994:112). For this reason, both medial and distal debitage measurements were taken.

Mass is considered one of the most reliable size characteristics for interpreting reduction stages. Heavier debitage is commonly found in earlier stages while lighter debitage is frequently found in lighter stages (Whitaker 1994). Mass was explored here in terms of consistency. For example, how consistent are the blades produced by masters compared to those of novices? Mass is a useful tool here, especially when combined with the other metrics listed above. Errors (here defined as shattering, hinging, stepping, *outrepassé*, and angle correction needed) occur when angles have not been properly assessed by the flintknapper or can be due to the internal characteristics of the raw material itself (i.e., variation in texture or inclusions). Feathered terminations require precise manual control over both the core and the percussor. Ultimately, successful reduction sequences require planned approaches including the preparation of platforms, various percussors, and multiple striking angles (Cotterell et al. 1985).

The following discussion will provide an overview of the statistical data derived from the metrics collected during analysis the experimental flintknapping work (i.e., removal maximum length, maximum width, proximal thickness, medial thickness, distal thickness, and mass). Each section will discuss significant findings based on characteristics of the following removal types: blades, profile correction blades, core face rejuvenation elements, partially ridged blades, and crested blades. Other removal types were tested, however, due to small sample sizes or their achronological position in the *chaîne opératoire* they were not included in this analysis. For all statistical outputs related to this data see Appendix I.

Removal Type Length: Width Ratio

Maximum length and maximum width measurements were used for analysis of the length: width ratio. The ratios are separated by removal type and by ASL. Ratio statistics for all removal types measured can be found in Table 7.3.

Blade removals are notably variable. Novices produce blades that are long and wide which have a Coefficient of Dispersion (COD) of .269 with 72% of the blades being within the first quartile. This is greater than the COD of both intermediate flintknappers and masters suggesting that novices produce blades that are more variable. Intermediate flintknappers produced blades with a COD of .210 with 65.9% of the blades being within the first quartile. Masters produced blades with a COD of .213 with 68.4% of the blades in the first quartile.

Maximum length:width ratios do not appear to be good standalone indicators of skill. Blades produced by novices are more variable than those produced by intermediate flintknappers and masters. In combination with other variables this characteristic is useful in distinguishing between skilled and unskilled individuals (Figure 7.16).

Ratio Statistics for Max Length (mm) / Max Width (mm)				
Assigned Skill	Group	Mean	Std. Deviation	Coefficient of Dispersion
Novice	Blade	3.244	2.518	.269
	Lateral core trimming	.742	.194	.200
	Faceted non-initial core tablet	1.990	.684	.251
	Angle correction	2.260	.981	.370
	Profile correction blade	2.882	.598	.165
	Core face rejuvenation	2.101	.492	.178
	Partial ridged blade	2.860	.941	.250
	Crested blade	3.769	4.646	.470
	Initial core tablet	1.885	.625	.269
	Non-initial core tablet	2.343	.569	.180
	Corrective non-initial core tablet	2.018	.147	.052
	Overall	2.797	2.512	.359
Intermediate	Blade	3.092	.816	.210
	Lateral core trimming	.726	.096	.083
	Faceted non-initial core tablet	2.445	.849	.276
	Angle correction	2.866	.806	.202
	Profile correction blade	2.840	.699	.190
	Core face rejuvenation	2.098	.572	.210
	Partial ridged blade	3.663	.667	.124
	Crested blade	2.972	1.088	.240
	Initial core tablet	2.486	.	.000
	Non-initial core tablet	1.839	.526	.197
	Corrective non-initial core tablet	2.351	.137	.041
	Overall	2.930	.886	.237
Master	Blade	3.490	.853	.213
	Lateral core trimming	1.109	.542	.439
	Faceted non-initial core tablet	2.448	.	.000
	Profile correction blade	3.838	.846	.172
	Core face rejuvenation	2.803	.895	.241
	Partial ridged blade	3.708	1.215	.211
	Crested blade	15.085	23.278	3.264
	Non-initial core tablet	2.532	.174	.049
	Overall	3.415	3.272	.336

Table 7.3: Length/width ratios of all removal types by Assigned Skill Level.

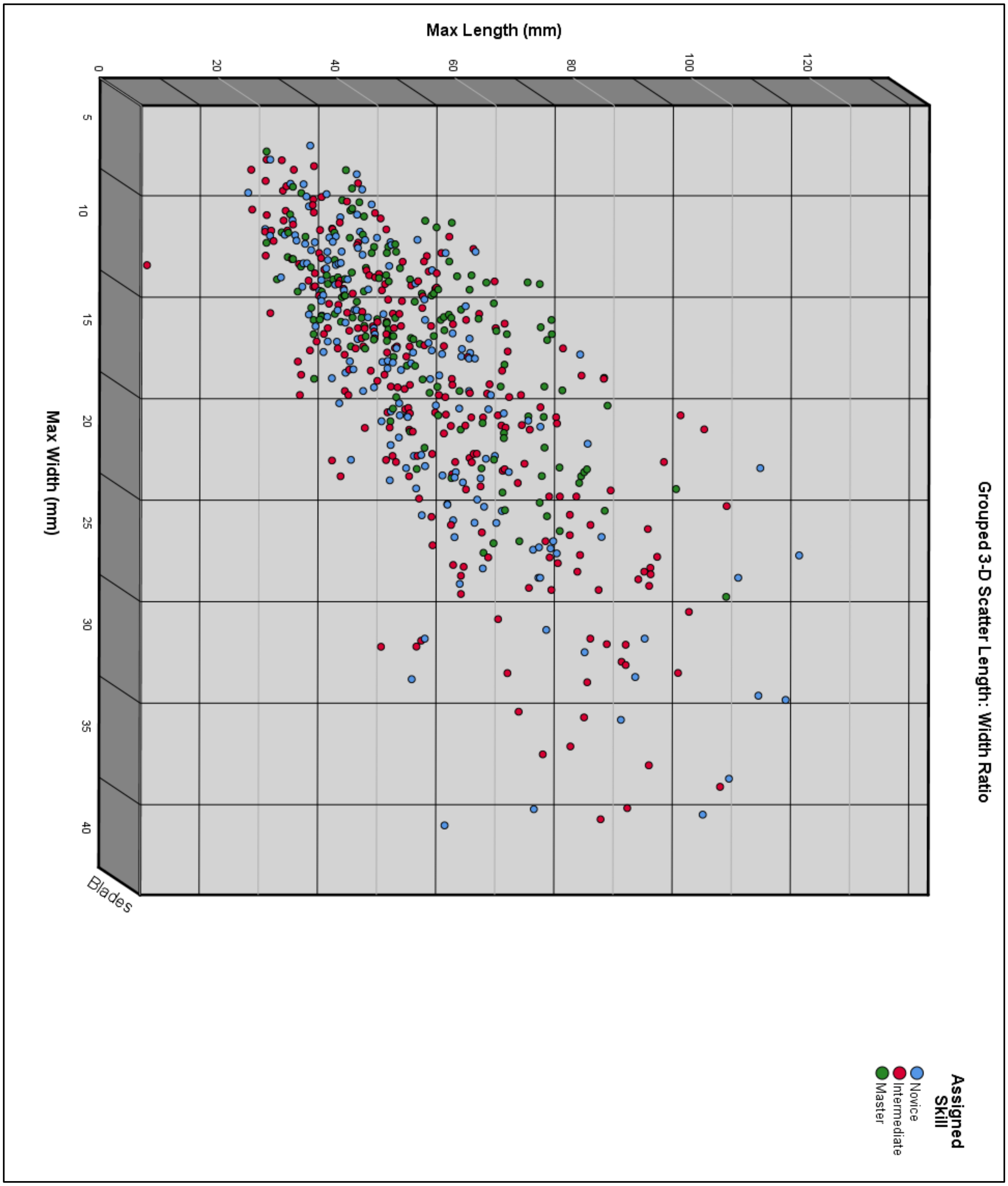


Figure 7.16: Scatter plot of blade length: width ratios. Master blades are less variable in length and width than novice blades. Blades produced by intermediate flintknappers were less variable in length and width than the master blades. This could be explained by a smaller sample size among the intermediate flintknappers but does not detract from the fact that both intermediate and master flintknappers produce more consistent blades than novices.

Maximum Length

To evaluate flintknapping patterns within each skill level, the previously identified removal types (blades, profile correction blades, core face rejuvenation elements, partially ridged blades and crested blades) were studied individually. Each removal was measured for the maximum length and z-scores were generated for each assigned skill level. The z-score value is a standardized score based on the mean of the whole sample. A z-score of 0 would equate to exactly average while a z-score of 2 is 2 standard deviations higher than the sample average. Maximum length z-scores from novice, intermediate, and master individuals are compared below to identify similarities or differences in removal lengths. The sd of the maximum lengths of each removal type are also reported in the discussion for each removal type and by assigned skill level. The sd is calculated from the raw measurements of each removal (mm). Averages for all removal types that were tested can be found in Figure 7.22.

Blades

Maximum blade length is not a useful characteristic to distinguish between novice, intermediate, and master individuals. Novices frequently produce blades below the mean sample blade length (z-score= -0.285). Intermediate flintknappers produced the longest blades in the sample with a z-score of -0.156. Masters produced shorter blades than the intermediate flintknappers (z-score = -0.259 but were more consistent in their blade lengths (Figure 7.17). z-scores closer to 0 potentially indicate skilled individuals but the correlation is not strong. Blade

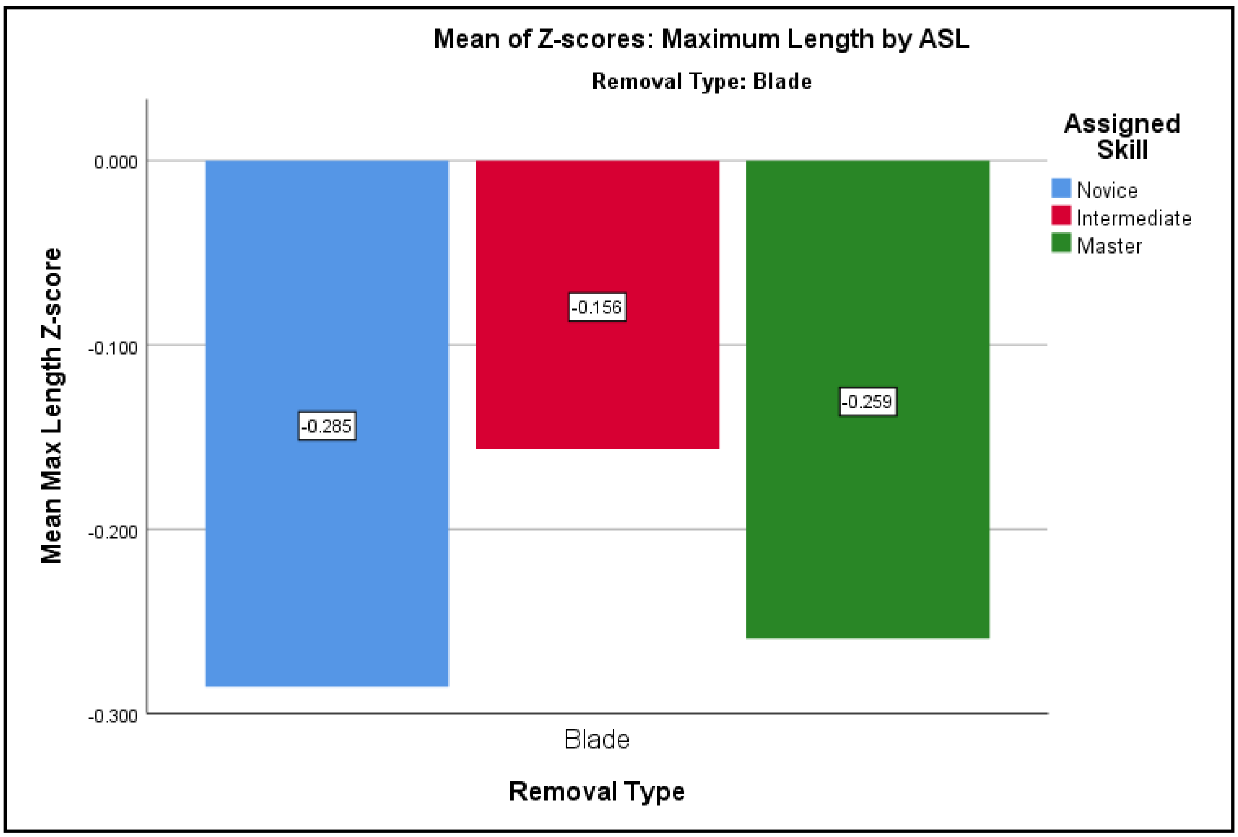


Figure 7.17: Mean of blade length z-scores by assigned skill level.

length sd among all groups was high. Novices and intermediate flintknappers had the highest sd (sd of 18.11 and 18.62, respectivley) while masters had a lower sd of 15.38 (Figure 7.22). Masters produced the most consistent blade lengths, while not significant in the determination between skill levels, this does support the notion that skilled flintknappers show consistency in their flintknapped products.

Profile Correction Blades

Maximum profile correction blade length is a useful characteristic to distinguish between skilled and unskilled individuals. Novices commonly produced shorter than average profile correction blades with a z-score of 0.298 and had the lowest standard of deviation in total length (12.09). Novices therefore most consistently produced short profile correction blades. Intermediate flintknappers produced shorter than average profile correction blades with a z-score of 0.202. There was more variation in the lengths of the profile correction blades produced by intermediate flintknappers as the sd was 17.46. Masters produced the longest profile correction blades with a z-score of 0.761 (Figure 7.18). Additionally, masters produced profile correction blades with highly variable lengths (sd = 15.55) (Figure 7.22). This suggests that masters produced profile correction blades in different phases of blade core reduction. Due to the reductive nature of flintknapping, longer profile correction blades would likely have to be removed earlier in blade core reduction while shorter profile correction blades can be removed at any point in blade production. Higher z-scores with more variability in length indicates more skilled individuals.

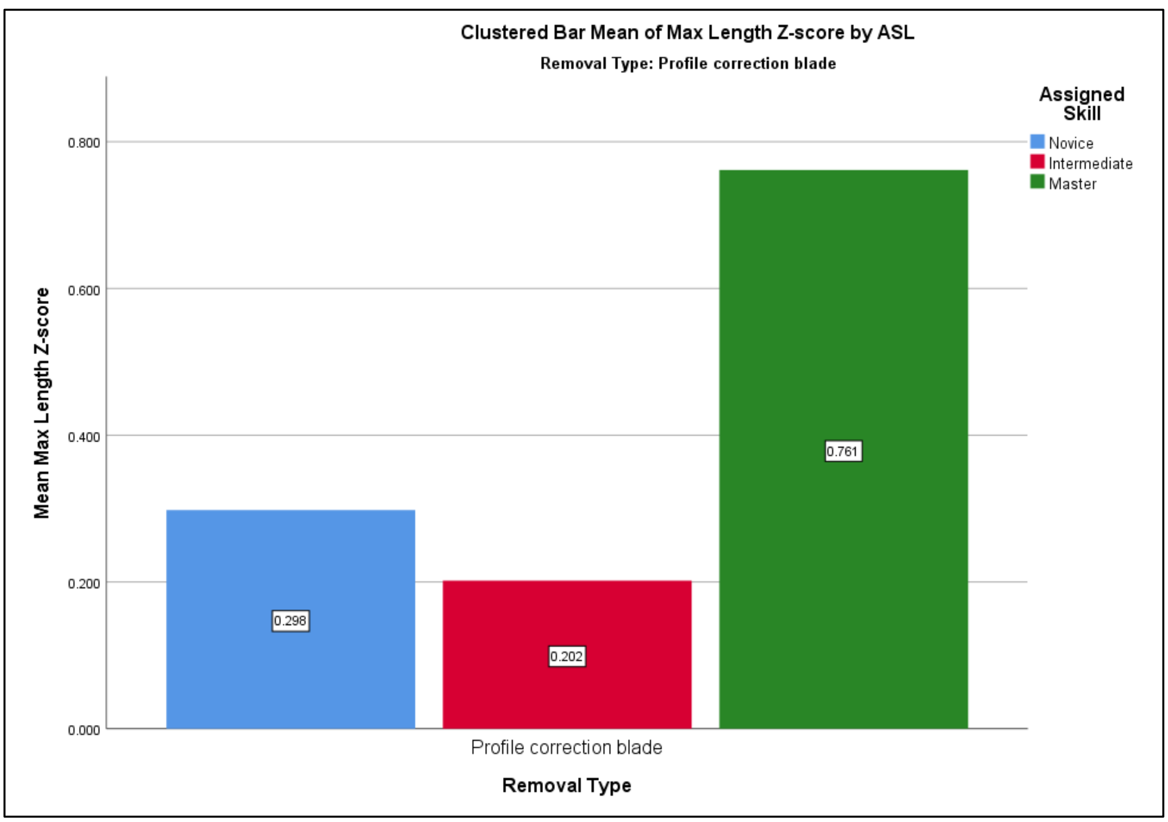


Figure 7.18: Mean of profile correction blade length z-scores by assigned skill level.

Core Face Rejuvenation Elements

Maximum core face rejuvenation element length is a useful characteristic to distinguish between skilled and unskilled individuals. Novices commonly produced longer than average core face rejuvenation elements with a z-score of 0.700 and a sd of 13.66. Intermediate flintknappers produced shorter core face rejuvenation elements with more variation in length than the novices with a z-score of 0.400 and a sd of 17.19. Masters produced the shortest core face rejuvenation elements with a z-score of 0.359 (Figure 7.19). Masters also had the most variability in the length of the core face rejuvenation elements with a sd of 19.86 (Figure 7.22). Variable core face rejuvenation length suggests that skilled individuals produced more variable pieces as a form of error correction. Higher z-scores with less variation indicate unskilled individuals.

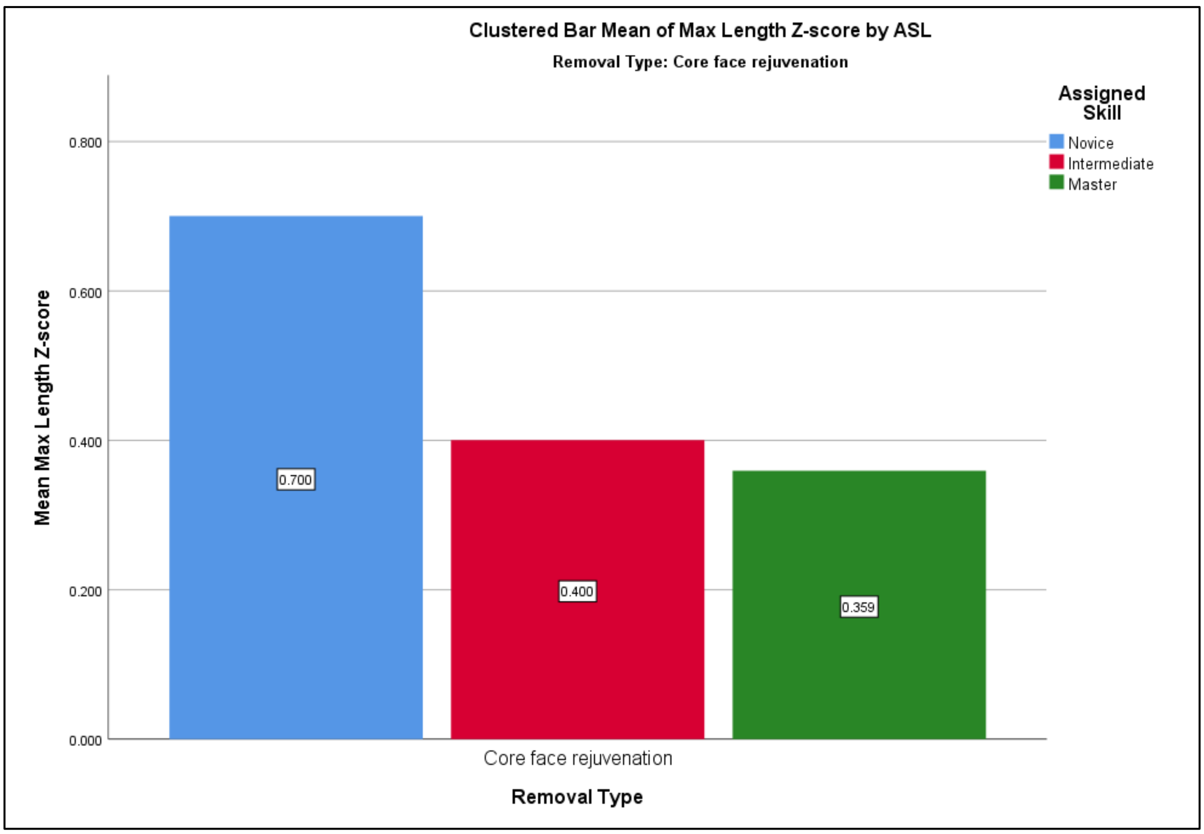


Figure 7.19: Mean of core face rejuvenation element length z-scores by assigned skill level.

Partially Ridged Blades

Maximum partially ridged blade length is a useful characteristic to distinguish between skilled and unskilled individuals. Novices produced shorter partially ridged blades with a z-score of 0.362. Intermediate flintknappers produced longer partially ridged blades with a z-score of 0.787. Masters produced the longest partially ridged blades with a z-score of 0.890 (Figure 7.20). All skill levels produced highly variable partially ridged blades (Figure 7.22). Partially ridged blades tend to occur later in the reduction sequence after a blade core has been prepared and are considered core maintenance pieces. Masters and intermediates appear to have used this maintenance technique in both early and late phases of the reduction sequence to maintain blade core shape. Novices on the other hand appear to have used the technique opportunistically (and rarely) resulting in the low sd. Lower z-scores indicate unskilled individuals and z-score higher z-scores indicate skilled individuals.

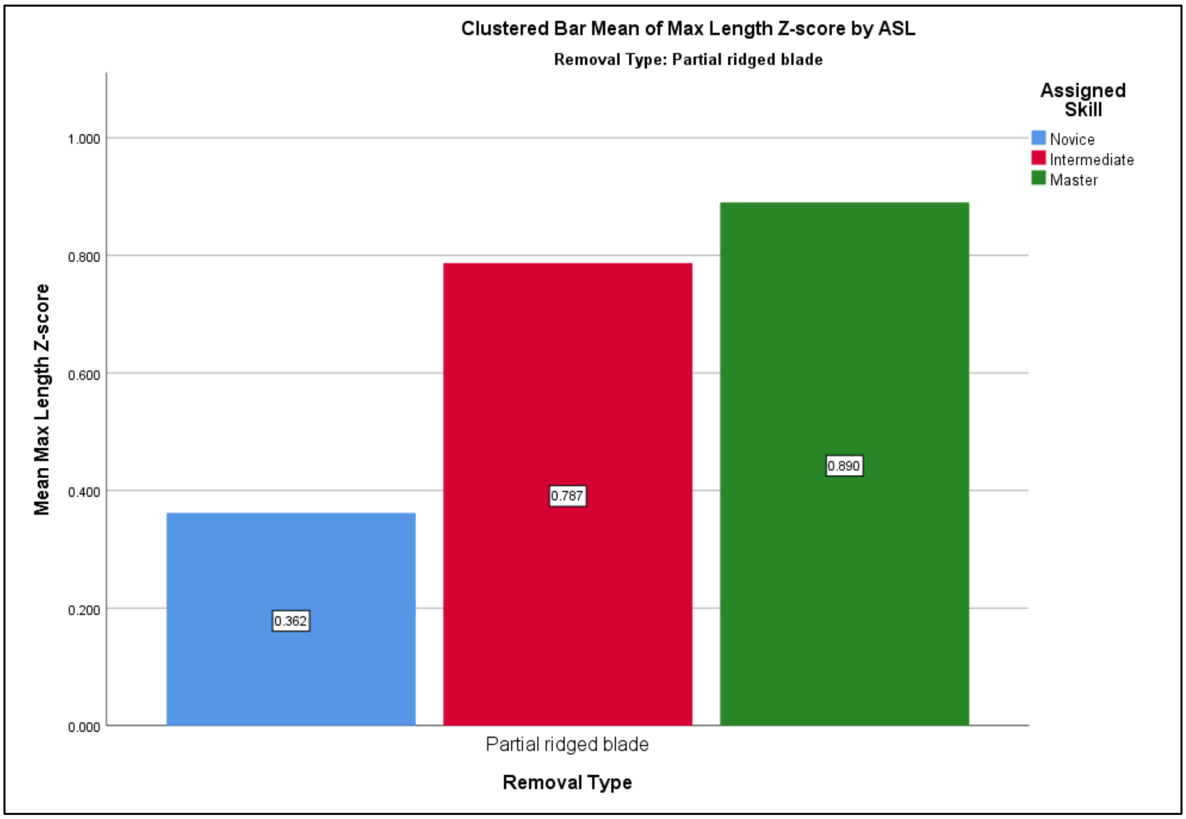


Figure 7.20: Mean of partial ridged blade length z-scores by assigned skill level.

Crested Blades

Maximum crested blade length is a useful characteristic to distinguish between novice, intermediate, and master individuals. Novices produced short-crested blades with a z-score of 0.406, these removals were also highly variable in length (sd = 22.05). Intermediate flintknappers produced longer crested blades that were also highly variable (sd = 27.22) with a z-score of 0.995. Masters consistently produced the longest crested blades with a z-score of 1.598 and a sd of 19.11 (Figure 7.21). Masters had the least variability in the length of the crested blades (Figure 7.22). Crested blades require significant preparation to remove (production of the crest, preparation of the platform, and an appropriate angle and striking force). Master and intermediate individuals commonly utilize this technique and remove long crested blades while novices appear to have difficulty in removing long crested blades. Lower z-scores indicate novice individuals, z-scores near 1 indicate intermediate individuals, and z-scores above 1 indicate master individuals.

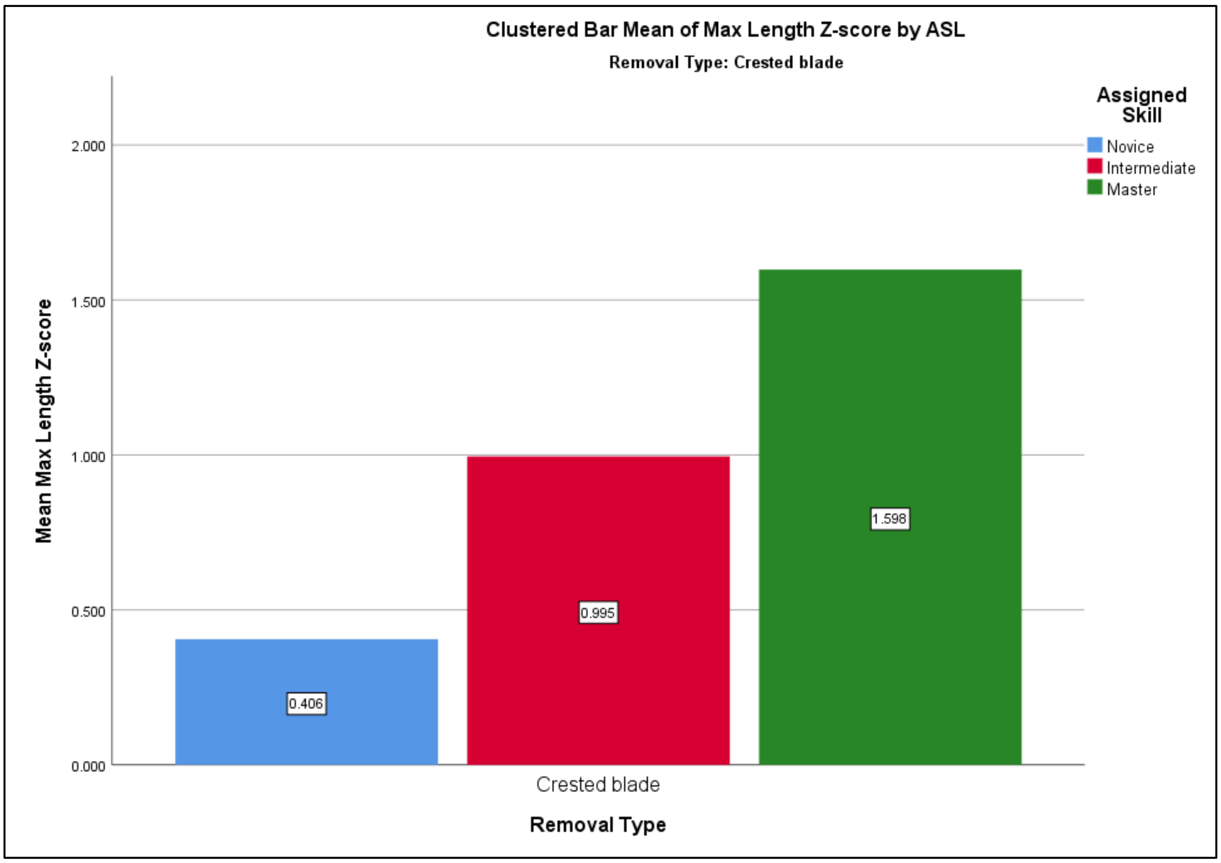


Figure 7.21: Mean of crested blade length z-scores by assigned skill level.

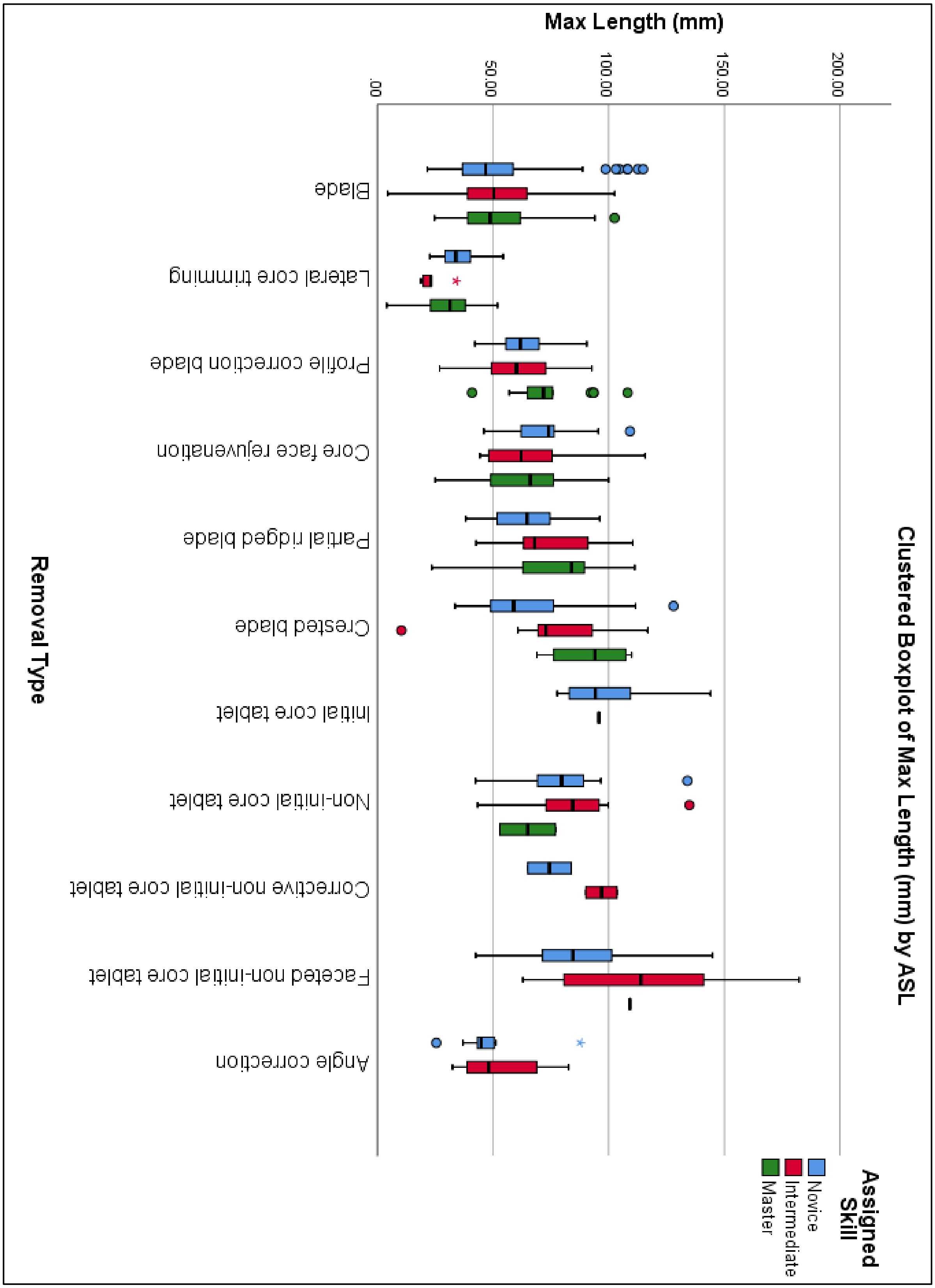


Figure 7.22: Clustered boxplot of maximum length by assigned skill level.

Maximum Width

To evaluate flintknapping patterns within each skill level, the previously identified removal types (blades, profile correction blades, core face rejuvenation elements, partially ridged blades and crested blades) were studied individually. Each removal was measured for the maximum width and z-scores were generated for each assigned skill level. The z-score value is a standardized score based on the mean of the whole sample. A z-score of 0 would equate to exactly average while a z-score of 2 is 2 standard deviations higher than the sample average. Maximum width z-scores from novice, intermediate, and master individuals are compared below to identify similarities or differences in removal widths. The sd of the maximum widths of each removal type are also reported in the discussion for each removal type and by assigned skill level. The sd is calculated from the raw measurements of each removal (mm). Averages for all removal types that were tested can be found in Figure 7.28.

Blades

Maximum blade width is a useful characteristic to distinguish between skilled and unskilled individuals when combined with other skill identifiers. Novices commonly produced wide blades with a z-score of -0.408. Intermediate flintknappers also produced wide blades with a z-score of -0.340. Both novices and intermediate flintknappers produced blades with more variable widths (sd = 7.03 and 7.26 respectively). Masters produced the narrowest blades with a z-score of -0.584 (Figure 7.23). Additionally, masters also produced narrow blades more consistently than the other two groups (sd = 4.47). Negative z-scores in combination with a low

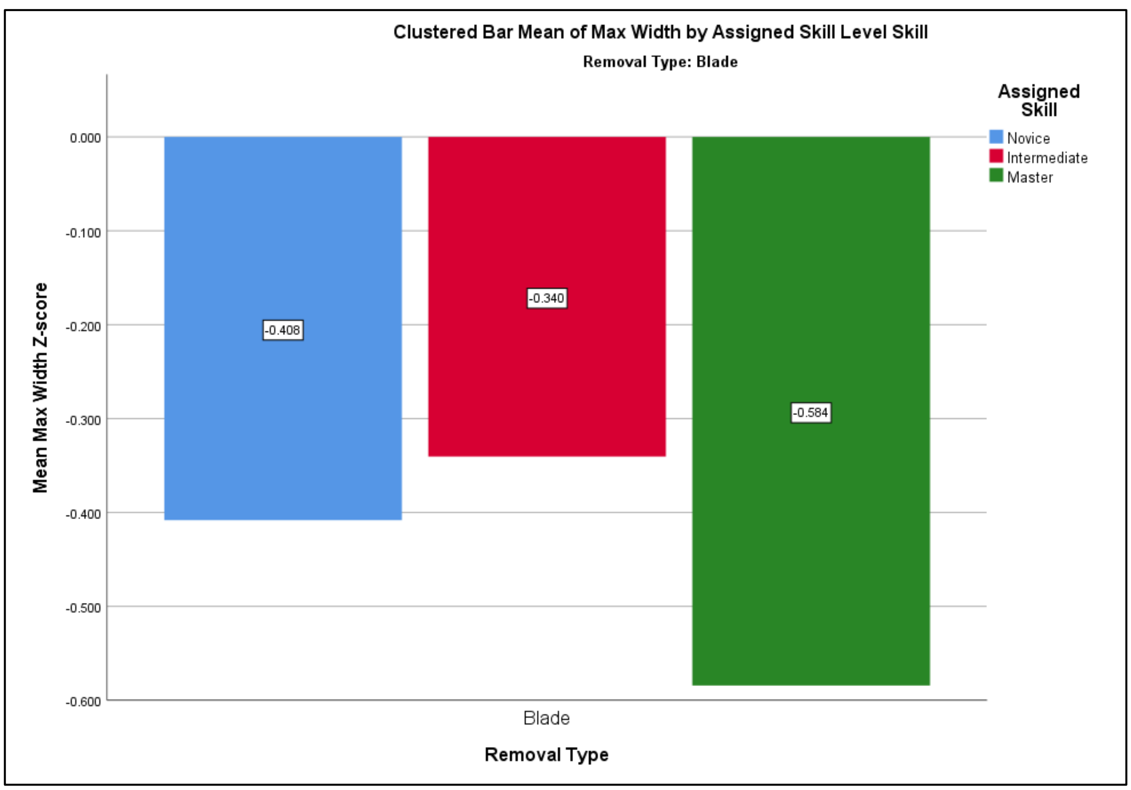


Figure 7.23: Mean of maximum blade width z-scores by assigned skill level.

sd of blade width indicates highly skilled individuals. Novice and intermediate flintknappers both show significant variability in blade width z-score and produce wider blades than masters (Figure 7.28).

Profile Correction Blades

Maximum profile correction blade width is a useful characteristic to distinguish between novice, intermediate, and master individuals as masters are consistently able to produce narrow profile correction blades. Novices produced wide profile correction blades just above the profile correction blade width average with a z-score of 0.015. Intermediate flintknappers produced average width profile correction blades with a z-score of 0.000. Masters produced the narrowest profile correction blades with a z-score of -0.199 (Figure 7.24). Additionally, masters also produced narrow profile correction blades consistently. This is likely the result of masters creating and maintaining narrow faced blade cores where narrow blades were consistently removed, leaving behind blade scars and ridges to more easily remove profile correction blades when necessary. Additionally, masters utilize this maintenance technique frequently, it is possible that they fix the core face profile before it becomes unworkable, a technique that novice flintknappers still lack. Negative z-scores in combination with a low sd of profile correction blade width indicates master individuals. Near average z-scores and high sd suggest intermediate skill levels. Above average z-scores and lower sd suggest novice individuals (Figure 7.28).

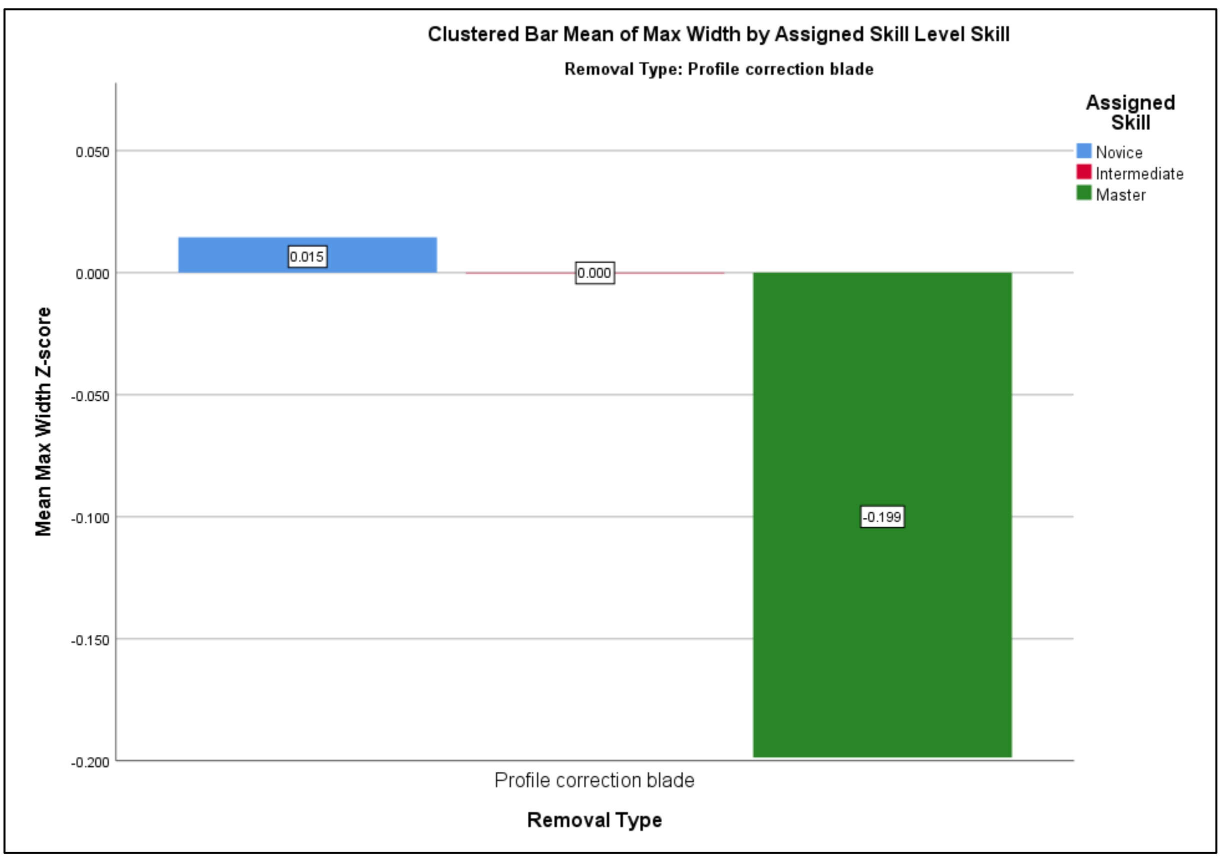


Figure 7.24: Mean of profile correction blade width z-scores by assigned skill level.

Core Face Rejuvenation Elements

Maximum core face rejuvenation element width is a useful characteristic to distinguish between novice, intermediate, and master individuals. Novices produced core face rejuvenation elements with above average widths and had a z-score of 1.111. Intermediate flintknappers produced widths above average for the core face rejuvenation elements with a z-score of 0.829. Masters produced the narrowest core face rejuvenation elements with a z-score of 0.125 (Figure 7.25). Masters produced narrow core face rejuvenation elements consistently with a sd of 6.19 while novices had significant variation in their removal widths (13.52). Intermediate flintknappers also had more variation than masters with a sd of 10.85 (Figure 7.28). Novices produce core face rejuvenation elements less frequently, both because they produce cores less frequently and they do not regularly perform core maintenance. This likely results in wide and inconsistent removals. Intermediate individuals are more capable of creating and maintaining core faces, which is likely a produce of improved core maintenance. This may explain the more narrow and consistent core face rejuvenation elements among intermediates. While masters frequently produce core face rejuvenation elements in order to maintain a workable core face. This likely results in the consistently narrow core face rejuvenation elements. Low z-scores in combination with a low sd of core face rejuvenation elements width indicates master individuals (Figure 7.28).

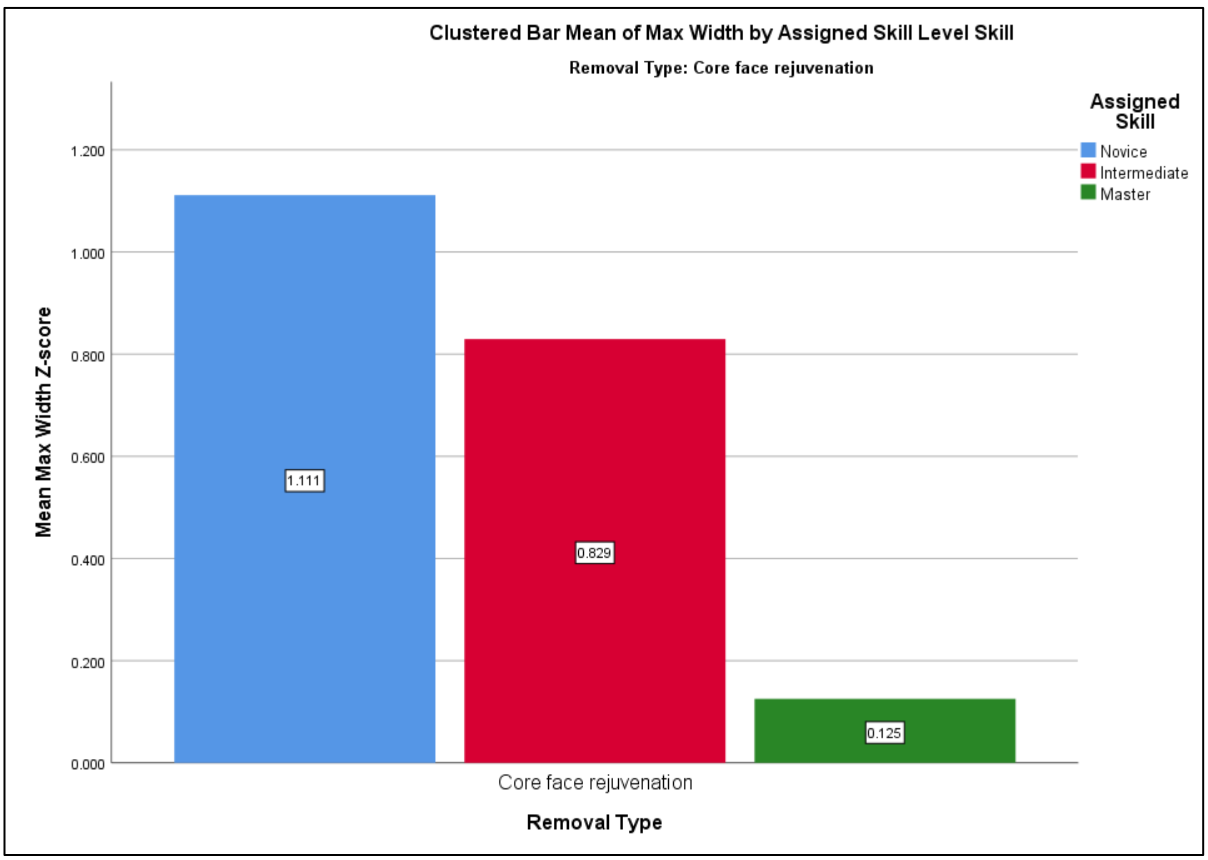


Figure 7.25: Mean of core face rejuvenation element width z-scores by assigned skill level.

Partially Ridged Blades

Maximum partially ridged blade width may be a useful characteristic to distinguish between skilled and unskilled individuals. Notably, the sample size for novices is low (N=7) while intermediate and master sample sizes are larger (N=9 and N= 17, respectively). Novices produced wide partially ridged blades and had a z-score of 0.110. Intermediate flintknappers produced narrower partially ridged blades with a z-score of -0.129. Masters produced the widest partially ridged blades with a z-score of 0.275 (See Figure 7.26). Masters also had significant variation in the removal widths with a sd of 20.24. While intermediate flintknappers (sd= 7.47) and novices (sd=8.31) had less variation in their removal widths (Figure 7.28). Here there is an opposite pattern to what was observed in the blades, profile correction elements, and core face rejuvenation elements; masters produced wider removals and less consistently. It is likely that partially ridged blades were produced by masters as a corrective or maintenance technique thus resulting in less consistent removals. While novices and intermediate individuals used the technique opportunistically while removing blades thus removing narrow partially ridged blades as blades as opposed to using them to maintain the core. Lower z-scores in combination with a lower sd of partially ridged blade width indicates lesser skilled individuals (Figure 7.28).

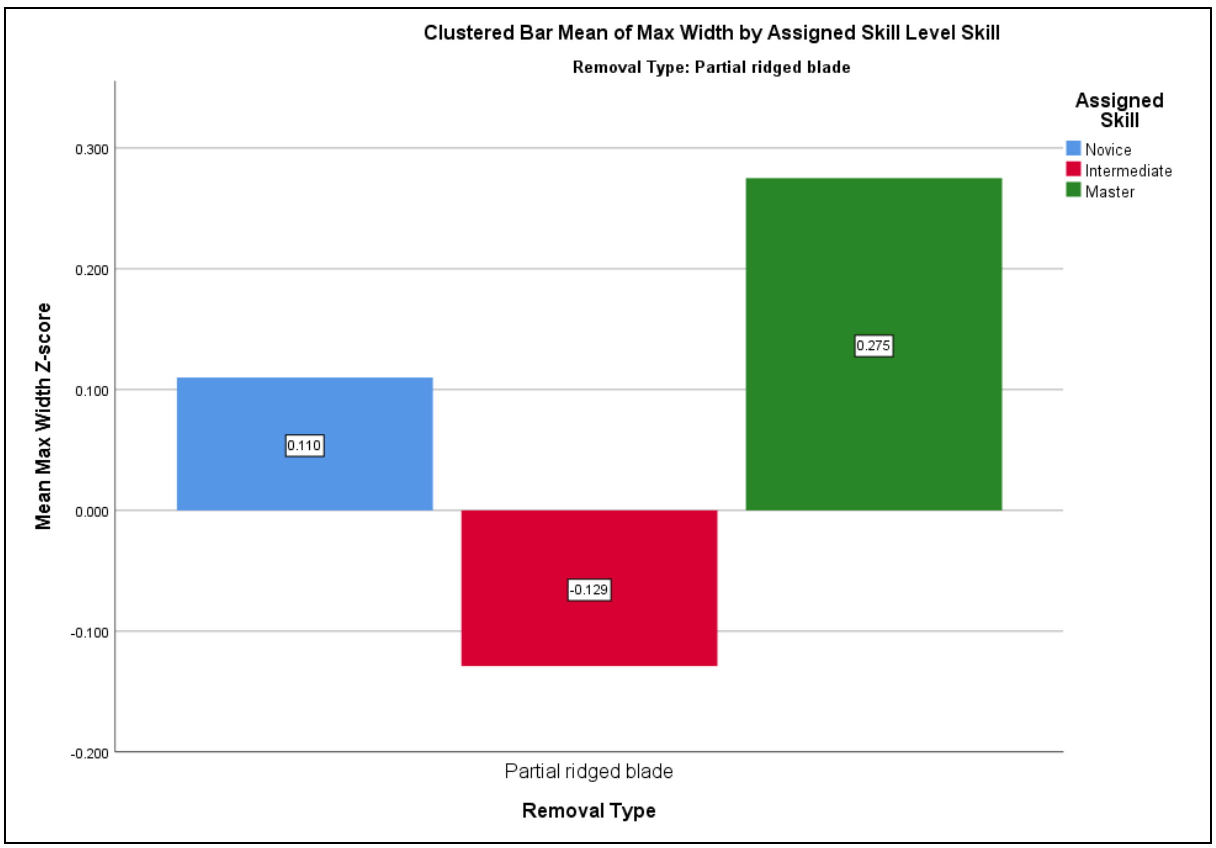


Figure 7.26: Mean of partial ridged blade width z-scores by assigned skill level.

Crested Blades

Maximum crested blade width is not a useful characteristic to distinguish between novice, intermediate, and master individuals. Notably the sample size for masters is low (N=4) while the sample sizes for intermediate flintknappers (N=14), and novices (N=39) is much larger. Novices produced crested blades with near average widths with a z-score of 0.002 and sd of 8.79. Intermediate flintknappers produced the broadest crested blades with widths with a z-score of 0.395 and a sd of 5.61. Masters produced the narrowest crested blades with a z-score of -0.224 and had the highest sd of 12.33 (Figure 7.27). Crested blades are often removed in early phases of blade core reduction to prepare a core face for further removals. With master's propensity for platform preparation and their consistent production of narrow faced cores, it is likely that masters are able to produce narrow crested blades while novices produce about average width crested blades. Intermediate individuals produced the widest crested blades, this is likely due to the core shape that the intermediate individuals were producing, many of whom produced broad faced cores, possibly resulting in wider crested blades. Relatively narrow crested blades appear to indicate high skill level. With the collected data, the sd of the crested blade widths does not appear to be a reliable metric to distinguish skill level (Figure 7.28).

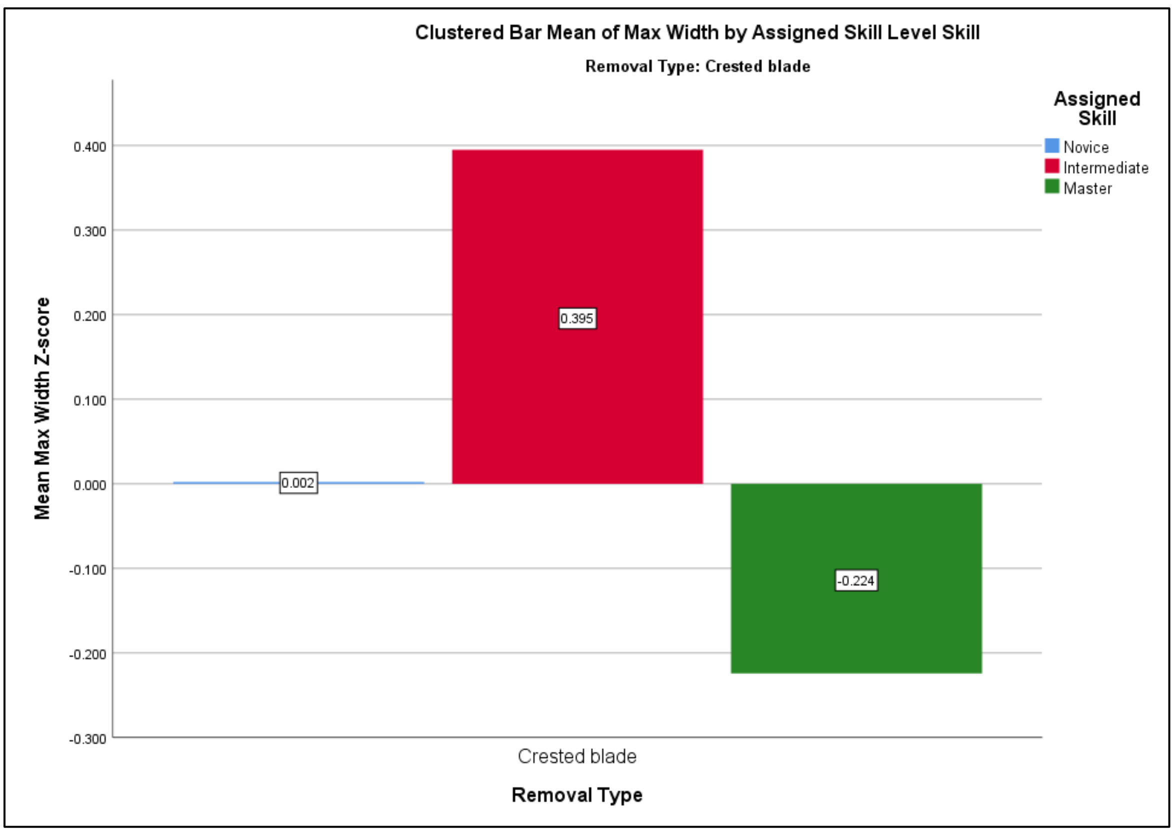


Figure 7.27: Mean of crested blade width z-scores by assigned skill level.

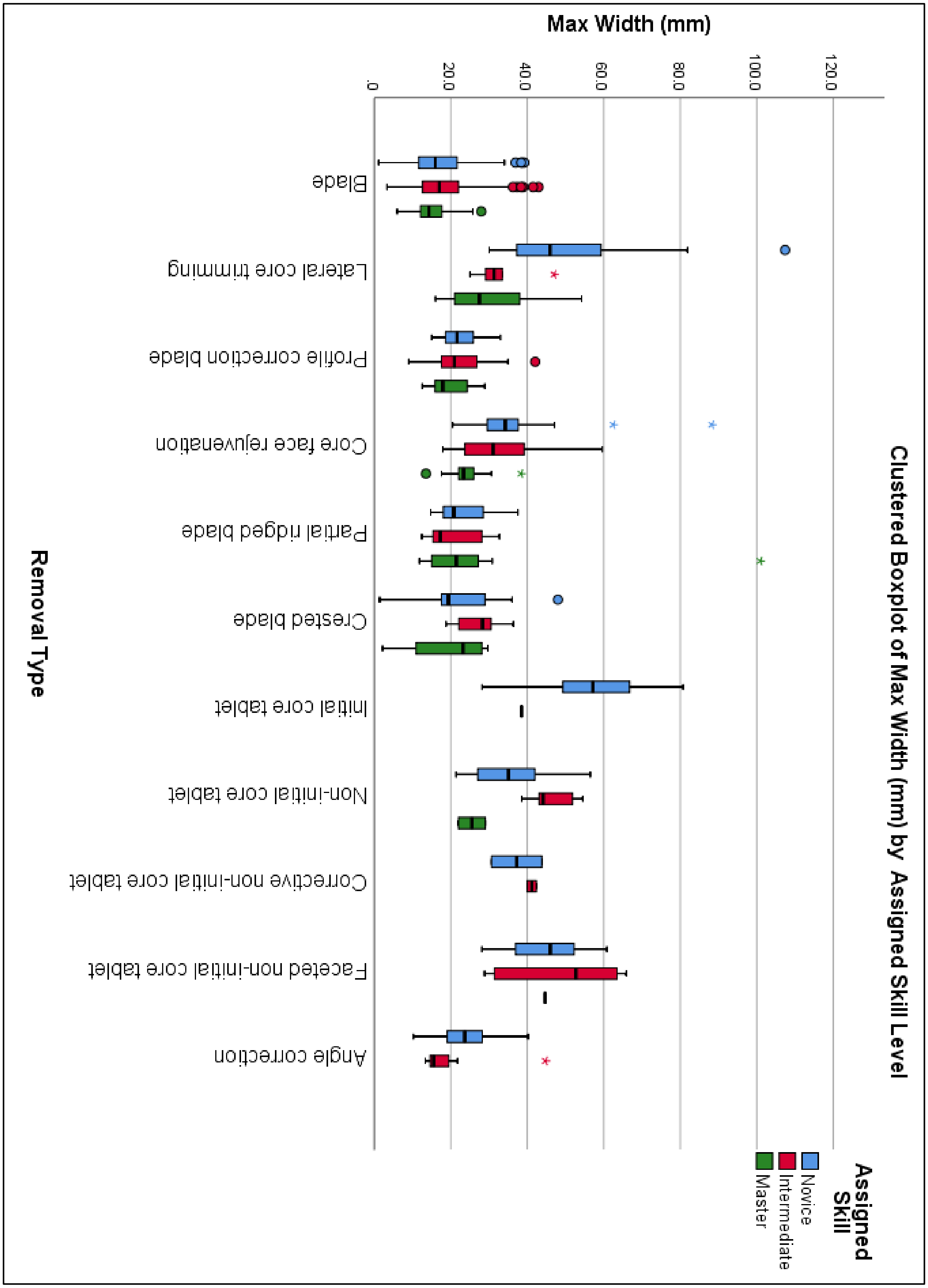


Figure 7.28: Clustered boxplot of maximum width by assigned skill level.

Proximal Thickness

To evaluate the consistency of proximal thicknesses produced within each skill level, the previously identified removal types (blades, profile correction blades, core face rejuvenation elements, partially ridged blades and crested blades) were studied individually. Each removal was measured for the proximal thickness and z-scores were generated for each assigned skill level. The z-score value is a standardized score based on the mean of the whole sample. A z-score of 0 would equate to exactly average while a z-score of 2 is 2 standard deviations higher than the sample average. Z-scores based on the proximal thicknesses produced by novice, intermediate, and master individuals are compared below to identify similarities or differences in removals. The sd of the proximal thicknesses of each removal type are also reported in the discussion for each removal type and by assigned skill level. The sd is calculated from the raw measurements of each removal (mm). Averages for all removal types that were tested can be found in Figure 7.34.

Blades

The proximal thickness of blades is a useful characteristic to distinguish between novice, intermediate, and master individuals. Novices produced the thickest platforms with a z-score of -0.192. Intermediate flintknappers produced thinner platforms with a z-score of -0.292. Masters produced the thinnest platforms with a z-score of -0.547 (Figure 7.29). Masters had the least amount of variation in platform thickness with a sd of 0.67. While intermediate flintknappers (sd= 1.69) and novices (sd=2.34) had more variation in their platform thicknesses (Figure 7.34).

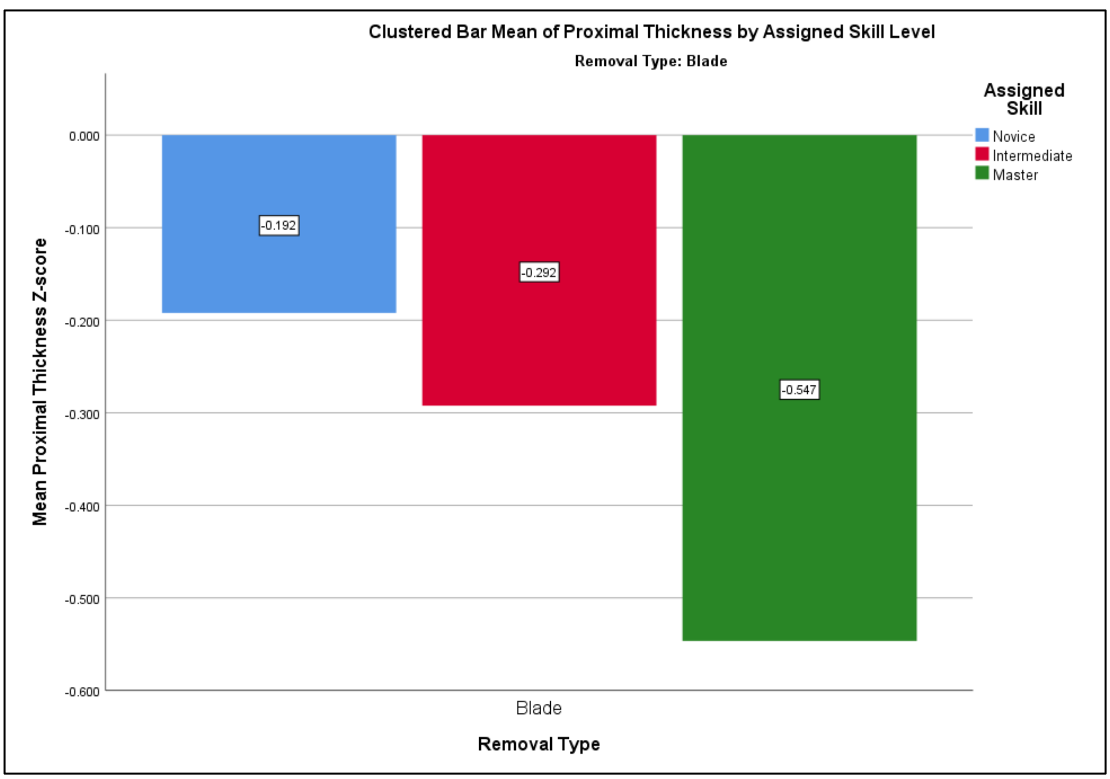


Figure 7.29: Mean of proximal thicknesses on blades (z-scores) by assigned skill level.

Low z-scores in combination with a low sd of blade platform thickness indicates master individuals while high z-scores and significant variation in platform thickness indicates novice individuals. Intermediate individuals frequently produce blades with thinner platforms than novices and thicker than masters (Figure 7.34). This pattern generally fits the expressed skill pattern seen thus far. Masters invest significant time into platform preparation and remove thin platforms and consistent blades while intermediate individuals do not invest in platform preparation as extensively (Figure 7.6) resulting in less consistent platform thickness. Novices are considerably less likely than either skilled group to prepare platforms and therefore they produce thick and irregular platforms.

Profile Correction Blades

Proximal thickness of profile correction blades is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce the thickest platforms with a z-score of 0.834. Intermediate flintknappers produce thinner platforms than novices with a z-score of -0.007. Masters produce the thinnest platforms with a z-score of -0.461 (Figure 7.30) and most consistently produce the thin platforms with a sd of 0.56. This sd is significantly lower than the sd of novices (sd = 4.35) and intermediate flintknappers (sd = 2.66) (Figure 7.34). Thin platforms (proximal thickness) in combination with a low sd indicates master level individuals. Platforms with a thickness near the sample mean and a higher sd suggest intermediate individuals. Thick platforms and high sd suggest novice individuals. This pattern is

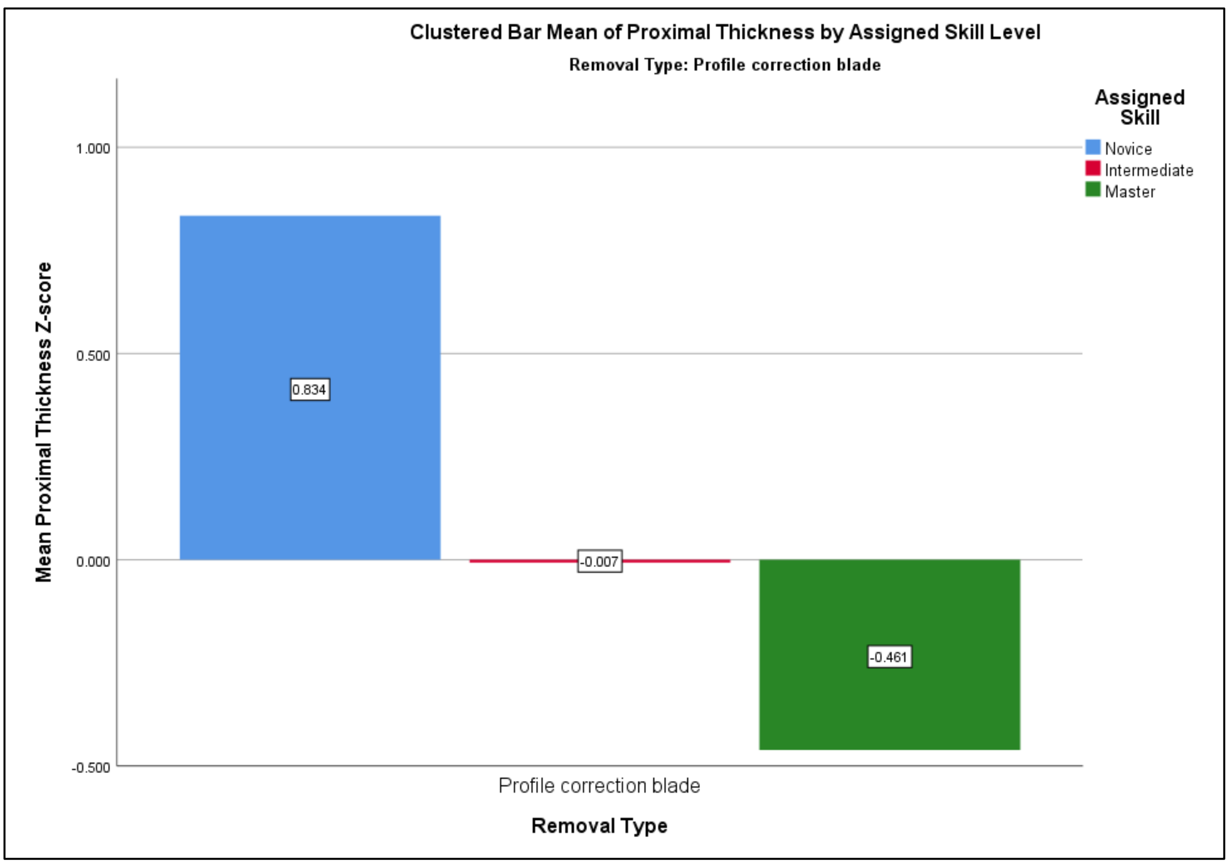


Figure 7.30: Mean of proximal thicknesses on profile correction blades (z-scores) by assigned skill level.

a reflection of the investment masters, intermediates, and novices put into platform preparation (Figure 7.6) where masters invest heavily in platform preparation, intermediate individuals invest less time and effort into platform preparation, and novices do not commonly prepare platforms.

Core Face Rejuvenation Elements

Proximal thickness of core face rejuvenation elements is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce the thickest platforms with a z-score of 1.256. Intermediate flintknappers produce thinner platforms than novices with a z-score of 0.458. Masters produce the thinnest platforms with a z-score of -0.332 (Figure 7.31) and most consistently produce the thin platforms with a sd of 1.17. This sd is significantly lower than the sd of novices (sd = 5.75) and intermediate flintknappers (sd = 3.75) (Figure 7.34). Thin platforms (proximal thickness) in combination with a low sd indicates master level individuals. Platforms with a thickness near the sample mean and a higher sd suggest intermediate individuals. Thick platforms and high sd suggest novice individuals. This pattern reflects the investment masters, intermediates, and novices put into platform preparation (Figure 7.6) where masters invest heavily in platform preparation, intermediate individuals invest less time and effort into platform preparation, and novices do not commonly prepare platforms.

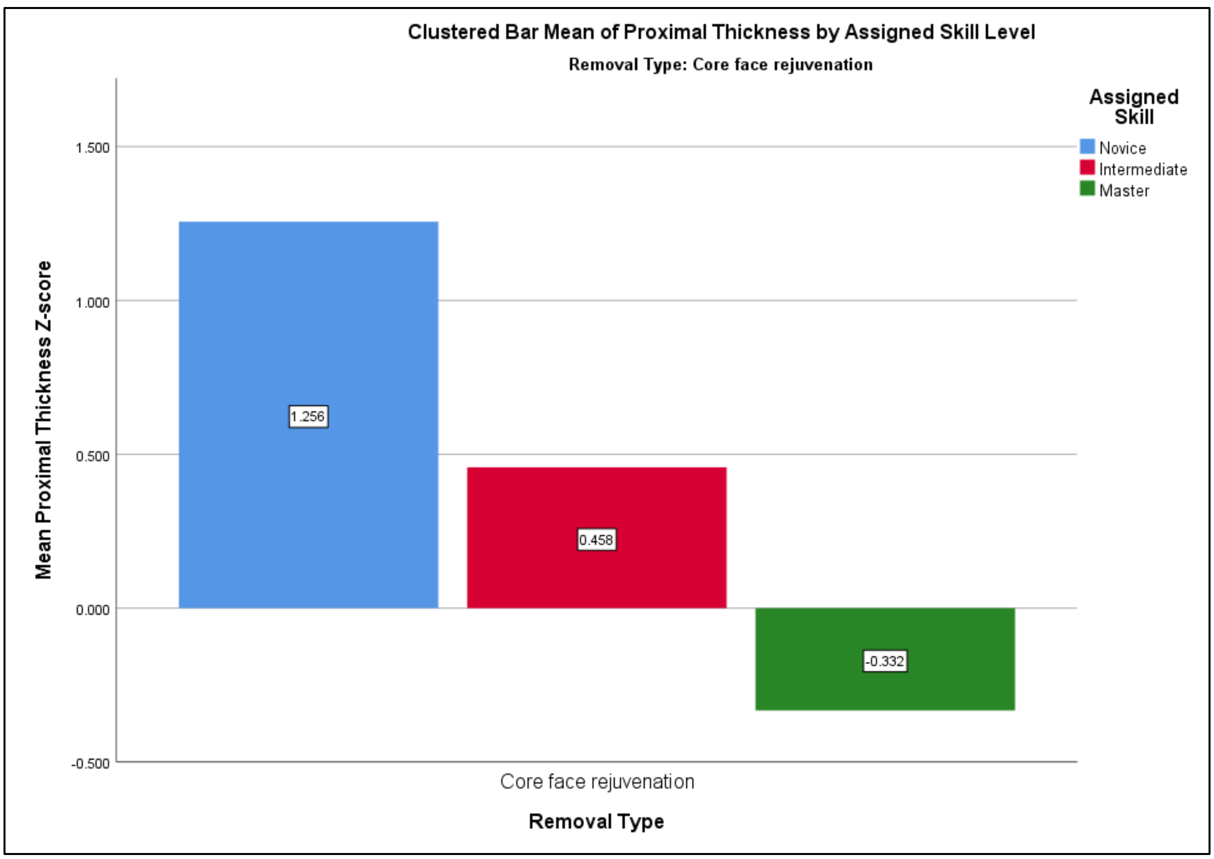


Figure 7.31: Mean of proximal thicknesses on core face rejuventation elements (z-scores) by assigned skill level.

Partially Ridged Blades

Proximal thickness of partially ridged blades is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce the thickest platforms with a z-score of 0.328. Intermediate flintknappers produce thinner platforms than novices with a z-score of -0.081. Masters produce the thinnest platforms with a z-score of -0.421 (Figure 7.32) and most consistently produce the thin platforms with a sd of 0.89. This sd is significantly lower than the sd of novices (sd = 1.76) and intermediate flintknappers (sd = 1.89) (Figure 7.34). Thin platforms (proximal thickness) in combination with a low sd indicates master level individuals. Platforms with a thickness near the sample mean and a higher sd suggest intermediate individuals. Thick platforms and high sd suggest novice individuals. This pattern reflective of the investment masters, intermediates, and novices put into platform preparation (Figure 7.6) where masters invest heavily in platform preparation, intermediate individuals invest less time and effort into platform preparation, and novices do not commonly prepare platforms.

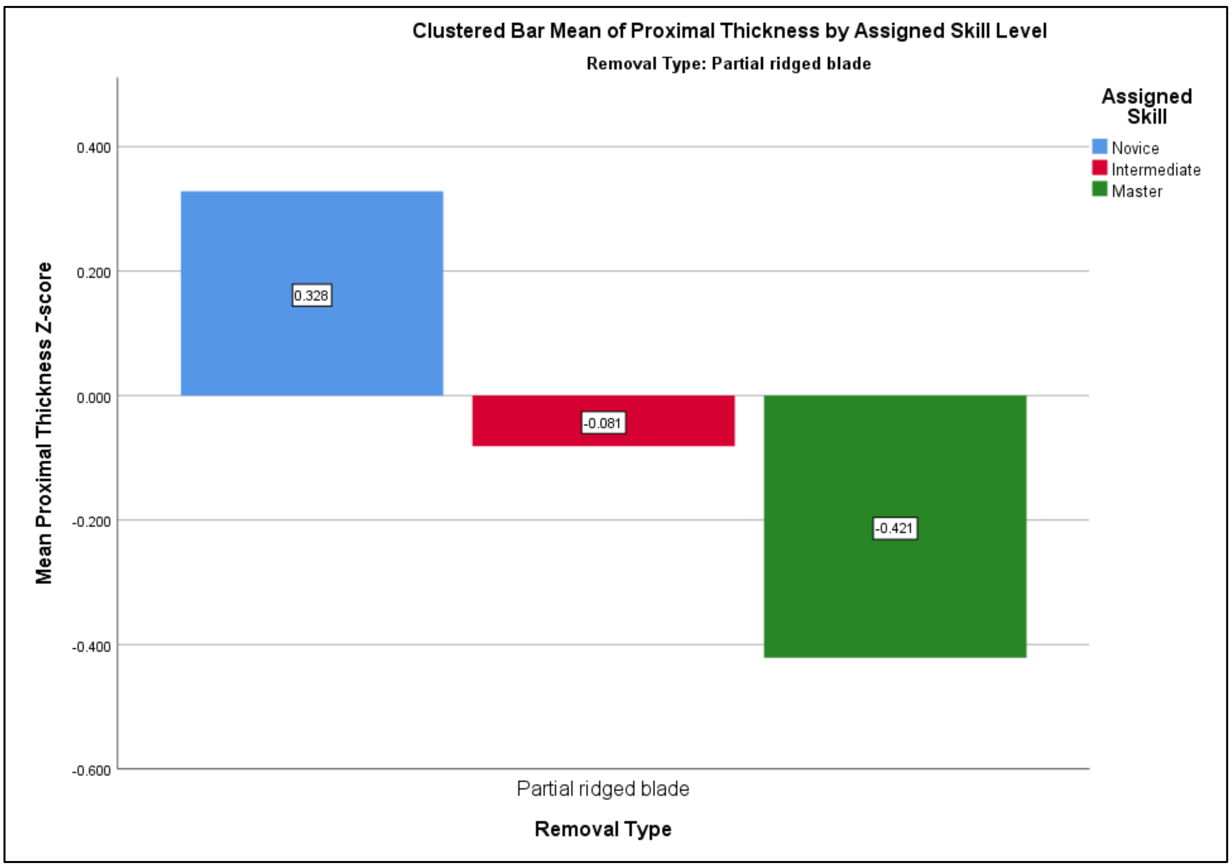


Figure 7.32: Mean of proximal thicknesses on partial ridged blades (z-scores) by assigned skill level

Crested Blades

Proximal thickness of partially ridged blades is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Notably the sample size for masters is low (N=4) while the sample sizes for intermediate flintknappers (N=14) and novices (N=42) is much larger. Novices produce the thickest platforms with a z-score of 0.501. Intermediate flintknappers produce thinner platforms than novices with a z-score of 0.339. Masters produce the thinnest platforms with a z-score of 0.114 (Figure 7.33). There is variation among all three groups as novices have an sd of 3.40, intermediate flintknappers have an sd of 2.32, and masters have a sd of 3.07 (Figure 7.34). Thin platforms indicate master level individuals. Platforms with a thickness near the sample mean suggest intermediate individuals. Thick platforms suggest novice individuals. This pattern aligns with the previous assessments of platform thickness. Masters, intermediates, and novices invest differently in platform preparation (Figure 7.6) where masters invest heavily in platform preparation, intermediate individuals invest less time and effort into platform preparation, and novices do not commonly prepare platforms.

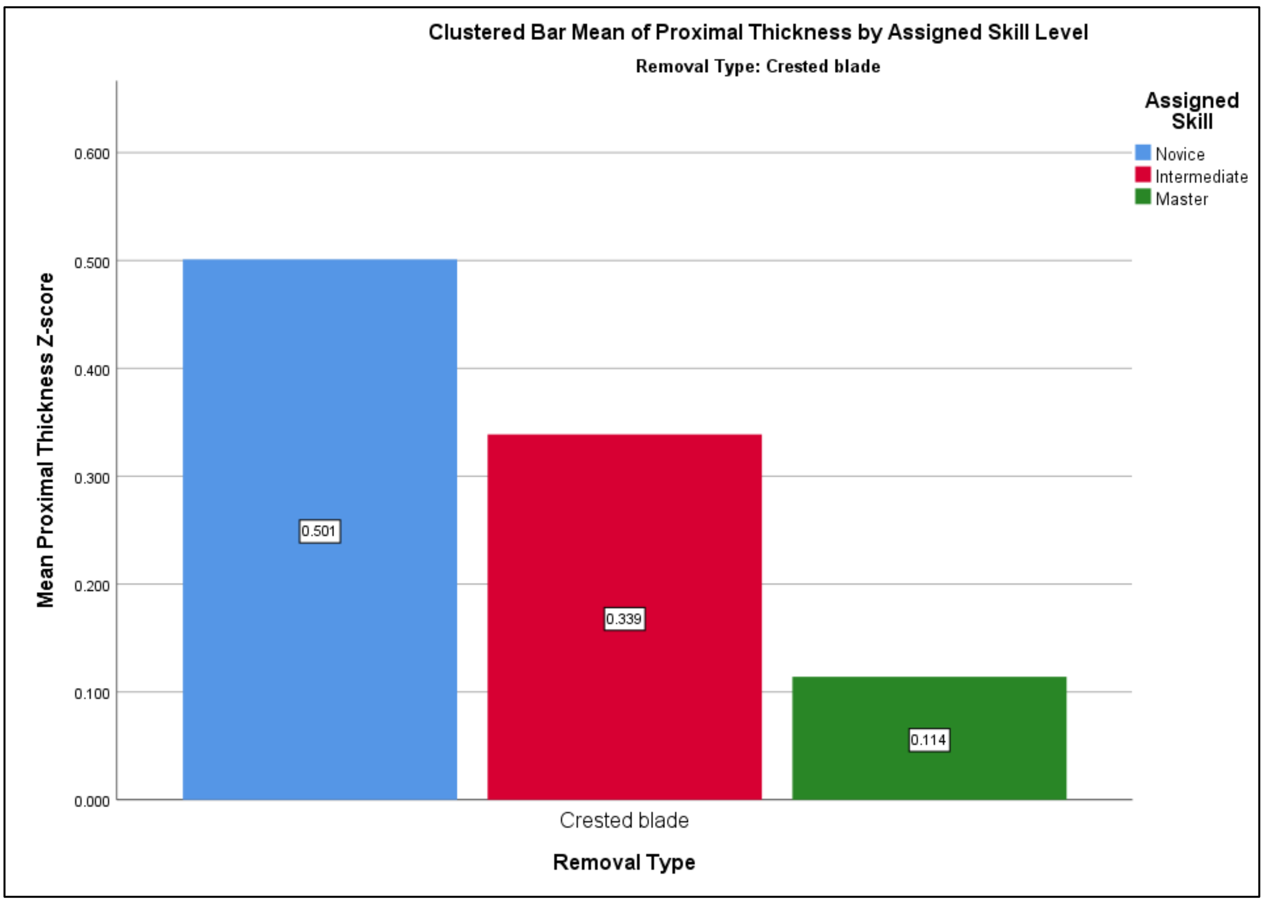


Figure 7.33: Mean of proximal thicknesses on crested blades (z-scores) by assigned skill level

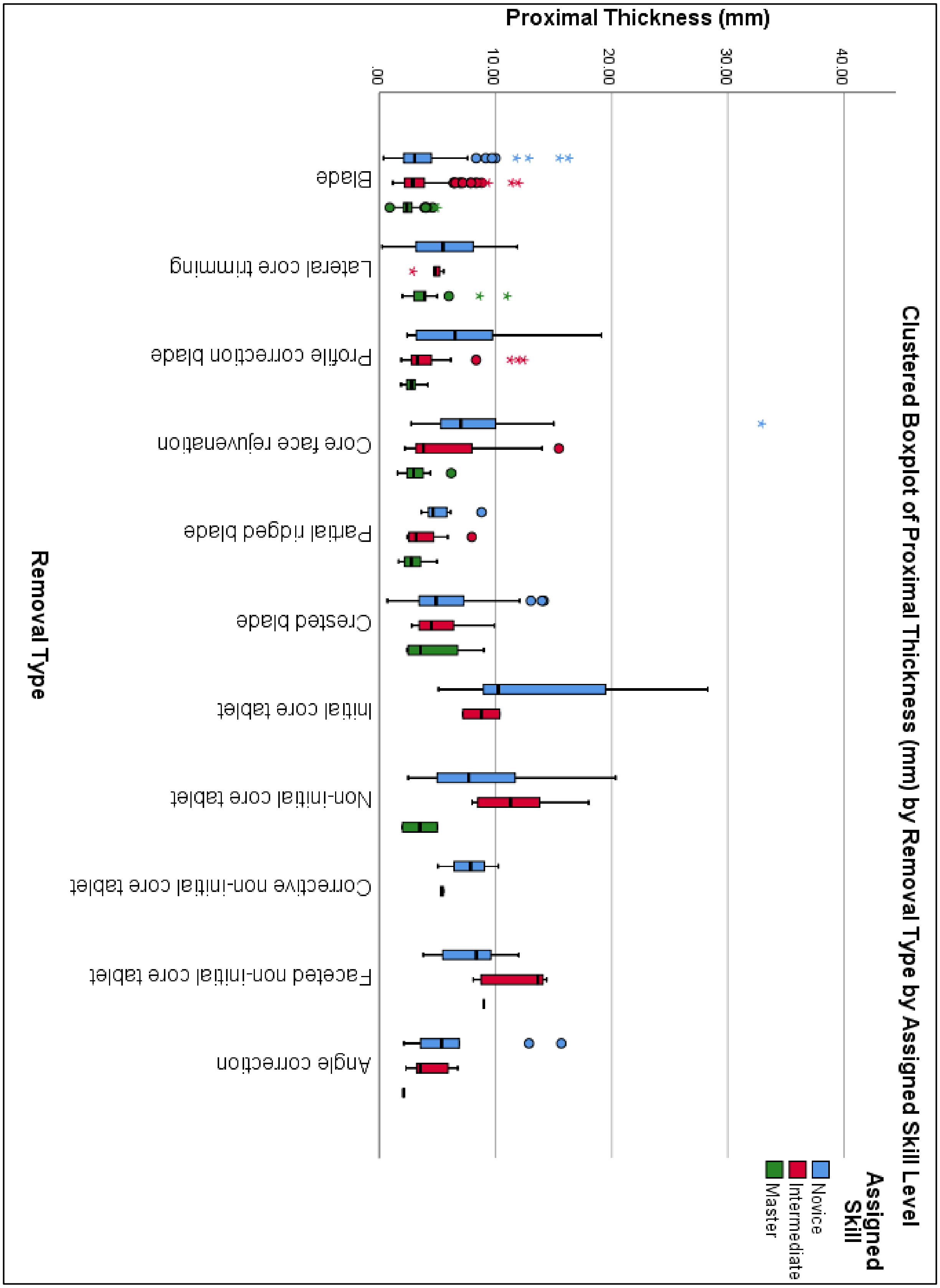


Figure 7.34: Clustered boxplot of proximal thickness by assigned skill level

Medial Thickness

To evaluate flintknapping patterns within each skill level, the previously identified removal types (blades, profile correction blades, core face rejuvenation elements, partially ridged blades, and crested blades) were studied individually. Each removal was measured for medial thickness and z-scores were generated for the removals. The z-score value is a standardized score based on the mean of the whole sample. A z-score of 0 would equate to exactly average while a z-score of 2 is 2 standard deviations higher than the sample average. Z-scores from the averages of novices, intermediate flintknappers, and masters are compared below to identify similarities or differences in medial thicknesses. The sd of the medial thicknesses for each removal type are also reported in the discussion based on removal type and by assigned skill level. The sd is calculated from the raw measurements of each removal (mm). Averages for all removal types that were tested can be found in Figure 7.40.

Blades

The medial thickness of blades is a useful characteristic to distinguish between skilled and unskilled individuals. Novices produced slightly thicker blades with a z-score of -0.363. Intermediate flintknappers produced thinner blades with a z-score of -0.398. Masters produced the thinnest blades with a z-score of -0.491 (Figure 7.35). Masters had the least amount of variation in medial thickness with a sd of 1.40. While intermediate flintknappers (sd= 1.95) and

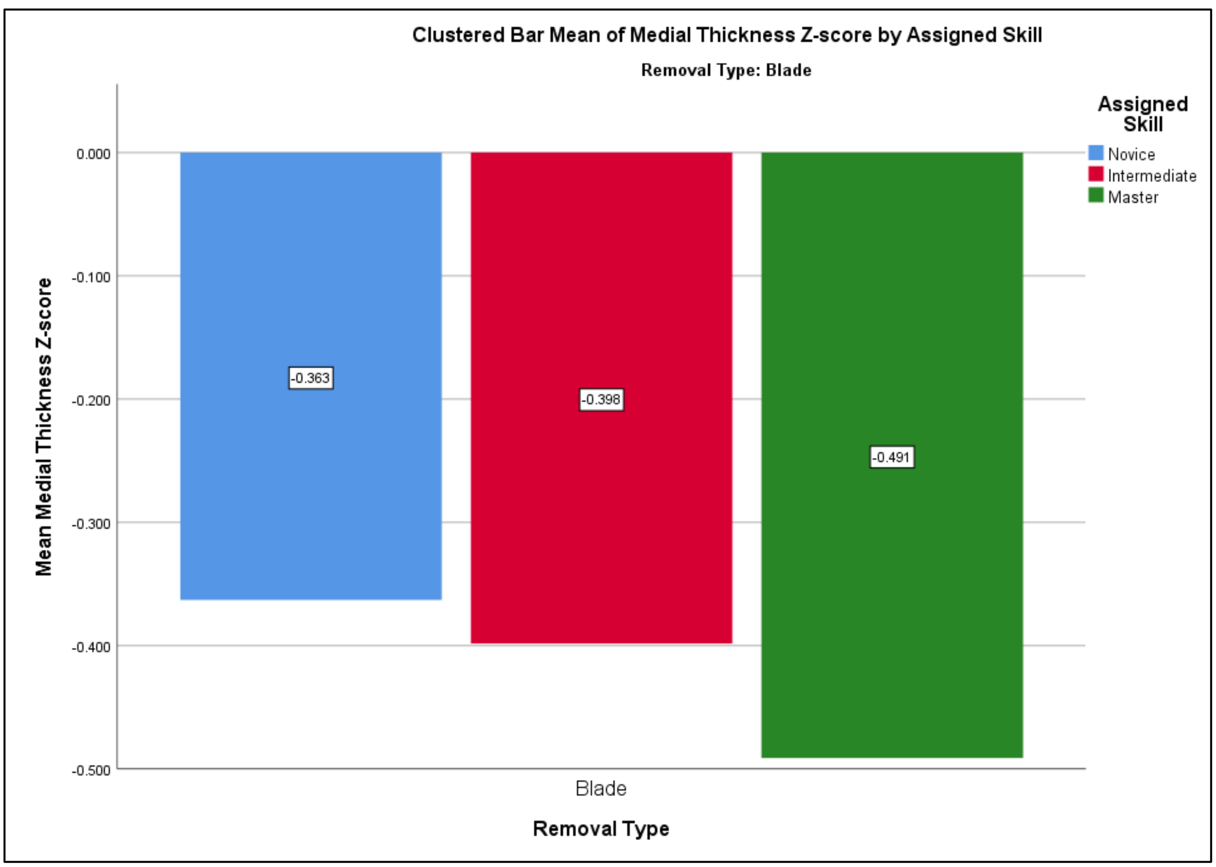


Figure 7.35: Mean of medial thicknesses on blades (z-scores) by assigned skill level

novices (sd=2.36) had more variation in their blade thicknesses (Figure 7.40). Low z-scores in combination with a low sd of blade thickness indicates highly skilled individuals and higher z-scores with more variability indicate less skilled individuals (Figure 7.40). Masters are frequently able to produce gracile blades in part due to platform preparation, but also their knowledge of error correction, core maintenance, and percussor use aids the production of thin blades. Intermediates certainly have some of the knowledge but cannot or do not mobilize it. Novices appear to have not gained most of the types of knowledge or know that a particular action exists or that it "should be done" but do not know how to do it.

Profile Correction Blades

Medial thickness of profile correction blades is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce the thickest profile correction blades with a z-score of 0.503. Intermediate flintknappers produce thinner profile correction blades than novices with a z-score of 0.145. Masters produce the thinnest profile correction blades with a z-score of -0.164 (Figure 7.36) and most consistently produce the thin medial sections with a sd of 2.58. This sd is significantly lower than the sd of novices (sd = 4.79) and intermediate flintknappers (sd = 3.16) (Figure 7.40). Thin medial sections of profile correction blades in combination with a low sd indicates master level individuals. Medial sections of profile correction blades with a thickness near the sample mean

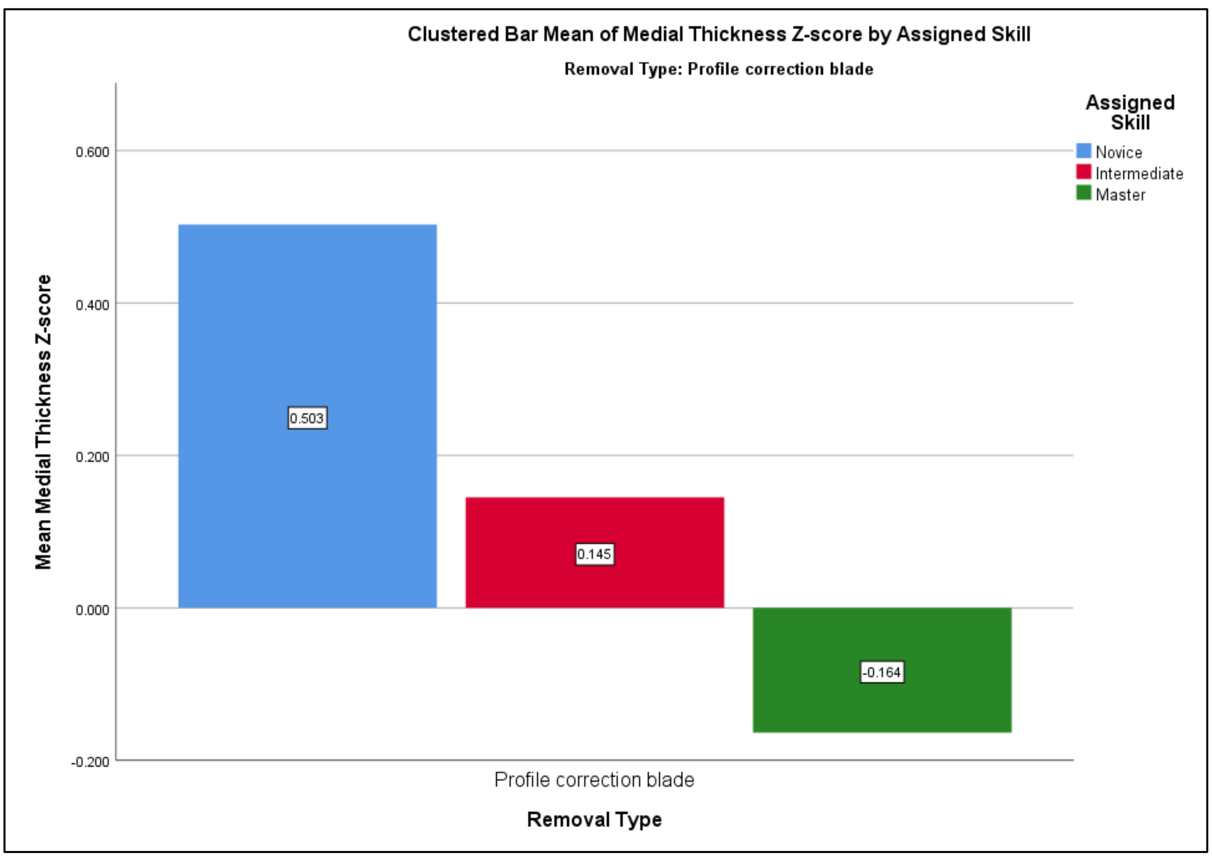


Figure 7.36: Mean of medial thicknesses on profile correction blades (z-scores) by assigned skill level

and a higher sd suggest intermediate individuals. Thick medial sections of profile correction blades and high sd suggest novice individuals. This pattern my be the result of the way core maintenance knowledge is utilized. Masters frequently produce profile correction blades as both core face maintenance and error correction. It is possible that masters produce profile correction blades before significant amounts of core face need to be removed. While intermediates allow more time to pass between profile correction phases and thus require thicker profile correction blades. Finally, novices struggle to produce core faces, so it is likely that the profile correction blades produced by novices are infrequent and remove significant amounts of core face.

Core Face Rejuvenation Elements

Medial thickness of core face rejuvenation elements is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce the thickest core face rejuvenation elements with a z-score of 0.850. Intermediate flintknappers produce thinner core face rejuvenation elements than novices with a z-score of 0.336. Masters produce the thinnest core face rejuvenation elements with a z-score of -0.199 (Figure 7.37) and most consistently produce the thin medial sections with a sd of 2.05. This sd is significantly lower than the sd of novices (sd = 5.94) and intermediate flintknappers (sd = 4.75) (Figure 7.40). Thin medial sections of core face rejuvenation elements in combination with a low sd indicates master level individuals. Medial sections of core face rejuvenation elements with a thickness

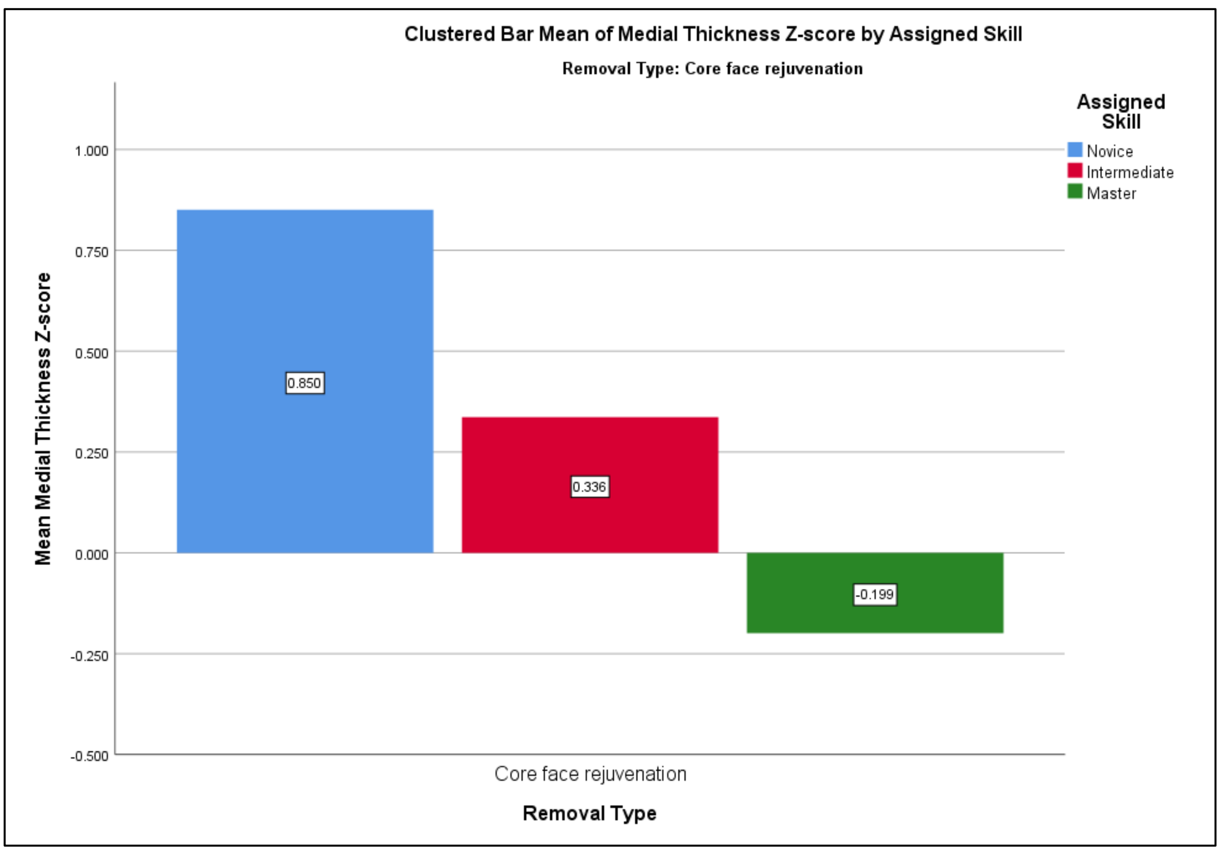


Figure 7.37: Mean of medial thicknesses on core face rejuventation elements (z-scores) by assigned skill level

near the sample mean and a higher sd suggest intermediate individuals. Thick medial sections of core face rejuvenation elements and high sd suggest novice individuals. This pattern may be the result of the way error correction knowledge is utilized. Masters frequently produce core face rejuvenation elements to correct errors. It is possible that masters produce core face rejuvenation elements before significant amounts of core face need to be removed. While intermediates allow more time to pass between profile correction phases and thus require thicker core face rejuvenation elements. Finally, novices struggle to produce core faces, so it is likely that the core face rejuvenation elements produced by novices are infrequent and remove significant amounts of core face.

Partial Ridged Blades

Medial thickness of partially ridged blades is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce the thickest partially ridged blades with a z-score of 0.545. Intermediate flintknappers produce thinner partially ridged blades than novices with a z-score of 0.256. Masters produce the thinnest partially ridged blades with a z-score of -0.014 (Figure 7.38) and most consistently produce the thin medial sections with a sd of 1.78. This sd is significantly lower than the sd of novices (sd = 3.63) and intermediate flintknappers (sd = 3.83) (Figure 7.40). Thin medial sections of partially ridged blades in combination with a low sd indicates master level individuals. Medial sections of

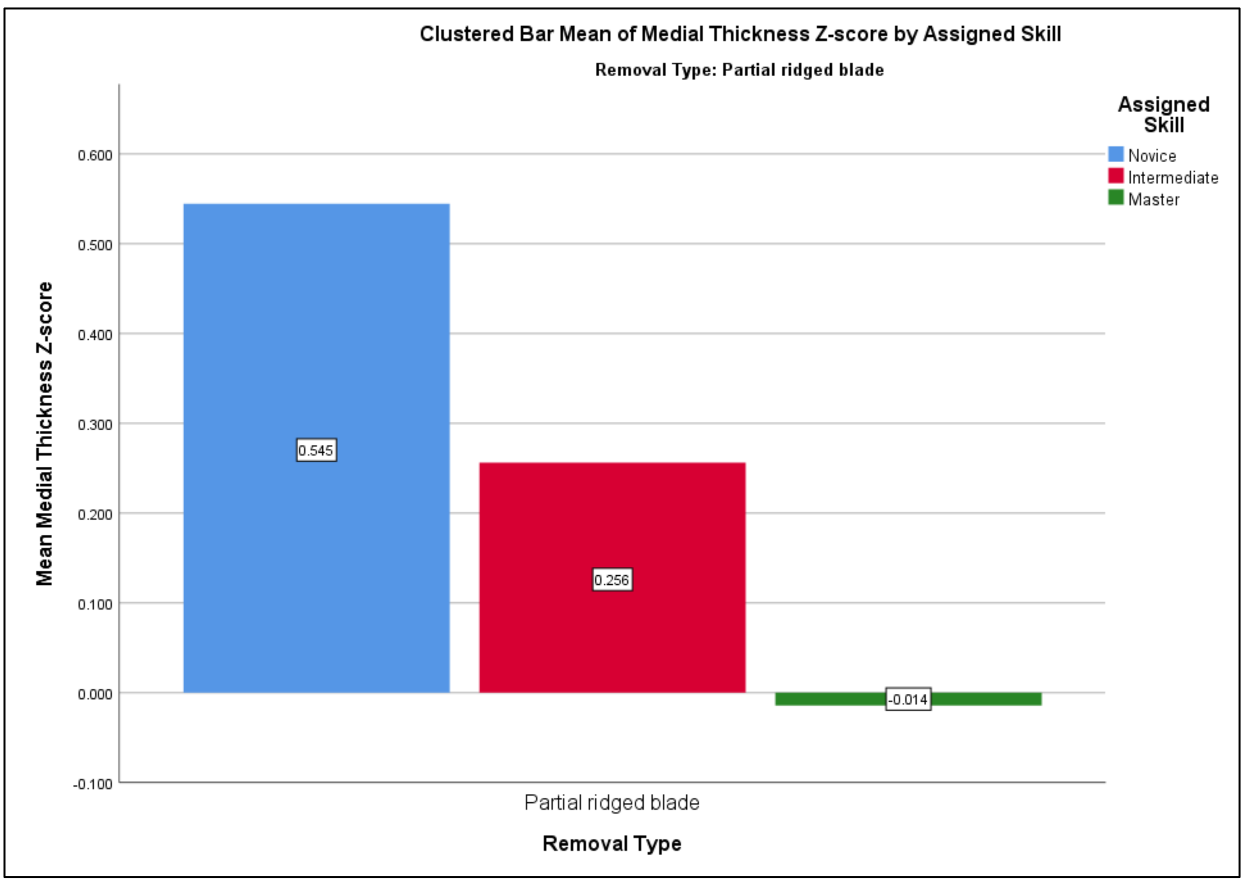


Figure 7.38: Mean of medial thicknesses on partial ridged blades (z-scores) by assigned skill level

partially ridged blades with a thickness near the sample mean and a high sd suggest intermediate individuals. Thick medial sections of partially ridged blades and high sd suggest novice individuals. This pattern is likely the result of the way core maintenance knowledge is utilized. Masters frequently produce partially ridged blades for core face maintenance. It is possible that masters produce partially ridged blades before significant amounts of core face need to be removed. While intermediates allow more time to pass between profile correction maintenance phases and thus require thicker partially ridged blades. Finally, novices struggle to produce core faces and to isolate platforms, so it is likely that the partially ridged blades produced by novices are infrequent and remove significant amounts of core face due to a lack of core maintenance knowledge and techniques.

Crested Blades

The medial thickness of crested blades is not a useful characteristic to distinguish between skilled and unskilled individuals. Notably the sample size for masters is low (N=4) while the sample sizes for intermediate flintknappers (N=14) and novices (N=40) is much larger. Novices produced crested blades with a z-score of 0.879. Intermediate flintknappers produced thicker crested blades with a z-score of 0.931. Masters produced the thinnest crested blades with a z-score of 0.744 (Figure 7.39). Masters (sd = 3.71) and intermediate flintknappers (sd = 3.79) had the least amount of variation in medial thickness while novices (sd=5.86) had more variation in their crested blade medial thicknesses (Figure 7.40). There were no significant differences in

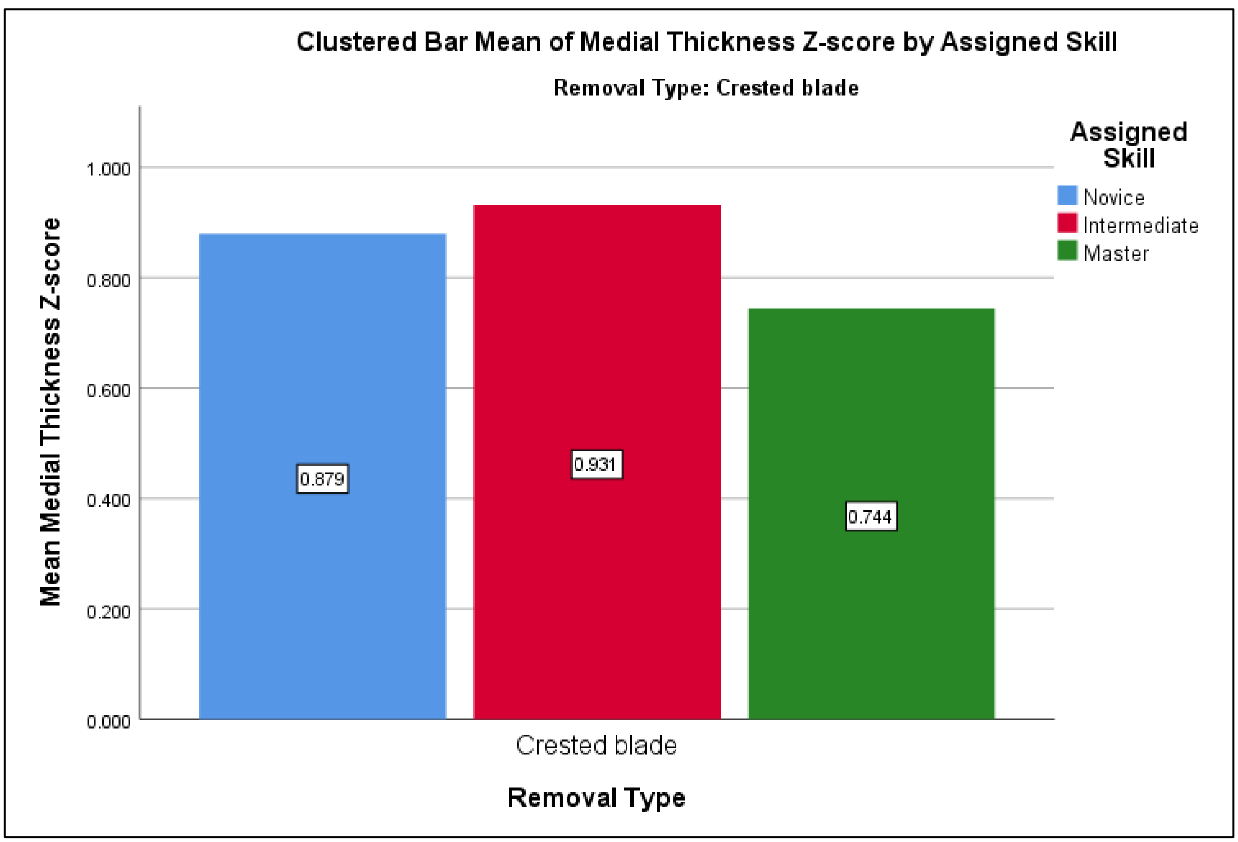


Figure 7.39: Mean of medial thicknesses on crested blades (z-scores) by assigned skill level

the medial thicknesses or variability of the crested blades. All skill groups produced relatively thick crested blades. Crested blades necessitate the loss of large amounts of raw material. Crested blades are usually produced early in the reductions sequence to prepare a blade core for further removals. They are prepared by removing a series of flakes and lateral core trimming elements to produce a crest down the future core face. Novices tend to produce serpentine crests and do not prepare platforms likely resulting in thick medial sections of the crested blades. Intermediates produced the thickest crested blades likely due to a lack of platform preparation. Masters produced the thinnest crested blades by a thin margin. This is likely due to the master's ability to conserve material and significant platform preparation.

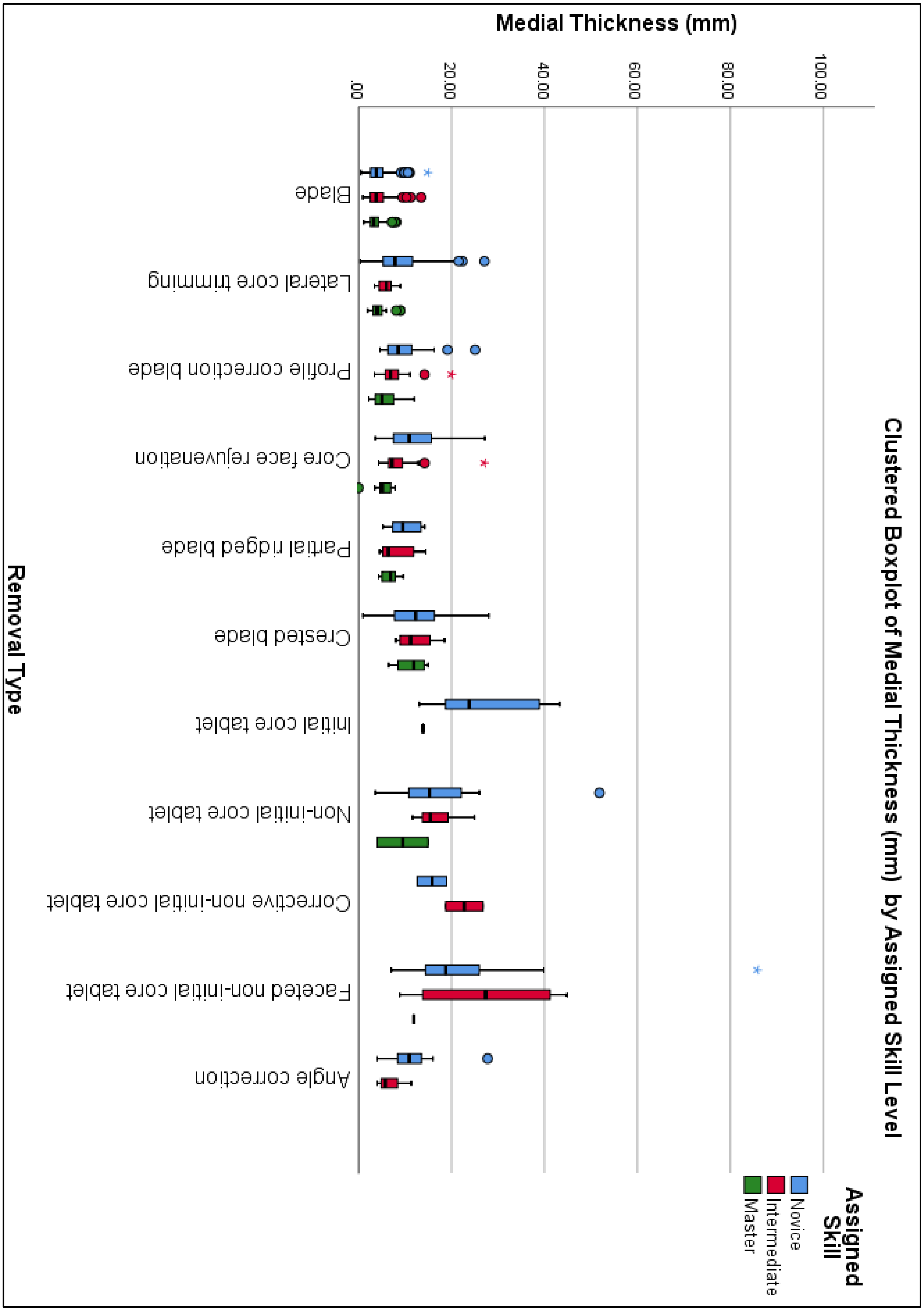


Figure 7.40: Clustered boxplot of medial thickness by assigned skill level

Distal Thickness

Distal thickness was tested among the previously identified removal types (blades, profile correction blades, core face rejuvenation elements, partially ridged blades and crested blades) to determine patterns within the chaîne opératoire mobilized by the flintknappers. Due to the core shape, it is likely that flintknappers will need varying distal thicknesses to maintain the core face (Wilke and Quintero 1994). Each removal was measured at the distal end regardless of termination type and z-scores were generated for each assigned skill level. Z-scores from novice, intermediate, and master individuals are compared below to identify similarities or differences in distal thicknesses. The z-score value is a standardized score based on the mean of the whole sample. A z-score of 0 would equate to exactly average while a z-score of 2 is 2 standard deviations higher than the sample average. The sd of the distal thicknesses of each removal type are also reported in the discussion for each removal type and by assigned skill level. The sd is calculated from the raw measurements of each removal (mm). Averages for all removal types that were tested can be found in Figure 7.49.

Blades

The distal thickness of blades is a useful characteristic to distinguish between skilled and unskilled individuals. Novices produced blades slightly thicker distal terminations with a z-score of -0.266. Intermediate flintknappers produced thinner distal terminations with a z-score of –

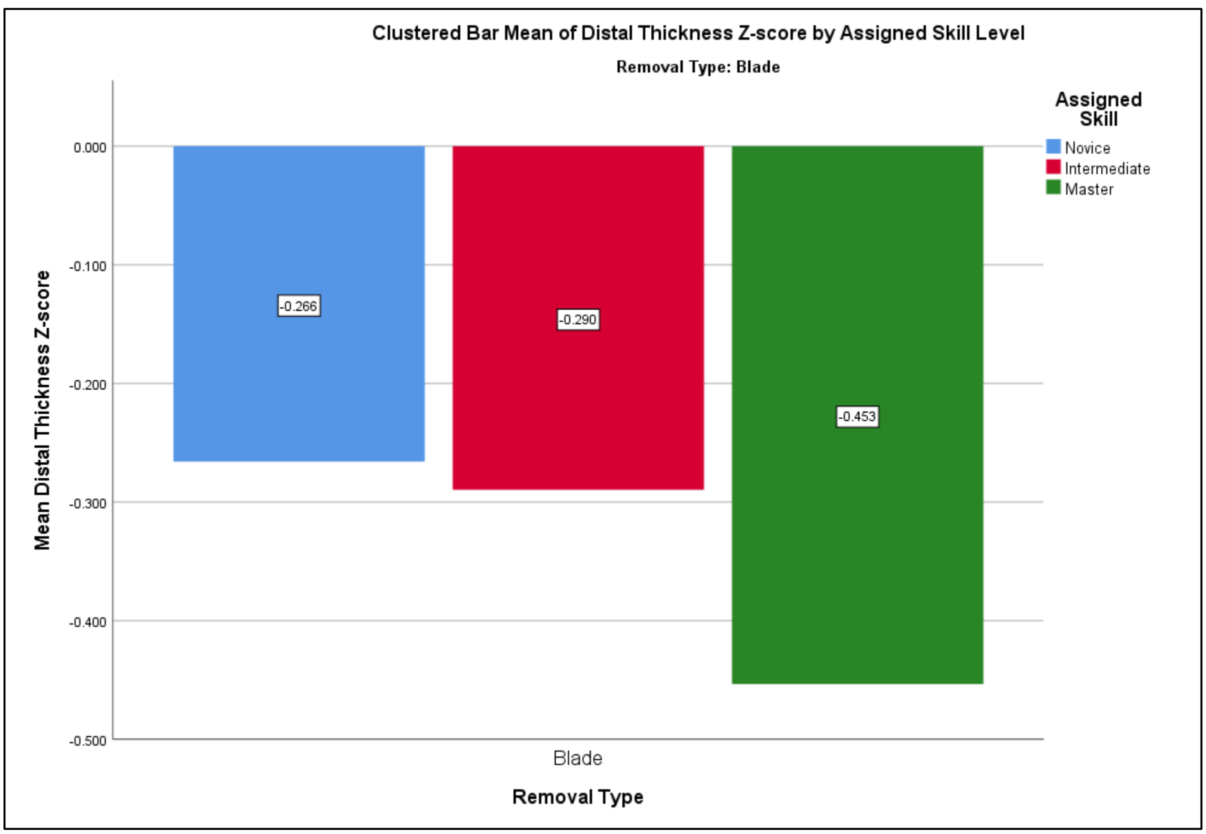


Figure 7.41: Mean of distal thicknesses on blades (z-scores) by assigned skill level

0.290. Masters produced the thinnest distal terminations with a z-score of -0.453 (Figure 7.41). Masters had the least amount of variation in distal thickness with a sd of 0.49. While intermediate flintknappers (sd= 1.24) and novices (sd=1.44) had more variation in their blade thicknesses (Figure 7.46). Low z-scores in combination with a low sd of distal termination thickness indicates highly skilled individuals while higher z-scores and more variation in distal thickness indicates unskilled individuals (Figure 7.46). Novices and intermediates likely produced thicker and more variable blade terminations both due to a lack of platform preparation and percussor selection. Frequently novices selected large hammerstones to remove blades resulting in thicker terminations. Masters consistently produced thin blade terminations likely due to their consistent core maintenance, platform preparation, and experience with the tool set.

Profile Correction Blades

Distal thickness of profile correction blades is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce the thickest distal terminations on profile correction blades with a z-score of 0.412. Intermediate flintknappers produce thinner terminations on profile correction blades than novices with a z-score of 0.303. Masters produce the thinnest distal terminations on profile correction blades with a z-score of -0.127 (Figure 7.42) and most consistently produce the thin distal terminations with a sd of 0.85. This sd is significantly lower than the sd. of novices (sd = 4.18) and intermediate flintknappers (sd = 3.14) (Figure 7.46). Thin distal terminations of profile correction blades in

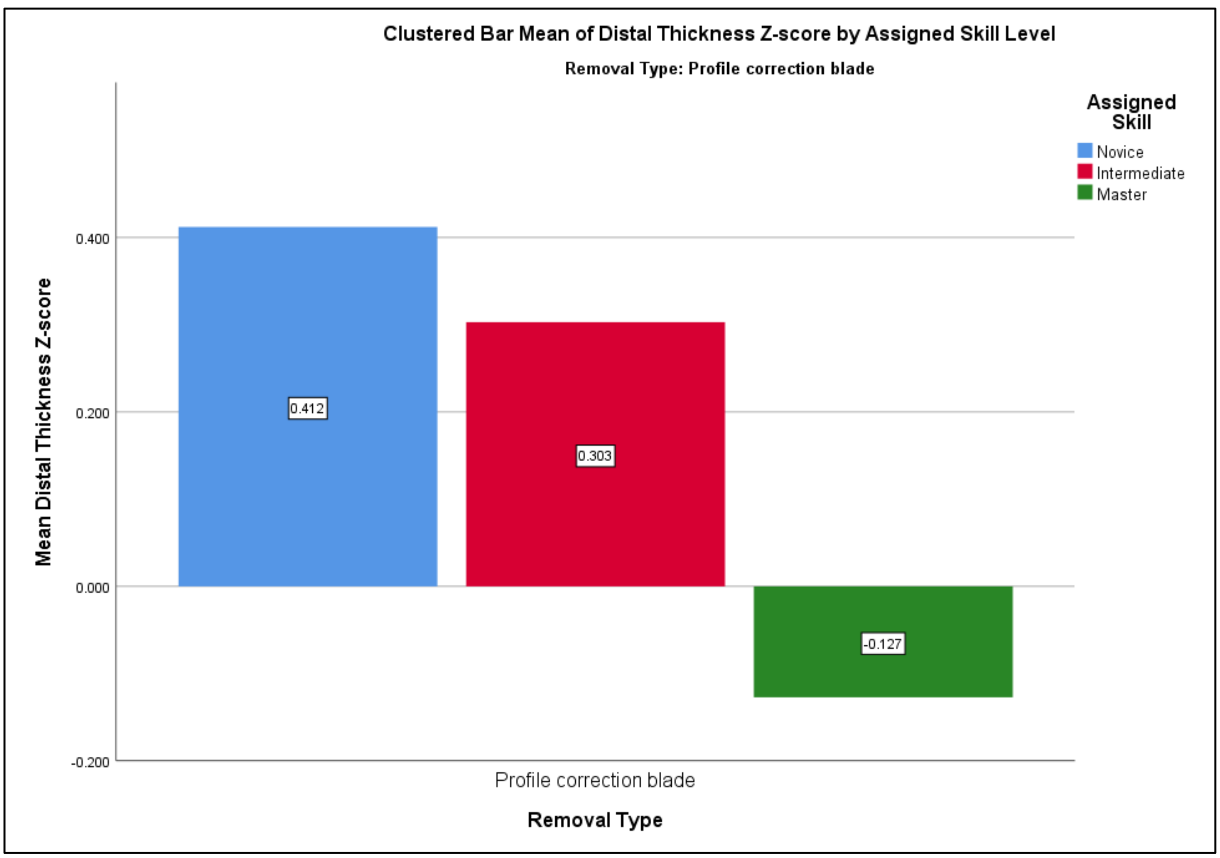


Figure 7.42: Mean of distal thicknesses on profile correction blades (z-scores) by assigned skill level

combination with a low sd. indicates master level individuals. Distal terminations of profile correction blades with a thickness near the sample mean and a higher sd suggest intermediate individuals. Thick distal terminations of profile correction blades and high sd suggest novice individuals. Novices and intermediates likely produced thicker and more variable profile correction blade terminations both due to a lack of platform preparation and core maintenance throughout the blade core reduction. Masters consistently produced thin profile correction blade terminations likely due to their consistent core maintenance and platform preparation.

Core Face Rejuvenation Elements

Distal thickness of core face rejuvenation elements is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce the thickest distal terminations on core face rejuvenation elements with a z-score of 1.030. intermediate flintknappers produce thinner terminations on core face rejuvenation elements than novices with a z-score of 0.390. Masters produce the thinnest distal terminations on core face rejuvenation elements with a z-score of -0.069 (Figure 7.43) and most consistently produce the thin distal terminations with a sd of 1.88. This sd is significantly lower than the sd of novices (sd = 4.27) and intermediate flintknappers (sd = 4.04) (Figure 7.46). Thin distal terminations of core face rejuvenation elements in combination with a low sd indicates master level individuals. Distal terminations of core face rejuvenation elements with a thickness near the sample mean and a high sd suggest intermediate individuals. Thick distal terminations of core face rejuvenation

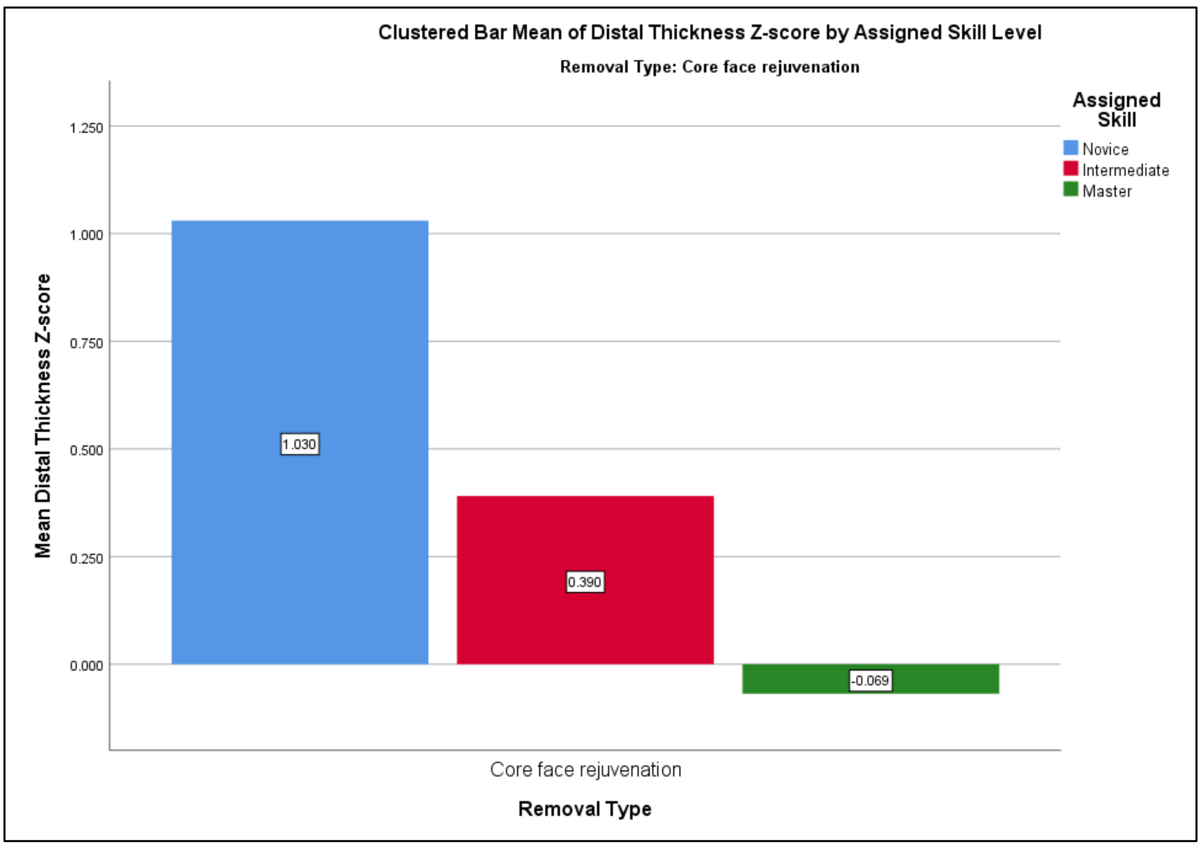


Figure 7.43: Mean of distal thicknesses on core face rejuventation elements (z-scores) by assigned skill level

elements and high sd suggest novice individuals. Novices likely produced thick and more variable core face rejuvenation element terminations both due to a lack of platform preparation, core maintenance, and successful utilization of corrective techniques which results in thick distal terminations. Intermediates produced thinner core face rejuvenation element terminations yet still produced above average terminations. Again, this is likely due to the amount of maintenance that is done during the core reduction process and possibly due intermediate individuals utilizing maintenance and corrective techniques less than masters throughout the reduction process. Masters consistently produced thin core face rejuvenation element terminations likely due to their consistent core maintenance, platform preparation, and successful utilization of corrective techniques.

Partial Ridged Blades

Distal thickness of partially ridged blades is a useful characteristic to determine skill differences between skilled and unskilled individuals. Novices produce the thinnest distal terminations on partially ridged blades with a z-score of 0.033. Intermediate flintknappers produce thicker terminations on partially ridged blades than novices with a z-score of 0.343. Masters produce the thickest distal terminations on partially ridged blades with a z-score of 0.359 (Figure 7.44). Masters (sd = 2.68) and intermediate flintknappers (sd = 3.66) produced more variable distal terminations on partially ridged blades while novices (sd = 0.71) were more consistent in the termination thickness (Figure 7.46). Thick distal terminations of partially ridged blades in combination with a high sd indicates skilled individuals. Thin distal terminations of partially

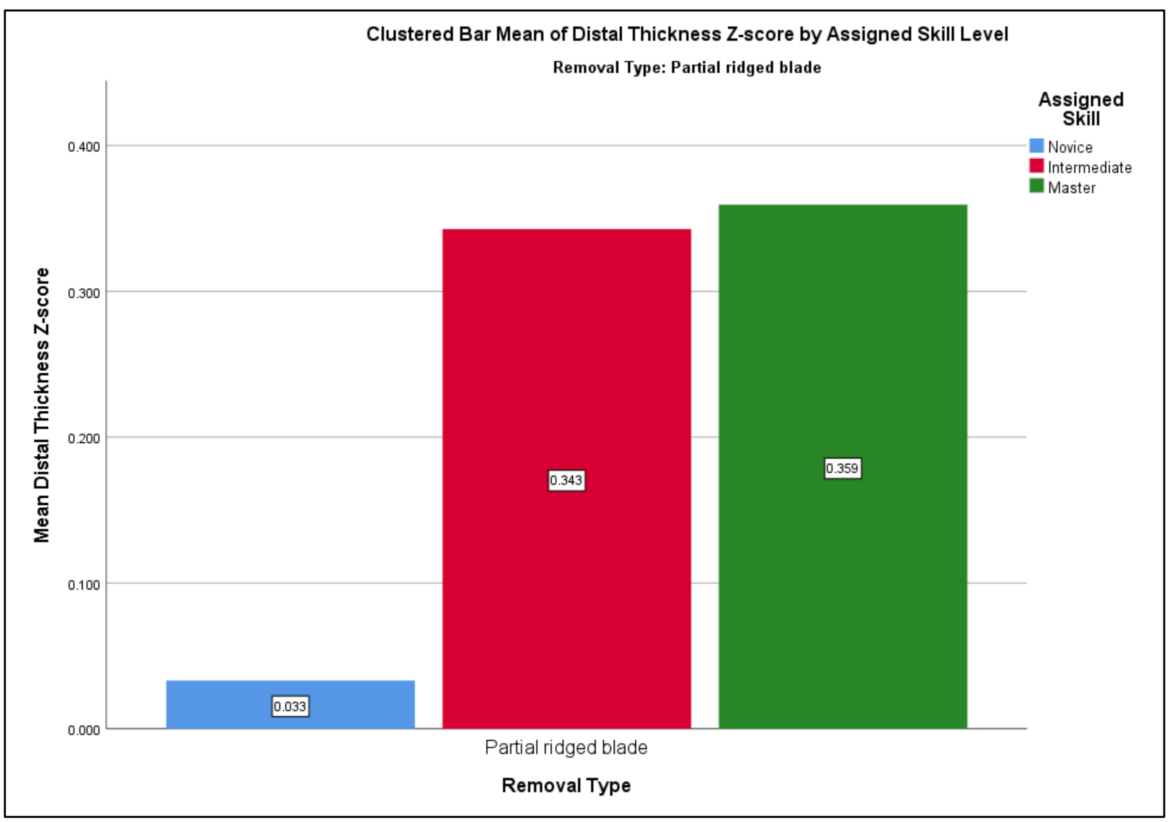


Figure 7.44: Mean of distal thicknesses on partial ridged blades (z-scores) by assigned skill level

ridged blades and lower sd suggest novice individuals. The sample size of novices is notable here as novices (N=7) produced less partially ridged blades than intermediate flintknappers (N=11) and masters (N=19). Novices likely produced thinner and less variable partial ridged blade terminations because the removal type is a core face maintenance technique that is used to remove extra mass from the bottom of a core face. Novices rarely isolate platforms and do not commonly use core face maintenance techniques (both because blade removals are rare and they likely have not obtained the experience needed to predict when a partial ridge blade would be useful to maintain the core face). Intermediate and master flintknappers utilize the maintenance technique frequently and through platform preparation and previous blade scars on the core face produce thick distal terminations on partial ridged blades.

Crested Blades

The distal thickness of crested blades is a useful characteristic to distinguish between skilled and unskilled individuals. Notably the sample size for masters is low (N=6) while the sample sizes for intermediate flintknappers (N=16), and novices (N=42) is much larger. Novices produced crested blades with slightly thinner distal terminations than average with a z-score of -0.459. Intermediate flintknappers produced thin distal terminations with a z-score of 0.477. Masters produced the thickest distal terminations with a z-score of 0.1.292 (Figure 7.45). Masters had the most amount of variation in distal thickness with a sd of 6.92. While intermediate flintknappers (sd= 2.95) and novices (sd=3.20) had less variation in the distal

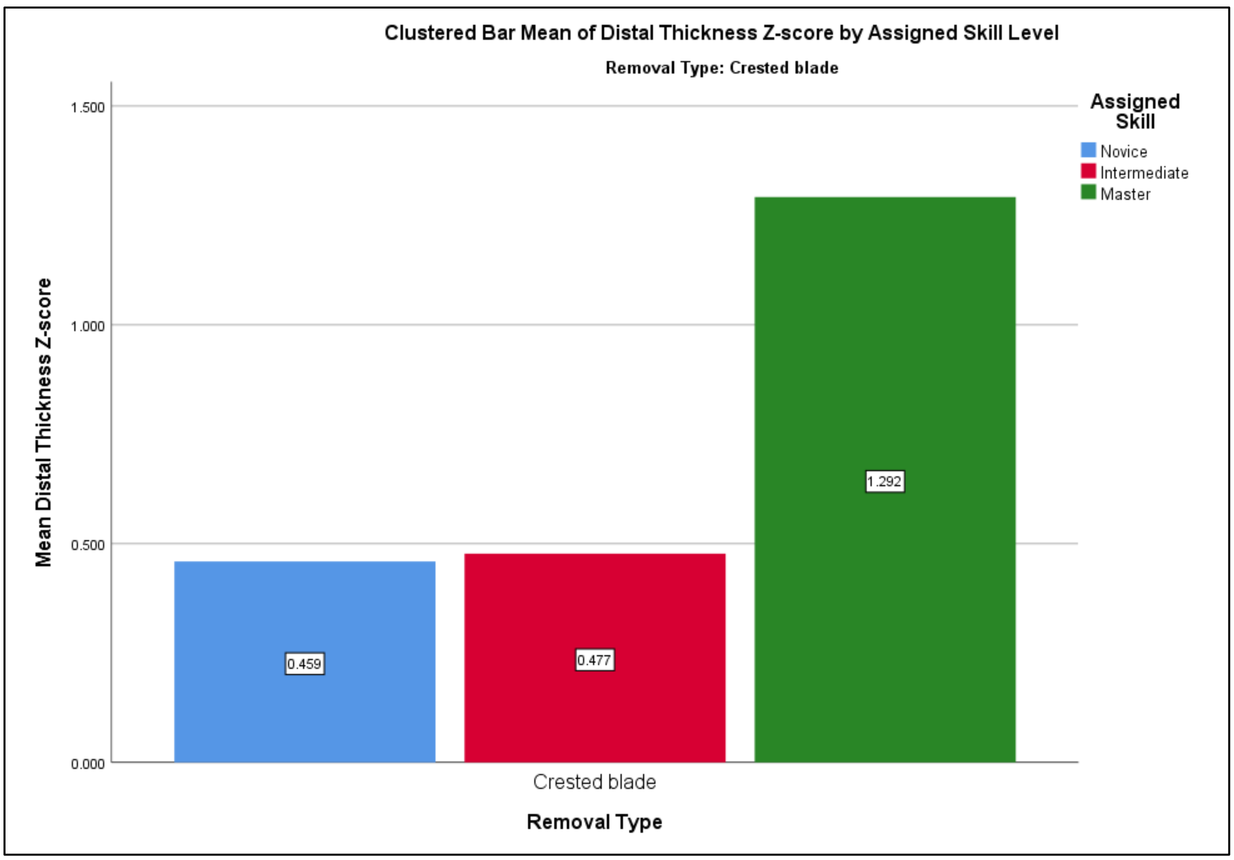


Figure 7.45: Mean of distal thicknesses on crested blades (z-scores) by assigned skill level

thicknesses of crested blades (Figure 49). High z-scores in combination with a high sd of distal termination thickness suggests skilled individuals while lower z-scores and a lower sd suggest unskilled individuals (Figure 7.46). Here it is likely that novice and intermediate flintknappers produced thinner crested blades due to their crest preparation techniques, platform preparation, and percussor selection. Novices and intermediate flintknappers tend to produce crested blades with more sinuous crests while masters tend to produce crested blades with straight crests. Masters invest significant time into platform preparation, preparation of the crest, and have the knowledge to select a heavier percussor tool which allows them to produce a large crested blade.

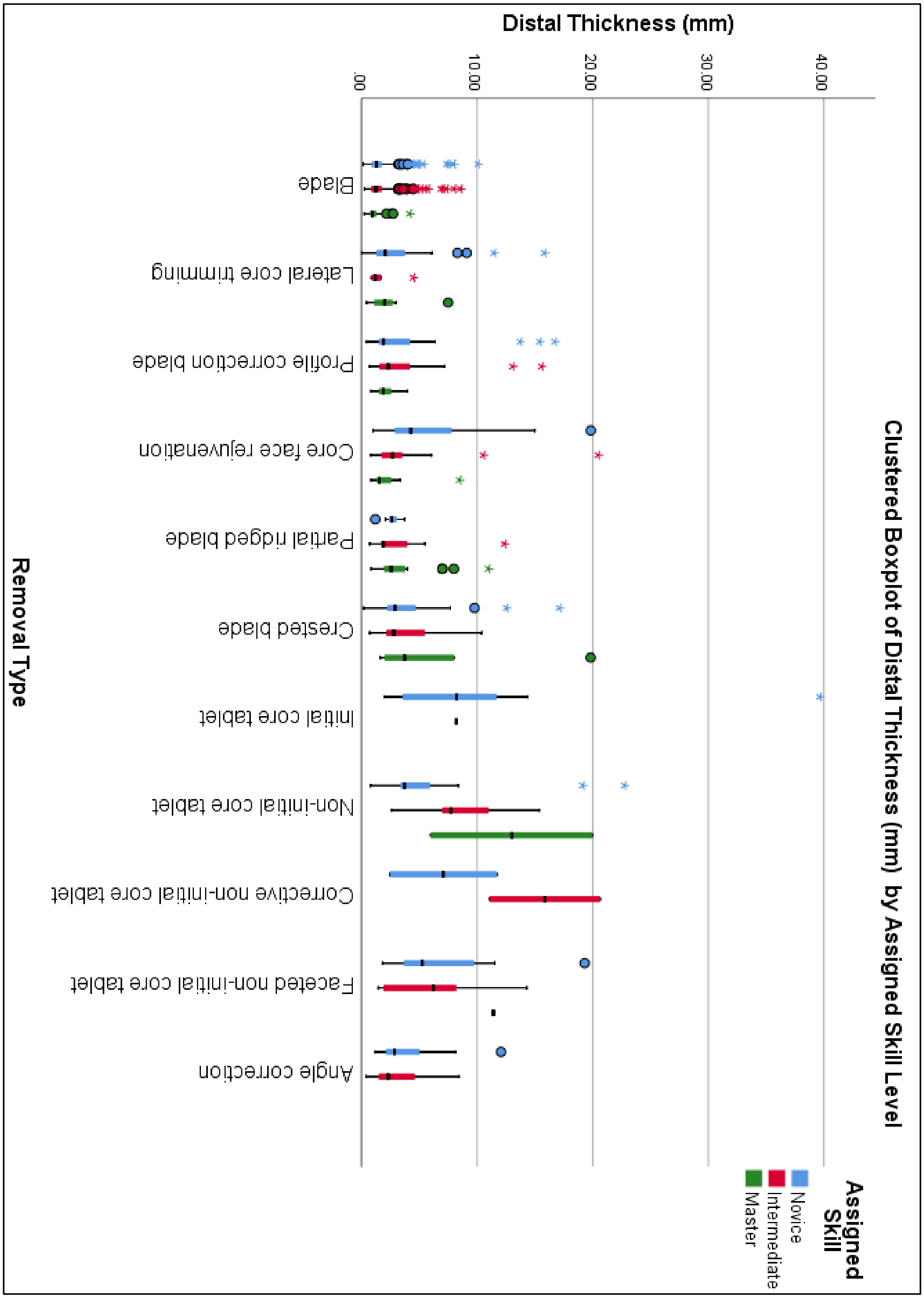


Figure 7.46: Clustered boxplot of distal thickness by assigned skill level

Mass

To determine if mass is a useful identifier of skill, the previously identified removal types (blades, profile correction blades, core face rejuvenation elements, partially ridged blades and crested blades) were studied individually. Each removal was weighed in grams and z-scores were generated for each assigned skill level. The z-score value is a standardized score based on the mean of the whole sample. A z-score of 0 would equate to exactly average while a z-score of 2 is 2 standard Average mass z-scores from novice, intermediate, and master individuals are compared below to identify similarities or differences in removal weights. The sd of the mass of each removal type are also reported in the discussion for each removal type and by assigned skill level. The sd is calculated from the raw measurements of each removal (g). Averages for all removal types that were tested can be found in Figure 7.52.

Blades

The mass of a blade is a useful characteristic to distinguish between skilled and unskilled individuals. Novices produced blades with a z-score of -0.250. Intermediate flintknappers produced heavier blades with a z-score of -0.240. Masters produced the lightest blades with a z-score of -0.318 (Figure 7.47). Masters had the least amount of variation in mass with a sd of 3.08. While intermediate flintknappers (sd= 7.32) and novices (sd=7.53) had more variation in the blade mass (Figure 52). Low z-scores in combination with a low sd of blade mass suggests

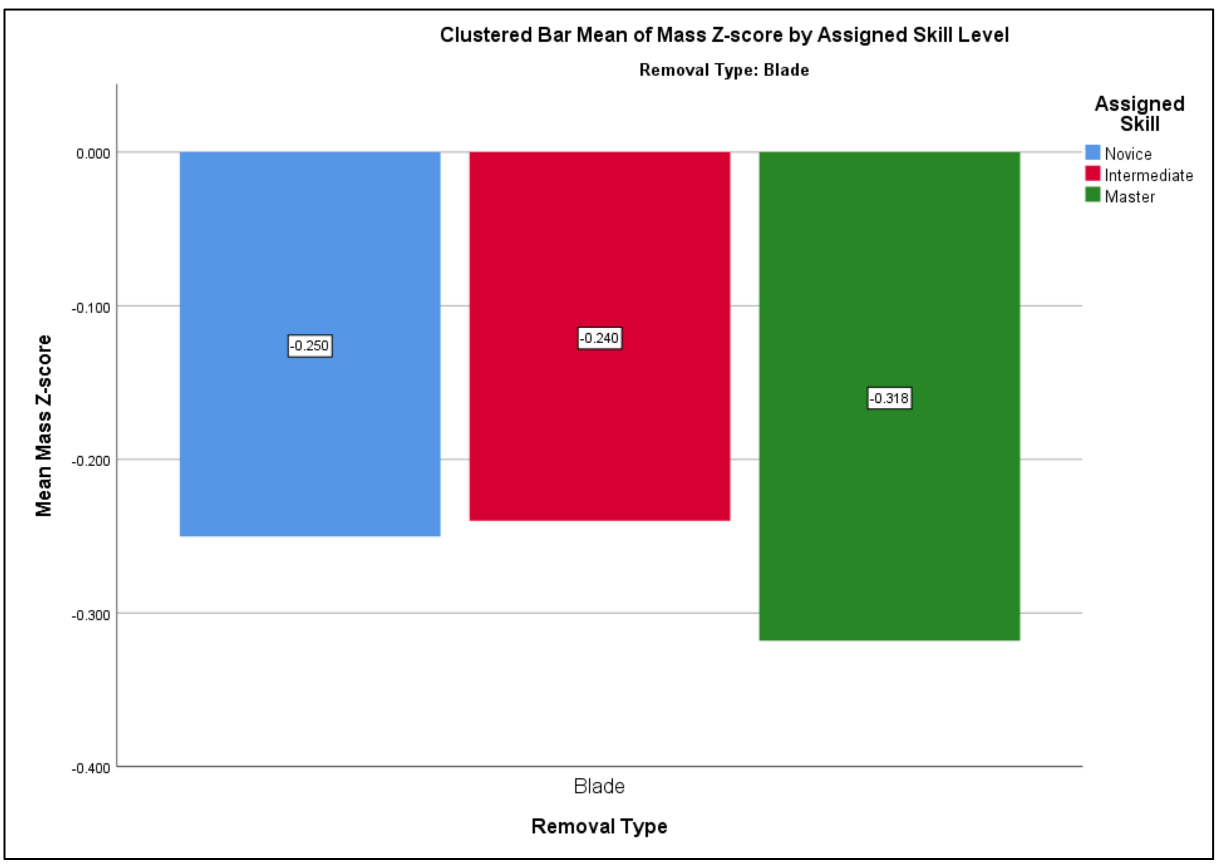


Figure 7.47: Mean of blade mass z-scores by assigned skill level

skilled individuals. Higher z-scores and a higher sd suggests unskilled individuals (Figure 7.52). Masters are able to produce consistently long, narrow, and light blades. Intermediate flintknappers inconsistently produce very long blades that are commonly narrow, and slightly heavier than the blades produced by masters. Finally, novices produce blades that are short, wide, and heavy. These blades are the most inconsistent of all the skill groups and frequently have single-faceted platforms.

Profile Correction Blades

Mass of profile correction blades is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce the heaviest profile correction blades with a z-score of 0.037. Intermediate flintknappers produce lighter profile correction blades than novices with a z-score of -0.005. Masters produced the lightest profile correction blades with a z-score of -0.122 (Figure 7.48) and most consistently produced light profile correction blades with a sd of 6.64. This sd is significantly lower than the sd. of novices (sd = 10.39) and intermediate flintknappers (sd = 11.29) (Figure 7.52). Light profile correction blades in combination with a low sd. indicate master level individuals. Profile correction blades with a mas near the sample mean and a higher sd suggest intermediate individuals. Profile correction blades with a high mass and high sd suggest novice individuals. Novices tend to produce profile correction blades with thick platforms, medial segments, and distal terminations resulting in heavier removals. Intermediate flintknappers tend to produce removals with thin

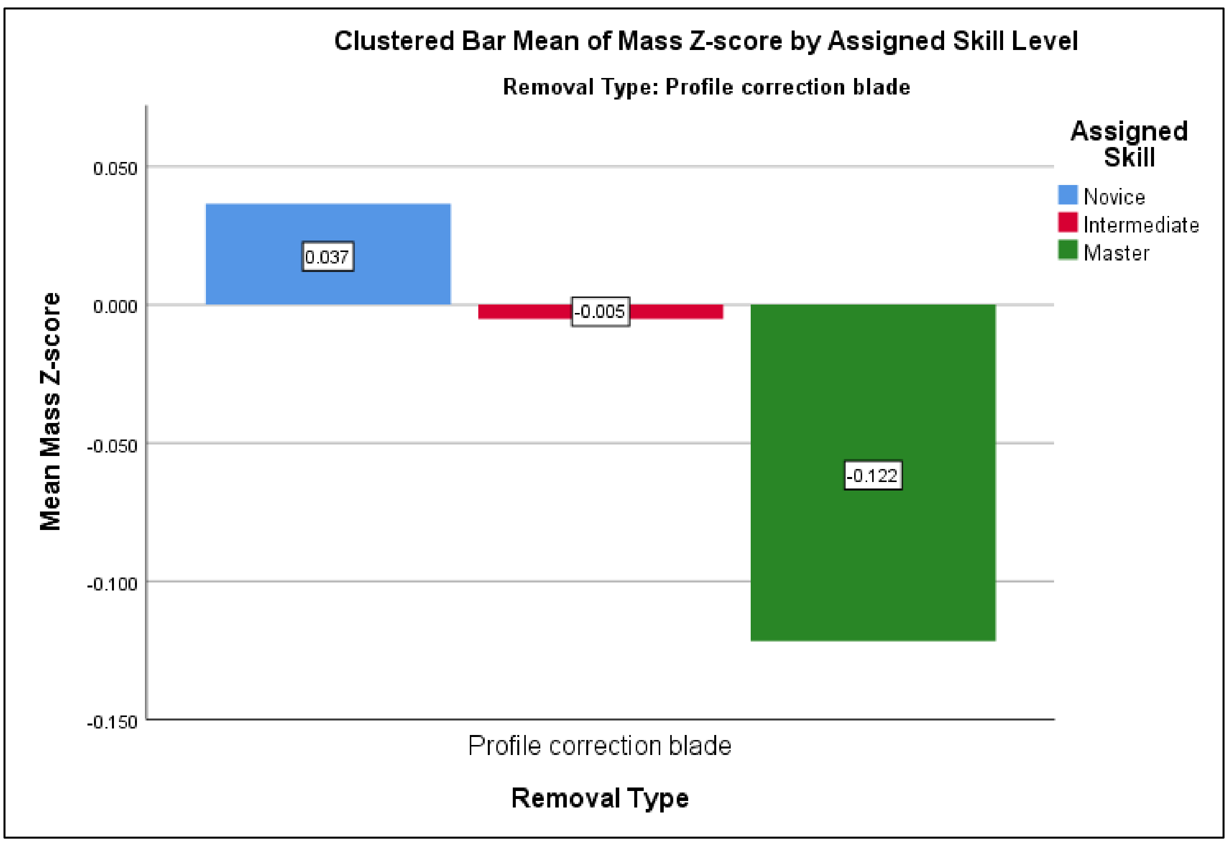


Figure 7.48: Mean of profile correction blade mass z-scores by assigned skill level

platforms, thinner medial sections than novice flintknappers, and thinner distal terminations than novices. Masters consistently produce profile correction blades with thin platforms, medial segments, and terminations resulting in removals with a low average mass.

Core Face Rejuvenation Elements

The mass of core face rejuvenation elements is a useful characteristic to determine skill differences between novices, intermediate flintknappers, and masters. Novices produce heaviest core face rejuvenation elements with a z-score of 0.807. Intermediate flintknappers produce core face rejuvenation elements with a near average mass and a z-score of 0.251. Masters produce the lightest core face rejuvenation elements with a z-score of -0.084 (Figure 7.49) and most consistently produce light core face rejuvenation elements with a sd of 7.44. This sd is significantly lower than the sd of novices (sd = 33.69) and intermediate flintknappers (sd = 16.68) (Figure 7.52). Core face rejuvenation elements with below average mass and low sd indicate master level individuals. Core face rejuvenation elements with a mass near the sample mean and a higher sd suggest intermediate individuals. Heavier than average core face rejuvenation elements and high sd suggest novice individuals. Novices tend to produce core face rejuvenation elements with thick platforms, medial segments, and distal terminations resulting in heavier removals. Intermediate flintknappers tend to produce core face rejuvenation elements with thin platforms, thinner medial sections than novice flintknappers, and thinner distal

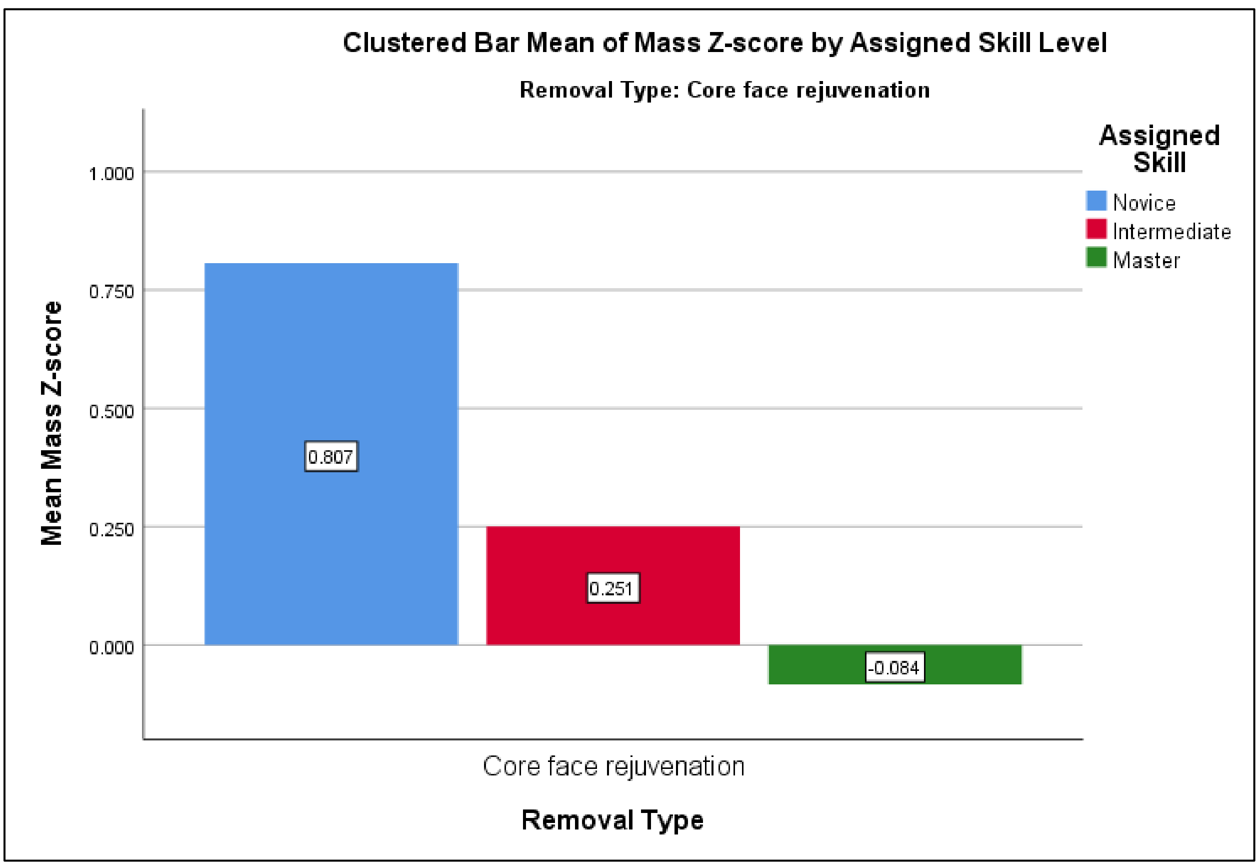


Figure 7.49: Mean of core face rejuvenation element mass z-scores by assigned skill level

terminations than novices. Masters consistently produce core face rejuvenation elements with thin platforms, medial segments, and terminations resulting in removals with a low average mass.

Partial Ridged Blades

The mass of a partially ridged blade is a not a useful characteristic to distinguish between skill levels of individuals. Novices produced light partially ridged blades with a z-score of -0.007. Intermediate flintknappers produced heavier partially ridged blades with a z-score of 0.106. Masters produced the lightest partially ridged blades with a z-score of -0.034 (Figure 7.50). Masters (sd = 7.81) and novices (sd = 10.19) had the least amount of variation in mass while intermediate flintknappers (sd= 16.91) had more variation in the partially ridged blade mass (Figure 7.52). There is no distinguishable relationship between skill level and the mass of partially ridged blades.

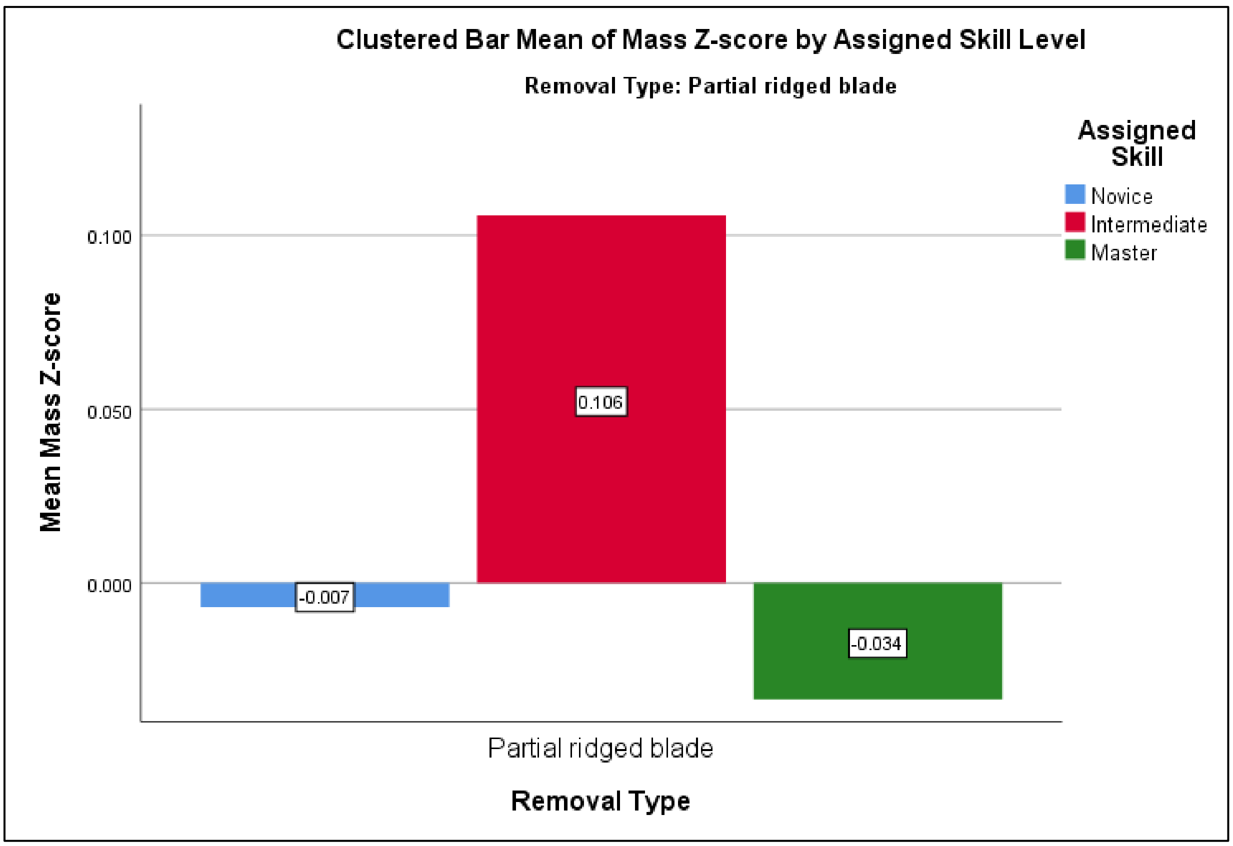


Figure 7.50: Mean of partial ridged blade mass z-scores by assigned skill level

Crested Blades

The mass of a crested blade is a not a useful characteristic to distinguish between skill levels of individuals. Novices produced crested blades with a z-score of 0.263. Intermediate flintknappers produced crested blades with a z-score of 0.476. Masters produced the lightest crested blades with a z-score of 0.238 (Figure 7.51). Masters produced crested blades with the least variability in mass (sd = 13.75), followed by intermediate flintknappers (sd = 16.64), and novices (sd = 25.85) (Figure 7.52). There is no distinguishable relationship between skill level and the mass of crested blades.

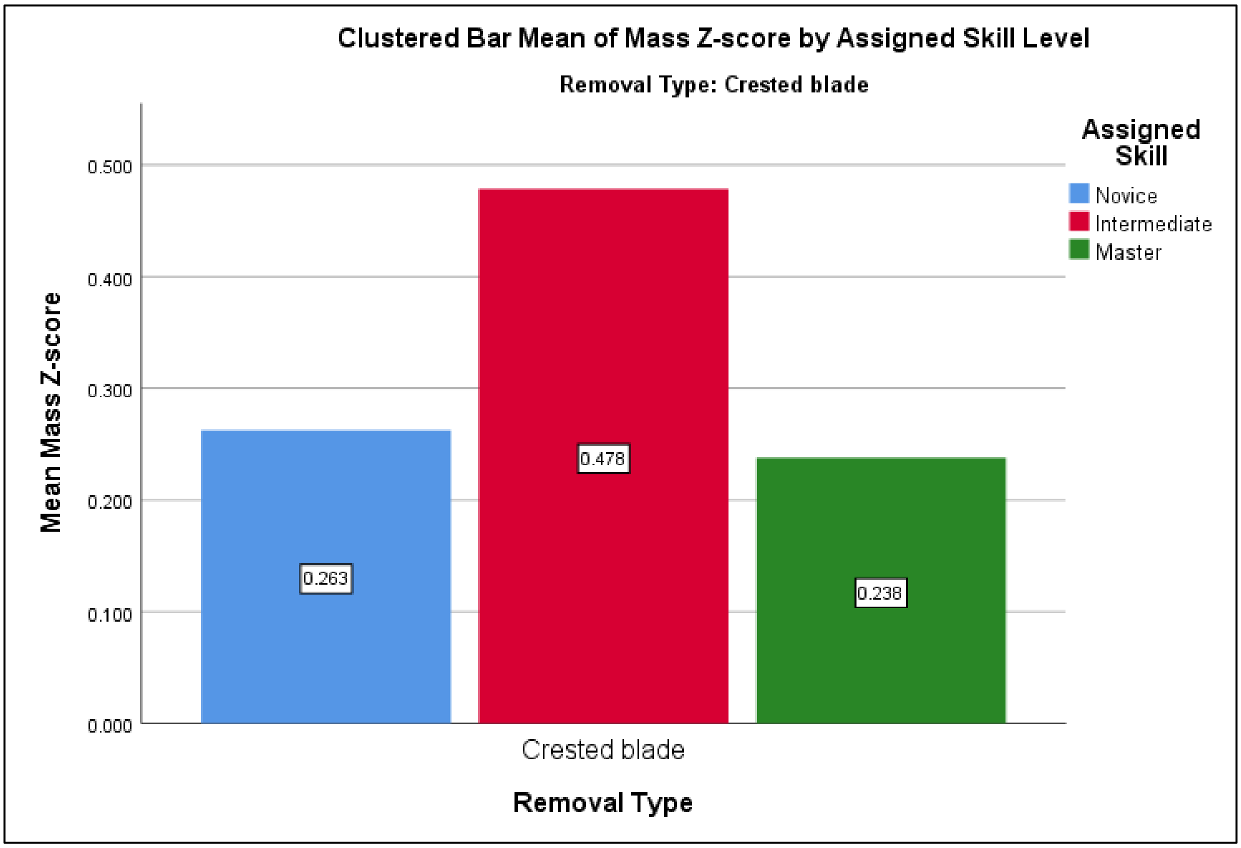


Figure 7.51: Mean of crested blade mass z-scores by assigned skill level

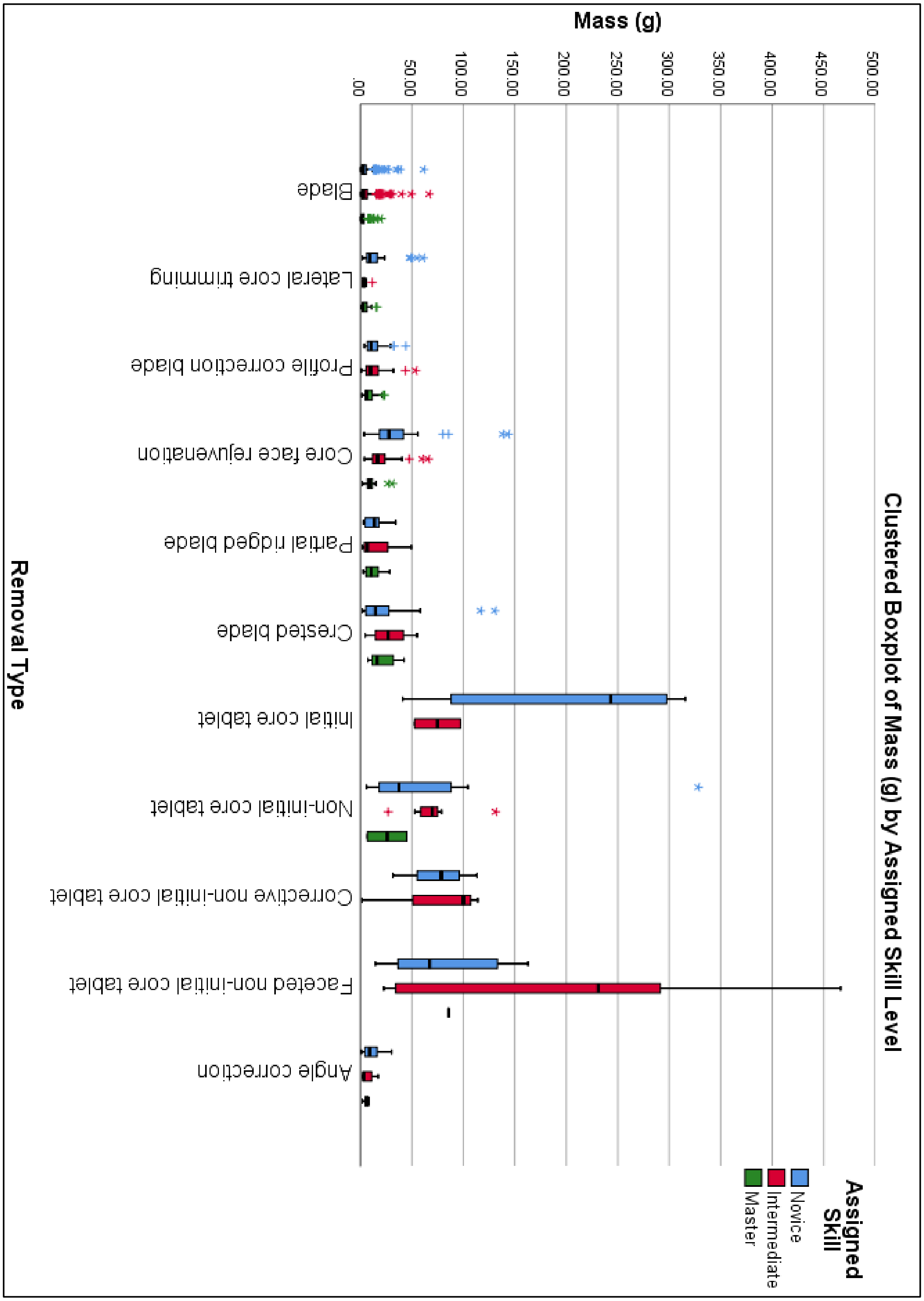


Figure 7.52: Clustered boxplot of removal mass by assigned skill level

Discussion

Interpreting skill archaeologically has historically been a daunting task and must be done with a robust knowledge of a specific technology and the *chaîne opératoire* utilized at a particular site (Bleed 2008; Olausson 1998 & 2008; Takakura 2019). Skill is unique to an individual as knowledge is internalized, structured, and contextualized by each practitioner (Wenger 1998; Clark 2003; Ferguson 2003; Bamforth and Finlay 2008; Finlay 2008;). Therefore, a single set of rules defining when one 'becomes' a master flintknapper is not supported by this data. Rather, a broad-spectrum approach with sets of skill indicators is effective for determining skill level (Table 7.4).

The data suggests that there are three different classificatory schemes and that to interpret skill a fluid approach must be utilized. First the novice, intermediate, master scheme is supported by the k-cluster formation of three distinct clusters that each have statistically significant cluster centers. This scheme is further supported by the relative frequencies of platform preparation, blade and core trimming element production, ability to remove sequential blades, production of regular and extremely regular blades, flake: blade ratios, and blade core production (Table 7.4). The novice, intermediate, and master scheme can also be used in combination with metric analysis as proximal thickness, medial thickness, and distal thickness frequently reflect novice, intermediate, and master skill levels. There are some exceptions to this; they are discussed at length above and can be found in Table 7.5.

A skilled and unskilled scheme is also supported by the data as some characteristics and metrics revealed distinct differences between novices and masters yet intermediate skill levels were difficult to identify. In these situations, a skilled/unskilled approach is likely most beneficial for analysis. The analytical categories that support the skilled/unskilled approach include platform damage (battering and crushing), termination type frequency, length: width ratio of blades, blade metrics (length, proximal thickness, medial thickness, distal thickness, and mass), removal length, removal width, and a small number of corrective element metrics (Tables 7.4 and 7.5).

A small selection of the tested variables did not have any relationship to skill level and were determined to not be indicators of skill level. These include the width, medial thickness, and mass of crested blades and partially ridged blades, presence of single faceted platforms, and flake counts.

Novice Skills

Novices do not consistently prepare platforms resulting in unpredictable removals. Due to this lack of preparation, blade core shaping, blade core maintenance, and blade production are rare. Novices tend to produce flake cores and many flakes with single faceted platforms. Blades are rare among novice assemblages. Extremely regular blades were never found among the novice blade core reductions. Regular blade removals were rare and irregular blade removals—while uncommon—were the only blades produced by novices. Sequential blades were rare and only occurred in the later flintknapping events after the novices had acquired hours of experience.

Intermediate Skills

Intermediate flintknappers expend more effort preparing platforms than novices but not as much effort as masters. This likely makes predictable removals easier for the intermediate flintknappers. Intermediate flintknappers produce core trimming elements but are not yet proficient enough to utilize the full set of corrective techniques available to them. With the increase in core trimming elements there is also an increase in blade production and blade regularity. Intermediate flintknappers consistently produce irregular and regular blades on blade cores. They are also capable of consistently producing blade cores.

Master Skills

Masters expend significant amounts of effort in preparing platforms and have a significantly higher rate of producing multi-faceted flakes. By investing in platform preparation master flintknappers frequently produce core trimming elements. Masters also know how and when to mobilize the various forms of core trimming and thus maintain blade core profiles through the production of diverse core trimming elements. This investment in both platform preparation and core trimming elements allows masters to frequently produce regular and extremely regular blades as well as sequential blade removals. Masters frequently produce exhausted blade cores since, unlike novice and intermediate flintknappers, they continue the maintenance of a core face until the core is too small to continue flintknapping.

Metric Skill Indicators			
	Novice/Intermediate/ Master	**Skilled/Unskilled**	**No Skill Indication**
Length: width ratio		Blades	
Length	Crested blade	Blades, profile correction blades, core face rejuvenation elements, and partially ridged blades	
Width	Profile correction blades	Blades, core face rejuvenation elements, and partially ridged blades	Crested blades
Proximal Thickness	Blades, profile correction blades, core face rejuvenation elements, partially ridged blades, and crested blades		
Medial Thickness	Profile correction blades, core face rejuvenation elements, and partially ridged blades	Blades	Crested blades
Distal Thickness	Profile correction blades and core face rejuvenation elements	Blades, partially ridged blades, and crested blades	
Mass	Profile correction blades and core face rejuvenation elements	Blades	Partially ridged blades and crested blades

Table 7.4: Level of skill distinction through metric analysis of experimental data. The Novice/Intermediate/Master column indicates lithic measurements that can statistically designate between the three skill levels. The Skilled/Unskilled column denotes metric attributes that can statistically distinguish between skilled and unskilled individuals. The last column, No Skill Indication, indicates the metric attributes that were not useful in determining individual skill level.

Qualitative Skill Indicator			
	Novice	**Intermediate**	**Master**
Platform Preparation		X	X
High Blade Frequency			X
High Core Trimming Element Frequency			X
High Core Trimming Element Diversity			X
Sequential Blades Produced		X	X
Irregular Blades	X	X	
Regular Blades		X	X
Extremely Regular Blades			X
Blade Cores		X	X
Flake Cores	X		

Table 7.5: Qualitative skill indicators. This table presents the common indicators of skill with skill level in the columns and qualitative skills in the rows. Here, platform preparation is indicative of intermediate and master flintknappers, while irregular blades would be indicative of novice or intermediate flintknappers. If one were to find an assemblage with a high blade frequency, high core trimming element frequency, and extremely regular blades, the assemblage could be interpreted as the work of a master flintknapper. If one were to work with an assemblage that had flake cores, a low frequency of blades and they tended to be irregular, and a lack of platform preparation it could be interpreted as an assemblage produced by a novice flintknapper.

Application of Findings

To mobilize the statistical findings of the experiment the key predictors of novice, intermediate, and master skill levels were targeted with a questionnaire. The questions outlined in Appendix H target the range of variability within each skill level group and allow for an individual flintknapper some flexibility within their applied *chaîne opératoire*. Averages and standard deviations of characteristics and metrics were used to set the responses for the questionnaire. The response to each question was weighted and the total number of points accumulated indicate the skill level of the flintknapper who produced the core. Scores between

0-5 indicate a novice flintknapper, 6-11 indicate an intermediate flintknapper, and 12-17 indicate a master flintknapper.

To test the questionnaire, the three test cores identified earlier in this chapter (and produced by the researcher during different phases of learning, i.e., novice, intermediate, and master) were analyzed. Each blade core was entered into the questionnaire to determine the validity of the questions.

The first core produced by the researcher in the earliest stages of learning to knap (DE01) was determined to be a novice through the three dependent variable k-means cluster analysis discussed above. Within the questionnaire, the first core was also identified as a novice core as it acquired five points in the questionnaire.

The second core, DE02, was designated as an intermediate core through the three dependent variable k-means cluster analysis discussed above. Within the questionnaire, DE02 scored eleven points and was identified as an intermediate core in the questionnaire.

The third core, DE03, was designated as a master core through the three dependent variable k-means cluster analysis discussed above. Within the questionnaire, DE03 scored fifteen points and was identified as a master core.

The questionnaire proves to distinguish between the skill levels of flintknappers effectively as each blade core was correctly identified both in the three-dependent variable k-means cluster analysis and through the author's own experience in flintknapping the blade cores.

Effectiveness of Skill Questionnaire within Caches

The experimental reductions, for which skill level analysis is predicated on are complete core reductions missing only flakes smaller than 2.5 cm. Therefore, the skill level approach would work effectively on archaeological flintknapping floors where most or all of the core reduction events occurred. Caches present a different challenge as they are small, intentionally placed collections of lithic artifacts. The entire reduction sequence is not present, nor are cores commonly found in the caches analyzed for this research project at Kharaneh IV.

To test if the skill level analysis approach is effective in caches and concentrations, a medium sized cache was selected to stand in as a representative cache[14]. First, a cache was selected as they are discrete collections of artifacts intentionally placed by a flintknapper (or community member) into the cached location. This is different from a concentration that has diffuse borders and is determined by the excavators to be a location densely packed with debitage and tools of the same or similar raw material. The smallest caches are comprised of 16 artifacts and have a limited number of removals present while the largest cache is comprised of 435 artifacts and has a wide array of removal types present. A middle-sized cache of 29 artifacts was selected (Lithic Concentration 4) to test the viability of the skill level questionnaire on caches. This size cache allows for reproduction of Lithic Concentration 4 within the longitudinal experimental cores (DE01, DE02, and DE03).

[14] It is important to note that cache size is an arbitrary way to distinguish between caches as they are archaeologically produced for a variety of purposes. However, given that the caches from Kharaneh IV, analyzed for this project, are generally similar in composition, this 'representative cache' is useful for assessing skill as it represents many stages of knapping and likely one or a few individuals. This cache has enough pieces to contain the indicators of skill necessary to identify skill listed above.

DE01, DE02, and DE03 were used to replicate Lithic Concentration 4. Twelve flakes, nine blades[15], and five core trimming elements were randomly selected from each blade core reduction. Each test cache was entered into the skill level questionnaire. DE01, the novice core, scored the lowest with five points, clearly identifying this test cache as a novice produced cache. DE02, the intermediate core, scored thirteen points. A high percentage of regular blades, high frequency of multi-faceted platforms, and sequential blade removals placed this cache as a master produced core. Notably, this is two points higher than the entire blade core scored thus selectivity can clearly have an impact on the score of a cache. DE03, the master core, scored sixteen points. A lower frequency of extremely regular blades was the only category that registered lower than 'master' in the cache test. While DE02 does register as a master cache, it does clearly express less skill than DE03. The skill level questionnaire was effectively able to distinguish between skilled and unskilled caches and provided an insight to the level of skill individuals express within the skilled category (more skilled vs less skilled).

Broader Implications

By using an array of skill indicators to determine the skill level of ancient knappers we can further explore assemblage variability. With the ability to determine the skill level of a person(s) who produced a blade core reduction we can distinguish between internal and external variation (Wenger 1998: 128-129). This allows for exploration of communities of practice as internal variation encompasses both: a) community level variability like variable understandings of processes, shared *chaînes opératoires* and technological choices, cultural values and traditions, and shared repertoires for error corrections as these are all socio-genetic actions negotiated within a community of practice and have meaning within the community (Wenger 1998; Saxe 2014) and b) individual level variability like style, idiosyncrasies, and microvariables (Creese 2012) which occur on a micro-genetic level (Saxe 2014). On the other hand, external variation is the variation between communities of practice. Geographic space and educational trajectories within a community of practice can cause new traditions, meanings, and processes within a practice, even when the practice is constrained by raw materials or the fundamental components of knapping (a reductive process that requires percussion or pressure to remove flakes from a larger parent material). Different communities of practice have unique meanings, understandings and knowledge constructed around their practice (Lave and Wenger 1991; Wenger 1998; Saxe 2014).

This experiment allows us to distinguish between internal and external variation. For example, if assemblage variability is high with many variations to a *chaîne opératoire* evident and the knappers are skilled (intermediates or masters) it is likely that the assemblage is a product of external variation. Similarly, if the assemblage variability is high with many variations to the *chaîne opératoire* evident and the knappers are unskilled (novices) it is likely that the assemblage is the product of a learning space. If there is minimal variation to the *chaîne opératoire* and the knappers are both skilled and unskilled, we might further explore the spatial aspects of the flintknapping space to approach community values like inclusivity. We can investigate the spatial relationships between skilled and unskilled individuals, novice accessibility to high quality materials, and even if masters and novices worked together on knapping projects.

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[15] DE01 did not have nine blades as it was a novice level core therefore all of the blades available in DE01 were used in this test (n=2).

The metric and qualitative findings of this experiment make it possible to distinguish between novice, intermediate, and master flintknappers within the archaeological record. In some instances, only skilled and unskilled individuals can be distinguished but this is still useful information when interpreting the archaeological record. These experimental findings can be applied to any blade dominate assemblage from large flintknapping floors to small caches. Making it useful for a variety of site types from small camps and scatters to aggregation sites with large quantities of debitage. The constraining factor is RMU size and determination. Applying this method to a variety of unrelated debitage would not be particularly useful as it would test the skill of all of the participating flintknappers as a whole. Restricting analysis to a single RMU constrains the analysis to the one or the limited number of flintknappers who participated in the reduction of a single blade core. Testing each RMU against the other can then allow for an interpretation for use of space while flintknapping. At Kharaneh IV, seven caches and concentrations from the Early Epipalaeolithic were tested using the methods outlined above to explore skill level within one flintknapping floor. The entire flintknapping floor was analyzed using qualitative analysis only and presents a general overview of the *chaîne opératoire* and techno-typological variation to be expected within the caches.

Chapter Eight
Lithic Analysis and Skill Level Analysis at Kharaneh IV

Early Epipalaeolithic Excavations

Excavations by the Epipalaeolithic Foragers of Azraq Project (EFAP) have revealed six lithic concentrations and caches within Area B near two excavated hut structures. Locus 043 sits above hut structures 1 and 2 (Figure 8.1). This locus is interpreted as an occupation surface and or activity area due to the profuse flat-lying lithic and bone artifacts, as well as an intact hearth in the southeast portion of the area. Small pieces of charcoal are present throughout the layer. This compact layer of sandy sediment is gray (10YR 6/3) with light brown and clay rich patches throughout. Significant flintknapping likely occurred in this area which will be discussed below. The following analysis is focused on three squares: AY72, AY73, and AY74, all of which contained Locus 043 (Figure 8.2). Loci 208, 213, and 212 are associated with Locus 043 (Table 8.1).

Locus 316 is a compact dark brown sediment (10YR 5/3) located outside of Hut Structure 2 (Figure 8.2). This locus has a lower artifact density than the loci above it and adjoining it to the west, but a notably higher artifact density than the hut structure loci. Artifacts are flat-lying and include faunal remains, lithics, and small pieces of charcoal. The layer is interpreted as the outer edge of the hut structure and is distinct from the hut structure feature as well as the adjoining layers.

One locus from Area E was identified and analyzed. BT58 is a 1x1 m excavation unit northwest of Area B, situated between Area A and Area B (Maher et al. 2015). This area was initially excavated by EFAP in 2008 and was expanded in 2019. Locus 014 is a small pale yellow compact layer within BT58 that expands westward into BS57 (Figures 8.3 and 8.4). This layer has fewer artifacts within it than the layer above and the layer below it. Lithics and faunal remains are flat-lying with no other artifact types noted. Within this locus, one RMU was found, a dark brown fine flint. This Early Epipalaeolithic reduction sequence was dated to 19,200 cal BP. Successful refitting work suggests that this area was the primary location of the lithic reduction.

Skill Level Analysis

The criteria for assessing the skill level of ancient flintknappers was determined through the experimental work described in Chapters 5 and 6. It should be noted that the experimental analysis had access to complete blade core reductions. In approaching archaeological lithic caches and concentrations, it must be acknowledged that pieces of the reduction sequence were selected by the flintknapper or other individual and cached or left behind in a concentration. Other parts of the blade core reductions could have occurred elsewhere or were removed from the flintknapping location. The present skill level analysis accounts for the act of caching as it is still possible to score as a novice even with a high blade to flake ratio or a high core trimming element to flake ratio. Characteristics like platform isolation, platform thickness, and ratios of regular and extremely regular blades are highly indicative of skill level and can aid in the determination of skill even in partial reduction sequences.

Early Epipalaeolithic Lithic Caches and Concentrations					
Number	**Locus**	**Squares Present**	**Number of Artifacts**	**Skill Level Expressed**	**Score on Skill Assessment Questionnaire**
LC1	208	AX72	435	Master; sequential blade removals, a diverse array of core trimming techniques employed, thin and prepared platforms, a high core trimming element to flake ratio, a high blade to flake ratio, and the high proportion of regular and extremely regular blades.	16
LC2	043	AY73	17	Master; a high frequency of thin and prepared platforms, has one pair of sequential blades, a high core trimming element to flake ratio, a high blade to flake ratio, and a high proportion of regular and extremely regular blades.	15
LC3	213	AY72 and AX72	16	Master; no sequential blades, core trimming techniques were minimally represented, and no extremely regular blades.	13
LC4	212	AY72	29	Master; variety of core trimming techniques were utilized, platforms were thin and prepared, there was a high blade to flake ratio and a high core trimming element to flake ratio.	13
LC5	316	AV70	101	Master; wide variety of core trimming techniques employed, thin and well-prepared platforms, a high blade to flake ratio and core trimming element to flake ratio, a low frequency of irregular blades, and a high frequency of regular blades.	14
LC6	014	BT58	158	Master; sequential blade removals, a diverse array of core trimming techniques utilized, thin and prepared platforms, a high core trimming element to flake ratio, a high blade to flake ratio, and high frequencies of regular and extremely regular blades.	15
LC7	043	AY72, AY73, AY74, AV72, AV74, and R52/60.P3	199	Master; Sequential blade removals, a wide array of core trimming techniques utilized, thin and prepared platforms, high blade to flake ratio as well as the core trimming element to flake ratio, and there was a high frequency of extremely regular blades.	14

Table 8.1: The seven analyzed caches and concentrations are organized here with locus, square, cache/concentration size, brief overview of skill expression, and the skill assessment score.

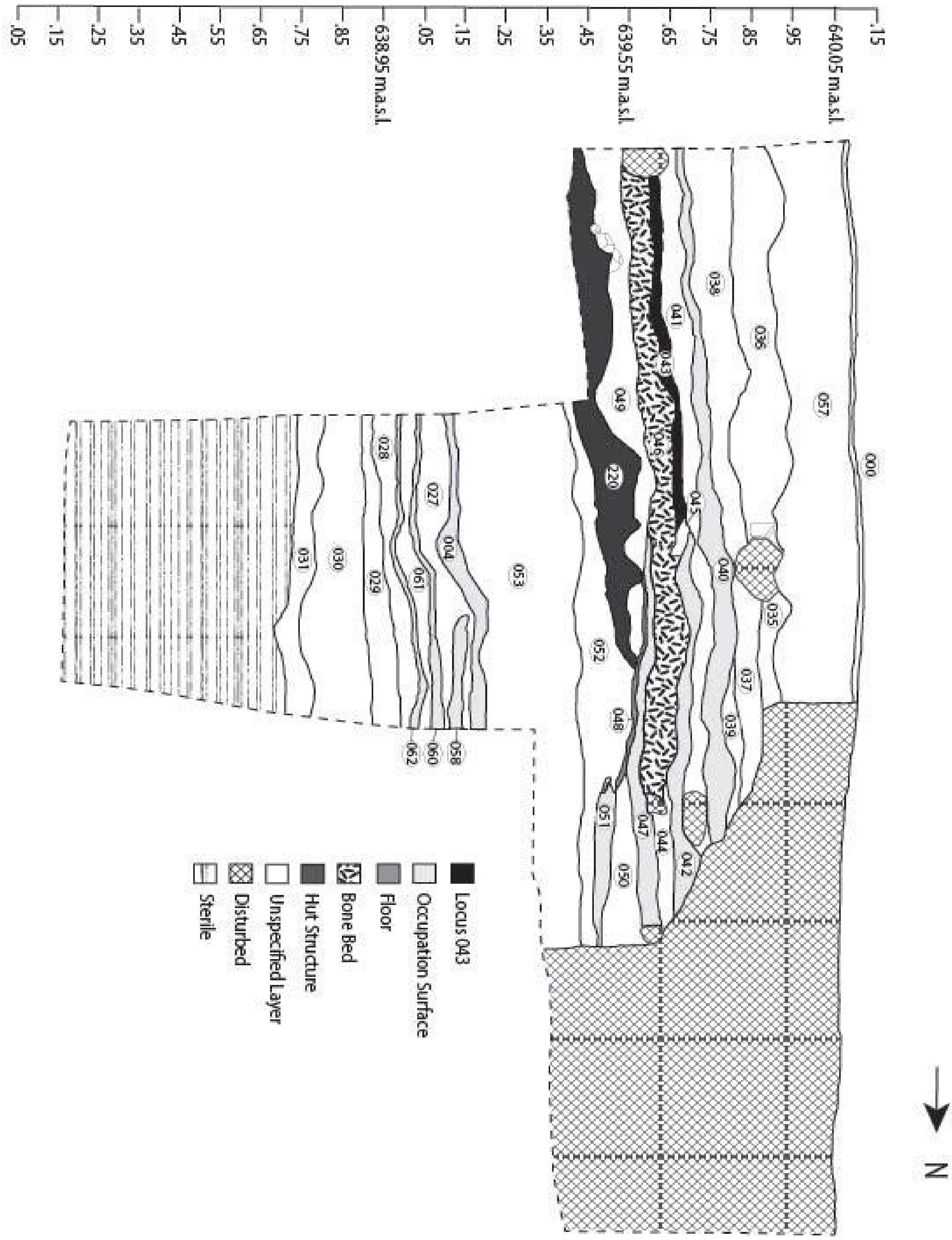


Figure 8.1: Stratigraphic section of Area B with Locus 043, occupation surfaces, structures, and other notable features detailed.

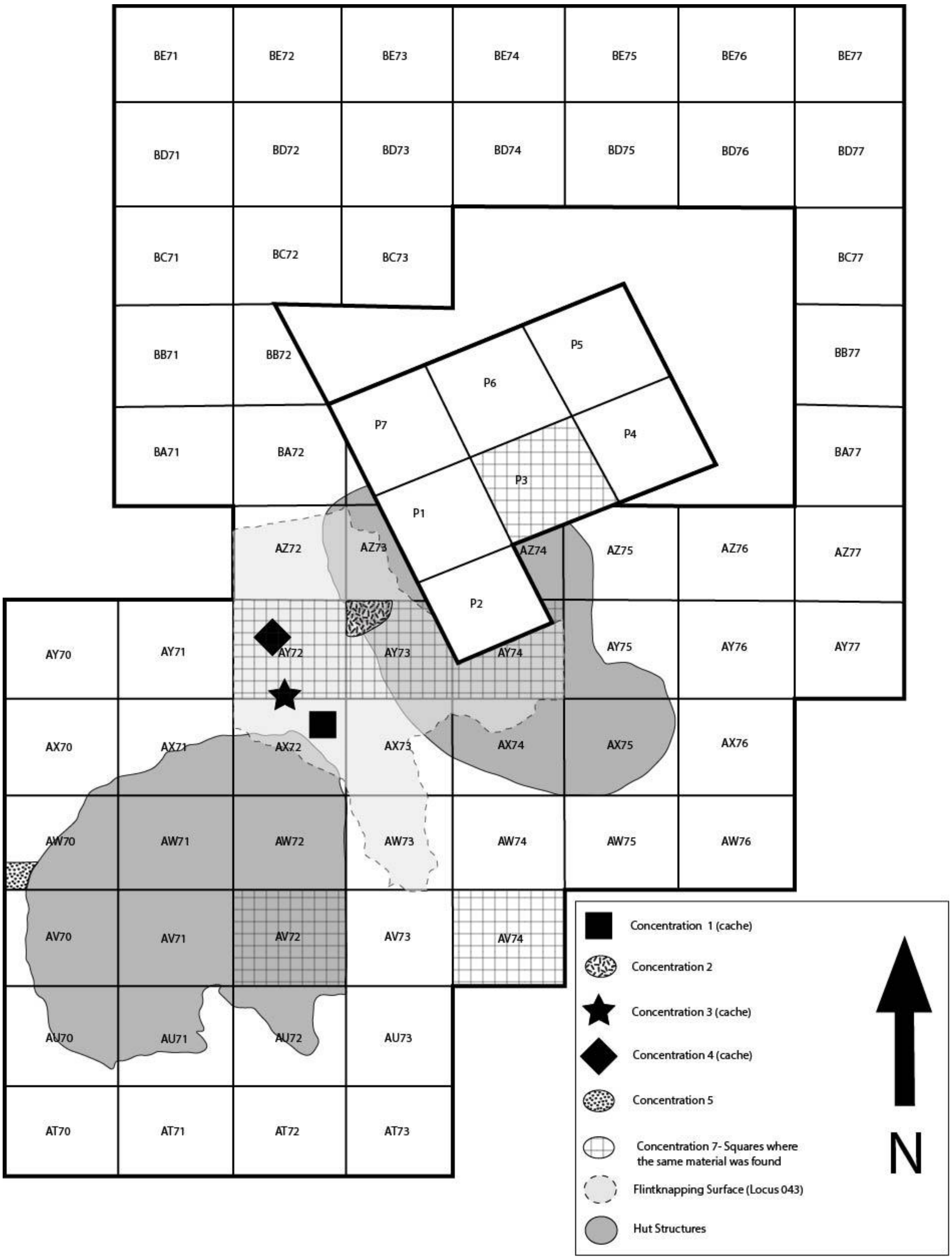


Figure 8.2: This plan map of Area B shows the excavated extent of Locus 043, lithic caches, lithic concentrations, and hut structures.

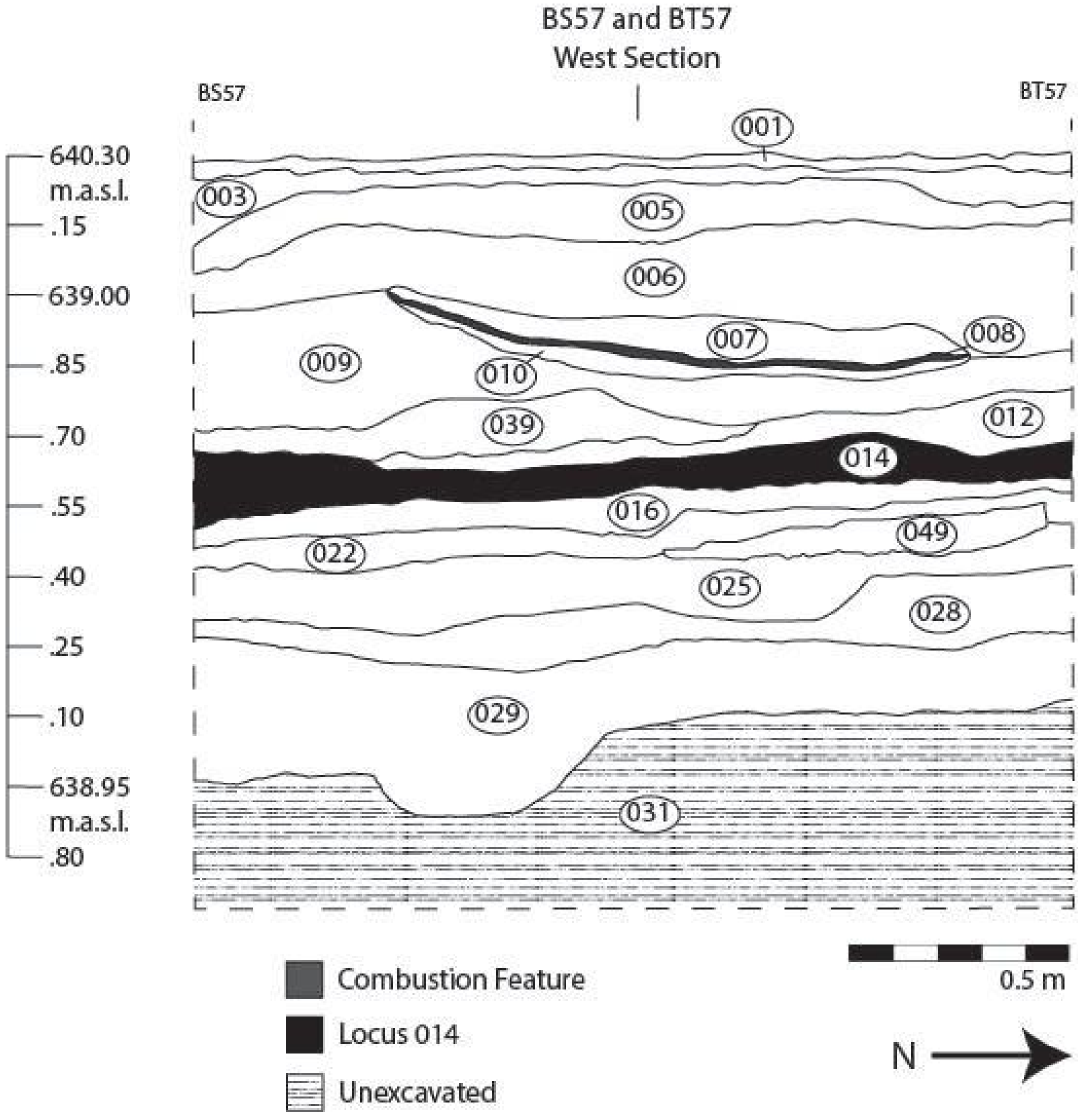


Figure 8.3: Stratigraphic section of Area E with Locus 014 and a combustion feature highlighted.

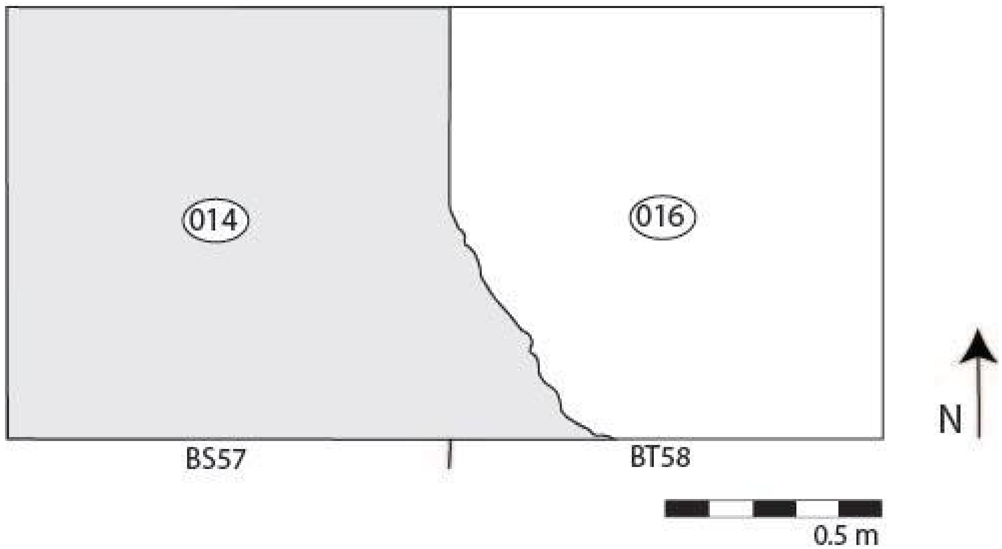


Figure 8.4: This plan map of BS57 and BS58 shows the extent of Locus 014 within BT58.

Figure 8.5: Excavation photo of Locus 014 and 016 in BT58 (BT57 to the West). Locus 014 is described by the excavator as a pale yellow compact silty loam layer with flat laying artifacts. Photo courtesy of E.F.A.P.

Techno-typological Analysis of Locus 043 and Lithic Concentrations

Locus 043

Excavated by EFAP in 2010, Locus 043 is a flintknapping floor[16] where all stages of reduction are present from primary cortex removal to core preparation, core maintenance, and tool production (Figure 8.1). Two incidental refits were found while analyzing the locus. One of the refits is a primary piece that refits to a flake core while the other is a lateral core trimming element that refits to a narrow-faced blade core. While more refits likely exist in the large assemblage, these two refits in combination with the micro-debitage and the limited number of RMU's indicate that Locus 043 is a flintknapping floor. The typo-technological analysis of Locus 043 aligns with other Early Epipalaeolithic excavations at Kharaneh IV (see Figure 8.6 and Table 8.2) (Maher and Macdonald 2013; Macdonald et al. 2018).

Unretouched debitage (n=12,527) is dominant in the assemblage and correlates with previous research in AS42. Unretouched debitage makes up 88.1% of the assemblage compared to 88.3% in AS42. Flakes (n=6,505), writ broadly (includes flakes, secondary flakes, platform isolation elements, and edge preparation elements), compose a large segment of unretouched debitage at 25.6%. Blades (n=2,225) make up 15.7% of the unretouched debitage category and primary pieces (n=14) make up less than 1%. Secondary flakes (n=447) and secondary blades (n=31) are both present. In combination with primary flakes, early phase removals constitute 4.4% of the total assemblage. This suggests that all phases of reduction occurred in Locus 043. The significant presence of chips and shatter (n=6,022) support the interpretation of the flintknapping floor as they compose 42.4% of the assemblage (see Appendix K for detailed lithic analysis of Locus 043 and the Lithic Concentrations). The high frequency of chips and shatter in combination with macro-debitage suggest that Locus 043 is a primary flintknapping location (Hull 1987; Nadel 2001).

Core trimming elements of Locus 043 are significantly more numerous than those of AS42. Core trimming (n=1,026) makes up 7.2% of the assemblage compared to 4.1% in AS42. Diverse approaches to core trimming and error correction in combination with a high core trimming element to flake ratio (.296) suggest highly skilled flintknappers produced the debitage in Locus 043. The blade to flake ratio (.643) further supports this interpretation as experimental findings suggest that core trimming element to flake rations above 0.08 and blade to flake ratios above 0.17 indicate master level flintknappers.

The diversity of core trimming elements by RMU within Locus 043 supports the interpretation of Locus 043 as a masterful flintknapping area. Each RMU within Locus 043 has more than three types of core trimming elements represented. In AY72, the densest of the squares within Locus 043, the fine brown RMU has six types of core trimming elements, the fine gray RMU has eight types of core trimming elements, the medium grained tan confetti RMU has four types of core trimming elements, and the miscellaneous category—which is not considered a single RMU—has four types of core trimming elements present.

In AY73, slightly less densely packed with lithic artifacts, Locus 043 has two distinct RMU's. A fine brown and a fine gray flint, both similar to the RMU's identified in AY72. The

[16] Flintknapping floors are primary flintknapping locations where the practice of flintknapping and stone tool production took place. *In situ* macro-debitage and micro-debitage are considered indicators of primary deposition (Hull 1987).

medium grained tan stippled flint is not present in this square and the miscellaneous category is notably smaller than the miscellaneous RMU in AY72. The fine brown RMU has seven types of core trimming elements represented and the fine gray RMU has five types of core trimming elements present. The miscellaneous category has three types of core trimming elements present.

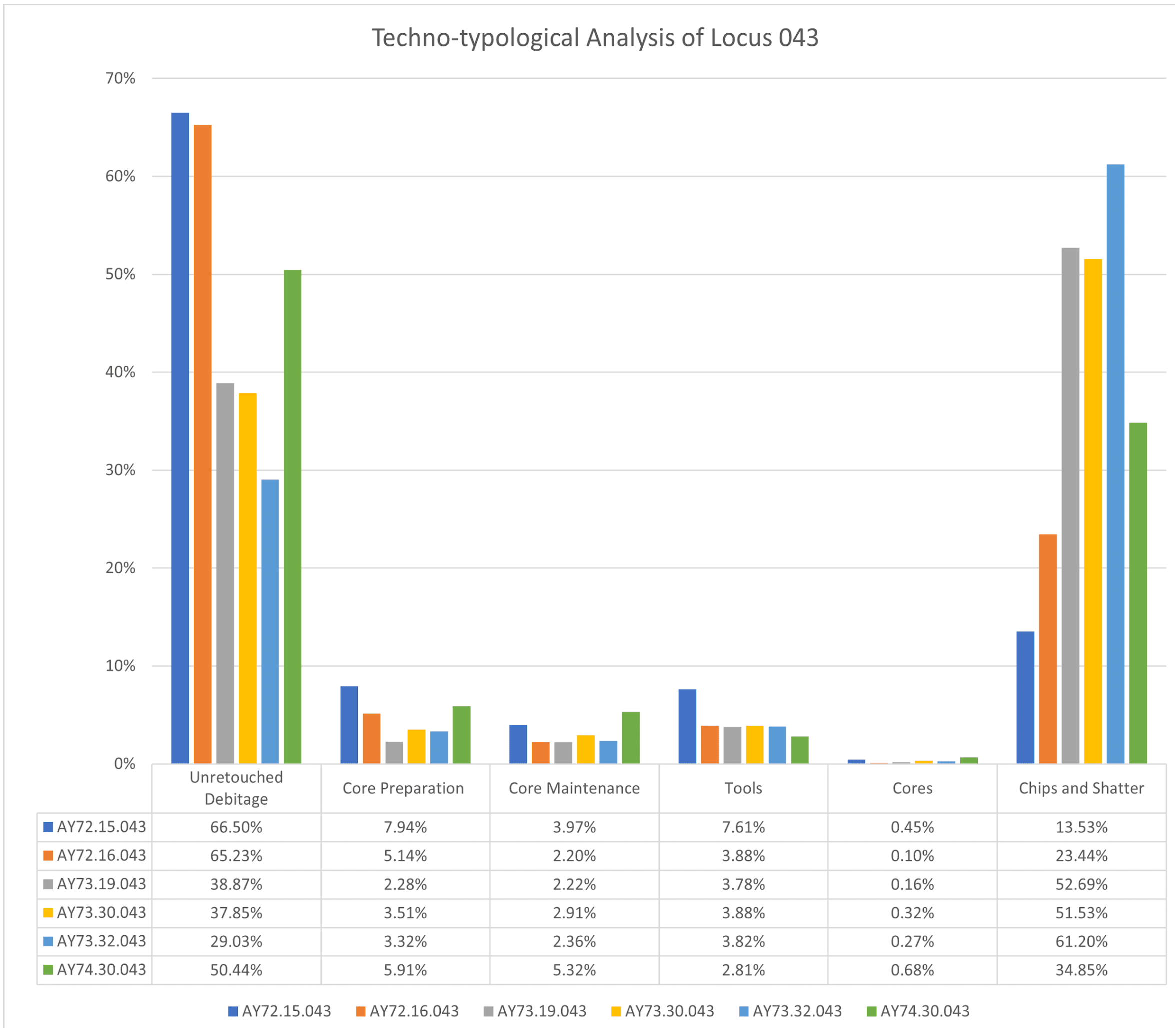
AY74, the least artifact-rich square within Locus 043 has three distinct RMU's and no miscellaneous category. The same fine brown, fine gray, and medium grained tan confetti flint found in AY72 is present in AY74. The fine brown RMU has four types of core trimming elements present, the gray RMU has three types of core trimming elements, and the medium grained tan RMU has four types of core trimming elements present.

The diversity of core trimming elements across the three distinct RMU's within Locus 043 suggest a master level flintknapper(s) produced this reduction. Metric analysis of these deposits will refine the current skill level analysis of Locus 043.

The presence of blade cores (of any type) further suggests skilled reduction in Locus 043. Drawing from the experimental work discussed in previous chapters, novices are consistently unable to produce blade cores while intermediate and master level flintknappers are consistently able to produce blade cores. This suggests that the presence of blade cores indicates master flintknappers were present rather than unskilled flintknappers. AY72 has a total of 12 cores across the three RMU's. Narrow faced cores (n=8) are most common and make-up 66.7% of the core assemblage. Opposed platform cores (n=2) represent 16.6% of the core assemblage. Flake cores (n=1) and core fragments (n=1) are the smallest proportion of the core assemblage and make up 8.3% of the assemblage, respectively. AY73 has a total of 23 cores. Narrow faced cores (n=12) make up 52.2% of the core assemblage, broad faced cores (n=1) and opposed platform cores (n=1) make up 4.3% of the core assemblage, respectively. While flake cores (n=3) make up 13% and core fragments (n=6) make up 26.1% of the total core assemblage. AY74 has a total of seven cores. Narrow faced cores (n=3) and broad faced cores (n=3) are most common and make up 42.9% of the core assemblage respectively, and core fragments (n=1) make up 14.3% of the assemblage. Across Locus 043, blade cores are dominant at 71.4% of the assemblage, followed by core fragments at 19%, and flake cores at 9.6% of the assemblage. While flake cores are indeed common and used for making stone tools (Bar Yosef 1970; Goring-Morris 1987; Belfer-Cohen and Goring-Morris 2002; Garrard and Byrd 2013; Maher and Macdonald 2016), the assumption that blade cores are the goal in core reduction has been made here as the tools produced at Kharaneh IV are predominately made on blades and bladelets and the *chaîne opératoire* present is dominated by a blade-based industry. With this assumption, the dominance of blade cores in Locus 043 suggests skilled flintknappers worked in the area to produce the debitage and cores on the flintknapping floor.

When compared to AS42, Locus 043 matches previous findings for Early Epipalaeolithic excavations at Kharaneh IV. Early phase reductions and production of non-retouched debitage in Locus 043 (88.1%) is consistent with the reductions of AS42 (88.3%). Tool presence is slightly lower in 043 (4.4%) than AS42 (5.2%) while core trimming elements in Locus 043 (7.2%) are more common than in AS42 (4.1%). Finally, cores are significantly less common in Locus 043 (0.3%) than they are in AS42 (2%). This may suggest that Locus 043 was a specialized tool production area where tool use and disposal was not emphasized in this location. This is evidenced by the large number of unretouched debitage in early and non-diagnostic phases and a significant core trimming element presence, further supporting the interpretation of this locus as a flintknapping floor.

Lithic concentrations related to Locus 043 support this middle phase interpretation as core trimming elements and blades are frequent and dominate over the tool assemblages within their respective lithic concentrations (see Figure 8.7). Larger lithic concentrations (>100 artifacts) have a core trimming element frequency similar to Locus 043. Smaller lithic concentrations (<100) have a much higher frequency of core trimming elements than Locus 043 or AS42, which is likely due to the small sample size and the selective nature of caching.

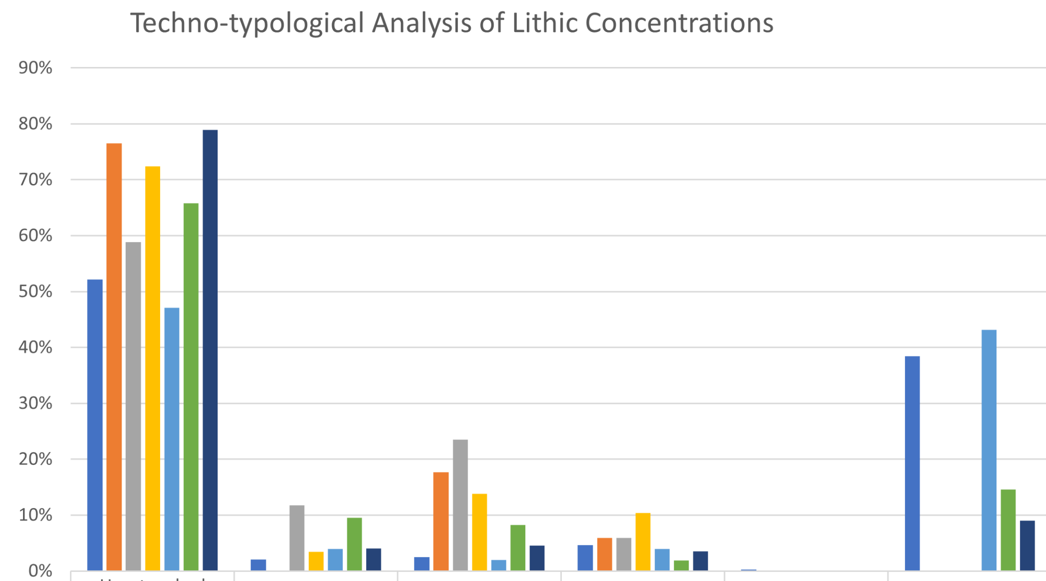


	Unretouched Debitage	Core Preparation	Core Maintenance	Tools	Cores	Chips and Shatter
AY72.15.043	66.50%	7.94%	3.97%	7.61%	0.45%	13.53%
AY72.16.043	65.23%	5.14%	2.20%	3.88%	0.10%	23.44%
AY73.19.043	38.87%	2.28%	2.22%	3.78%	0.16%	52.69%
AY73.30.043	37.85%	3.51%	2.91%	3.88%	0.32%	51.53%
AY73.32.043	29.03%	3.32%	2.36%	3.82%	0.27%	61.20%
AY74.30.043	50.44%	5.91%	5.32%	2.81%	0.68%	34.85%

Figure 8.6: This bar graph compares the lithic artifacts of Locus 043 across three excavated squares (AY72, AY73, and AY74). Unretouched debitage and chips and shatter are the most common artifact types in Locus 043. This is consistent with the interpretation of the locus being an active flintknapping area during the Early Epipalaeolithic. All phases of flintknapping are represented here from early cortex removal to core preparation, maintenance, and tool production. Core preparation is more frequent in this locus than core maintenance, which aligns with previous research at the site of Kharaneh IV in square AS42 where core preparation was also prioritized over core maintenance (Maher and Macdonald 2013).

Techno-Typological Analysis Locus 043				
Lithic Class	Lithic Sub-Class	Sub-Count	Count	Percent
Debitage			6505	45.76%
	Flakes	3461		
	Blades	2225		
	Primary Pieces	141		
	Secondary Flakes	447		
	Secondary Blades	31		
	Platform Isolation Elements	85		
	Edge Preperation Elements	93		
	Other	22		
Core Trimming Elements			1026	7.22%
	Core Preperation	611		
	Core Maintenance	415		
Tools			619	4.35%
Cores			42	0.30%
Chips and Shatter			6022	42.37%
Total:			14214	100.00%

Table 8.2: Techno-typological analysis of the lithic assemblage from Early Epipalaeolithic deposit Locus 043. All phases of flintknapping are present in this locus with blades clearly a dominate unretouched debitage type. Core preparation is more common in this locus than core maintenance. The significant presence of chips and shatter suggest that this locus is a primary deposition (Hull 1987) location making this locus a flintknapping floor.



	Unretouched Debitage	Core Preparation	Core Maintenance	Tools	Cores	Chips and Shatter
Lithic Concentration 1	52.18%	2.07%	2.53%	4.60%	0.23%	38.39%
Lithic Concentration 2	76.47%	0.00%	17.65%	5.88%	0.00%	0.00%
Lithic Concentration 3	58.82%	11.76%	23.53%	5.88%	0.00%	0.00%
Lithic Concentration 4	72.41%	3.45%	13.79%	10.34%	0.00%	0.00%
Lithic Concentration 5	47.06%	3.92%	1.96%	3.92%	0.00%	43.14%
Lithic Concentration 6	65.82%	9.49%	8.23%	1.90%	0.00%	14.56%
Lithic Concentration 7	78.89%	4.02%	4.52%	3.52%	0.00%	9.05%

Lithic Concentration 1 Lithic Concentration 2 Lithic Concentration 3 Lithic Concentration 4
Lithic Concentration 5 Lithic Concentration 6 Lithic Concentration 7

Figure 8.7: This bar graph compares the lithic artifacts found within the seven lithic concentrations. Unretouched debitage is far more prominent in the lithic concentrations (an average of 64.78% across the lithic concentrations) than in Locus 043 (averaging 47.99% across Locus 043). Core preparation and core maintenance debitage is highly variable in the caches but skewed towards core maintenance. Tools are generally well represented, predominantly as non-geometric microliths. Cores were uncommon and only present in one lithic concentration. Chips and shatter were highly variable. This is likely because the lithic concentrations are secondary contexts and less likely to have chips and shatter deposited with them (Hull 1987).

Lithic Concentration 1

Locus 208 is located in AX72 (Figure 8.2) and is a cache cut into Locus 043 consisting of a flake core with many small flakes of the same material. This large homogenous cache (n=435) is a light brown fine flint (Table 8.3)
. The flakes were in direct contact with each other and had no sediment in between them (Figure 8.3). The cache continued under Locus 043 to the west approximately 10 cm. A bone point was excavated with this cache and was situated below the lithic artifacts. Twenty-four refits were found in this flake dominated cache.

Lithic Concentration 1 has seven unique refit sequences within the one RMU. Listed from the earliest removal to the latest removal, sequence one consists of four lateral core trimming pieces and then a flake. Sequence two consists of three flakes. Sequence three consists of two blades. Sequence four consists of three lateral core trimming elements and a blade. Sequence five consists of a secondary blade, a flake, and a blade. Sequence six consists of two blades, two profile correction blades, and a blade. Sequence seven consists of two blades. See Appendix L for detailed images of all refits. Lateral core trimming elements were the most common refit and the easiest to match due to their curved shape and clear stripes which aided in the identification of potential matches. Removals with cortex were also easy to refit as the texture and patterning of the cortex aided in identifying potential matches. Finally, blades with no cortex and no striped pattern were the most difficult to refit. As most of the blades were regular or extremely regular in form, the consistent blade shape with minimal visual cues made blades the most difficult category to refit.

The artifacts in this cache showed evidence for expert skills in blade/bladelet production; arguably more so than other analyzed contexts. The presence of sequential blade removals, a diverse array of core trimming techniques employed, thin and prepared platforms, a high core trimming element to flake ratio, a high blade to flake ratio, and the high proportion of regular and extremely regular blades present all suggest master level knapping skills. Indeed, this concentration received a 16 out of a total of 17 points in the questionnaire, indicating that the individual who produced this concentration was a master flintknapper.

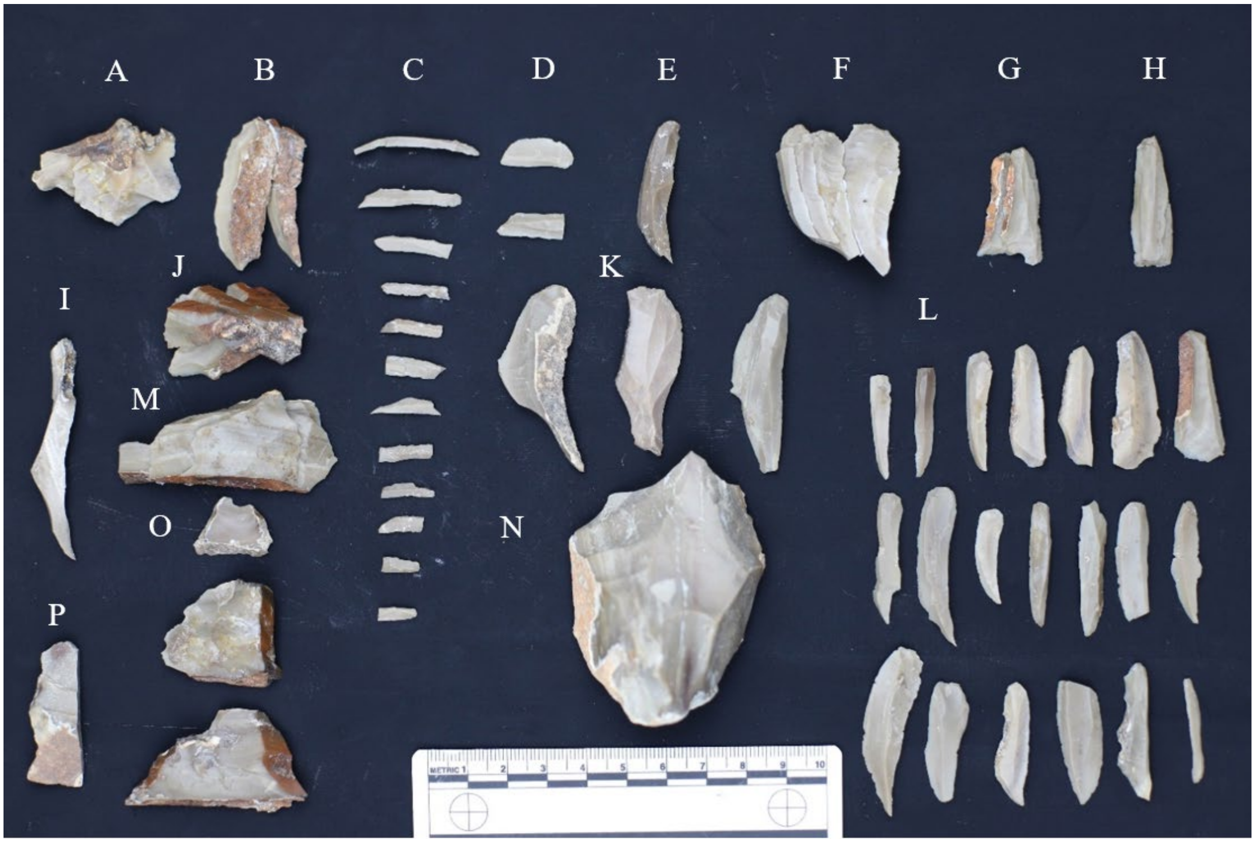


Figure 8.8: Lithic Concentration 1 see Appendix L for detailed photos of refitted artifacts. From left to right, A) refit sequence two, B) refit sequence five, C) non-geometric microliths, D) geometric microliths, E) Profile correction blade, F) refit sequence six, G) refit sequence three, H) refit sequence seven, I) crested blade, J) refit sequence one, K) core face rejuvenation elements, L) blades, M) refit sequence four, N) flake core, O) lateral core trimming elements, P) non-initial core tablet. Flakes, fragmented blades, chips, and shatter were excluded from the photo.

Figure 8.9: Lithic Concentration 1 excavated from AX72 Locus 208, cut into Locus 043. Photo courtesy of E.F.A.P.

Techno-Typological Analysis Lithic Concentration 1				
Lithic Class	Lithic Sub-Class	Sub-Count	Count	Percent
Debitage			227	52.18%
	Flakes	85		
	Blades	88		
	Primary Pieces	6		
	Secondary Flakes	1		
	Secondary Blades	1		
	Platform Isolation Elements	40		
	Edge Preperation Elements	6		
Core Trimming Elements			20	4.60%
	Core Preperation	9		
	Core Maintenance	11		
Tools			20	4.60%
Cores			1	0.23%
Chips and Shatter			167	38.39%
Total:			435	100.00%

Table 8.3: Techno-typological analysis of the Early Epipalaeolithic deposit Locus 208. Blades and bladelets are well represented in this cache and make up nearly half of the unretouched debitage.

Lithic Concentration 2

Lithic concentration 2 is a small blade concentration (n= 17) that was excavated within Locus 043 in AY73. This Locus was collected separately from the rest of Locus 043 but given the same locus number as the rest of the larger locus. The artifacts are all made on the same glassy light brown flint. One refit sequence with two blades were found in this blade dominated concentration (Figure 8.9).

The artifacts within this cache are homogonous in color, translucency, grain size, luster, and patterning (stippled) thus suggesting a single RMU. The single pair of refits in this concentration were quickly identified due to the presence of unique cortex color, pattering, and similar removal scars. The *chaîne opératoire* of this assemblage is clearly intended for blade production as the core trimming elements are all core maintenance pieces (partial ridge blade and profile correction blades) with significant evidence of previous bladelet removal (See Table 8.4).

This concentration has a high frequency of thin and prepared platforms, has one pair of sequential blades, a high core trimming element to flake ratio, a high blade to flake ratio, and a high proportion of regular and extremely regular blades. Blade regularity and the frequency of blades are the two most distinct indicators of highly skilled individuals, while the lack of core trimming technique diversity is an indicator of less skill. Overall, the concentration scored 15 of 17 total points and was likely produced by a master flintknapper.

Figure 8.10: Glassy light brown lithic concentration from within Locus 043. Lithic Concentration 2 consists of: A) partial ridged blade, B) burin, C) blades, D) flakes, E) profile correction blades, F) refit sequence one. For detailed images of the refit sequence see Appendix L.

Techno-Typological Analysis Lithic Concentration 2				
Lithic Class	Lithic Sub-Class	Sub-Count	Count	Percent
Debitage			13	76.47%
	Flakes	3		
	Blades	10		
	Primary Pieces	0		
	Secondary Flakes	0		
	Secondary Blades	0		
	Platform Isolation Elements	0		
	Edge Preperation Elements	0		
Core Trimming Elements			3	17.65%
	Core Preperation	0		
	Core Maintenance	3		
Tools			1	5.88%
Cores			0	0.00%
Chips and Shatter			0	0.00%
Total:			17	100.00%

Table 8.4: Lithic assemblage from Early Epipalaeolithic lithic concentration within Locus 043. This concentration is blade dominate and represents later phases of blade core reduction.

Lithic Concentration 3

Locus 213 is a small cache cut into Locus 043 (n=16) on the border between AY72 and AX72 (Figure 8.11). This blade dominated cache was produced on a fine tan flint (Table 8.5). The orange cortex was utilized to aid in refitting and the graded coloration (from orange to light tan) was useful for determining the relatedness of debitage. Even with useful RMU identifiers like color and patterns I was unable to find refits within the artifacts of this cache or with Lithic Concentration 4.

The artifacts in this cache suggest a skilled flintknapper produced the reduction. The cache did display thin and prepared platforms, a high core trimming element to flake ratio, a high blade to flake ratio and a high frequency of regular blades suggest the artifacts in the cache were produced by a master flintknapper. There were no sequential blades, core trimming techniques were minimally represented, and no extremely regular blades were present resulting in a score of 13 of 17 points. This score is the lowest in the master range (13-17) and the lowest score (with lithic concentration 4) of the lithic concentrations analyzed. It should be noted that as this is a cache, "good" blades were likely removed for tool making before caching took place.

Figure 8.11: Fine tan lithic cache cut into Locus 043. No refits were found in this cache although some of the blades looked like they would refit to some of the core trimming elements. Pictured here: A) profile correction blades, B) lateral core trimming elements, C) flakes, D) blades, E) partial ridged blade.

Techno-Typological Analysis Lithic Concentration 3				
Lithic Class	Lithic Sub-Class	Sub-Count	Count	Percent
Debitage			10	62.50%
	Flakes	4		
	Blades	6		
	Primary Pieces	0		
	Secondary Flakes	0		
	Secondary Blades	0		
	Platform Isolation Elements	0		
	Edge Preperation Elements	0		
Core Trimming Elements			6	37.50%
	Core Preperation	2		
	Core Maintenance	4		
Tools			0	0.00%
Cores			0	0.00%
Chips and Shatter			0	0.00%
Total:			16	100.00%

Table 8.5: Lithic assemblage from Early Epipalaeolithic cache Locus 213, within Locus 043. This small cache is blade dominate with core maintenance better represented than core preparation. This cache represents part of a middle-late phase reduction.

Lithic Concentration 4

Locus 212 is a small cache cut into Locus 043 (n= 29) in the northwest quadrant of AY72. This blade dominant cache was produced on a fine tan flint (Figure 8.12). No refits were found within this cache and no artifacts refitted with Lithic Concentration 4 which has similar material. Some transparent flint artifacts (n=7) were present in this cache and were analyzed with Lithic Concentration 7. The transparent flint artifacts from within Lithic Concentration 4 included: blades (n=4), primary pieces (n=1), and flakes (n=2). Two pieces of brown flint were also found and analyzed with this cache; a profile correction blade (n=1) and a non-initial core tablet (n=1) (Table 8.6).

The artifacts in this cache have characteristics that suggest they were produced by a master flintknapper. A wide variety of core trimming techniques were utilized, platforms were thin and prepared, there was a high blade to flake ratio and a high core trimming element to flake ratio. There were no sequential blades found in the assemblage, a high percentage of blades were irregular in shape and a low percentage of the blades were extremely regular. This cache totaled 13 of 17 points and is considered to have been produced by a master flintknapper.

Figure 8.12: Fine tan lithic cache cut into Locus 043. No refits were found in this cache although some of the blades looked like they would refit to some of the core trimming elements. Pictured here: A) profile correction blades, B) lateral core trimming elements, C) flakes, D) blades, E) partial ridged blade. Not pictured here are flakes and platform isolation elements.

Techno-Typological Analysis Lithic Concentration 4				
Lithic Class	Lithic Sub-Class	Sub-Count	Count	Percent
Debitage			21	72.41%
	Flakes	12		
	Blades	6		
	Primary Pieces	0		
	Secondary Flakes	0		
	Secondary Blades	0		
	Platform Isolation Elements	2		
	Edge Preperation Elements	0		
Core Trimming Elements			5	17.24%
	Core Preperation	1		
	Core Maintenance	4		
Tools			3	10.34%
Cores			0	0.00%
Chips and Shatter			0	0.00%
Total:			29	100.00%

Table 8.6: Lithic assemblage from Early Epipalaeolithic cache Locus 212, within Locus 043. This small cache is flake dominate with core maintenance better represented than core preparation. This cache represents part of a middle-late phase reduction.

Lithic Concentration 5

Locus 316 is a large concentration (n=101) of lithic artifacts located in Locus 316 near the exterior border of Hut Structure 2 in AV70 (Table 8.7). This concentration consists of three separate RMU's: brown (n= 37), gray (n= 13), and miscellaneous (n=51). This concentration is flake dominant and made on fine flint. No refits were found in the brown or grey RMU's.

The artifacts in this concentration have characteristics that suggest they were produced by a skilled flintknapper. with a wide variety of core trimming techniques employed, thin and well-prepared platforms, a high blade to flake ratio and core trimming element to flake ratio, a low frequency of irregular blades, and a high frequency of regular blades this assemblage was likely produced by a master flintknapper. The assemblage scored low within the master range (14 out of 17) due to the lack of sequential blades and a low frequency of extremely regular blades.

Figure 8.13: Fine brown RMU within the lithic concentration West of Hut Structure Two. The lithics in this concentration are not homogonous. Pictured above: A) faceted initial core tablet, B) partial ridged blade, C) non-geometric microliths, D) burin spall, E) initial core tablet, F) lateral core trimming element, G) blades. Not pictured here are flakes, secondary flakes, or edge preparation elements.

Figure 8.14: Fine grey RMU within the lithic concentration West of Hut Structure Two. The lithics in this concentration were homogenous. Pictured above: A) profile correction blade, B) blades.

Techno-Typological Analysis Lithic Concentration 5				
Lithic Class	Lithic Sub-Class	Sub-Count	Count	Percent
Debitage			48	47.06%
	Flakes	31		
	Blades	14		
	Primary Pieces	0		
	Secondary Flakes	2		
	Secondary Blades	0		
	Platform Isolation Elements	0		
	Edge Preperation Elements	1		
Core Trimming Elements			6	5.88%
	Core Preperation	4		
	Core Maintenance	2		
Tools			4	3.92%
Cores			0	0.00%
Chips and Shatter			44	43.14%
Total:			102	100.00%

Table 8.7: Lithic assemblage from Early Epipalaeolithic deposit Locus 316. Lithic assemblage from Early Epipalaeolithic and located to the West of Hut Structure Two. This small cache is flake dominate with core maintenance better represented than core preparation. This cache represents part of a middle-late phase reduction.

Lithic Concentration 6

Locus 014 is located in a different excavation area of Kharaneh IV (Area E). Square BT58 was excavated in 2019 by EFAP. This large dark brown concentration of fine flint (n= 158) was noted for the similarity in raw material of all of the lithic artifacts (Table 8.8). This blade dominant concentration has produced thirteen refit sequences.

All of the material in this lithic concentration is homogonous with the exception of the end scraper (Figure 8.15). Refits were relatively easy to make as the core trimming elements had unique curvatures and cortex that allowed for matching of shapes, colors, and textures. Early phase removals (secondary flakes, flakes, and lateral core trimming) as well as later phase removals (blades, profile correction blades, partial ridged blades, and blades/bladelets). The frequency of refits is much higher in this concentration than any of the other concentrations and suggests that this concentration represents a full blade core reduction. There was a minimal presence of chips which suggests that the concentration is a secondary deposit.

This large lithic concentration has many characteristics of being produced by a skilled flintknapper. This assemblage has sequential blade removals, a diverse array of core trimming techniques utilized, thin and prepared platforms, a high core trimming element to flake ratio, a high blade to flake ratio, and high frequencies of regular and extremely regular blades. There was also a high frequency of irregular blades, which alone, indicates lower skill levels but in combination with high frequencies of regular and extremely regular blades it does not suggest unskilled flintknapping. This concentration was likely produced by a master flintknapper as it scored 15 out of 17 points on the skill assessment questionnaire.

Figure 8.15: Dark brown flint concentration from square BT58, Locus 014. Pictured here from right to left: A) refit sequence one, B) refit sequence two, C) refit sequence three, D) refit sequence four, E) refit sequence five, F) refit sequence six, G) refit sequence seven, H) refit sequence eight, I) refit sequence nine, J) refit sequence ten, K) refit sequence eleven, L) refit sequence twelve, M) refit sequence thirteen, N) geometric microlith (top) and non-geometric microlith (bottom), O) lateral core trimming elements, P) partial ridged blade, Q) end scraper, R) blades, S) core face rejuvenation element, T) profile correction blade. Not pictured here are primary pieces, flakes, platform isolation elements, and chips. For detailed images of the refit sequences see Appendix L.

Techno-Typological Analysis Lithic Concentration 6				
Lithic Class	Lithic Sub-Class	Sub-Count	Count	Percent
Debitage			104	65.82%
	Flakes	19		
	Blades	60		
	Primary Pieces	4		
	Secondary Flakes	0		
	Secondary Blades	2		
	Platform Isolation Elements	19		
	Edge Preperation Elements			
Core Trimming Elements			28	17.72%
	Core Preperation	15		
	Core Maintenance	13		
Tools			3	1.90%
Cores			0	0.00%
Chips and Shatter			23	14.56%
Total:			158	100.00%

Table 8.8: Lithic assemblage from Early Epipalaeolithic deposit (Area E) Locus 014. This large concentration is blade dominated with core preparation better represented than core maintenance. This concentration has a wide variety of debitage types including tools which suggests that the concentration is a late phase reduction.

Lithic Concentration 7

Lithic concentration 7 was found during techno-typological analysis of Locus 043. This concentration is notable as it is a translucent white flint. This concentration is most dense in AY72 (n=168) but similar material has been found in AY73 (n=22), AY74 (n= 6), and has a minimal presence in AV72 (n=1), AV74 (n=1), and R52/60.P3 (n=1) (Figure 8.27). This large concentration (n=199) is blade dominant with a significant non-geometric microlith presence (n= 5) (Table 8.9 and see Appendix K for detailed lithic analysis).

Refitting in this concentration was particularly difficult. While the translucent flint was easy to distinguish from other raw materials, the flint is extremely homogenous and has few patterns, color changes, texture changes, or opacity differences. Some lateral core trimming elements did have banding which aided in situating the more opaque pieces with the more translucent ones. Cortex is uncommon in this concentration and is either black, white, or orange. This also aided in refitting the artifacts but there was not enough cortex to be significantly useful. The most useful characteristic for refitting this concentration was the shape of the removals. While this did not help with refitting the blades because they tended to be regular or extremely regular, the removal shape did aid in refitting core trimming elements. Extremely regular blades are difficult to refit as they are often very narrow and nearly identical to other extremely regular blades. Therefore, removal shape and curvature is the determining factor in whether two extremely regular (or regular blades) refit with one another.

The skill level analysis of this concentration is an amalgamation of all the areas the translucent material was found in near and within Locus 043. No cores were associated with this assemblage. Sequential blades were present, a wide array of core trimming techniques was employed to produce the assemblage. Platforms were thin and well prepared, the blade to flake ratio is high as well as the core trimming element to flake ratio, and there was a high frequency of extremely regular blades. There was a high proportion of irregular blades and a lower frequency of regular blades. This concentration was likely produced by a master flintknapper as it scored 14 of 17 points.

The following photos are divided by square, locus, and bag number. Blades, core trimming elements, tools, and refits are included in the photos while flakes, chips, edge preparation elements, platform isolation elements, and secondary flakes are not pictured. For detailed images of the refit sequences see Appendix L.

Figure 8.16: AY72 Locus 041, Bag 10. This assemblage is predominantly blades and does not have any refitting material.

Figure 8.17: Translucent flint from square AY72, Locus 043, Bag 14. Pictured here: A) refit sequence one, B) refit sequence two, C) non-geometric microliths, D) profile correction blades, E) lateral core trimming elements, F) blades. Not pictured here are flakes or chips.

Figure 8.18: Translucent flint from square AY72, Locus 043, Bag 15. Pictured here: A) lateral core trimming element, B) blades.

Figure 8.19: Transluscent flint from square AY72, Locus 043, Bag 16. Pictured here: A) lateral core trimming elements, B) blades.

Figure 8.20: Transluscent flint from square AY72, Locus 212, Bag 17. Pictured here are two irregular blades and two extremely regular blades.

Figure 8.21: Transluscent flint from square AY73, Locus 043, Bag 19. Pictured here are two irregular blades, three regular blades, and two extremely regular blades.

Figure 8.22: Transluscent flint from square AY73, Locus 043, Bag 30. Pictured here: A) non-geometric microliths, B) blade fragments.

Figure 8.23: Transluscent flint from square AY74, Locus 088, Bag 12. Pictured here: A) lateral core trimming element, B) blades.

Figure 8.24: A finely retouched non-geometric microlith on transluscent flint from AV72, Locus 143, Bag 15.

Figure 8.25: Transluscent flint from square AV74, Locus 088, Bag 18. Pictured here is a core face rejuvenation element.

Figure 8.26: Transluscent flint from square R/52/60.P3, Locus 102, Bag 88. This notch is the only macro tool found within Lithic Concentration 7.

Techno-Typological Analysis Lithic Concentration 7				
Lithic Class	Lithic Sub-Class	Sub-Count	Count	Percent
Debitage			157	78.89%
	Flakes	68		
	Blades	65		
	Primary Pieces	1		
	Secondary Flakes	6		
	Secondary Blades	3		
	Platform Isolation Elements	12		
	Edge Preperation Elements	2		
Core Trimming Elements			17	8.54%
	Core Preperation	8		
	Core Maintenance	9		
Tools			7	3.52%
Cores				0.00%
Chips and Shatter			18	9.05%
Total:			199	100.00%

Table 8.9: Lithic assemblage from Early Epipalaeolithic deposits Loci 043, 041, 212, 088, and 143. Flakes and blades are evenly distributed with significant core trimming element and tool presence. This lithic concentration likely represents the late phase of a blade core reduction.

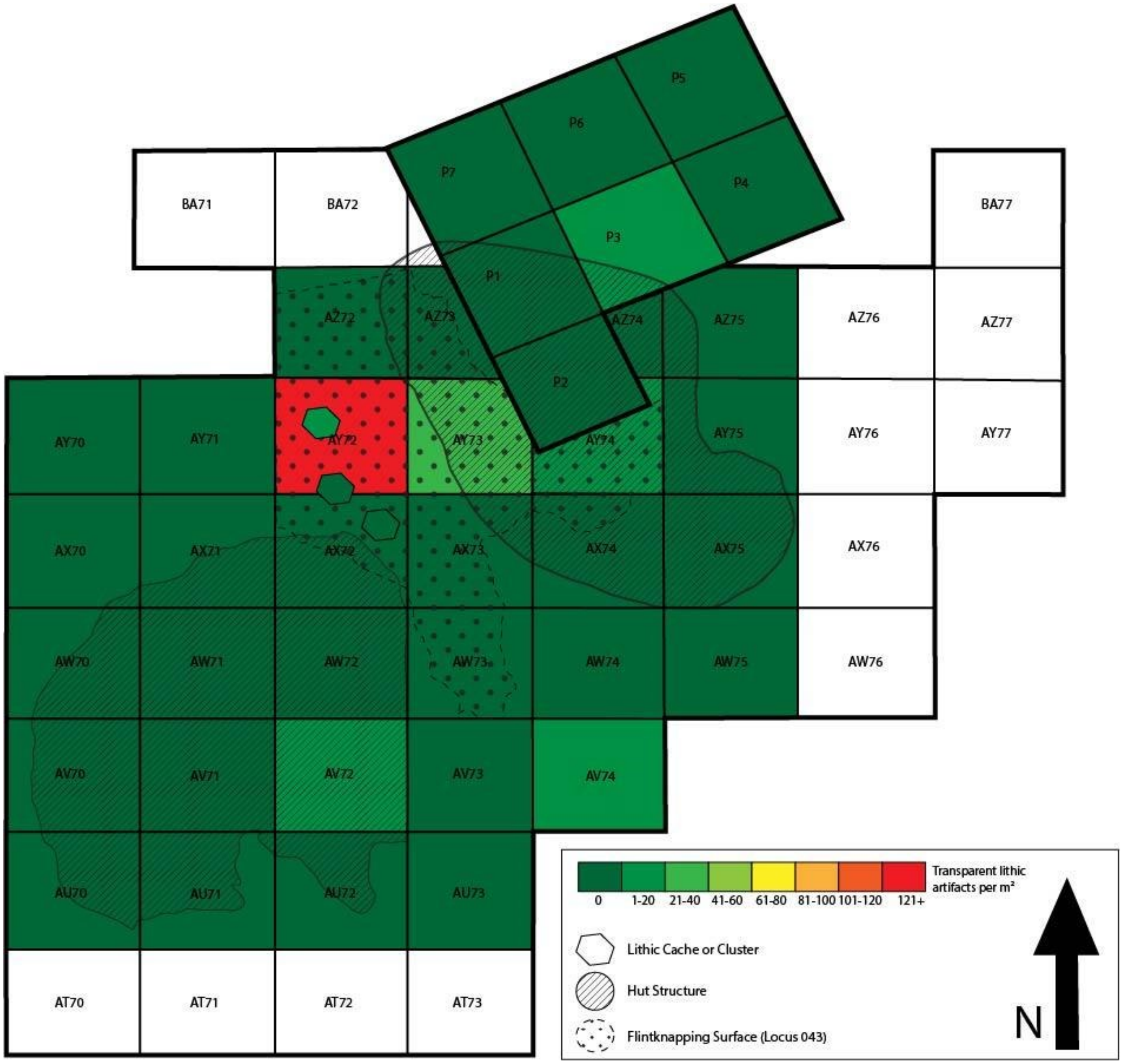


Figure 8.27: This heat map depicts the presence of clear flint from Lithic Concentration 7 across Area B in excavation units adjacent to Locus 043.

Chapter 9
Interpretations and Conclusions

Contextualizing Flintknapping Skill

Technological practices do not occur within a vacuum and are clearly influenced by social environments, local ecosystems, material agencies, and individual knowledge or skill. Therefore, to gain a contextualized understanding of blade core reduction sequences at Kharaneh IV we must look at the community that produced them. Communities of practice include members of all skill levels and to understand how a technological tradition is organized and maintained through time we must distinguish between skilled masters, intermediate practitioners, and unskilled novices to clearly define the community and the negotiated importance of various aspects of the *chaîne opératoire,* here viewed as values within the flintknapping community (Lave and Wenger 1991; Wenger 1998). By evaluating how masters, intermediates, and novices interact with the same body of knowledge we can reconstruct meaningful actions and divide them from less meaningful ones that would likely be more prone to change through time (Walleart-Petre 2012).

Through my experimental work I have identified both morphological and metric aspects of blade core reductions that are connected to skill level. This work has fundamentally questioned the assumptions that have been made by flintknappers and lithic analysts alike to empirically demonstrate how skill level is expressed by flintknappers.

While it is widely accepted that all flintknappers have good and bad days, struggle with flaws in raw materials, and can even express less skill when feeling unmotivated or frustrated (Bamforth and Finlay 2008) — this experiment shows that debitage can be used to consistently predict the skill level of a flintknapper. I have demonstrated that novices have difficulty controlling the angles of removals and making predictable removals, are unable to fix most errors, have limited ability to produce core trimming elements, do not frequently produce multi-faceted platforms, are unable to frequently produce irregular or regular blades, and are unable to produce extremely regular blades. Intermediate level knappers are generally able to correct errors and are able to produce a broader array of debitage and corrective elements, can consistently produce irregular and regular blades, and infrequently produce extremely regular blades. Masters are consistently able to correct errors, produce a full array of debitage types including core trimming elements, and consistently produce a high frequency of regular and extremely regular blades. Using these findings, it is possible to push archaeological interpretations from the realm of assumption and analogy to testable sets of variables and categorical guidelines for skill.

<u>Floors</u>

Skill expression during the Early Epipalaeolithic period at Kharaneh IV is explored in both floors and concentrations. The floor of Locus 043 is considered to express high levels of skill. This analysis is based off of the techno-typological analysis and how it compares to the experimental reductions with regard to the core trimming element to blade ratio and blade to flake ratio. With metric and morphological analysis of each RMU to complete the skill level analysis a clearer picture of skill within the flintknapping floor could reveal more information regarding individual flintknappers and the communal flintknapping undertakings at Kharaneh IV.

Skill analysis of caches and concentrations consist of techno-typological analysis, and the collection of metric and morphological features on core trimming elements, and blades. Lithic Concentration 1, a cache within Locus 043[17], is classified as the most skilled reduction sequence. The presence of microliths, primary, secondary, and tertiary debitage suggest that this reduction represents a complete reduction of a blade core. While only parts of the reduction were cached, it is likely that the reduction took place nearby as chips and shatter were also present in the cache.

Lithic Concentration 2, a small blade concentration within Locus 043, likely represents a short period of middle staged flintknapping[18] within the flintknapping area. This concentration was produced by a master flintknapper, which suggests that master flintknappers were utilizing the flintknapping floor for multiple and incomplete flintknapping endeavors.

Lithic Concentration 3, a small cache cut into Locus 043, is one of the two least skilled of the analyzed lithic concentrations. This cache scores just above the cutoff between intermediate and master skill. This could be due to the size of the cache (n=16), causing the cached artifacts to stand in for the much larger reduction that would have been necessary to produce them. There were no extremely regular blades within the cache and a low diversity of core trimming elements. Both are indicative of lower skill expression, however, based on the caching test skill expression in caches is likely to be reliable. It is probable that the individual who produced this cache was less skilled than the individual who produced Lithic Concentration 1—yet was still a master flintknapper.

Lithic Concentration 4, a cache within Locus 043, is equivalent in skill to Lithic Concentration 3. Both caches show a masterful skill expression but are less skilled than the flintknappers of the other lithic concentrations. While this can be a bias due to the small assemblage size, the lack of sequential blades and high frequency of irregular blades are more consistent with less skilled individuals.

Lithic Concentration 5, a concentration near Hut Structure 2, represents the middle to late phase reduction of a blade core produced by a master flintknapper due to the lack of primary debitage and minimal secondary debitage. It is likely that the master flintknapper produced a blade core nearby and disposed of the debitage in this area as chips, shatter, and tools are not well represented within this concentration.

Lithic Concentration 6, a large concentration in Area E, represents early, middle, and late phase blade core reduction by a master flintknapper. Future work expanding into BS57 may reveal more of this blade core reduction, but even with the small area of Locus 014, significant numbers of refits, sequential blade removals, and sequential core trimming elements are present. The presence of primary pieces and core preparation pieces indicate that early phase reduction occurred here, while middle and late phase reduction is evidenced by the presence core maintenance pieces, blades, and microliths. This concentration is likely the secondary deposition of the debitage as minimal numbers of chips, shatter, and tools were recovered.

Lithic Concentration 7, a concentration of clear flint that expands over most of Locus 043, was identified due to its unique properties. Lithic Concentration 7 is most dense in square AY72 (n=167) and significantly less dense in the surrounding squares. AY73 has 22 pieces of

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[17] Lithic Concentration 1 also had a bone tool that had been made into a point on one end. It is possible that this cache represents an Early Epipalaeolithic tool kit.

[18] Flintknapping is broken down into three stages, early, middle, and late. Early stages of flintknapping include cortex removal (primary and secondary flakes) and basic shaping. Middle stages of flintknapping involve some secondary flake removal but predominantly tertiary flake removal, core preparation elements, and some blades. In addition to tertiary flake removal and blade production, late stage flintknapping also involves core maintenance elements, and ultimately tool production from any of the removals in the process (Andrefsky 1998).

translucent flint, AY74 has 6 pieces of translucent flint, and all of the other adjacent squares had one or less pieces of translucent flint present (see Chapter 8 for further discussion). This suggests that the individual who produced the blade core reduction likely sat in AY72 and reduced the core from middle to late phases. There is minimal primary and secondary debitage suggesting that primary reduction did not occur in Locus 043. The high blade, core trimming element (both core preparation and core maintenance), and tool frequency suggest middle and late phase reduction was completed by a master flintknapper.

Master and intermediate flintknappers are expected to be represented at Kharaneh IV in larger numbers than novices, which is reflected in the skill level analysis. The experimental work previously discussed found that it is possible for a novice flintknapper to produce blade core reductions that cluster with intermediate flintknappers (notably considered to be an unskilled intermediate) within ten sessions of flintknapping of two hours each (see Dingo in Appendix I). While none of the other novice flintknappers were able to produce blade cores with intermediate skill signatures, the ability of Dingo to improve from novice to intermediate by their ninth blade core reduction suggests that the time investment necessary to improve from novice to intermediate is not as great as the time investment necessary to improve from intermediate to master (see FDP and TB in Appendix I). Other researchers have discussed this phenomenon in that gaining initial skills to become adequate does not require much time as improving from intermediate to master (Bamforth and Finlay 2008; Eren et al. 2011).

Furthermore, skill acquisition appears to require more than just exposure to the process of flintknapping and access to debitage and tools (Bleed 2008). Interaction within a community is a key component in improving skill. Novice flintknapper Gecko did not attend flintknapping sessions with the flintknapping group and attempted to produce blade cores by replicating videos of blade core reductions. Without feedback from the community members, Gecko did not improve their flintknapping skill throughout the experiment (see Gecko in Appendix I). Other novice flintknappers showed varying levels of "improvement", here defined as the ability to produce blades.

Reassessment of Skill Indicators

<u>Terminations</u>

The experimental work completed in this research questions assumed connections between skill level and flake termination type. Generally, feathered terminations are viewed as ideal termination types while step, hinge, and *outrepassé* are considered errors (Shelly 1990; Ahler 1989; Clark 2003; Bamforth and Finaly 2008). Anecdotally this is a reasonable assumption as modern flintknappers aim to produce bifaces and blades with feathered terminations, steps, hinges, and *outrepassé* terminations frequently get in the way of modern flintknapping *chaînes opératoires.*

Previous research indicates the manual dexterity and knowledge necessary to produce feathered terminations and further argues that hinging and *outrepassé* terminations can easily occur if the striking angle and force are not appropriate. A high skill level is not necessary to produce feathered terminations (Cotterell et al. 1985). This is supported by the assemblages produced by novices in the flintknapping experiment. Novices were quickly able to produce feathered terminations and by the end of their first flintknapping session were able to consistently produce feathered flakes.

Step terminations occur frequently among all of the flintknapping groups yet less frequently among novices than among intermediates and masters. This contradicts previous notions of skill where masters are presumed to produce less errors. As all participants were instructed to use direct percussion, a known precipitant of step fractures (Crabtree 1968; Cotterell and Kamminga 1987), skilled individuals produced more removals per blade core on average and thus likely produced more step fractures as a result.

Hinge terminations were less common in intermediate individuals and most common among masters. Again, this challenges the view that masters consistently produce feathered terminations and produce less errors. Cotterell and Kamminga (1987) suggest that thin removals from flat surfaces, like that of a core face, frequently result in hinge terminations. Therefore, it is likely that a flatter blade core face will result in hinge terminations. Novices are unable to produce blade cores and thus they produce less hinge terminations. Since masters most frequently produce blade cores with consistent core faces, master flintknappers produce hinge terminations most frequently but are notably able to fix these terminations on the core face and continue making blade removals on the core face.

Outrepassé terminations occur less frequently among novices than among intermediates and masters. This is likely due to the blade core morphology and the physics behind blade removal. Blade cores require a narrowly angled bottom creating a sharp corner or ridge. These narrow ridges are prone to plunging removals and are much more common in blade core production than in biface production (Cotterel and Kamminga 1987). As masters and intermediates can produce blade cores with narrow bottoms that allow them to make consistent blade removals, *outrepassé* terminations naturally are more frequent than among novices who tend to produce flake cores.

To better understand skill expression, it is necessary to fully explore how technological approaches affect flintknapping methods and thus the expression of skill in the archaeological record. Clearly, assumptions based on biface technologies are not adequate for understanding skill in blade core technologies.

Error Correction

Error correction is a frequently explored aspect of skill expression. Previous research in skill suggests that novices lack the ability to fix errors and rejuvenate their blade cores to allow for further blade removals (Pigeot 1990; Bamforth and Finaly 2008; Finlay 2008). On the other hand, masters are able to use a complex set of approaches to produce the ideal removal types and continue producing blades even after errors are produced. This approach suggests that all knappers produce errors no matter their skill level (Shelly 1990). The findings from this experimental work support their anecdotal assumptions and experimental findings. In the experimental blade core reductions novices produced on average one core trimming element per blade core. These core trimming elements tend to be core preparation elements rather than core maintenance elements however both types are present in the novice assemblages. Intermediates produce six core trimming elements per blade core on average, while masters average 20 core trimming elements per blade core. In addition to a dramatic increase in the quantity of core trimming elements, there is also an increase in diversity of core trimming elements with increased skill. Novices rarely produce more than two types of core trimming elements per blade core while intermediates and masters produce a wider variety. A wide variety of core trimming elements suggests that a flintknapper is skilled as they can fix their mistakes and continue producing blades on a blade core. Novice flintknappers do not yet know how to fix their mistakes and do not produce the variety of core trimming elements that masters or intermediate flintknappers do, resulting in abandoned cores or exhausted flake cores.

Successfully identifying skill level in blade core technologies through error correction, is a three-step approach. First a core trimming element to flake ratio highlights the frequency of core trimming elements within an assemblage. Very low frequencies indicate novices, relatively low frequencies indicate intermediates while high frequencies indicate masters. This should be combined with an assessment of corrective approaches. This is a simple count of the number of types (techno-typological categories) of corrective elements present within a reduction. Finally, assessing the blade: flake ratio is imperative to understanding skill as production of corrective removals is not effective if they do not allow for further blade removals. The experimental findings show that novices have the lowest blade: flake ratio (0.014), while intermediates (0.165) and masters (0.290) have significantly higher ratios. Thus, to determine the effectiveness of error correction the inclusion of blade: flake ratios is necessary. By combining the three approaches it is possible to determine an individual's adeptness in correcting errors that occur during the flintknapping process.

Platform Preparation

Platform preparation is interpreted differently among researchers even within blade core technologies. Some argue that more platform preparation (including isolation and abrasion) indicates lower skilled individuals (Clark 2003) while others suggest that significant platform preparation is indicative of skilled individuals (Shelly 1990). The data presented from this experiment supports the later argument as prepared platforms are correlated with skill level. In all three skill level clustering models, the frequency of multi-faceted platforms is a significant factor in skill determination. Novices infrequently produce multi-faceted platforms (averaging nine per blade core reduction), intermediates average 43 per blade core reduction, while masters average 119 per blade core reduction. Platform preparation is also significantly correlated to blade production. Multi-faceted platforms are strongly correlated with regular and extremely regular blades while moderately correlated with irregular blades. Blade cores with more multi-faceted platforms are significantly more likely to also produce more blades. Therefore, a high frequency of multi-faceted platforms acts as an indicator of the effectiveness of a knapper when combined with blade counts and blade regularity counts.

Blade Regularity

Blade regularity assumes that the ideal blade form is a straight blade with parallel edges and straight removal scars parallel to the blade's edge (Pelegrin 2006; Finlay 2008; Bleed 2008). This approach has the potential to bias archaeological work where assemblages and ancient knowledge does not value consistency, regularity, or uniform blanks/blades. For example, *dufour* bladelets are small twisted bladelets that occur predominantly during the Upper Palaeolithic period throughout Europe and the Levant (Belfer-Cohen and Bar-Yosef 1981; Belfer-Cohen and Goring-Morris 2002). Blade regularity as it is mobilized in this experiment would not be a useful way to investigate skill at archaeological sites that predominantly or regularly produces *dufour* bladelets, as the ideal archaeological form varies from the ideal form used for this measure (i.e., regularity). The Early Epipalaeolithic blade core reductions at Kharaneh IV are predominantly produced on narrow faced blade cores that create narrow gracile bladelets with parallel margins and frequently parallel removal scars (Maher and Macdonald 2016; Macdonald et al. 2018). Therefore, this measure is useful for investigating skill at a site like Kharaneh IV.

The experimental data shows a light correlation between irregular blades and skill level. This is likely because all skill levels produce irregular blades in differing frequencies. Novices frequently produce irregular blades while intermediates and masters produce fewer irregular blades than novices. The quantity of regular blades is a medium impact indicator of skill as 73.4% of variation in the quantity of regular blades is attributed to skill level. Masters produce more regular blades than intermediates (averaging 18.8 and 7.6 per blade core, respectively) while novices rarely produce regular blades (averaging 0.4 per blade core). Extremely regular blades have the strongest correlation to skill as 77.6% of the extremely regular blade count variation is attributed to skill level. Masters average 15.8 extremely regular blades per blade core while intermediates average 2.5 extremely regular blades per blade core. Novices never produce extremely regular blades.

Blade regularity has significant potential to determine the skill level of ancient flintknappers with the assumption that the blade industry values regular and uniform blades.

Communities at Work

Producing stone tools, maintaining technological knowledge, retaining environmental knowledge and reifying the social roles that tools play in daily life require a community of flintknapping practitioners. Communities of practice by their very nature require masters who have invested significant time and effort into the community to become central members. Often, these central members are highly skilled and have a robust repertoire of social knowledges regarding the community's roles within broader communities. Masters require novices. Novices learn technological and social practices from masters. In order to maintain a practice through time, masters must educate novices in all regards of the practice. As novices become more competent through skill acquisition and social negotiations and interactions, they become intermediately skilled individuals and gradually become increasingly central members within the community of practice (Lave and Wenger 1991). Within a community of practice focused on the production of stone tools it is probable that unskilled individuals (novices) worked alongside more skilled individuals and learned tasks, habitus, and muscular patterns as well as social and environmental knowledge through legitimate peripheral participation (Pigeot 1990; Milne 2012; Weedman-Arthur 2018; Arnold 2018).

There is a large body of ethnographic research available that investigates precisely this set of interactions, questions how novice individuals become skilled masters, and what the apprenticeship process does to an individual's identity (Cole 1971; Childs and Greenfield 1980; Lancy 1980; Saxe 1990; Rogoff 1990; Greenfield et al. 1997; Wallart-Petre 2012; Weedman-Arthur 2018). In these works, novices are frequently given simple, menial tasks to complete until they are proficient at them, at which point they are assigned increasingly complex tasks until they have mastered the fundamental aspects of the practice and are able to interact within the communities competently.

Given the presence of master level debitage in the caches and concentrations within the flintknapping floor (Locus 043) at Kharaneh IV it is possible that the flintknapping community of practice utilized a similar training model. Early stages of flintknapping, primary and secondary flake removal, are largely absent from the lithic concentration assemblages. This is likely due to the selection process during a caching event. Yet, it is of notable importance that the blade core reductions are predominantly middle and late phase reductions. In the experimental work, novices were quickly capable of removing flakes with feathered terminations and cortex. I propose that it is possible that flintknappers at Kharaneh IV during the Early Epipalaeolithic period communally worked on producing stone tools. Novices could have prepared cores by removing cortex and completing initial shaping tasks while more skilled individuals (intermediates and masters) produced blade cores and ultimately blades tools. Similar work patterns are seen ethnographically among the Gamo (Weedman-Arthur 2018) and archaeologically in the French Magdelenian (Pigeot 1990) and the Upper Palaeolithic period in Hokkaido, Japan (Takakura and Naoe 2019).

This structure could effectively blunt the signatures of novices and early intermediate flintknappers as primary and secondary removals are nearly indistinguishable between skill levels. Battering on flake platforms would help distinguish between skilled and unskilled individuals in early stages of reduction (Shelly 1990) as battering is distinctly more frequent among novices than intermediates or masters. To further tease apart this potential palimpsest, additional refitting work of flintknapping floors, complete skill analysis of each RMU, and spatial analysis of the flintknapping floor would aid in clarifying this complex activity area.

Archaeological examples of educational scaffolding exist in the French Magdalenian where master flintknappers are located indoors near hearth structures and surrounded by concentric rings of less skilled individuals ending with unskilled children in the peripheral areas of the hut (Pigeot 1990). An outdoor area where two intermediately skilled individuals sat and prepared cores for further reduction by the masters was also noted. Here there is both a division of labor by skill and a division of space by skill. This type of labor and space division is not yet seen at Kharaneh IV, but further research of this type will increase the resolution of the flintknapping community of practice.

Alternatively, a different form of flintknapping education could have taken place at Kharaneh IV. Instructional blade core production like that present at the Upper Palaeolithic site of Kyushirataki-5 in Hokkaido, Japan a masterful flintknapper produced a blade core and it was later used (in the same space) by novice flintknappers. Refitting of the blade core suggests that individuals of varying skill levels knapped the same core and left most of the blade core reduction together after flintknapping the blade core had ended. There is even evidence to suggest that abandoned blade cores produced by masters were preferentially utilized by novices to practice blade production (Takakura 2013; Takakura and Naoe 2019). There is no reason to discount direct instruction at Kharaneh IV, as there are caches with core trimming elements, blades, and tools– is it possible that these are instructional tools intended for novice reference and instruction?

It is not yet possible to determine the instructional models utilized at Kharaneh IV. Due to the expansive flintknapping floor with multiple lithic concentrations, the varying levels of expressed skill among the lithic concentrations, it is clear that flintknapping was a community endeavor. Participating within this community would not have required much skill as even the most unskilled of novices can successfully remove flakes with minimal (and in some cases no) instruction. Many people could have come together and produced stone tools and contributed to this labor within their own capabilities. This type of inclusivity is the key to a robust community of practice that withstands time and external pressures as it allows all participants to identify as members and share in the meaningful acts of the practice. Community values are shared and shaped during these flintknapping events. Master flintknappers, the retainers of technical, locational, limitational, social, and environmental knowledges (Rockman 2012) likely shared their time and space with less skilled flintknappers within their community. Further skill level analysis on the flintknapping floor and other occupational deposits will illuminate the community of practice and the underlying educational structures based on spatial and labor divisions through skill level analysis.

While it is not yet possible to discuss educational practices at Kharnaeh IV, using the assemblages from the Early Epipalaeolithic flintknapping floor (Locus 043 and the Lithic Concentrations) we can investigate the spatial organization of skilled people during the flintknapping event. The percentages of removal types within the Lithic Concentrations are similar to one another and reflective of the much larger percentages of removal types within Locus 043. This suggests that a similar *chaîne opératoire* was used to reduce the blade cores. The reduction sequence is heavily focused on narrow bladelets and microlith production. The flintknapping floor, while more diverse ad expectedly so due to the nature of the floor and significant disparity between assemblage size, follows similar patterns and generally has similar frequencies as the lithic concentrations. As the lithic concentrations are predominantly within the flintknapping floor it is likely that the production of the concentrations likely occurred around the same time as the production of the flintknapping floor (but clearly after the deposition of the floor).

Using the skill level analysis of the caches and concentrations and the artifact density of Locus 043 to approach the structure of flintknapping sessions during the Early Epipalaeolithic, it is likely that a highly skilled master flintknapper(s) was positioned between AY72 and AX72 and produced blades, bladelets, and microliths while lesser skilled master flintknappers (near intermediate skill level) located themselves near the highly skilled master flintknapper(s) (Figure 9.1). Lithic debitage tends to scatter between 0.5 m and 0.92 m from the knapper. Small debitage on finer quality material travels shorter distances (just above 0.5 m on average) while larger removals on coarser material travel nearly a meter (Kvamme 1997). Within AY72, Lithic Concentration 7 has a high density of high-quality material and small removals suggesting that the highly skilled master flintknapping took place within the square. Lithic Concentration 1, located in AX72 was also likely produced by a highly skilled master flintknapper, suggesting that the individual(s) who produced the reductions were located between AY72 and AY73. The density of flint increases to the east and the Lithic Concentrations 2, 3, and 4 are located to the south and east of the densest area of Lithic Concentration 7. The other Lithic Concentrations represent less skilled reductions; therefore, it is likely that the lesser skilled master flintknappers were positioned near the highly skilled master flintknapper(s) and contributed to the production of the flintknapping floor (Locus 043).

More work needs to be completed to more accurately determine the skill level of the flintknappers who produced the flintknapping floor. Metric analysis of the flintknapping floor and skill level analysis will aid in identifying spatial relationships of flintknapping masters, intermediates, and novices during the production of the flintknapping floor during the Early Epipalaeolithic period at Kharaneh IV.

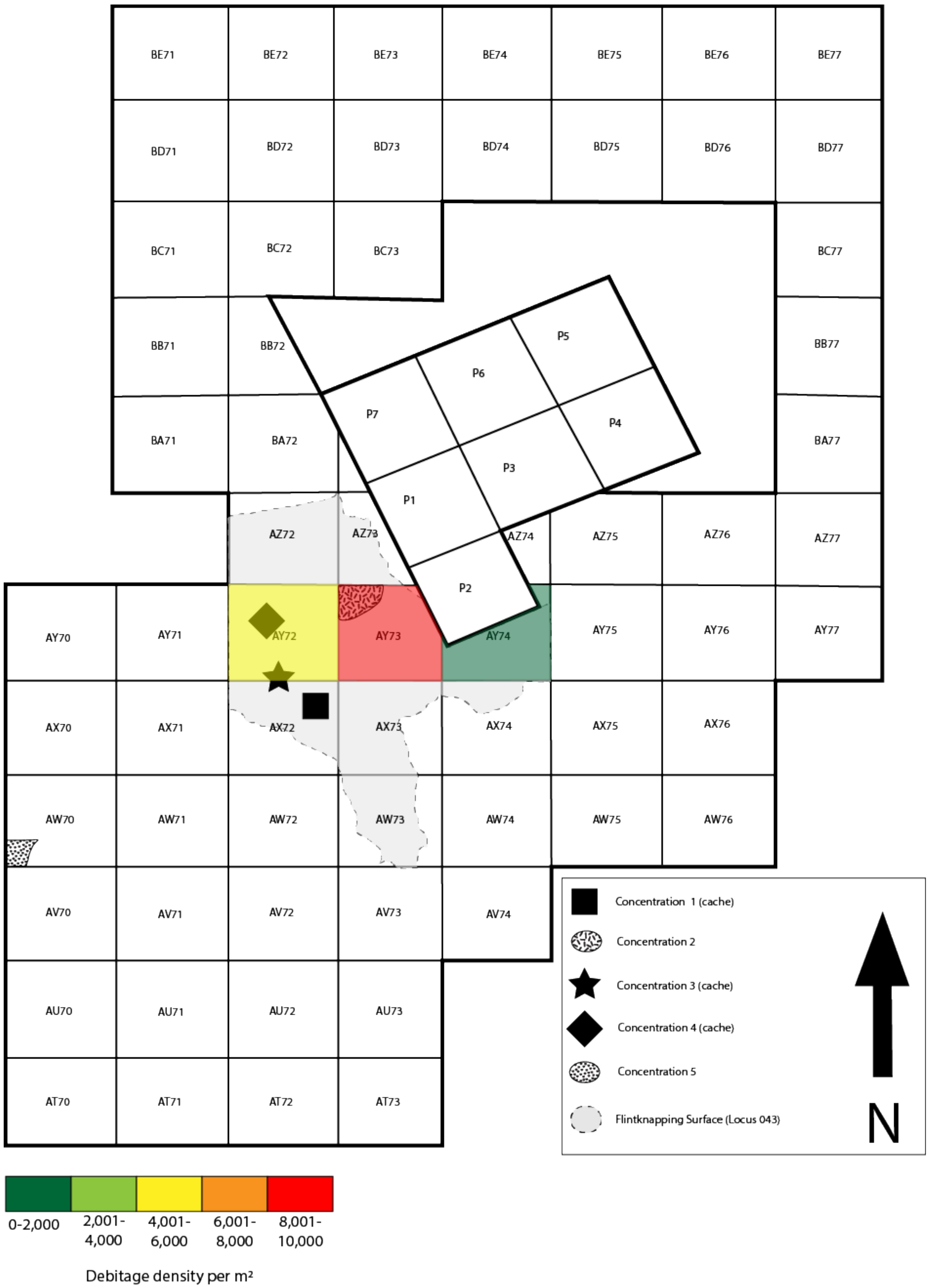

Figure 9.1: Debitage density map of the analyzed squares within Locus 043. AY73 has the highest density of debitage (n=9,056), followed by AY72 (n= 4,125), and AY74 (n=1,033).

Conclusions

Learning is necessary for us to successfully interact within a socially constructed world full of tasks and meanings. It allows us to build relationships with people who hold useful knowledge and utilize that knowledge. Communities of practice are one way in which people can learn not only social skills but also practical ones (Lave and Wenger 1991; Wenger 1998). At Kharaneh IV, ancient flintknappers clearly brought knowledge to the site and acted upon the knowledge they had gained utilizing the normative and negotiated flintknapping rules of the community of practice they learned in and interacted with.

The theoretical paradigms of communities of practice, practice theory, and genetic processes are a good fit for the analytical approach. They allow for the breakdown of knowledge into both its social and physical/material components. Combining communities of practice with debitage analysis creates a nexus where the *habitus* of a community can be thoroughly explored. The *habitus*, being the embodiment of negotiated meanings, is prone to change to meet the needs of social and physical environments (Wenger 1998; Arnold 2018). By investigating the process of flintknapping through *chaîne opératoire* and debitage, we can identify ancient flintknapping techniques and use them to understand social boundaries. Skill level analysis is imperative for teasing apart the significant variation present in lithic assemblages. As flintknapping is dependent on highly variable raw materials (e.g., stone type, cobble shape, quality, or consistency) flintknappers must be able to meet the challenge in order to produce useful tools. Master flintknappers have gained significant experience in converting cobbles of stone from the 'natural' world and converting them into tools, as a result, have learned to both avoid and fix problems. Novices flintknappers have not gained this knowledge and frequently repeat the same mistakes without being able to fix them. This is the key to growth as a flintknapper. As learners continue to make mistakes, they begin to learn how to both avoid and fix them. This is the intermediate stage, where knappers are more knowledgeable and proficient then they were as novices. They can identify mistakes, try to avoid them, try to fix them, and have an increased ability to produce blades as a result.

Proficiency is derived from experience (*savior faire*) as well as learned knowledge (*connaissance*). For example, during the experiment I told the novice participants that I was going to prepare and isolate a platform before making a removal. I spent time isolating and preparing a platform and would show them the platform when I was done. Novices knew that there was an act of isolating platforms but simply did not have the experience to know when and how to isolate platforms. As some of the novice participants gained basic skills like hand-eye coordination or knowing which percussors to use when, few learned how to isolate platforms. Novices noted their struggles and successes with platform preparation in a variety of ways that are all insightful to the process of learning to flintknap. Early in the learning process Hyena says, "Brute force to make a platform just didn't seem to work. Eventually I just gave up on the platform and just practiced making flakes". While later in the process Aardvark notes "I had trouble setting up a good platform to start taking blades off, I ended up mostly removing cortex". About halfway through the learning process Dingo reflects, "I tried quite a bit of (I think it's called) platform isolation- taking flakes off the platform to isolate the top of a ridge and often those pieces came off more nicely than actual flakes on the face…". Clearly novices had learned that platform isolation would be useful to them but had not acquired the *savoir faire* to fully engage with the knowledge and mobilize it for blade production. In this experiment, proficient flintknappers were determined to have to isolate platforms, create blades in regular and extremely regular forms, remove multiple blades sequentially, and use a variety of corrective and core maintenance techniques resulting in an array of core trimming elements.

Internal variability and external variability is useful to identify in lithic assemblages for answering questions about the social aspects of tools. Tools do not exist in a vacuum and do not simply manifest from the environment, there are no given or natural forms for stone tools to take. People make tools to serve purposes in their lives (Stout 2011). These are culturally constructed objects that are acted upon by people to serve a purpose that is relevant to the culture whence it was made. Variability exists within a group of practitioners (internal variation) because individuals apply knowledge differently (idiosyncrasies or microvariables) (Creese 2012), issues with rock quality or acquisition (access may be restricted to good or bad material), and individual skill level. Tools classes within this group would have a general mode of production (*chaîne opératoire*) but would still express some variability. On the other hand, external variability would arise from different histories and knowledge trajectories (Wenger 1998). Groups could experience different social or environmental pressures that would change the way they interact with stone tools. For example, if access to a tabular flint source was restricted due to social factors and a group of flintknappers started to use globular flint cobbles, adjustments to the *chaîne opératoire* would have to be made and taught to the next generation of flintknappers. This could become engrained in the group's history and tool tradition. Rather quickly, the group with access to tabular flint would then have a notably different *chaîne opératoire* than the group with access to globular flint.

The ability to distinguish between novice/intermediate/master individuals can aid archaeologists in understanding and interpreting the variability within assemblages. Assemblages (with the same end goal, here narrow faced core blades and bladelet production) with high degrees of variability produced by skilled individuals would suggest different learning trajectories and by extension— different communities of practice. High degrees of variability and varying degrees of skill suggest a learning space or unskilled peoples. Low degrees of variability suggest highly skilled individuals from the same community of practice. While high degrees of variability and high degrees of skill indicate skilled people from different communities of practice.

Refitting is beneficial to this approach but is not integral. Refitting helps narrow the interpretation to a single core reduction, and likely to one or a small number of people who participated in the reduction of that core. Another way to narrow the scope is to use RMU's. This can help reduce the static of an entire debitage assemblage by grouping debitage by its raw material and analyzing each of the units separately. This serves the same purpose as refitting but can be used for any assemblage with two or more raw materials present. The RMU approach is also more expedient and easily trainable, while refitting is time consuming to both complete and to train. Conducting skill level analysis on a large assemblage with more than one RMU can effectively blunt the skill level indicators and reduce resolution of individual knappers as it decreases the resolution from one core to multiple cores thus potentially involving more flintknappers.

With the research presented above I intend to analyze the flintknapping floor (Locus 043) with a complete analysis of the metrics to determine the skill levels of the flintknappers who produced the assemblage. This may add resolution to the caches and concentrations discussed above and may help illuminate the use of space regarding an individual's skill level. Adding this information may provide insight to the use of space at a large aggregation site like Kharaneh IV.

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Appendix A

Techno-Typological categories in use at Kharaneh IV and used in this research project courtesy of the Epipalaeolithic Foragers of Azraq Project. Adapted from Barket et al. In Press.

Unretouched Debitage	
Blades/bladelets	Flakes that are generally twice as long as they are wide with a parallel ridge system on the dorsal surface that shows the preplanning and intention to remove them in that fashion.
Secondary blades/bladelets	Blades on which 50-99% of dorsal surface is cortical.
Flakes	Pieces removed during core reduction or maintenance that lack diagnostic features.
Secondary flakes	Flakes on which 50-99% of dorsal surface contains cortex.
Primary pieces	The entire (100%) dorsal surface is cortical.
Platform isolation elements	Small, twisted or curved bladelets that isolate the platform for further bladelet removals. Some such elements may be large enough to make into microlithic tools and are therefore grouped with blades.
Edge preparation elements	Small bladelets/flakes that remove overhangs left from previous blade removals and that change the platform angle (when too acute). These come in a range of sizes and some have broad proximal ends and platforms (that is, the platform is not isolated) with a tapered distal end, while others look more like small bladelets with a narrow proximal end and tapered distal end.
Chips	Pieces under 1 cm.
Shatter	Angular pieces with no clear ventral or dorsal surface.
Burnt shatter	Heat damaged angular pieces or potlidded and crazed fragments produced because of exposure to fire.
Sectioned blade fragments	Small medial blade fragments, usually triangular in plan that result from the intentional sectioning of blades during tool production.
Burin spall	A removal that results in the formation of a burin on any type of debitage. Often triangular or rectangular in cross-section.
Core Trimming Elements	
Initial core tablets	First core tablet removed, identifiable by having cortex on the dorsal surface.
Initial faceted core tablets	Core tablets or spalls with a portion of the tablet faceted to flatten the platform and create a suitable profile for removal. They are often partially cortical.
Non-initial spontaneous core tablets	Accidental core tablets with parallel dorsal and ventral surfaces and remnant removals all around the circumference of the tablet. Note: Not sure how common this category is, but I imagine it is not very common. Anyway, these are likely the result of double-initiations, which can occur when the hammer makes contact in two places during removal. Specifically, double initiations (mostly on blade and flake removals) can occur when hammers are not well tended and have a lot of pitting on them.
Non-initial corrective core tablets	Core tablets (or spalls) removed during the course of core reduction to correct the angle of removals where the platform edge meets the face of the core. This category can also include non-initial faceted tablets. These tablets should have evidence of a prior core tablet removal, or, if faceted, there should be little cortex on the dorsal surface of the tablet and evidence of remnant removals surrounding the platform.
Profile correction blades	Blades removed to improve a core's profile. The dorsal surface of such blades usually contains hinged flake scars from previous removals, and they often bulge distally.
Core face rejuvenation elements	Flakes or blades removed from the working face of the core, which are intended to fix problems like hinge/step terminations, but can also correct the overall direction of removals or bulges on the face of the core.
Partial ridged blade	Plunging blade with distal end partially ridged and with a twisted profile.
Lateral core trimming piece	Flat to medially curved expanding flakes, often with cortex on the distal end, removed to flatten platforms and/or shape the base and sides of a core during core preparation and maintenance. This category includes flakes removed to flatten platforms (faceting flakes) before spall removal, which are typically flat, expanding (especially distally), with broad platforms.

	Some may terminate in hinges if they do not travel all the way across, and they often, but not always, have cortex on the distal end of the flake. Additionally, it includes flakes removed to shape the side and the base of the core that may not have all the same characteristics as faceting flakes. For instance, flakes removed either bifacially or unifacially from the base of the core may look somewhat more medially curved than faceting flakes, because the goal is to narrow the core base, to remove errors, and/or to improve the profile of the working face of the core.
Crested blade	Fully ridged blades removed initially to facilitate blade removals along a core face. The ridge may result from bifacial or unifacial removals and it extends mostly or completely on the dorsal surface from the proximal to distal end of the blade.
Angle correction element	A Corrective platform piece that is ridged on one side, and retains the edge of the platform and a portion of the core face. These pieces are removed horizontally across the face of the core where the platform and core face meet.
Bottom partial ridged blade	Ridge running along distal end of plunging blade from the removal of part of the opposing platform on a bidirectional core.
Cores	
Single direction nosed core Exhausted (Y/N)	Thin or tabular pieces of flint, where removals are focused on a single, narrow platform along one 'edge' or face of the core. Produces a core that appears pinched or narrower along the core face.
Narrow-faced cores Exhausted (Y/N)	Up to 180° of core face has removals, from essentially a single platform.
Broad-faced core Exhausted (Y/N)	Approx. 180-270° of core face has removals from a single platform, creating a broad removal face.
Sub-pyramidal bladelet core Exhausted (Y/N)	360° or almost all of core face has blade(let) removals from a single platform.
Opposed-platform cores Exhausted (Y/N)	Core with two dominant platforms situated opposite of each other on the core (at 180° to each other). Such platforms typically share a removal face (called bidirectional opposed-platform) with blades and corrective elements removed from both ends, but in some cases, one platform may have been favored for blade production, while removals from the other platform were more often corrective in nature.
Change of orientation cores Exhausted (Y/N)	Core with two or three dominant platforms at 90° to each other.
Flake cores	This includes cores for which the aim was to produce flakes. Such a category could be broad including flake cores of any orientation: single direction, bidirectional, and multi-directional, or these types could be considered separately.
Core on a flake	A core on a large flake.
Multi-directional cores Exhausted (Y/N)	A core with several randomly oriented platforms.
Core fragment	Broken core of indeterminate type.
Tools	
Non-Geometric Microliths	Gracile and narrow retouched bladelets with backing on at least one side. This microlith category is broad and encompasses: completely backed bladelets, partially backed bladelets, pointed bladelets, obliquely truncated bladelets, obliquely truncated and backed bladelets, curved and pointed bladelets, pointed retouched bladelets, microgravettes, narrow micropoints, broad micropoints, La Mouillah points, Ramon points, arch backed bladelets, bladelets retouched on both sides, and completely retouched bladelets (See Macdonald 2013 for detailed discussion of these types and their presence at Kharaneh IV).
Geometric Microliths	Broad tools on bladelets with retouch that create a geometric shape this includes tool forms such as: rectangles, trapeze-rectangles, asymmetrical trapezes, triangles, and lunates (Maconald 2013 and Bar-Yosef 1970).

Fragmentary Microliths	Fragmentary microlith with backing but at least end broken, snapped or segmented to the point where it is not possible to determine if the microlith is geometric or non-geometric.
Perforators	A blade or bladelet with an unmodified base and a heavily modified and elongated point with a triangular cross section.
Microburins	Bladelet spall that has been intentionally snapped to segment the bladelet for further modification.
Endscraper on blade	Blade with the distal end modified as a scraper and some retouch along either edge.
Endscraper on flake	Flake with invasive retouch along the distal end to form a convex shape.
Side scraper	Flake or blade with invasive retouch along one edge of the piece.
Double endscraper	Blade with invasive retouch on both ends.
Burin	Any piece of debitage with one or more burinations.
Retouched Burin spall	Any burin spall exhibiting retouch that occurred after removal of the spall.
Retouched blade	Blade with partial or complete retouch on one or more edges.
Truncations	A blade with one end retouched straight across to create a piece that is rectangular in plan view.
Multiple tools	Any combination of more than one tool type on a flake or blade.
Notches and Denticulates	Blades or flakes with one retouched notch on any edge. Multiple overlapping notches producing a serrated edge are denticulates.
Retouched pieces	A flake with retouch on any surface.
Varia	A blade or flake with any combination of or variations of the characteristics above.
Utilized pieces	A blade or flake with macroscopic traces of use but no evidence of modification (i.e. backing, burinations, or retouch).
Heavy duty tools	Extraordinarily large versions of the tool types listed above (i.e. denticulates, scrapers, burins, notches, retouched pieces, or truncations).

Appendix B

I. Translucency has two categories, translucent and opaque. To determine translucency the debitage is held over a piece of paper with a printed black line. If the line can be seen through the debitage then it is deemed translucent. If the line cannot be seen through the debitage then it is deemed opaque. The vast majority of flint at Kharaneh IV is opaque with rare exception.

Translucency Categories	
Opaque	
Translucent	

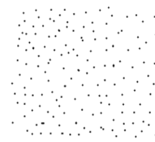
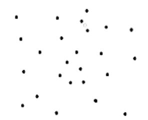
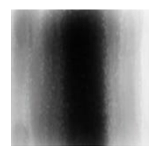
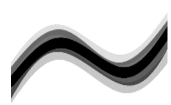
II. Grain size assessment is completed by both touch (texture) and assessment with the bare eye. The grain size classifications are based on Blair and McPherson's (1999) research which utilized the widely accepted Udden-Wentworth sedimentary grain-size scale.

Grain Size Categories		
Designation and Grain Size	Texture	Visual Cues
Coarse (≥0.031mm)	Feels course like sandpaper or dry silt.	Has individual crystals can be seen with the naked eye.
Medium (≈0.015mm)	Feels slightly gritty, similar to wet silt.	Has individual crystals that cannot be seen with the naked eye but can be seen with a 10x loupe.
Fine (≈0.008mm)	Feels smooth to the touch like plastic or wet clay.	Does not have a visible crystalline structure.
Glassy (≈0.004mm)	Feels silky to the touch similar to glass.	Does not have a visible crystalline structure.

III. Luster has two categories, matte and vitreous. Matte does not reflect light when put under a florescent light while vitreous does reflect light when placed under a fluorescent light.

Luster Categories	
Matte	
Vitreous	

IV. Veins and patterning charts for determining RMU's within archaeological assemblages. These veins and patterns can coexist and are not mutually exclusive to a single flint cobble.

Veins and Patterning Chart		
Stippling (S)	Small <0.5mm light coloration, high density, full coverage of debitage	
Dots (D)	Small, <.05mm light or dark coloration, moderate-sparse coverage of debitage	
Spots (P)	Medium, >0.5mm light or dark coloration, moderate-sparse coverage of debitage	
Inclusions (I)	Any size, rough spots that differ drastically from surrounding material, often crystals or chalk-like veins	
Graded (G)	Gradual, smooth, and complete transition from one color to another	
Stripes (R)	Clearly defined lines, light or dark coloration, can be any thickness.	
Bands (B)	Poorly defined lines, light or dark coloration, can be any thickness.	
Mottled (M)	No distinct pattern, multiple colors, often interfingered.	

Appendix C

Skill level questionnaire produced by the author based on the experimental findings of this project.

Skill Assesment Questionnaire

Core Identifier:

____

Is a blade core present?

- ◯ No (+0)
- ◯ Yes (+1)

Are sequencial blades present?

- ◯ No (+0)
- ◯ Yes (+1)

How many TYPES of Core Trimming Elements are present per blade core?

- ◯ < 2 (+0)
- ◯ >3 (+1)

What is the average proximal thickness of Blades and Core Trimming Elements?

- ◯ > 5.5 mm (+0)
- ◯ < 5.4 mm (+1)
- ◯ < 3.0 mm (+2)

What is the percentage of Core Trimming Elements compared to Flakes? (Divide CTE/Flake)

- ◯ < 2% (+0)
- ◯ < 7% (+1)
- ◯ > 8% (+2)

What is the percentage of Blades compared to Flakes? (Divide Blades/Flakes)

- ◯ < 3% (+0)
- ◯ < 16% (+1)
- ◯ > 17% (+2)

What is the percentage of Multi-Faceted Platforms on Blades and Core Trimming Elements?

- ◯ < 50% (+0)
- ◯ < 70% (+1)
- ◯ > 71% (+2)

What is the percentage of Irregular Blades when compared to ALL of the blades in the assemblage?

- ◯ < 100% (+0)
- ◯ < 40% (+1)
- ◯ < 15% (+2)

What is the percentage of Regular Blades when compared to ALL of the blades in the assemblage?

- ◯ < 25% (+0)
- ◯ < 45% (+1)
- ◯ > 46% (+2)

What is the percentage of Extremely Regular Blades when compared to ALL of the blades in the assemblage?

- ◯ 0% (+0)
- ◯ < 15% (+1)
- ◯ > 16% (+2)

Add up all the points above and enter the number in the box below. Max Possible Points= 17

0-5= Novice 6-11= Intermediate 12-17= Master

____

Appendix D

Information provided to the participants of the flintknapping experiment.

I. Assigned readings for novice participants
   a. *Flintknapping: Making and Understanding Stone Tools* by John C. Whittaker
      i. Chapters: 2) Flintknapping: Basic Principals, 4) Raw Materials, and 5) Safety

II. Assigned videos for novice participants
   a. Dr. Chris Clarkson- University of Queensland
      i. Blade Core Reduction- 20 mins
      ii. https://www.youtube.com/watch?v=KfA2WjhYvN0
   b. Dr. Chris Clarkson- University of Queensland
      i. Naviform Blade Core Reduction- 35 mins
      ii. Note: this is a different type of blade core than the narrow faced cores that are the goal for this experiment but the premise is still the same.
      iii. https://www.youtube.com/watch?v=0yLubbSlkl4
   c. "Blattspitez"- a flintknapping Youtuber
      i. Microblade Microburin Microlith- 3.5 mins
      ii. Note: small blades are what our ultimate goal is for this experiment. This video shows the blade production but not the setup and preparation.
      iii. https://www.youtube.com/watch?v=fqIf6JsBZ_0

III. Images provided to all participants
   a. Refit blade core from Kharaneh IV.

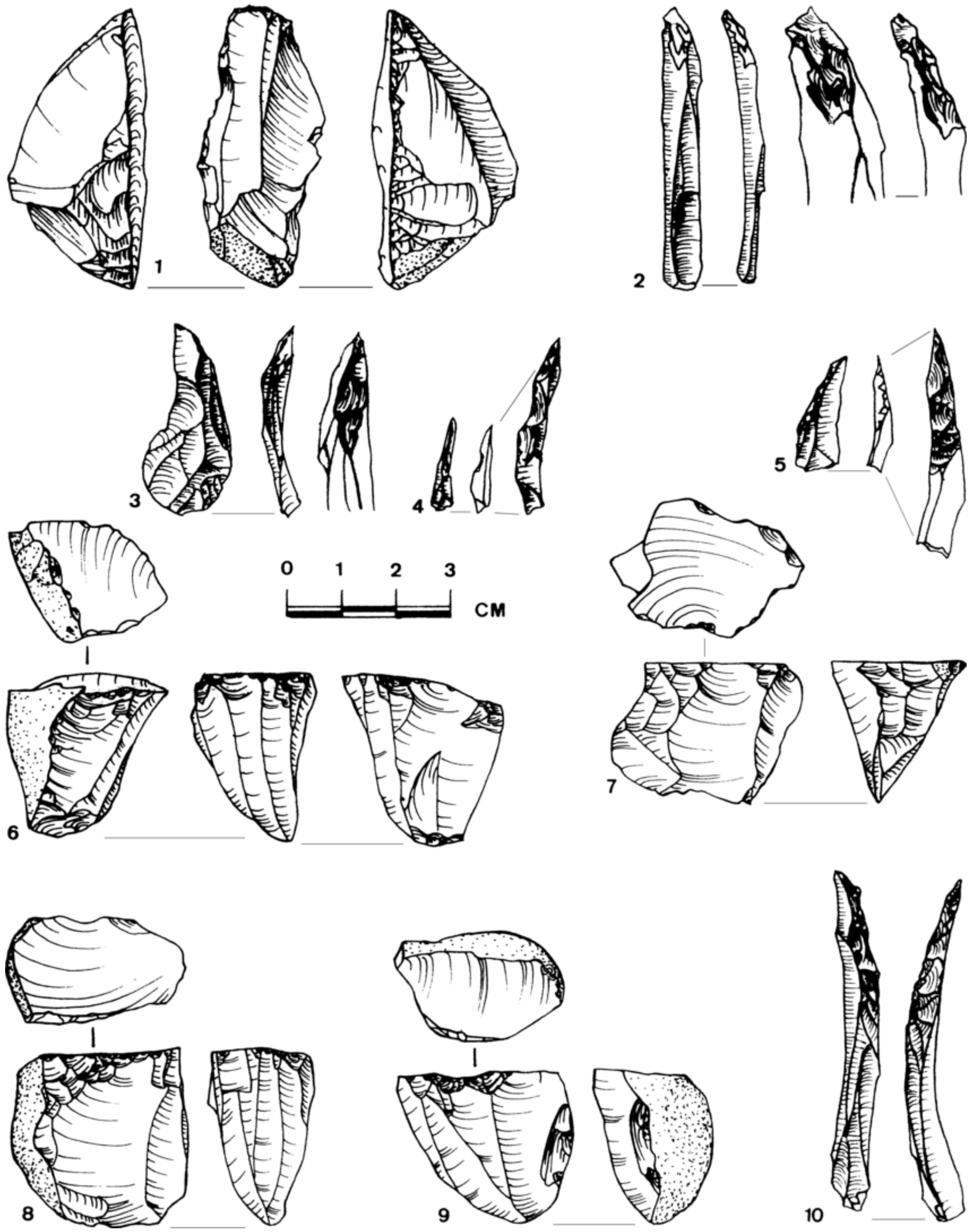
b. Refit blade core from Kharaneh IV.

c. Narrow faced blade core from Kharaneh IV.

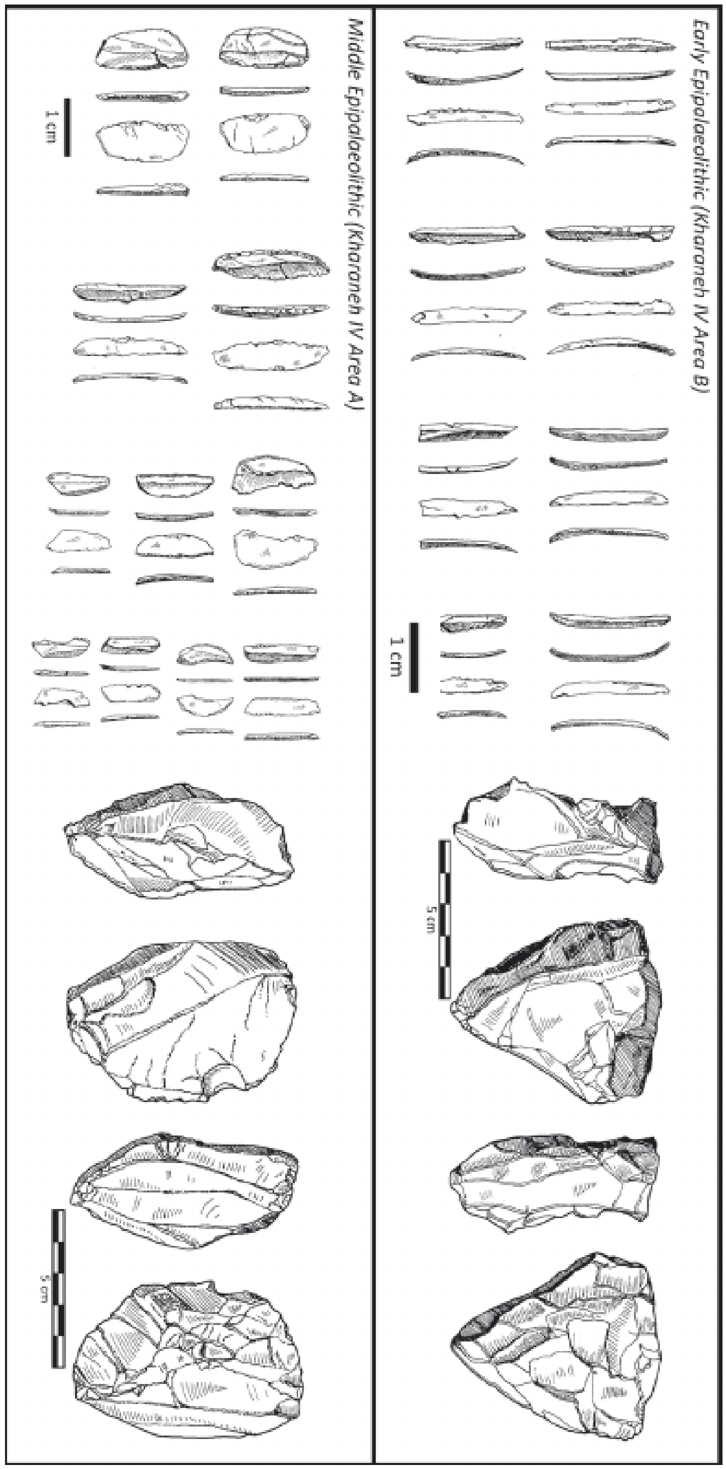
d. Broad faced blade core from Kharaneh IV.

e. Opposed platform core from Kharaneh IV.

f. Image of blade cores and blades published in “Indoor/Outdoor Flint Knapping and Minute Debitage Remains: The Evidence from the Ohaloii Submerged Camp (19.5Ky, Jordan Valley)” by Dani Nadel (2001).



g. Blade cores and microliths from Kharaneh IV, published in “Assessing typo-technological variability in Epipalaeolithic assemblages: Preliminary results from two case studies from the Southern Levant” by Lisa Maher and Danielle Macdonald (2013).



IV. Consent forms for novice participants.

UNIVERSITY OF CALIFORNIA AT BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO SAN FRANCISCO • SANTA BARBARA • SANTA CRUZ

CONSENT TO PARTICIPATE IN RESEARCH

Communities of Practice at Kharaneh IV: Flintknapping and Skill Level Analysis

Key Information

- You are being invited to participate in a research study. Participation in research is completely voluntary.
- The purpose of the study is to compare skilled flintknapping products and debitage to unskilled flintknapping products and debitage in order to identify characteristics of various skill levels present in flintknapped products. This allows researchers to determine the skill level of ancient flintknappers at the site of Kharaneh IV.
- The study will take a total of 25 hours and you will be asked to attend 10 two-hour long flintknapping events, bag and label their products, and review background materials.
- Risks and/or discomforts may include minor cuts or abrasions from making stone tools.
- There is no direct benefit to you, aside from learning how to flintknapp. The results from the study may help inform interpretations of the past and identify spatial relationships between skilled and unskilled flintknappers in the past.

Introduction

My name is Felicia De Peña. I am a graduate student at the University of California, Berkeley, working with my faculty advisor, Professor Lisa Maher in the Department of Anthropology. I am planning to conduct a research study, which I invite you to take part in.

You are being invited to participate in this study because you have no previous background or knowledge regarding stone tool production.

Purpose

The purpose of this study is to compare skilled and unskilled the waste products of stone tool production in order to identify characteristics of various skill levels present in flintknapping. This allows researchers to determine the skill level of ancient flintknappers at the site of Kharaneh IV.

About eight people will take part in this study. Two groups of four individuals will be made and each group will have different flintknapping time slots.

Procedures

If you agree to be in this study, you will be asked to do the following:

- Read background literature (three chapters), watch one hour of flintknapping videos prior to your first flintknapping event, and attend a one-hour long orientation meeting.

- Attend 10 two-hour long flintknapping events. These flintknapping events will be held remotely via Zoom.
- Observe flintknapping techniques and try to replicate them.
- Collect your flintknapped materials, bag them, and label them with your unique code.
- I will want to use some of the audio recordings or video recordings of you in public presentations related to the research. Please read the attached Media Records Release Form. It outlines several possible uses of the recordings and asks for your specific consent to use them in each way. I will not use any recordings of you in any future presentations without your consent.

Study time: Your study participation will take a total of approximately 25 hours over the Fall 2020 semester.

Study location: All study procedures will take place behind Kroeber Hall in the flintknapping area unless the weather interferes, in which case we will meet in Kroeber Hall room 1.

Benefits

There is no direct benefit to you, aside from learning how to flintknapp. The results from the study may help inform interpretations of the past and identify spatial relationships between skilled and unskilled flintknappers in the past.

Risks/Discomforts

- **Minor cuts or abrasions** from the flint. Unlikely if students are properly protected. If students are not properly protected they can get cut or get flint in their eyes. For this reason, students will be given appropriate protective gear and must wear protective clothing during all flintknapping events.
- **Silicosis,** a lung disease caused by long periods of exposure to silicate dust. This is extremely unlikely (as the flintknapping events are short and outside). To prevent this, all flintknapping events will be held outside in open-air conditions to reduce the exposure to silica to the absolute minimum.
- **Sunburn.** Unlikely. Students must wear protective clothing (including head protection). This reduces the chances of sunburn. Furthermore, I will keep sunscreen with my flintknapping materials to ensure that students are as protected as possible against sunburn.
- **Breach of confidentiality:** As with all research, there is a chance that confidentiality could be compromised; however, we are taking precautions to minimize this risk.

Confidentiality

- Your study data will be handled as confidentially as possible. If results of this study are published or presented, individual names and other personally identifiable information will not be used.

- To minimize the risks to confidentiality, we will not collect any personal data except your name, email address, and emergency contact information. If you are unable to come to campus to pick up the flintknapping materials, I will ask for your mailing address so that the materials can be sent to you. Furthermore, you will be provided a four-digit alphanumeric code to label your products to keep your name and your products unassociated. Names will be edited out of video recordings.

- ***Retaining research records:*** The data that I will have regarding the participants is the participants' name, email, emergency contact information, in some cases a mailing address, audio and video recordings, and their subsequent transcriptions. This data will be kept for three years then will get destroyed. After which point, the personal data will get destroyed properly. Non-identifiable information, like the flinknapped materials, will be kept for five years then will be recycled.
- Your information collected as part of the research, even if identifiers are removed, will not be used or distributed for future research studies.

Compensation

You will not be paid for taking part in this study, you will however be allowed to keep your flintknapping kits. If you are a participating Undergraduate Research Apprentice, you will receive 1-2 credits depending on the student contract set up through Dr. Lisa Maher for the time spent flintknapping.

Treatment and compensation for injury

It is important that you promptly tell the researcher, Felicia De Pena, if you believe that you have been injured because of taking part in this study. You can tell the researcher in person or call her at ***443- 859-*2770.**

If you are injured as a result of taking part in this study, University of California will provide necessary medical treatment. The costs of the treatment may be billed to your insurer just like other medical costs, or covered by the University of California. The University does not normally provide any other form of compensation for injury. For more information, call OPHS at (510) 642-7461.

Rights

Participation in research is completely voluntary. You have the right to decline to participate or to withdraw at any point in this study without penalty or loss of benefits to which you are otherwise entitled.

Questions

If you have any questions or concerns about this study, you may contact
Dr. Lisa Maher (maher@berkeley.edu) or Felicia De Pena

(felicia_depena@berkeley.edu)

If you have any questions or concerns about your rights and treatment as a research subject, you may contact the office of UC Berkeley's Committee for the Protection of Human Subjects, at 510-642-7461 or subjects@berkeley.edu.

****

CONSENT

You will be given a copy of this consent form to keep.

If you wish to participate in this study, please sign and date below.

______________________________	____________
Participant's Name *(please print)*	Date
______________________________	____________
Participant's Signature	Date
______________________________	____________
Person Obtaining Consent	Date

V. Experimental supplies- core tracking tags for all participating flintknappers.

Experimental Core Tag

Flintknapper ID: ________________

Core Code: ______________________

Date: ______________________

Core Quality:

Coarse Medium Fine Glassy

VI. Experimental supplies- core tracking forms for novice flintknappers.

Core Tracking Form

Flintknapper ID:_______________

Core Code:___________________

Date:________________________

1) What is your goal for this nodule of flint?

2) What problems do you foresee yourself dealing with to accomplish that goal?

3) What did you struggle with the most while working on this nodule?

4) What was the easiest part of working on this nodule?

5) Today I made [circle all that apply]:

   Flakes   Blades   Corrective Elements

6) Today, I found it useful to watch others flintknap [circle].

   Yes   No   Unsure

7) Today I observed other flintknappers working for approximately [circle]:

   <30 mins   30-60 mins   60-90 mins   90-120 mins

Appendix E

Author protocols and suggested scripts for responses during the flintknapping events with novice participants.

<u>Flintknapping with Novices</u>

Meeting Protocol:

1) Meet with flintknappers via Zoom.
2) Gather supplies: Flint nodules, flintknapping kits (hammerstones, pressure flakers, abraders), protective gear, tarps, recording supplies (plastic bags, sharpies, paper tags), and first aid kits.
3) Check to make sure flintknappers are prepared to flintknap (dressed appropriately).
4) Situate the camaras so that all flintknappers can see what I am doing and check to see if participant cameras are also focused correctly.
5) Remind flintknappers to use as much or as little of the flint as they see fit.
6) Begin the 'lesson' by asking the flintknappers the following question: (do not offer answers, just support reasonable claims and discuss why something may not be an issue) "What problems do you think I might face with this piece of flint?"
7) Have flintknappers look at their own nodules of flint and assess their goals and predict problems that they may come across while flintknapping.
8) Allow time for them to fill this information out on their core tracking sheets.
9) Begin flintknapping
10) Narrate what I am doing and why it prepares the core for the next step. (only necessary for the first removal of a sequence- when taking off lateral core trimming flakes do not narrate each flake, just the first one and what it does for the next step).
11) Only work one step at a time
12) Point out when a change in method is necessary. For example, if I run into an inclusion make sure to say something like, "See this inclusion here? That's not going to let the next blade come off the core, so we are going to have to work around it. I'm going to take some flakes off this side here…"
13) Wrapping up- Have all flintknappers label their bags, tag and bag their products, and finish filling out the core tracking sheet.
14) Enter data into the Master Core Tracking Sheet and backup video recordings.

Lesson Scripts:

Remember, this is not instruction. Events are a time that individuals get observe a flintknapper and practice what they see. Minimal instruction is ideal. Events start with flintknappers filling out their core tracking sheets, then watching me flintknap. They can choose to start flintknapping or observe for a while then try flintknapping. This is up to the individual flintknapper.

Sample script for flintknapper questions and responses: (NK=Novice Flintknapper /FD= Felicia De Peña):

NK: "How do I start this piece"
Suggest flintknappers consider the easiest way to start the core and the most effective way to start a core. Let them choose from there:
FD: "Where do you think you could take off a successful flake? What type of removal do you think would help you set up this core the most?"
NK: "What should I use to take [this piece] off?
Suggest experimentation or observation:
FD: "Experiment with your hammerstones and see what types of removals come off when you use the hard hammer versus the soft hammer."
NK: "What do you think I should do next?"
Should be returned with affirmation, then a return of the question itself:
FD: "This [last removal] looks [good/like you had a hard time]. What are you trying to remove next? What do you think is the best way to go about doing that?". "Go ahead and give that a try, see if it works"
NK: "I messed this up. How do I fix it?"
Affirm the flintknapper's challenge then help walk them through their own solution:
FD: "Yes, I see that [problem] that you are dealing with. How do you think you could have avoided [problem]? What do you think would be the most effective way to fix the [problem]? Go ahead and prepare for fixing that [problem] and I will come back to check on you in a bit."
NK: "Is this the material or am I doing a bad job?"
Affirm flintknapper attempts by discussing the difficulties that the flintknapper may have had due to the material. Ask flintknapper to talk about how they would solve the current problem.
FD: "Good question. Sometimes it is the material- there are inclusions, fissures, changes in texture and other problems to worry about. Here in this piece we see [list of potential issues] but they can be mediated. How do you think you can fix this [problem], what would be the first step?"
NK: "Does what I'm trying to do make sense?"
Affirm successful attempts and ask flintknappers their motivations for their current or recent removals.
FD: "You have made a few good [flakes/blades] here. Can you explain why you chose this approach? How does that approach advance your overall goal for the core?"

Appendix F

Table of all participants with their experience, reported capabilities, and reported skill levels.

Flintknapping Participants								
Flintknapper ID	Proficient with traditional flintknapping tool kit	Familiar with flint as a raw material	Has historically produced blade cores	Has historically produced blades on blade cores	Has historically produced sequential blade removals	Has historically produced regular blade removals	Flintknapping Experience	Reported Skill Level
SF1	Yes	Yes	Yes	Yes	Yes	Yes	14 years	Master
SF2	Yes	Yes	Yes	Yes	Yes	Yes	4 years	Master
SF3	Yes	Yes	Yes	Yes	Yes	Yes	15 years	Master
SF4	No	Yes	Yes	Yes	Yes	Yes	30 years	Master
SF5	No	No	Yes	Yes	Yes	Yes	35 years	Master
SF6	No	Yes	No	No	No	No	12 years	Intermediate
SF7	No	Yes	No	No	No	No	30 years	Intermediate
SF8	No	No	No	No	No	No	5 years	Intermediate
SF9	No	No	No	No	No	No	1 year	Intermediate
SF10	Yes	Yes	Yes	Yes	Yes	Yes	7 years	Master
US1 (Aardvark)	No	No	No	No	No	No	None	Novice
US2 (Bobcat)	No	No	No	No	No	No	None	Novice
US3 (Coyote)	No	No	No	No	No	No	None	Novice
US4 (Dingo)	No	No	No	No	No	No	< 5 hours	Novice
US5 (Eagle)	No	No	No	No	No	No	< 5 hours	Novice
US6 (Flamingo)	No	No	No	No	No	No	< 5 hours	Novice
US7 (Gecko)	No	No	No	No	No	No	None	Novice
US8 (Hyena)	No	No	No	No	No	No	None	Novice
US9 (Iguana)	No	No	No	No	No	No	None	Novice
US10 (Jerboa)	No	No	No	No	No	No	None	Novice
US11 (Kangaroo)	No	No	No	No	No	No	None	Novice
US12 (Llama)	No	No	No	No	No	No	None	Novice
US13 (PSK)	No	No	No	No	No	No	< 5 hours	Novice

Appendix G

Table of the lithic attributes collected during phase one of the experimental data collection. Phase one analysis is an aggregate approach to skill level based on attributes of individual core reductions.

Information Recorded	Response Type	Measurement or Recording Technique	Relation to Research
Core Code	Identifier code for each blade core.	Each flintknapper was assigned a code and asked to identify each blade core with a sequential number. For example, FDP01 is the first core that was produced by the author.	Tracking data.
Raw Material Type	Origin and material quality	Georgetown flint, Edward's Plateau flint, and English flint were used in the experiment. Each source is variable. Quality is noted as: coarse, medium, fine, or glassy. These assessments were made by the flintknappers and verified by the author.	Relationship of material quality to skill level.
Skill Level	Skill level of the flintknapper based on their experience. Novice, Intermediate, or Master	Nearly all of the flintknappers were classified by their self-reported skill level. In the experimental assemblage six masters, four intermediate, and thirteen novices are represented. As noted above, one individual self-reported as a novice, but due to their experience of over a year of flintknapping with other skilled individuals they were classified as intermediate in accordance with the previously outlined skill levels.	Tracking data.
Number of Cores	Total number of any core type in assemblage	All core types were accounted for in this analysis.	Techno-typological analysis.
Core Type	Incomplete/unfinished core, prepared blade core, exhausted blade core, exhausted flake core, no core	Incomplete or unfinished cores are cores that have flake removals and lack blade core face preparation. These cores are large and have a significant amount of material that could still be removed from the core. Prepared blade cores are cores that have been shaped into blade cores and have some blade and core trimming element removals. These cores are not exhausted and are primed for more blade removals. Exhausted blade cores are cores that have numerous blade and core trimming element removals and no longer have enough mass to allow for further blade removal. Exhausted flake cores have extensive striking scars, no remaining platforms, often exhibit crushing or battering on most protruding areas, and have little to no potential for further flake removal due to nodule size. No core is used when there are no prepared cores of any type within the assemblage.	Techno-typological analysis.
Flakes	Total flake count	All flakes larger than 25 mm were included in this count.	Techno-typological analysis.
Blades	Total blade count	All blades were included in this count. Broken blades were glued back together, when possible, to help reduce overcounting of blades in each assemblage.	Relates to research question number 5.

Core Trimming Elements	Total core trimming element count	All core trimming elements were included in this count. Broken core trimming elements were glued back together, when possible, to help reduce overcounting of CTE in each assemblage.	Relates to research question number 2.
Single Faceted Platforms	Total number of single faceted platforms	All pieces of debitage within the assemblage are assessed for the platform type. The total number of debitage with single faceted platforms are accounted for in this category.	Relates to research question number 3.
Multi-Faceted Platforms	Total number of multi-faceted platforms	All pieces of debitage within the assemblage are assessed for the platform type. The total number of debitage with multi-faceted platforms are accounted for in this category.	Relates to research question number 3.
Hinge Terminations	Total number of hinge terminations	All pieces of debitage within the assemblage are assessed for the termination type. The total number of debitage with hinge terminations are accounted for in this category.	Relates to research question number 1.
Step Terminations	Total number of step terminations	All pieces of debitage within the assemblage are assessed for the termination type. The total number of debitage with step terminations are accounted for in this category.	Relates to research question number 1.
Outrepassé Terminations	Total number of *outrepassé* terminations	All pieces of debitage within the assemblage are assessed for the termination type. The total number of debitage with *outrepassé* terminations are accounted for in this category.	Relates to research question number 1.
Platform Battering	Total number of battered platforms	All pieces of debitage within the assemblage are assessed for platform damage. The total number of debitage with battered platforms (platforms with multiple unsuccessful attempts at removing the piece or visible cones of percussion) are accounted for in this category.	Relates to research question number 4.
Platform Crushing	Total number of crushed platforms	All pieces of debitage within the assemblage are assessed for platform damage. The total number of debitage with crushed platforms (platforms with extensive damage to the point of the platform being nearly non-existent) are accounted for in this category.	Relates to research question number 4.
Escanté de bulb	Total number of *escanté de bulb*	*Escanté de bulb* are irregular flakes that appear to have two dorsal sides. This is due to their nature as incidental removals. First identified by (Newcomer 1975) as potential indicators of heavy hammer usage, these flakes are counted separately from all other debitage categories above.	Relates to research question number 6.
Presence of Sequential Blade Removals	Presence or absence of sequential blade removals	The blades from each assemblage are refit. If there are two or more sequential blade removals the category is marked as presence. If there are no sequential blade removals, then the category is marked as absent.	Relates to research question number 5.
Blade Regularity	Irregular blades, regular blades, extremely regular blades	Irregular blades have irregular lateral edges, are asymmetrical, and have irregular dorsal ridges. Regular blades have parallel lateral edges and dorsal ridges. Extremely regular blades are highly symmetrical, have parallel lateral edges and dorsal ridges (Pelegrin 2006:42)	Relates to research question number 5.

Notes	Annotations of flintknapper notes and other notable findings during analysis	Any notes provided by the flintknapper regarding difficulties they had or techniques they employed while producing the core reduction sequence are included in this section.	Relates to research question number 6.

Appendix H

Table of all the lithic attributes collected during the second phase of experimental data collection. Phase two analysis of skill level attributes is based on metric and morphological assessments during debitage analysis.

Information Recorded	Response Type	Measurement or Recording Technique	Relation to Research Question
Core Code	Identifying code of each blade core.	Each flintknapper was assigned a code and were asked to identify each blade core with a sequential number. For example, FDP01 is the first core that was produced by the author.	Tracking data.
Skill Level	Skill level of the flintknapper based on their experience.	Nearly all of the flintknappers were classified by their self-reported skill level. In the experimental assemblage six masters, four intermediate, and thirteen novices are represented. As noted above, one individual self-reported as a novice, but due to their experience of over a year of flintknapping with other skilled individuals they were classified as intermediate in accordance with the previously outlined skill levels.	Tracking data.
Removal Type	Blades and core trimming elements were analyzed.	The removal types in this category include: blades, lateral core trimming elements, profile correction elements, core face rejuvenation pieces, partial ridged blades, bottom partial ridged blades, crested blades, initial core tablets, non-initial core tablets (corrective or faceted), and angle correction elements. See the Kharaneh IV techno-typological list for further information regarding these definitions.	Techno-typological analysis Relates to research question number 1, 2, and 5.
Complete Piece	Yes or no	If a piece of debitage was complete it was marked as a 'yes'. If a piece of debitage was incomplete, it was marked as a 'no'. If a piece of debitage was broken into two or more pieces and was able to be entirely refit, the piece was glued back together and marked as complete. The refitting of the piece is noted in the 'Error Present' category below.	Relates to research question number 1.
Platform Type	Single faceted, multi-faceted, or absent	The type of platform preparation is noted as single faceted, multi-faceted, or absent. Single faceted platforms have no preparation prior to removal. Multi-faceted platforms are prepared prior to removal. Absent platforms are either broken or crushed and therefore unable to be determined.	Relates to research question number 3.
Platform Damage	None, crushing, battering, double initiation, or not present	None was used when there is no damage to the platform. Crushing was used when a platform had extensive damage and was nearly non-existent. Battering was used when platforms had evidence of multiple unsuccessful attempts at	Relates to research question number 4.

		removing the piece. This includes hinge and step stacking, cones of percussion in the platform, or multiple small flake removals prior to the final flake removal.	
Proximal Thickness	Recorded in (mm)	Proximal thickness was measured on pieces that had proximal ends. Measurement was taken directly above the bulb of percussion.	Relates to research question number 5.
Medial Thickness	Recorded in (mm)	Measurement taken on complete pieces only. Measurement was taken from the middle of the piece of debitage.	Relates to research question number 5.
Distal Thickness	Recorded in (mm)	Distal thickness was measured on pieces that had distal ends. Measurement was taken at the most distal point of piece.	Relates to research question number 5.
Maximum Length	Recorded in (mm)	Measurement taken on complete pieces only. Measurement was taken in proximal-distal orientation, the longest part of the removal was measured.	Relates to research question number 5.
Maximum Width	Recorded in (mm)	Measurement taken on complete pieces only. Measurement was taken in a lateral orientation across the dorsal surface of the flake in the widest point on the piece of debitage.	Relates to research question number 5.
Weight	Recorded in (g)	Each piece was placed on a scale and the weight was recorded to the hundredths place.	Relates to research question number 5.
Error Present	None, shatter, platform battering, platform crushing, hinging, stepping, *outrepassé*, angle correction needed.	None was used when the piece of debitage was completely intact, had a feathered termination, and had no other observable errors. Shatter was used when a piece had been broken but was refit and glued back together to form a complete piece. Platform battering was used when the platform had been damaged due to flintknapping but was still present. Platform crushing was used when the platform had been severely damaged to the point where determining platform characteristics was unreliable or the platform was removed during the flintknapping process. Hinge terminations end with a rounded edge. Step terminations end abruptly at a 90 degree angle. *Outrepassé* terminations plunge into the core and remove large amounts of material from the parent core. Angle correction needed was used when a removal had a feathered termination, however, the angle at which the removal terminated indicated that a lump would have been left on the core face below that would require corrective action from the flintknapper.	Relates to research question number 1.
Termination Type	Feather, hinge, step, *outrepassé*	Feather terminations evenly thin out at the distal end of a removal.	Relates to research question number 1.

		Hinge terminations end with a rounded edge. Step terminations end abruptly at a 90-degree angle. *Outrepassé* terminations plunge into the core and remove large amounts of material from the parent core. For additional discussion of terminations see Andrefsky (2005).	

Appendix I: Statistical outputs of all flintknapping participants.

In the following pages, Appendix I is split into two sections. First, is the debitage analysis where each piece of experimentally produced debitage was analyzed. Second is the aggregate analysis where each core reduction produced during the experiment was analyzed.

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US1	A08	Novice	Blade	Yes	Multi-faceted	None	No
US1	A08	Novice	Blade	Yes	Single faceted	Battering	No
US2	B01	Novice	Blade	Yes	Multi-faceted	None	No
US2	B01b	Novice	Blade	Yes	Multi-faceted	None	No
US2	B01b	Novice	Blade	Yes	Single faceted	None	No
US2	B01b	Novice	Blade	Yes	Single faceted	None	No
US2	B01b	Novice	Blade	Yes	Multi-faceted	None	No
US2	B02c	Novice	Blade	Yes	Multi-faceted	None	No
US2	B02c	Novice	Blade	Yes	Multi-faceted	Battering	No
US2	B02c	Novice	Blade	Yes	Multi-faceted	None	No
US2	B04a	Novice	Blade	Yes	Multi-faceted	Crushing	No
US2	B04a	Novice	Blade	Yes	Multi-faceted	None	No
US2	B04b	Novice	Blade	No	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.90	3.79	1.36	39.06	21.19	3.10
Shatter	Outrepasse	5.62	9.16	10.11	72.85	25.56	13.34
None	Feather	1.89	2.07	0.25	32.88	10.47	0.60
None	Feather	3.65	2.69	1.07	33.69	12.86	1.25
None	Feather	1.04	1.50	0.61	36.45	10.18	0.54
None	Feather	2.58	2.11	0.41	42.88	14.71	1.29
None	Feather	2.64	2.91	0.86	36.33	12.56	1.40
None	Feather	4.03	4.71	1.10	42.93	17.62	4.00
None	Feather	3.89	5.19	3.34	47.50	16.76	5.66
None	Feather	1.43	1.91	1.22	40.18	10.75	1.10
None	Feather	2.33	1.74	0.45	40.02	9.11	0.60
None	Feather	1.25	2.54	0.50	44.51	14.01	1.52
None	Feather	3.07	3.26	0.89	41.10	17.80	2.21

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-0.707	-0.707	-0.707	-0.707	-0.707	-0.707
Novice	Unskilled	0.707	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	1.089	0.613	1.154	-0.933	0.152	0.332
Novice	Unskilled	-1.335	-1.269	-0.442	-0.227	-1.289	-1.480
Novice	Unskilled	0.095	-0.304	-1.137	1.418	1.147	0.434
Novice	Unskilled	0.151	0.960	0.425	-0.258	-0.009	0.715
Novice	Unskilled	0.625	0.437	-0.624	-0.164	0.688	0.179
Novice	Unskilled	0.529	0.708	1.153	1.072	0.459	0.898
Novice	Unskilled	-1.153	-1.144	-0.529	-0.908	-1.147	-1.077
Novice	Unskilled	0.707	-0.707	-0.707	-0.707	-0.707	-0.707
Novice	Unskilled	-0.707	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US2	B04c	Novice	Blade	Yes	Multi-faceted	None	No
US2	B06	Novice	Blade	Yes	Multi-faceted	None	No
US2	B06	Novice	Blade	Yes	Multi-faceted	Battering	No
US2	B07a	Novice	Blade	Yes	Multi-faceted	None	No
US2	B07a	Novice	Blade	Yes	Multi-faceted	Battering	No
US2	B07a	Novice	Blade	Yes	Multi-faceted	Battering	No
US2	B07a	Novice	Blade	Yes	Multi-faceted	Battering	No
US2	B07a	Novice	Blade	Yes	Multi-faceted	Crushing	No
US2	B07a	Novice	Blade	Yes	Multi-faceted	None	No
US3	C01	Novice	Blade	Yes	Multi-faceted	None	No
US3	C01	Novice	Lateral core trimming	Yes	Single faceted	Battering	No
US3	C01	Novice	Lateral core trimming	Yes	Single faceted	Battering	No
US3	C01	Novice	Crested blade	Yes	Single faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	3.84	4.59	0.79	31.90	14.03	2.20
None	Feather	2.48	2.21	1.33	31.04		0.68
Platform battering	Feather	1.92	2.77	1.64	29.10	9.39	0.88
None	Feather	1.80	4.31	1.59	38.09	14.43	2.54
None	Feather	2.74	3.97	1.15	34.09	14.08	2.38
None	Feather	3.12	4.83	1.46	35.09	11.35	1.84
None	Feather	2.00	2.30	0.84	34.00	13.36	1.03
None	Feather	N/A	3.25	1.38	33.96	13.22	1.73
None	Feather	2.27	4.47	1.75	35.09	15.36	2.02
None	Feather	0.38	0.50	0.16	49.70	21.00	4.76
None	Outrepasse	0.25	0.38	0.73	27.50	48.30	5.79
Platform battering	Feather	0.33	0.61	0.03	30.50	30.00	2.71
None	Feather	0.72	0.94	0.22	44.50	1.40	4.36

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	0.707	-0.707	-0.707	0.707	N/A	-0.707
Novice	Unskilled	-0.707	0.707	0.707	-0.707	N/A	0.707
Novice	Unskilled	-1.084	0.489	0.701	1.924	0.585	1.149
Novice	Unskilled	0.655	0.124	-0.650	-0.610	0.328	0.851
Novice	Unskilled	1.357	1.047	0.302	0.023	-1.677	-0.155
Novice	Unskilled	-0.714	-1.670	-1.602	-0.667	-0.201	-1.664
Novice	Unskilled	N/A	-0.650	0.056	-0.693	-0.303	-0.360
Novice	Unskilled	-0.214	0.661	1.193	0.023	1.268	0.180
Novice	Unskilled	-0.193	-0.447	-0.407	1.085	-0.214	0.277
Novice	Unskilled	-0.821	-0.945	1.449	-0.983	1.186	1.082
Novice	Unskilled	-0.435	0.010	-0.830	-0.703	0.247	-1.324
Novice	Unskilled	1.449	1.381	-0.212	0.601	-1.219	-0.035

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US3	C02	Novice	Blade	Yes	Multi-faceted	None	No
US3	C04	Novice	Lateral core trimming	Yes	Multi-faceted	None	No
US3	C04	Novice	Lateral core trimming	Yes	Single faceted	None	No
US3	C04	Novice	Crested blade	Yes	Single faceted	None	No
US3	C04	Novice	Crested blade	No	Multi-faceted	None	No
US3	C05	Novice	Blade	Yes	Multi-faceted	None	No
US3	C06	Novice	Blade	Yes	Single faceted	None	No
US3	C06	Novice	Blade	Yes	Multi-faceted	None	No
US3	C06	Novice	Lateral core trimming	Yes	Multi-faceted	None	No
US3	C06	Novice	Lateral core trimming	Yes	Multi-faceted	None	No
US3	C06	Novice	Crested blade	Yes	Multi-faceted	None	Yes
US3	C09	Novice	Blade	Yes	Multi-faceted	Double Initiation	No
US3	C09	Novice	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.87	2.24	0.90	34.31	13.08	1.17
None	Feather	5.49	8.29	2.27	31.30	45.75	9.48
None	Feather	3.15	5.14	2.58	31.56	33.22	6.49
None	Feather	2.45	7.04	2.77	62.02	28.23	11.53
None	Hinge	4.48	6.25	N/A	N/A	N/A	5.32
Hinging	Hinge	1.56	2.46	1.71	24.47	9.82	0.62
None	Feather	3.05	3.68	1.12	41.94	12.79	1.99
None	Feather	2.03	3.06	1.32	37.18	9.24	0.90
None	Feather	5.22	8.14	1.48	28.73	39.61	7.87
None	Feather	3.10	6.54	3.39	28.47	33.49	5.34
None	Feather	4.29	4.65	2.25	49.86	19.01	4.53
None	Feather	8.34	8.77	4.90	59.98	24.29	15.15
None	Feather	4.64	4.27	1.32	37.07	18.40	2.76

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	1.177	1.214	-1.070	-0.585	1.110	0.451
Novice	Unskilled	-0.547	-1.161	0.158	-0.570	-0.278	-0.607
Novice	Unskilled	-1.063	0.271	0.911	1.155	-0.831	1.177
Novice	Unskilled	0.433	-0.324	N/A	N/A	N/A	-1.021
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	-0.395	-0.731	-0.851	0.517	-0.761	-0.772
Novice	Unskilled	-1.221	-1.026	-0.636	-0.006	-1.031	-1.166
Novice	Unskilled	1.362	1.394	-0.464	-0.936	1.273	1.353
Novice	Unskilled	-0.355	0.632	1.588	-0.964	0.809	0.439
Novice	Unskilled	0.609	-0.269	0.363	1.388	-0.290	0.146
Novice	Unskilled	2.332	1.837	2.556	1.603	0.690	2.680
Novice	Unskilled	0.644	0.069	-0.160	-0.199	0.087	-0.103

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US3	C09	Novice	Blade	Yes	Multi-faceted	None	No
US3	C09	Novice	Blade	Yes	Multi-faceted	Battering	No
US3	C09	Novice	Blade	Yes	Multi-faceted	Battering	No
US3	C09	Novice	Blade	Yes	Multi-faceted	None	No
US3	C09	Novice	Blade	Yes	Multi-faceted	Crushing	No
US3	C09	Novice	Blade	Yes	Multi-faceted	None	No
US3	C09	Novice	Lateral core trimming	Yes	Multi-faceted	None	No
US3	C09	Novice	Angle correction	Yes	Multi-faceted	None	Yes
US3	C10	Novice	Blade	Yes	Single faceted	Crushing	No
US3	C10	Novice	Blade	Yes	Multi-faceted	None	No
US3	C10	Novice	Blade	Yes	Multi-faceted	Battering	No
US3	C10	Novice	Blade	Yes	Multi-faceted	None	No
US3	C10	Novice	Blade	Yes	Single faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Hinging	Hinge	1.74	3.25	1.20	33.03	14.61	1.72
Platform battering	Feather	3.92	7.21	1.97	59.19	15.92	5.33
Platform battering	Feather	2.48	3.06	0.70	38.44	12.30	1.10
None	Feather	1.25	0.90	0.67	30.96	7.61	0.21
None	Feather	N/A	N/A	1.22	N/A	N/A	0.45
None	Feather	2.04	1.23	0.58	31.57	11.51	0.72
None	Feather	2.54	4.08	0.52	22.62	40.42	2.00
Shatter	Feather	2.12	4.09	2.23	43.57	12.84	2.73
None	Feather	N/A	1.95	0.51	36.90	11.52	0.90
Hinging	Hinge	2.57	2.71	1.92	25.30	10.15	0.85
None	Feather	2.77	1.76	0.78	34.82	11.76	0.70
None	Feather	2.97	2.57	0.82	52.72	11.85	1.57
None	Feather	1.32	3.18	1.32	51.56	14.30	2.38

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-0.680	-0.332	-0.251	-0.517	-0.300	-0.336
Novice	Unskilled	0.315	1.224	0.333	1.541	-0.166	0.475
Novice	Unskilled	-0.342	-0.407	-0.630	-0.091	-0.536	-0.475
Novice	Unskilled	-0.904	-1.256	-0.653	-0.680	-1.016	-0.675
Novice	Unskilled	N/A	N/A	-0.236	N/A	N/A	-0.621
Novice	Unskilled	-0.543	-1.126	-0.721	-0.632	-0.617	-0.561
Novice	Unskilled	-0.315	-0.006	-0.767	-1.336	2.339	-0.273
Novice	Unskilled	-0.507	-0.002	0.530	0.312	-0.481	-0.109
Novice	Unskilled	N/A	-0.943	-0.901	-0.215	-0.344	-0.648
Novice	Unskilled	0.380	0.076	1.736	-1.292	-1.358	-0.728
Novice	Unskilled	0.675	-1.197	-0.396	-0.408	-0.167	-0.966
Novice	Unskilled	0.970	-0.112	-0.321	1.253	-0.100	0.415
Novice	Unskilled	-1.463	0.706	0.614	1.146	1.713	1.701

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US3	C10	Novice	Blade	No	Single faceted	Battering	No
US3	C11	Novice	Blade	No	Absent	Not present	No
US3	C11	Novice	Blade	Yes	Multi-faceted	Battering	No
US3	C11	Novice	Blade	Yes	Multi-faceted	Battering	No
US3	C11	Novice	Blade	Yes	Multi-faceted	Battering	No
US3	C11	Novice	Angle correction	No	Absent	Not present	Yes
US3	C11	Novice	Angle correction	No	Absent	Not present	Yes
US3	C11	Novice	Profile correction blade	Yes	Multi-faceted	None	Yes
US3	C11	Novice	Partial ridged blade	Yes	Multi-faceted	Crushing	Yes
US3	C11	Novice	Crested blade	Yes	Multi-faceted	None	Yes
US3	C11	Novice	Corrective non-initial core tablet	No	Single faceted	Battering	Yes
US3	C13	Novice	Faceted non-initial core tablet	Yes	Absent	Crushing	No
US4	D02	Novice	Blade	Yes	Multi-faceted	Battering	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Platform battering	Feather	1.93	3.75	0.60	33.99	12.33	1.45
Shatter	Step	N/A	N/A	N/A	N/A	N/A	1.52
Platform battering	Hinge	6.02	4.62	1.75	39.44	16.73	3.15
None	Feather	2.46	3.26	0.75	43.39	10.25	1.84
None	Feather	2.30	4.24	2.03	51.44	13.29	3.50
Shatter	Feather	N/A	N/A	N/A	N/A	N/A	4.53
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	1.03
Shatter	Feather	2.93	5.94	1.46	60.85	16.42	5.49
None	Feather	4.63	14.24	3.06	63.02	17.22	14.00
Shatter	Feather	3.74	5.72	2.52	47.87	7.28	2.02
None	Step	5.05	N/A	N/A	N/A	N/A	113.40
None	Feather	12.01	39.88	19.31	86.87	49.41	148.03
None	Feather	5.45	5.50	1.61	56.37	24.17	8.68

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-0.563	1.470	-0.733	-0.485	0.255	0.225
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.389
Novice	Unskilled	1.520	-0.430	-0.220	-1.228	0.789	-0.342
Novice	Unskilled	-1.003	-0.770	-1.455	-0.809	-0.810	-0.380
Novice	Unskilled	-1.117	-0.525	0.126	0.047	-0.060	-0.332
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.303
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.403
Novice	Unskilled	-0.670	-0.099	-0.578	1.046	0.713	-0.275
Novice	Unskilled	0.535	1.978	1.397	1.277	0.910	-0.030
Novice	Unskilled	-0.096	-0.154	0.730	-0.333	-1.543	-0.375
Novice	Unskilled	0.832	N/A	N/A	N/A	N/A	2.829
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	-0.447	-0.782	-0.482	-1.071	-0.138	-0.562

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US4	D02	Novice	Profile correction blade	No	Absent	Crushing	Yes
US4	D02	Novice	Profile correction blade	Yes	Multi-faceted	Battering	Yes
US4	D02	Novice	Profile correction blade	Yes	Multi-faceted	Battering	No
US4	D02	Novice	Non-initial core tablet	Yes	Single faceted	None	No
US4	D03	Novice	Profile correction blade	Yes	Multi-faceted	None	Yes
US4	D03	Novice	Core face rejuvenation	No	Multi-faceted	Double Initiation	No
US4	D03	Novice	Partial ridged blade	Yes	Multi-faceted	None	Yes
US4	D03	Novice	Crested blade	No	Absent	Not present	Yes
US4	D04	Novice	Blade	Yes	Single faceted	Battering	No
US4	D05	Novice	Blade	Yes	Multi-faceted	None	No
US4	D05	Novice	Blade	Yes	Multi-faceted	Crushing	No
US4	D05	Novice	Blade	Yes	Single faceted	None	No
US4	D05	Novice	Profile correction blade	Yes	Single faceted	Battering	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	N/A	6.81	1.52	63.03	16.50	5.82
None	Feather	9.74	13.30	3.26	69.06	30.78	28.22
Platform battering	Feather	3.73	8.52	1.41	61.78	23.33	12.73
None	Outrepasse	7.53	25.97	22.77	80.12	30.08	104.59
None	Feather	19.12	10.48	6.37	81.66	32.23	32.16
Hinging	Hinge	8.57	7.53	N/A	N/A	N/A	18.48
None	Feather	6.14	9.50	3.07	82.75	18.94	13.65
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	116.76
None	Feather	5.11	4.72	1.23	55.37	23.37	4.00
None	Feather	11.80	9.77	2.81	87.21	31.89	27.03
None	Feather	4.73	4.98	0.83	60.00	16.20	6.01
None	Feather	5.65	3.44	1.20	54.54	21.96	5.02
Platform battering	Feather	9.90	16.26	2.24	70.71	32.96	32.78

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	N/A	-0.625	-0.492	-0.336	-1.459	-0.631
Novice	Unskilled	1.203	0.153	-0.306	0.330	1.000	-0.091
Novice	Unskilled	-1.109	-0.420	-0.504	-0.474	-0.283	-0.465
Novice	Unskilled	0.353	1.673	1.783	1.551	0.879	1.750
Novice	Unskilled	1.137	0.872	0.707	-0.707	0.707	-0.271
Novice	Unskilled	-0.392	-1.092	N/A	N/A	N/A	-0.554
Novice	Unskilled	-0.744	0.220	-0.707	0.707	-0.707	-0.654
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	1.480
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	0.210	-0.375	-0.312	0.185	-0.001	-0.379
Novice	Unskilled	-0.922	-0.615	-0.565	-0.665	-1.018	-0.529
Novice	Unskilled	-0.775	-0.692	-0.518	-0.836	-0.645	-0.536
Novice	Unskilled	-0.094	-0.050	-0.385	-0.331	0.069	-0.337

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US4	D05	Novice	Non-initial core tablet	Yes	Single faceted	None	No
US4	D06	Novice	Blade	Yes	Multi-faceted	Battering	No
US4	D06	Novice	Blade	Yes	Multi-faceted	None	No
US4	D06	Novice	Blade	Yes	Single faceted	Battering	No
US4	D06	Novice	Angle correction	No	Absent	Not present	Yes
US4	D06	Novice	Profile correction blade	Yes	Multi-faceted	Battering	Yes
US4	D06	Novice	Partial ridged blade	Yes	Single faceted	None	Yes
US4	D06	Novice	Crested blade	Yes	Single faceted	None	Yes
US4	D07	Novice	Blade	Yes	Single faceted	None	Yes
US4	D07	Novice	Blade	Yes	Single faceted	None	No
US4	D07	Novice	Profile correction blade	Yes	Single faceted	Battering	Yes
US4	D07	Novice	Profile correction blade	Yes	Multi-faceted	None	Yes
US4	D07	Novice	Profile correction blade	No	Absent	Not present	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Step	20.35	51.82	19.16	134.04	56.48	328.24
Platform battering	Hinge	4.63	4.69	3.19	57.80	15.73	4.98
None	Feather	2.54	3.00	1.55	42.48	8.61	1.02
Platform battering	Feather	3.18	4.31	1.03	44.36	16.37	3.17
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	4.41
Platform battering	Feather	10.81	15.71	4.34	73.07	24.14	28.31
None	Feather	8.81	7.93	3.73	66.45	25.03	17.90
Shatter	Hinge	6.54	13.59	5.70	98.10	18.34	19.68
None	Feather	7.23	8.79	3.91	108.05	32.81	35.12
Shatter	Feather	5.65	7.75	2.13	81.47	24.99	15.01
Shatter	Feather	3.69	9.27	1.41	75.07	21.20	11.97
None	Outrepasse	3.03	6.64	13.76	56.96	17.07	9.67
None	Outrepasse	N/A	N/A	15.44	N/A	N/A	9.76

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	1.580	1.732	1.780	1.648	1.595	1.782
Novice	Unskilled	-0.447	-0.664	-0.038	-0.286	-0.381	-0.607
Novice	Unskilled	-1.088	-0.984	-0.977	-1.027	-1.557	-0.983
Novice	Unskilled	-0.892	-0.736	-1.275	-0.936	-0.275	-0.779
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.661
Novice	Unskilled	1.450	1.418	0.620	0.453	1.008	1.614
Novice	Unskilled	0.836	-0.052	0.271	0.133	1.155	0.623
Novice	Unskilled	0.140	1.018	1.399	1.663	0.050	0.793
Novice	Unskilled	0.979	-0.116	-0.376	1.724	2.003	1.707
Novice	Unskilled	0.238	-0.328	-0.675	0.355	0.513	-0.155
Novice	Unskilled	-0.682	-0.019	-0.796	0.025	-0.209	-0.436
Novice	Unskilled	-0.992	-0.555	1.281	-0.907	-0.996	-0.649
Novice	Unskilled	N/A	N/A	1.563	N/A	N/A	-0.641

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US4	D07	Novice	Profile correction blade	Yes	Single faceted	Battering	Yes
US4	D07	Novice	Crested blade	No	Single faceted	None	Yes
US4	D07	Novice	Crested blade	Yes	Single faceted	Battering	Yes
US4	D07	Novice	Non-initial core tablet	Yes	Single faceted	None	No
US4	D08	Novice	Blade	Yes	Single faceted	None	No
US4	D08	Novice	Core face rejuvenation	Yes	Single faceted	None	Yes
US4	D08	Novice	Crested blade	Yes	Single faceted	None	Yes
US4	D08	Novice	Crested blade	Yes	Single faceted	None	Yes
US4	D09	Novice	Blade	Yes	Multi-faceted	None	No
US4	D09	Novice	Blade	Yes	Single faceted	None	No
US4	D09	Novice	Blade	Yes	Single faceted	None	No
US4	D09	Novice	Blade	Yes	Multi-faceted	None	No
US4	D09	Novice	Blade	Yes	Single faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	8.83	10.12	1.93	58.43	19.57	10.64
Hinging	Hinge	5.19	N/A	N/A	N/A	N/A	17.33
None	Outrepasse	5.03	19.37	9.78	86.82	19.02	34.59
None	Feather	2.50	3.59	0.79	55.25	21.41	6.02
None	Feather	10.01	7.93	1.52	61.89	21.14	14.34
Angle	Outrepasse	9.17	18.81	19.84	95.56	44.30	85.70
None	Feather	14.16	16.64	3.59	111.67	29.83	42.48
None	Feather	10.04	15.30	3.79	100.83	34.12	40.80
None	Feather	2.81	2.86	1.34	32.52	8.64	0.72
None	Feather	2.76	2.92	1.15	30.21	11.54	1.14
None	Feather	2.63	2.06	1.05	24.58	11.13	0.73
None	Feather	1.48	2.05	1.17	27.27	6.43	0.40
None	Feather	2.71	2.47	0.77	25.91	10.41	0.97

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	1.730	0.155	-0.709	-0.832	-0.519	-0.559
Novice	Unskilled	0.022	N/A	N/A	N/A	N/A	0.060
Novice	Unskilled	-0.053	2.040	0.611	0.630	-0.624	1.658
Novice	Unskilled	-1.241	-1.176	-0.900	-0.995	-0.169	-0.987
Novice	Unskilled	-0.372	-1.428	-0.667	-1.425	-1.164	-1.066
Novice	Unskilled	-0.746	0.877	1.489	0.143	1.242	1.350
Novice	Unskilled	1.476	0.417	-0.423	0.893	-0.262	-0.113
Novice	Unskilled	-0.358	0.133	-0.399	0.389	0.184	-0.170
Intermediate	Unskilled	-0.536	-0.591	-0.394	-0.423	-0.629	-0.481
Intermediate	Unskilled	-0.548	-0.585	-0.432	-0.493	-0.433	-0.475
Intermediate	Unskilled	-0.580	-0.667	-0.451	-0.662	-0.461	-0.481
Intermediate	Unskilled	-0.857	-0.668	-0.428	-0.581	-0.779	-0.485
Intermediate	Unskilled	-0.560	-0.628	-0.506	-0.622	-0.510	-0.478

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US4	D09	Novice	Blade	Yes	Single faceted	None	No
US4	D09	Novice	Blade	Yes	Multi-faceted	None	No
US4	D09	Novice	Blade	Yes	Multi-faceted	Double Initiation	No
US4	D09	Novice	Faceted non-initial core tablet	Yes	Multi-faceted	Battering	Yes
US4	D09	Novice	Profile correction blade	Yes	Single faceted	None	Yes
US4	D09	Novice	Profile correction blade	Yes	Single faceted	None	Yes
US4	D09	Novice	Profile correction blade	Yes	Multi-faceted	None	Yes
US4	D09	Novice	Profile correction blade	Yes	Single faceted	None	Yes
US4	D09	Novice	Core face rejuvenation	Yes	Single faceted	Battering	Yes
US4	D09	Novice	Core face rejuvenation	Yes	Single faceted	Battering	Yes
US4	D09	Novice	Crested blade	Yes	Single faceted	Battering	No
US4	D09	Novice	Initial core tablet	No	Single faceted	None	No
US4	D09	Novice	Corrective non-initial core tablet	Yes	Single faceted	Battering	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	1.38	2.60	1.16	27.47	7.93	0.52
None	Feather	2.18	1.66	0.60	24.54	7.45	0.36
None	Feather	1.72	2.35	0.85	32.72	6.72	0.70
Platform battering	Feather	13.86	34.46	5.05	141.07	59.41	291.34
None	Feather	2.79	3.97	1.32	29.70	11.72	1.59
None	Feather	4.24	5.23	2.19	32.18	16.19	2.82
None	Feather	2.63	3.40	1.56	29.33	9.01	1.03
None	Feather	6.15	6.87	1.11	26.92	11.08	2.30
None	Feather	14.00	27.07	4.85	82.56	23.47	59.97
Platform battering	Feather	9.98	12.09	1.69	48.03	31.05	16.99
Shatter	Outrepasse	3.44	15.41	10.42	87.26	33.00	53.14
None	Feather	10.37	N/A	N/A	N/A	N/A	97.24
Platform battering	Outrepasse	5.53	26.75	20.66	90.20	40.02	114.02

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.881	-0.616	-0.430	-0.575	-0.677	-0.484
Intermediate	Unskilled	-0.688	-0.705	-0.540	-0.663	-0.710	-0.486
Intermediate	Unskilled	-0.799	-0.639	-0.491	-0.417	-0.759	-0.481
Intermediate	Unskilled	2.125	2.415	0.334	2.836	2.801	3.494
Intermediate	Unskilled	-0.541	-0.485	-0.398	-0.508	-0.421	-0.469
Intermediate	Unskilled	-0.192	-0.365	-0.228	-0.433	-0.119	-0.452
Intermediate	Unskilled	-0.580	-0.539	-0.351	-0.519	-0.604	-0.477
Intermediate	Unskilled	0.268	-0.209	-0.440	-0.591	-0.464	-0.459
Intermediate	Unskilled	2.159	1.712	0.295	1.079	0.373	0.329
Intermediate	Unskilled	1.191	0.287	-0.326	0.042	0.885	-0.258
Intermediate	Unskilled	-0.385	0.603	1.388	1.220	1.017	0.236
Intermediate	Unskilled	1.284	N/A	N/A	N/A	N/A	0.839
Intermediate	Unskilled	0.119	1.681	3.397	1.308	1.491	1.069

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US4	D10	Novice	Blade	Yes	Single faceted	Battering	No
US4	D10	Novice	Blade	Yes	Single faceted	None	No
US4	D10	Novice	Blade	Yes	Single faceted	None	No
US4	D10	Novice	Blade	Yes	Single faceted	Battering	No
US4	D10	Novice	Blade	Yes	Single faceted	Crushing	No
US4	D10	Novice	Blade	No	Absent	Not present	No
US4	D10	Novice	Blade	No	Absent	Not present	No
US4	D10	Novice	Blade	No	Multi-faceted	None	No
US4	D10	Novice	Blade	Yes	Multi-faceted	None	No
US4	D10	Novice	Blade	Yes	Multi-faceted	None	No
US4	D10	Novice	Lateral core trimming	Yes	Single faceted	Crushing	No
US4	D10	Novice	Faceted non-initial core tablet	Yes	Single faceted	None	Yes
US4	D10	Novice	Angle correction	Yes	Single faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Platform battering	Hinge	9.39	5.72	3.18	41.40	19.62	5.45
None	Feather	3.30	4.36	1.95	38.38	13.94	2.58
None	Feather	2.86	3.02	1.50	37.75	12.76	1.55
Platform battering	Feather	3.96	8.92	1.64	47.64	13.37	4.80
None	Feather	N/A	3.77	1.77	44.24	12.84	2.35
Shatter	Feather	N/A	N/A	1.09	N/A	N/A	1.58
Shatter	Feather	N/A	N/A	0.78	N/A	N/A	0.98
Shatter	Step	2.17	N/A	N/A	N/A	N/A	1.26
None	Feather	6.45	2.46	0.78	40.21	10.49	1.03
None	Feather	2.58	2.39	1.03	45.14	15.90	1.68
None	Feather	5.55	9.03	0.86	23.14	31.30	4.68
None	Feather	8.76	8.84	1.45	62.84	31.41	22.50
None	Feather	6.74	5.76	1.39	32.51	14.11	2.44

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	1.051	-0.475	0.674	-0.521	-0.161	-0.354
Intermediate	Unskilled	-0.733	-0.848	-0.190	-0.767	-0.819	-0.584
Intermediate	Unskilled	-0.862	-1.216	-0.505	-0.818	-0.955	-0.666
Intermediate	Unskilled	-0.540	0.403	-0.407	-0.014	-0.885	-0.406
Intermediate	Unskilled	N/A	-1.010	-0.316	-0.290	-0.946	-0.602
Intermediate	Unskilled	N/A	N/A	-0.793	N/A	N/A	-0.664
Intermediate	Unskilled	N/A	N/A	-1.011	N/A	N/A	-0.712
Intermediate	Unskilled	-1.064	N/A	N/A	N/A	N/A	-0.690
Intermediate	Unskilled	0.190	-1.370	-1.011	-0.618	-1.218	-0.708
Intermediate	Unskilled	-0.944	-1.389	-0.835	-0.217	-0.592	-0.656
Intermediate	Unskilled	-0.074	0.433	-0.955	-2.006	1.191	-0.416
Intermediate	Unskilled	0.867	0.381	-0.541	1.222	1.203	1.009
Intermediate	Unskilled	0.275	-0.464	-0.583	-1.244	-0.799	-0.595

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US4	D10	Novice	Angle correction	Yes	Multi-faceted	None	Yes
US4	D10	Novice	Profile correction blade	Yes	Single faceted	None	Yes
US4	D10	Novice	Profile correction blade	Yes	Single faceted	None	Yes
US4	D10	Novice	Profile correction blade	No	Single faceted	None	Yes
US4	D10	Novice	Profile correction blade	Yes	Multi-faceted	None	Yes
US4	D10	Novice	Profile correction blade	Yes	Multi-faceted	Battering	Yes
US4	D10	Novice	Profile correction blade	Yes	Multi-faceted	Double Initiation	Yes
US4	D10	Novice	Core face rejuvenation	Yes	Single faceted	None	Yes
US4	D10	Novice	Core face rejuvenation	Yes	Single faceted	Battering	Yes
US4	D10	Novice	Partial ridged blade	Yes	Single faceted	Double Initiation	Yes
US4	D10	Novice	Crested blade	Yes	Single faceted	Battering	Yes
US4	D10	Novice	Crested blade	No	Absent	Not present	Yes
US4	D11	Novice	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	3.38	11.34	2.31	48.09	17.15	7.18
None	Outrepasse	11.31	14.18	4.17	77.27	42.05	43.74
None	Feather	2.46	7.15	2.64	46.91	16.21	4.61
Shatter	Hinge	3.44	N/A	N/A	N/A	N/A	11.67
None	Outrepasse	3.59	4.32	5.57	50.01	24.98	6.18
Platform battering	Feather	3.02	4.30	1.73	46.79	15.77	2.84
Platform battering	Feather	6.04	8.44	1.80	53.58	19.68	8.80
None	Feather	15.45	12.86	2.35	47.17	29.72	19.64
None	Feather	7.96	10.55	6.06	44.33	31.02	14.97
Angle	Feather	7.97	12.22	3.16	68.00	29.24	19.13
Platform battering	Feather	5.46	9.40	1.16	60.81	18.72	7.38
Shatter	Hinge	N/A	N/A	2.69	N/A	N/A	48.03
None	Feather	2.03	5.51	1.33	58.41	13.62	3.62

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.709	1.067	0.063	0.023	-0.447	-0.216
Intermediate	Unskilled	1.614	1.846	1.369	2.395	2.435	2.708
Intermediate	Unskilled	-0.979	-0.083	0.295	-0.073	-0.556	-0.422
Intermediate	Unskilled	-0.692	N/A	N/A	N/A	N/A	0.143
Intermediate	Unskilled	-0.648	-0.859	2.352	0.179	0.459	-0.296
Intermediate	Unskilled	-0.815	-0.865	-0.344	-0.083	-0.607	-0.563
Intermediate	Unskilled	0.070	0.271	-0.295	0.469	-0.154	-0.087
Intermediate	Unskilled	2.826	1.484	0.091	-0.052	1.008	0.780
Intermediate	Unskilled	0.632	0.850	2.696	-0.283	1.158	0.407
Intermediate	Unskilled	0.635	1.309	0.660	1.641	0.952	0.740
Intermediate	Unskilled	-0.100	0.535	-0.744	1.057	-0.266	-0.200
Intermediate	Unskilled	N/A	N/A	0.330	N/A	N/A	3.051
Novice	Unskilled	-0.740	-0.522	-0.793	0.854	-0.563	-0.831

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US4	D11	Novice	Blade	Yes	Multi-faceted	None	No
US4	D11	Novice	Blade	Yes	Multi-faceted	None	No
US4	D11	Novice	Lateral core trimming	Yes	Single faceted	None	No
US4	D11	Novice	Lateral core trimming	Yes	Single faceted	Battering	No
US4	D11	Novice	Profile correction blade	No	Absent	Not present	Yes
US4	D11	Novice	Crested blade	Yes	Single faceted	None	Yes
US4	D11	Novice	Crested blade	No	Absent	Crushing	Yes
US4	D12	Novice	Lateral core trimming	Yes	Single faceted	None	No
US4	D12	Novice	Angle correction	No	Absent	Not present	Yes
US5	E09	Novice	Blade	Yes	Single faceted	None	No
US5	E10a	Novice	Angle correction	No	Absent	Crushing	Yes
US5	E10b	Novice	Angle correction	Yes	Single faceted	Battering	Yes
US5	E10b	Novice	Crested blade	Yes	Single faceted	Double Initiation	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.13	2.30	1.56	40.88	7.87	0.78
None	Feather	1.72	3.96	1.74	34.86	8.10	1.10
None	Feather	9.70	10.22	6.12	36.16	64.19	23.65
Platform battering	Feather	4.37	11.28	2.26	37.87	65.28	16.73
Shatter	Feather	N/A	N/A	1.90	N/A	N/A	6.89
Shatter	Feather	12.10	18.75	2.18	69.36	16.29	18.64
Platform battering	Outrepasse	N/A	N/A	5.68	N/A	N/A	26.59
None	Feather	7.95	3.70	1.23	54.46	54.56	12.38
Shatter	Feather	N/A	N/A	3.33	N/A	N/A	16.88
None	Feather	3.01	3.20	0.59	45.84	10.60	1.63
None	Feather	N/A	N/A	2.77	N/A	N/A	8.69
Platform battering	Feather	3.56	10.92	2.22	43.18	21.49	8.98
None	Feather	2.97	9.74	0.84	48.62	14.32	5.40

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-0.718	-1.051	-0.672	-0.378	-0.771	-1.104
Novice	Unskilled	-0.810	-0.777	-0.578	-0.801	-0.763	-1.073
Novice	Unskilled	0.974	0.256	1.712	-0.710	1.262	1.097
Novice	Unskilled	-0.217	0.431	-0.307	-0.589	1.302	0.431
Novice	Unskilled	N/A	N/A	-0.495	N/A	N/A	-0.516
Novice	Unskilled	1.511	1.664	-0.348	1.624	-0.467	0.615
Novice	Unskilled	N/A	N/A	1.482	N/A	N/A	1.380
Novice	Unskilled	N/A	N/A	-0.707	N/A	N/A	-0.707
Novice	Unskilled	N/A	N/A	0.707	N/A	N/A	0.707
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	0.707	0.707	-0.397	-0.707	0.707	-0.493
Novice	Unskilled	-0.707	-0.707	-0.740	0.707	-0.707	-0.657

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US5	E10b	Novice	Non-initial core tablet	Yes	Single faceted	Battering	No
US5	E14	Novice	Profile correction blade	Yes	Single faceted	Crushing	Yes
US5	E11	Novice	Core face rejuvenation	Yes	Single faceted	Battering	Yes
US5	E11	Novice	Partial ridged blade	No	Absent	Not present	Yes
US5	E11	Novice	Crested blade	Yes	Single faceted	Double Initiation	Yes
US6	F01	Novice	Crested blade	Yes	Single faceted	Battering	No
US6	F02	Novice	Angle correction	No	Absent	Not present	Yes
US6	F02	Novice	Non-initial core tablet	Yes	Single faceted	None	No
US6	F02	Novice	Non-initial core tablet	Yes	Single faceted	None	No
US6	F03	Novice	Lateral core trimming	Yes	Single faceted	None	No
US6	F03	Novice	Non-initial core tablet	Yes	Single faceted	None	No
US6	F04	Novice	Partial ridged blade	Yes	Multi-faceted	None	No
US6	F05	Novice	Blade	Yes	Multi-faceted	Crushing	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	N/A	N/A	8.39	N/A	N/A	44.89
Angle	Feather	N/A	6.11	2.34	54.33	18.17	6.81
Overshot	Outrepasse	6.92	18.60	8.54	69.49	35.55	38.73
Shatter	Feather	N/A	N/A	2.36	N/A	N/A	6.12
Angle	Step	5.41	10.01	6.85	37.61	18.01	5.67
Platform battering	Feather	7.20	12.31	3.00	56.55	27.09	19.24
Shatter	Feather	N/A	N/A	5.47	N/A	N/A	15.31
None	Feather	9.50	15.13	1.27	81.00	43.51	44.35
Hinging	Hinge	4.16	6.24	2.41	42.49	39.67	9.20
None	Outrepasse	9.93	16.04	15.86	41.96	107.39	49.62
None	Feather	4.85	18.53	5.94	85.63	36.45	39.47
None	Feather	4.20	13.50	1.20	64.71	37.55	20.13
None	Feather	N/A	11.00	0.58	50.95	20.95	9.84

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	N/A	N/A	1.138	N/A	N/A	1.151
Novice	Unskilled	N/A	-0.855	-0.848	0.033	-0.569	-0.462
Novice	Unskilled	0.707	1.100	1.112	0.983	1.155	1.499
Novice	Unskilled	N/A	N/A	-0.842	N/A	N/A	-0.505
Novice	Unskilled	-0.707	-0.245	0.578	-1.016	-0.585	-0.532
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	1.114	N/A	N/A	-0.407
Novice	Unskilled	0.707	0.707	-0.820	0.707	0.707	1.139
Novice	Unskilled	-0.707	-0.707	-0.295	-0.707	-0.707	-0.732
Novice	Unskilled	0.707	-0.707	0.707	-0.707	0.707	0.707
Novice	Unskilled	-0.707	0.707	-0.707	0.707	-0.707	-0.707
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US6	F07	Novice	Lateral core trimming	Yes	Single faceted	None	No
US6	F07	Novice	Lateral core trimming	Yes	Single faceted	None	No
US6	F07	Novice	Lateral core trimming	Yes	Single faceted	None	No
US6	F07	Novice	Lateral core trimming	Yes	Multi-faceted	None	No
US6	F07	Novice	Faceted non-initial core tablet	Yes	Single faceted	None	No
US6	F07	Novice	Profile correction blade	No	Absent	Crushing	Yes
US6	F07	Novice	Core face rejuvenation	Yes	Single faceted	Battering	No
US6	F07	Novice	Crested blade	Yes	Multi-faceted	Battering	No
US6	F07	Novice	Corrective non-initial core tablet	No	Single faceted	None	Yes
US6	F08	Novice	Angle correction	Yes	Single faceted	Crushing	Yes
US6	F08	Novice	Angle correction	Yes	Single faceted	None	Yes
US6	F08	Novice	Angle correction	Yes	Single faceted	Crushing	Yes
US6	F08	Novice	Angle correction	Yes	Single faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	8.77	11.65	2.10	48.18	52.19	20.30
None	Feather	7.88	22.37	1.70	46.72	64.02	48.00
None	Outrepasse	10.76	17.25	2.50	51.91	81.92	48.18
None	Outrepasse	1.72	5.39	9.11	33.94	31.63	6.49
Hinging	Hinge	5.47	14.44	3.67	101.41	28.52	36.60
Platform battering	Hinge	N/A	N/A	4.86	N/A	N/A	4.97
Platform battering	Hinge	6.64	15.67	8.74	74.56	33.75	41.74
Hinging	Hinge	7.34	18.89	5.62	77.76	36.04	41.23
Hinging	Hinge	7.85	18.96	11.70	83.83	43.81	78.57
None	Feather	6.54	27.77	8.14	44.94	40.19	30.25
None	Feather	4.35	9.88	1.72	47.79	19.03	6.99
Hinging	Hinge	12.89	13.03	4.63	87.92	28.23	23.37
None	Feather	6.90	13.48	2.96	50.46	23.65	12.76

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	0.647	-0.750	-0.974	-0.724	0.307	-0.692
Novice	Unskilled	0.312	1.297	-1.087	-0.787	0.944	0.511
Novice	Unskilled	1.398	0.319	-0.861	-0.561	1.907	0.519
Novice	Unskilled	-2.012	-1.946	1.002	-1.344	-0.799	-1.291
Novice	Unskilled	-0.597	-0.217	-0.531	1.596	-0.967	0.016
Novice	Unskilled	N/A	N/A	-0.196	N/A	N/A	-1.357
Novice	Unskilled	-0.156	0.018	0.897	0.426	-0.685	0.239
Novice	Unskilled	0.108	0.633	0.018	0.565	-0.562	0.217
Novice	Unskilled	0.300	0.646	1.732	0.830	-0.144	1.838
Novice	Unskilled	-0.891	1.882	0.626	-1.051	0.825	-0.294
Novice	Unskilled	-1.380	-1.008	-0.770	-0.900	-1.409	-1.046
Novice	Unskilled	0.526	-0.499	-0.138	1.213	-0.438	-0.516
Novice	Unskilled	-0.811	-0.426	-0.501	-0.760	-0.921	-0.859

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US6	F08	Novice	Angle correction	Yes	Single faceted	None	Yes
US6	F08	Novice	Core face rejuvenation	Yes	Single faceted	Battering	Yes
US6	F08	Novice	Core face rejuvenation	Yes	Single faceted	None	Yes
US6	F08	Novice	Crested blade	Yes	Multi-faceted	None	Yes
US6	F08	Novice	Crested blade	Yes	Single faceted	None	Yes
US6	F08	Novice	Crested blade	Yes	Single faceted	Crushing	Yes
US6	F08	Novice	Non-initial core tablet	Yes	Single faceted	None	No
US6	F08	Novice	Non-initial core tablet	Yes	Single faceted	None	No
US6	F09	Novice	Blade	Yes	Single faceted	None	No
US6	F09	Novice	Crested blade	Yes	Single faceted	None	Yes
US6	F10	Novice	Blade	Yes	Single faceted	None	No
US6	F10	Novice	Crested blade	Yes	Single faceted	None	No
US6	F11	Novice	Blade	Yes	Single faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	15.67	8.43	2.00	51.31	34.84	20.48
Platform battering	Feather	15.02	23.74	10.32	67.35	47.10	80.23
None	Feather	8.91	15.93	4.75	62.40	33.31	37.00
Hinging	Hinge	14.00	18.56	17.15	67.02	33.20	46.97
None	Feather	6.23	8.04	0.88	40.42	17.94	4.90
None	Feather	9.20	14.20	3.32	71.02	30.21	29.86
None	Feather	18.37	21.79	3.68	95.29	33.76	88.16
None	Feather	8.30	18.58	3.60	92.74	47.03	91.31
None	Feather	5.90	6.31	1.70	39.94	13.81	3.03
None	Feather	9.55	7.76	2.34	41.98	13.61	3.62
None	Feather	6.69	4.45	0.72	41.39	10.36	1.64
None	Feather	6.06	13.76	4.20	51.15	17.86	11.58
None	Feather	1.91	3.51	1.11	38.38	1.11	1.11

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	1.147	-1.242	-0.710	-0.715	0.260	-0.610
Novice	Unskilled	1.002	1.231	1.100	0.130	1.555	1.320
Novice	Unskilled	-0.362	-0.031	-0.111	-0.131	0.099	-0.076
Novice	Unskilled	0.774	0.394	2.585	0.112	0.087	0.246
Novice	Unskilled	-0.960	-1.305	-0.953	-1.289	-1.524	-1.113
Novice	Unskilled	-0.297	-0.310	-0.422	0.323	-0.229	-0.307
Novice	Unskilled	1.750	0.916	-0.344	1.601	0.146	1.576
Novice	Unskilled	-0.498	0.398	-0.362	1.467	1.547	1.678
Novice	Unskilled	-0.707	-0.707	-0.707	-0.707	0.707	-0.707
Novice	Unskilled	0.707	0.707	0.707	0.707	-0.707	0.707
Novice	Unskilled	0.707	-0.707	-0.707	-0.707	-0.707	-0.707
Novice	Unskilled	-0.707	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	-0.707	-0.707	-0.707	-0.707	-0.707	-0.707

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US6	F11	Novice	Core face rejuvenation	Yes	Multi-faceted	Battering	Yes
US6	F13	Novice	Blade	Yes	Absent	Crushing	No
US6	F13	Novice	Blade	Yes	Multi-faceted	None	No
US6	F13	Novice	Blade	Yes	Single faceted	None	No
US7	G01	Novice	Crested blade	Yes	Single faceted	None	Yes
US7	G09	Novice	Crested blade	Yes	Single faceted	None	No
US8	H02	Novice	Faceted non-initial core tablet	Yes	Single faceted	None	No
US8	H02	Novice	Crested blade	Yes	Single faceted	None	No
US8	H05	Novice	Blade	Yes	Single faceted	Crushing	No
US8	H06	Novice	Crested blade	Yes	Single faceted	None	No
US8	H08	Novice	Blade	Yes	Single faceted	None	No
US8	H08	Novice	Blade	Yes	Single faceted	None	Yes
US8	H08	Novice	Crested blade	Yes	Single faceted	Battering	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Platform battering	Outrepasse	2.78	8.64	3.17	57.52	28.78	16.27
None	Feather	1.95	2.13	1.13	21.60	8.03	0.32
None	Feather	4.11	3.74	0.80	44.22	19.29	2.83
None	Feather	4.89	5.86	1.09	35.81	17.17	3.30
None	Feather	6.79	24.36	2.64	98.65	32.97	58.00
None	Feather	11.09	1.11	3.13	53.74	22.04	20.70
None	Feather	4.69	25.96	6.89	144.94	55.62	162.76
None	Feather	4.15	14.10	2.11	66.41	16.32	13.21
None	Feather	2.65	2.43	1.12	37.42	10.93	0.76
None	Feather	3.65	11.28	2.75	49.20	19.36	8.37
None	Feather	2.11	5.08	0.90	45.20	16.69	3.64
None	Feather	2.72	4.68	0.66	38.84	16.34	3.00
None	Feather	2.56	11.12	1.83	46.03	14.65	4.61

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	0.707	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	-1.116	-0.951	0.685	-1.074	-1.136	-1.142
Novice	Unskilled	0.302	-0.091	-1.148	0.905	0.745	0.424
Novice	Unskilled	0.814	1.042	0.463	0.169	0.391	0.718
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	0.707	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	-0.707	-0.707	-0.707	-0.707	-0.707	-0.707
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	-1.117	-0.521	-0.372	0.469	0.730	-0.136
Novice	Unskilled	0.812	-0.632	-0.761	-1.148	0.409	-0.925
Novice	Unskilled	0.306	1.153	1.133	0.680	-1.140	1.061

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US8	H09	Novice	Faceted non-initial core tablet	Yes	Multi-faceted	None	Yes
US8	H09	Novice	Profile correction blade	Yes	Single faceted	None	No
US8	H09	Novice	Crested blade	Yes	Single faceted	None	No
US8	H10	Novice	Blade	No	Multi-faceted	None	No
US8	H11a	Novice	Blade	Yes	Multi-faceted	None	No
US8	H11a	Novice	Faceted non-initial core tablet	Yes	Single faceted	Battering	No
US8	H11a	Novice	Crested blade	Yes	Multi-faceted	None	No
US8	H11b	Novice	Blade	Yes	Single faceted	None	No
US8	H11b	Novice	Crested blade	Yes	Single faceted	None	No
US8	HO4	Novice	Angle correction	Yes	Single faceted	None	Yes
US9	I02	Novice	Crested blade	Yes	Single faceted	None	No
US9	I03	Novice	Blade	Yes	Multi-faceted	None	No
US9	I03	Novice	Lateral core trimming	Yes	Single faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Platform battering	Outrepasse	3.80	7.04	11.53	56.54	28.15	14.50
Platform battering	Hinge	7.67	19.14	5.12	50.38	20.50	14.15
None	Outrepasse	4.90	12.37	12.57	58.24	19.34	16.13
Shatter	Hinge	3.94	N/A	N/A	N/A	N/A	3.89
None	Outrepasse	3.08	10.01	2.20	112.66	33.02	24.64
Platform battering	Feather	11.90	22.08	4.83	107.03	60.84	133.11
None	Feather	3.23	5.61	0.77	55.93	17.54	3.72
None	Feather	N/A	2.21	0.90	45.26	16.31	1.90
Platform battering	Feather	9.85	20.12	4.31	95.20	26.96	39.35
None	Outrepasse	5.37	16.01	12.07	25.48	26.82	12.00
None	Feather	5.51	9.97	7.70	33.63	17.58	5.97
None	Feather	1.47	1.92	0.89	39.95	7.12	0.35
None	Feather	2.64	11.57	2.81	25.74	67.21	11.35

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-0.831	-0.958	0.444	0.359	1.146	-0.404
Novice	Unskilled	1.110	1.037	-1.145	-1.130	-0.452	-0.735
Novice	Unskilled	-0.279	-0.079	0.701	0.771	-0.694	1.139
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	-0.592	-0.300	-0.194	0.665	-0.187	-0.420
Novice	Unskilled	1.155	1.116	1.083	0.485	1.080	1.142
Novice	Unskilled	-0.562	-0.816	-0.889	-1.150	-0.893	-0.721
Novice	Unskilled	N/A	-0.707	-0.707	-0.707	-0.707	-0.707
Novice	Unskilled	N/A	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	-1.154	-0.707	-0.707	0.707	-0.707	-0.943
Novice	Unskilled	0.607	0.707	0.707	-0.707	0.707	1.049

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US9	I03	Novice	Crested blade	No	Single faceted	None	Yes
US9	I06	Novice	Blade	Yes	Multi-faceted	Battering	No
US9	I07	Novice	Blade	Yes	Single faceted	None	No
US9	I08	Novice	Blade	No	Multi-faceted	Crushing	No
US9	I09	Novice	Blade	Yes	Single faceted	None	No
US9	I09	Novice	Blade	Yes	Multi-faceted	None	No
US9	I10	Novice	Blade	Yes	Multi-faceted	None	No
US9	I11	Novice	Blade	Yes	Multi-faceted	None	No
US9	I11	Novice	Partial ridged blade	Yes	Absent	Crushing	Yes
US10	J04	Novice	Faceted non-initial core tablet	Yes	Single faceted	Battering	No
US10	J04	Novice	Initial core tablet	Yes	Single faceted	None	No
US10	J05	Novice	Blade	Yes	Multi-faceted	None	No
US10	J05	Novice	Blade	Yes	Single faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Hinge	2.60	N/A	N/A	N/A	N/A	4.97
Platform battering	Feather	2.14	2.55	1.47	54.44	15.98	2.00
None	Feather	3.35	2.62	1.30	36.46	11.59	1.17
None	Feather	N/A	N/A	0.69	N/A	N/A	1.98
None	Feather	1.09	2.81	0.76	29.79	10.39	0.88
None	Feather	1.51	1.78	1.60	34.99	10.94	0.74
None	Feather	1.50	2.73	1.50	37.29	11.49	0.99
None	Feather	1.85	2.45	0.30	30.78	12.66	1.03
None	Feather	N/A	N/A	2.10	N/A	N/A	3.78
Platform battering	Feather	9.28	12.63	3.66	71.47	49.94	40.80
None	Feather	28.26	22.58	3.81	83.39	59.54	113.03
None	Feather	1.46	2.51	1.10	56.22	14.96	1.97
None	Feather	12.87	14.89	4.52	98.67	38.67	61.55

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	0.547	N/A	N/A	N/A	N/A	-0.106
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	-0.707	0.707	-0.707	-0.707	-0.707	0.707
Novice	Unskilled	0.707	-0.707	0.707	0.707	0.707	-0.707
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	-0.707	N/A	N/A	-0.707
Novice	Unskilled	N/A	N/A	0.707	N/A	N/A	0.707
Novice	Unskilled	-0.707	-0.707	-0.707	-0.707	-0.707	-0.707
Novice	Unskilled	0.707	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	-1.023	-0.969	-0.630	-0.821	-1.085	-0.869
Novice	Unskilled	1.055	0.490	-0.055	1.241	1.741	1.531

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US10	J05	Novice	Blade	Yes	Single faceted	None	No
US10	J05	Novice	Profile correction blade	Yes	Single faceted	Battering	No
US10	J05	Novice	Profile correction blade	Yes	Single faceted	Battering	Yes
US10	J05	Novice	Crested blade	Yes	Single faceted	Crushing	No
US10	J06a	Novice	Blade	Yes	Single faceted	None	No
US10	J06a	Novice	Blade	Yes	Single faceted	None	No
US10	J06a	Novice	Blade	Yes	Multi-faceted	None	No
US10	J08	Novice	Blade	Yes	Multi-faceted	None	No
US10	J09	Novice	Blade	Yes	Multi-faceted	None	No
US10	J09	Novice	Blade	Yes	Multi-faceted	None	No
US11	K01	Novice	Initial core tablet	Yes	Single faceted	None	No
US11	K03a	Novice	Crested blade	Yes	Multi-faceted	None	Yes
US11	K04	Novice	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	4.24	3.34	2.09	45.63	22.20	2.71
Platform battering	Outrepasse	8.46	25.07	16.76	81.53	27.19	44.02
Platform battering	Hinge	13.84	11.64	1.85	90.58	23.80	25.19
None	Feather	1.60	6.95	2.76	66.06	17.56	5.83
Shatter	Feather	3.60	5.77	2.20	63.67	24.30	9.48
None	Feather	5.01	4.07	1.63	69.04	19.26	6.14
None	Feather	3.33	1.99	1.12	31.87	8.70	0.57
None	Feather	2.57	2.88	1.17	35.34	10.24	1.16
None	Feather	1.35	1.47	0.48	32.07	5.71	0.30
None	Feather	2.78	3.33	1.08	36.76	13.82	1.59
None	Outrepasse	9.14	40.89	14.39	144.12	56.06	315.74
None	Feather	3.11	6.88	0.88	48.12	14.91	3.86
None	Feather	1.20	1.79	0.22	28.75	7.59	0.39

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-0.517	-0.871	-0.463	-1.335	-0.222	-0.840
Novice	Unskilled	0.252	1.689	2.002	0.409	0.373	0.825
Novice	Unskilled	1.231	0.107	-0.504	0.848	-0.031	0.066
Novice	Unskilled	-0.998	-0.446	-0.351	-0.343	-0.775	-0.714
Novice	Unskilled	-0.421	0.965	1.018	0.439	0.864	0.907
Novice	Unskilled	1.142	0.067	-0.037	0.706	0.231	0.165
Novice	Unskilled	-0.720	-1.032	-0.981	-1.144	-1.095	-1.072
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	-0.707	-0.707	-0.707	-0.707	-0.707	-0.707
Novice	Unskilled	0.707	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	N/A	N/A	-0.707	N/A	N/A	-0.707

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US11	K04	Novice	Crested blade	No	Absent	None	Yes
US11	K05	Novice	Blade	Yes	Multi-faceted	None	No
US11	K05	Novice	Profile correction blade	Yes	Single faceted	None	No
US11	K05	Novice	Partial ridged blade	Yes	Multi-faceted	None	Yes
US11	K05	Novice	Crested blade	Yes	Single faceted	None	No
US11	K05	Novice	Crested blade	Yes	Single faceted	None	No
US11	K06	Novice	Blade	Yes	Multi-faceted	None	No
US11	K06	Novice	Blade	Yes	Single faceted	None	No
US11	K09	Novice	Blade	Yes	Single faceted	None	No
US12	L01	Novice	Blade	Yes	Multi-faceted	None	No
US12	L01	Novice	Blade	Yes	Multi-faceted	None	No
US12	L01	Novice	Lateral core trimming	Yes	Single faceted	None	No
US12	L01	Novice	Lateral core trimming	Yes	Single faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	N/A	N/A	2.68	N/A	N/A	5.67
None	Feather	2.45	4.24	1.38	69.90	25.62	5.10
None	Feather	10.93	10.16	1.81	58.29	27.72	16.55
None	Outrepasse	4.28	5.24	2.62	40.59	14.72	3.02
None	Feather	8.45	12.84	2.23	66.82	34.20	19.33
None	Feather	13.05	11.52	1.70	58.29	26.50	14.48
None	Feather	2.38	2.48	0.88	29.54	10.12	0.69
None	Feather	2.21	2.63	1.01	35.02	14.14	1.03
None	Feather	4.31	5.09	1.90	46.12	16.40	3.97
None	Feather	1.81	1.47	0.42	25.32	6.40	0.26
Shatter	Feather	1.94	3.54	0.62	71.09	19.56	4.61
None	Feather	N/A	6.87	1.71	37.70	53.98	14.01
None	Feather	4.47	6.10	1.67	32.26	51.57	8.36

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	N/A	N/A	0.707	N/A	N/A	0.707
Novice	Unskilled	-1.213	-1.187	-1.175	0.976	-0.019	-0.914
Novice	Unskilled	0.698	0.354	-0.286	-0.043	0.280	0.673
Novice	Unskilled	-0.800	-0.927	1.390	-1.596	-1.570	-1.202
Novice	Unskilled	0.139	1.052	0.583	0.706	1.202	1.058
Novice	Unskilled	1.176	0.708	-0.513	-0.043	0.106	0.386
Novice	Unskilled	0.707	-0.707	-0.707	-0.707	-0.707	-0.707
Novice	Unskilled	-0.707	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Novice	Unskilled	-0.620	-1.225	-1.006	-0.801	-1.121	-1.123
Novice	Unskilled	-0.533	-0.387	-0.713	1.453	-0.564	-0.377
Novice	Unskilled	N/A	0.962	0.889	-0.192	0.894	1.235
Novice	Unskilled	1.154	0.650	0.830	-0.460	0.792	0.266

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US12	L02	Novice	Blade	Yes	Multi-faceted	None	No
US12	L02	Novice	Lateral core trimming	Yes	Single faceted	None	No
US12	L02	Novice	Lateral core trimming	Yes	Single faceted	None	No
US12	L02	Novice	Lateral core trimming	Yes	Single faceted	None	No
US12	L02	Novice	Initial core tablet	Yes	Single faceted	None	No
US12	L03	Novice	Blade	Yes	Multi-faceted	None	No
US12	L03	Novice	Blade	Yes	Multi-faceted	None	No
US12	L03	Novice	Lateral core trimming	Yes	Single faceted	None	No
US12	L03	Novice	Lateral core trimming	Yes	Single faceted	None	No
US12	L03	Novice	Core face rejuvenation	Yes	Single faceted	None	Yes
US12	L05	Novice	Blade	Yes	Multi-faceted	None	No
US12	L05	Novice	Blade	Yes	Multi-faceted	None	No
US12	L05	Novice	Lateral core trimming	Yes	Single faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.61	4.45	1.39	61.39	26.54	8.69
None	Feather	8.41	21.55	3.85	52.76	73.07	61.23
None	Feather	7.00	8.57	0.82	33.87	46.93	12.74
None	Feather	7.20	4.10	0.69	32.12	41.64	5.03
Hinging	Hinge	11.90	14.84	3.28	77.68	42.55	63.10
None	Feather	3.76	5.00	0.98	45.47	11.64	2.03
None	Feather	3.91	3.17	1.58	48.65	19.08	3.46
None	Feather	5.49	4.55	1.06	43.60	46.16	8.97
None	Feather	11.89	20.98	4.01	38.59	73.57	55.75
None	Outrepasse	5.76	20.43	6.22	73.70	36.17	53.62
None	Outrepasse	2.96	5.20	7.58	46.74	15.69	3.16
None	Feather	6.38	8.49	0.88	72.15	29.57	17.79
None	Feather	3.17	7.55	4.06	45.73	66.70	15.55

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-1.445	-0.839	-0.422	0.512	-1.160	-0.731
Novice	Unskilled	0.296	1.456	1.262	0.062	1.593	1.059
Novice	Unskilled	-0.127	-0.286	-0.812	-0.923	0.046	-0.593
Novice	Unskilled	-0.067	-0.886	-0.901	-1.014	-0.267	-0.856
Novice	Unskilled	1.343	0.555	0.872	1.362	-0.213	1.122
Novice	Unskilled	-0.722	-0.644	-0.782	-0.330	-1.052	-0.828
Novice	Unskilled	-0.677	-0.846	-0.520	-0.098	-0.747	-0.776
Novice	Unskilled	-0.202	-0.694	-0.747	-0.466	0.362	-0.576
Novice	Unskilled	1.722	1.123	0.541	-0.831	1.484	1.129
Novice	Unskilled	-0.121	1.062	1.506	1.725	-0.047	1.051
Novice	Unskilled	-1.045	-1.413	1.704	-0.556	-0.895	-1.608
Novice	Unskilled	0.083	-0.527	-1.126	1.177	-0.065	0.289
Novice	Unskilled	-0.976	-0.780	0.217	-0.625	2.156	-0.001

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US12	L05	Novice	Profile correction blade	Yes	Multi-faceted	None	Yes
US12	L05	Novice	Profile correction blade	Yes	Single faceted	None	Yes
US12	L05	Novice	Crested blade	Yes	Single faceted	None	No
US12	L05	Novice	Non-initial core tablet	Yes	Multi-faceted	None	No
US12	L06	Novice	Blade	Yes	Absent	None	No
US12	L06	Novice	Blade	Yes	Multi-faceted	None	No
US12	L06	Novice	Blade	Yes	Multi-faceted	Battering	No
US12	L06	Novice	Blade	Yes	Multi-faceted	None	No
US12	L06	Novice	Blade	Yes	Single faceted	None	No
US12	L06	Novice	Blade	Yes	Single faceted	None	No
US12	L06	Novice	Core face rejuvenation	Yes	Single faceted	None	Yes
US12	L06	Novice	Core face rejuvenation	Yes	Multi-faceted	None	Yes
US12	L06	Novice	Partial ridged blade	Yes	Single faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	6.74	11.21	2.44	42.09	22.87	10.45
None	Feather	6.69	11.98	1.20	47.63	21.60	13.88
None	Feather	4.97	16.54	3.32	50.41	30.74	20.52
None	Hinge	11.98	12.16	5.34	79.48	27.41	27.58
None	Feather	N/A	N/A	0.67	N/A	N/A	0.14
None	Feather	1.88	4.55	1.14	55.01	11.00	2.88
Platform battering	Feather	3.05	3.77	1.57	49.53	15.90	3.38
None	Feather	2.08	2.92	1.07	60.07	10.94	2.02
Hinging	Hinge	5.49	7.37	2.01	59.08	15.22	7.03
None	Feather	5.88	5.77	2.31	52.44	17.21	5.02
None	Feather	11.88	17.80	4.12	76.64	32.07	55.79
None	Feather	6.00	13.91	2.91	75.95	24.59	26.33
Hinging	Hinge	3.64	6.73	2.72	38.25	20.75	4.71

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	0.202	0.205	-0.467	-0.873	-0.466	-0.663
Novice	Unskilled	0.186	0.413	-0.991	-0.495	-0.541	-0.218
Novice	Unskilled	-0.382	1.641	-0.095	-0.306	0.005	0.643
Novice	Unskilled	1.931	0.461	0.758	1.677	-0.194	1.559
Novice	Unskilled	N/A	N/A	-1.375	N/A	N/A	-0.897
Novice	Unskilled	-1.164	-0.831	-1.001	-0.602	-1.342	-0.747
Novice	Unskilled	-0.752	-0.978	-0.659	-0.990	-0.690	-0.720
Novice	Unskilled	-1.093	-1.138	-1.057	-0.245	-1.350	-0.794
Novice	Unskilled	0.107	-0.300	-0.309	-0.315	-0.781	-0.520
Novice	Unskilled	0.245	-0.601	-0.070	-0.784	-0.516	-0.630
Novice	Unskilled	2.357	1.665	1.370	0.927	1.461	2.149
Novice	Unskilled	0.287	0.932	0.407	0.878	0.466	0.536
Novice	Unskilled	-0.544	-0.420	0.256	-1.788	-0.045	-0.647

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US12	L06	Novice	Crested blade	Yes	Multi-faceted	None	No
US12	L06	Novice	Initial core tablet	Yes	Single faceted	None	No
US12	L06	Novice	Non-initial core tablet	Yes	Single faceted	None	No
US12	L07b	Novice	Faceted non-initial core tablet	Yes	Single faceted	None	No
US12	L07b	Novice	Faceted non-initial core tablet	Yes	Single faceted	None	No
US12	L08a	Novice	Blade	No	Multi-faceted	None	No
US12	L08a	Novice	Blade	No	Multi-faceted	None	No
US12	L08a	Novice	Faceted non-initial core tablet	Yes	Multi-faceted	None	Yes
US12	L08a	Novice	Initial core tablet	Yes	Single faceted	None	No
US12	L08a	Novice	Corrective non-initial core tablet	Yes	Single faceted	None	Yes
US12	L08b	Novice	Blade	Yes	Multi-faceted	None	No
US12	L08b	Novice	Non-initial core tablet	No	Multi-faceted	None	No
US12	L08c	Novice	Blade	No	Absent	Crushing	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	4.33	16.37	3.58	74.39	29.39	31.80
None	Feather	5.10	13.05	1.98	82.67	28.20	41.00
None	Feather	7.71	6.32	4.70	74.79	26.69	18.24
None	Feather	6.08	16.07	1.83	42.51	36.93	23.74
None	Feather	7.85	21.45	5.70	84.20	42.52	57.39
Shatter	Step	3.11	N/A	N/A	N/A	N/A	4.97
Shatter	Step	3.29	N/A	N/A	N/A	N/A	1.29
Hinging	Hinge	9.60	15.45	9.74	78.46	52.22	77.18
None	Feather	8.81	36.83	9.00	94.30	57.12	243.16
None	Feather	10.26	12.66	2.45	65.03	30.65	31.63
Hinging	Hinge	3.82	3.11	1.69	27.16	12.20	1.21
Shatter	Step	5.00	N/A	N/A	N/A	N/A	6.38
None	Feather	N/A	N/A	1.30	N/A	N/A	5.31

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-0.301	1.396	0.940	0.768	1.105	0.836
Novice	Unskilled	-0.030	0.770	-0.333	1.354	0.946	1.339
Novice	Unskilled	0.889	-0.497	1.831	0.796	0.745	0.094
Novice	Unskilled	-0.707	-0.707	-0.707	-0.707	-0.707	-0.707
Novice	Unskilled	0.707	0.707	0.707	0.707	0.707	0.707
Novice	Unskilled	-1.109	N/A	N/A	N/A	N/A	-0.663
Novice	Unskilled	-1.058	N/A	N/A	N/A	N/A	-0.700
Novice	Unskilled	0.735	-0.469	0.667	-0.055	0.395	0.055
Novice	Unskilled	0.510	1.148	0.483	1.026	0.743	1.706
Novice	Unskilled	0.922	-0.680	-1.150	-0.971	-1.137	-0.398
Novice	Unskilled	-0.707	N/A	N/A	N/A	N/A	-0.707
Novice	Unskilled	0.707	N/A	N/A	N/A	N/A	0.707
Novice	Unskilled	N/A	N/A	-1.469	N/A	N/A	-0.900

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US12	L08c	Novice	Faceted non-initial core tablet	Yes	Single faceted	None	No
US12	L08c	Novice	Core face rejuvenation	Yes	Multi-faceted	Battering	Yes
US12	L08c	Novice	Non-initial core tablet	Yes	Multi-faceted	None	No
US12	L09	Novice	Blade	Yes	Multi-faceted	None	No
US12	L09	Novice	Blade	Yes	Multi-faceted	None	No
US12	L09	Novice	Crested blade	Yes	Multi-faceted	None	No
US12	L10	Novice	Crested blade	Yes	Multi-faceted	Battering	No
US12	L10	Novice	Crested blade	Yes	Single faceted	None	No
US12	L10	Novice	Initial core tablet	Yes	Single faceted	None	No
US12	L11a	Novice	Blade	Yes	Multi-faceted	None	No
US12	L11a	Novice	Blade	Yes	Multi-faceted	None	No
US12	L11a	Novice	Blade	Yes	Multi-faceted	None	No
US12	L11a	Novice	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	8.86	85.79	3.19	84.86	39.57	84.00
Platform battering	Feather	11.35	13.36	3.61	75.81	38.26	41.32
None	Feather	4.32	12.34	3.72	72.34	21.57	16.32
Shatter	Feather	3.79	5.18	2.58	65.76	21.79	7.54
None	Feather	2.02	2.08	1.25	40.52	9.95	0.90
None	Feather	4.04	6.87	1.00	49.60	18.08	4.65
Platform battering	Feather	4.87	8.95	2.91	59.49	19.87	7.58
None	Feather	2.49	7.83	2.68	48.73	13.51	4.40
None	Feather	10.24	43.28	8.24	95.08	73.97	303.11
None	Feather	1.43	1.98	0.97	41.90	14.17	0.97
None	Feather	3.13	2.09	0.68	31.24	10.55	0.83
Shatter	Step	5.05	N/A	N/A	N/A	N/A	2.40
None	Feather	3.05	4.54	0.99	56.60	22.06	6.28

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	0.192	1.155	0.209	1.112	0.641	1.353
Novice	Unskilled	0.890	-0.565	0.581	-0.288	0.511	0.131
Novice	Unskilled	-1.082	-0.589	0.679	-0.825	-1.152	-0.585
Novice	Unskilled	0.460	0.193	1.142	1.079	0.856	0.954
Novice	Unskilled	-1.147	-1.083	-0.424	-0.895	-1.099	-1.040
Novice	Unskilled	0.687	0.889	-0.718	-0.185	0.243	0.086
Novice	Unskilled	-0.251	-0.549	-0.540	-0.341	-0.479	-0.568
Novice	Unskilled	-0.851	-0.605	-0.614	-0.785	-0.670	-0.587
Novice	Unskilled	1.102	1.154	1.154	1.126	1.149	1.155
Novice	Unskilled	-0.828	-0.596	-0.461	-0.638	-0.567	-0.423
Novice	Unskilled	-0.460	-0.585	-0.547	-1.074	-0.740	-0.425
Novice	Unskilled	-0.044	N/A	N/A	N/A	N/A	-0.395
Novice	Unskilled	-0.477	-0.356	-0.455	-0.036	-0.190	-0.319

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US12	L11a	Novice	Blade	No	Absent	Crushing	No
US12	L11a	Novice	Profile correction blade	Yes	Multi-faceted	None	Yes
US12	L11a	Novice	Core face rejuvenation	Yes	Single faceted	None	Yes
US12	L11b	Novice	Blade	Yes	Multi-faceted	None	No
US12	L11b	Novice	Blade	Yes	Single faceted	None	No
US12	L11b	Novice	Blade	Yes	Multi-faceted	None	No
US12	L11b	Novice	Blade	Yes	Single faceted	None	No
US12	L11b	Novice	Blade	Yes	Absent	Crushing	No
US12	L11b	Novice	Profile correction blade	Yes	Multi-faceted	Crushing	Yes
US12	L11b	Novice	Profile correction blade	Yes	Single faceted	None	Yes
US13	PSK7-01	Novice	Blade	Yes	Multi-faceted	None	No
US13	PSK7-01	Novice	Blade	Yes	Single faceted	None	No
US13	PSK7-01	Novice	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	N/A	N/A	1.27	N/A	N/A	1.27
None	Feather	4.55	5.88	1.88	62.38	20.89	7.97
None	Outrepasse	14.32	27.18	9.36	95.32	62.52	138.30
None	Feather	2.56	1.63	0.58	37.83	12.84	0.82
None	Feather	2.01	2.35	1.01	30.95	11.51	0.81
None	Feather	4.91	3.89	1.12	45.77	20.46	3.25
None	Feather	1.48	3.26	1.02	53.40	18.51	3.12
None	Feather	N/A	N/A	1.36	N/A	N/A	2.90
None	Feather	2.41	7.05	0.45	58.28	22.13	6.88
None	Feather	3.74	5.49	1.91	62.99	26.57	8.89
None	Feather	2.28	2.92	0.66	34.38	15.88	1.45
None	Feather	1.95	3.86	1.22	39.63	13.80	2.56
None	Feather	1.70	3.14	1.48	40.96	11.09	1.39

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	N/A	N/A	-0.372	N/A	N/A	-0.417
Novice	Unskilled	-0.153	-0.230	-0.191	0.200	-0.246	-0.286
Novice	Unskilled	1.962	1.767	2.026	1.548	1.742	2.264
Novice	Unskilled	-0.232	-1.146	-0.995	-0.842	-1.022	-0.989
Novice	Unskilled	-0.670	-0.790	-0.111	-1.401	-1.255	-0.993
Novice	Unskilled	1.638	-0.027	0.114	-0.198	0.314	-0.185
Novice	Unskilled	-1.092	-0.339	-0.091	0.422	-0.028	-0.228
Novice	Unskilled	N/A	N/A	0.607	N/A	N/A	-0.301
Novice	Unskilled	-0.351	1.537	-1.262	0.818	0.606	1.016
Novice	Unskilled	0.707	0.765	1.737	1.201	1.384	1.681
Novice	Unskilled	-0.474	-0.637	-0.578	-0.660	-0.265	-0.523
Novice	Unskilled	-0.734	-0.438	-0.372	-0.367	-0.503	-0.412
Novice	Unskilled	-0.931	-0.590	-0.277	-0.293	-0.813	-0.528

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
US13	PSK7-01	Novice	Blade	Yes	Single faceted	Battering	No
US13	PSK7-01	Novice	Core face rejuvenation	Yes	Single faceted	None	Yes
US13	PSK7-02	Novice	Blade	Yes	Multi-faceted	None	No
US13	PSK7-02	Novice	Blade	Yes	Single faceted	None	No
US13	PSK7-02	Novice	Blade	Yes	Single faceted	None	No
US13	PSK7-02	Novice	Blade	No	Absent	Crushing	No
US13	PSK7-02	Novice	Blade	Yes	Multi-faceted	Crushing	No
US13	PSK7-02	Novice	Blade	Yes	Absent	Crushing	No
US13	PSK7-02	Novice	Blade	No	Absent	Not present	No
US13	PSK7-02	Novice	Core face rejuvenation	Yes	Multi-faceted	Crushing	Yes
US13	PSK7-02	Novice	Core face rejuvenation	Yes	Multi-faceted	Crushing	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	Crushing	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	3.98	5.55	0.74	38.12	16.90	3.50
None	Outrepasse	4.50	14.20	7.07	78.04	33.32	24.65
None	Feather	4.78	3.93	1.43	47.15	20.09	4.48
None	Feather	3.25	2.85	0.85	36.65	15.37	1.57
None	Feather	1.38	3.08	1.44	45.67	10.47	1.22
None	Feather	N/A	3.44	1.00	50.24	10.35	1.39
None	Feather	3.02	3.66	2.64	53.98	17.03	4.37
None	Feather	N/A	4.30	2.36	43.06	15.01	2.74
Shatter	Feather	N/A	N/A	1.59	N/A	N/A	2.03
None	Outrepasse	3.01	5.46	6.74	79.24	22.99	10.97
None	Step	2.74	3.58	3.29	46.88	20.48	3.88
None	Feather	2.34	3.89	0.94	54.72	14.16	2.87
Hinging	Hinge	N/A	N/A	N/A	N/A	N/A	4.49

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	0.865	-0.081	-0.548	-0.451	-0.149	-0.319
Novice	Unskilled	1.274	1.746	1.775	1.772	1.730	1.782
Novice	Unskilled	1.609	0.175	-0.516	-0.252	0.784	0.281
Novice	Unskilled	0.202	-1.152	-0.835	-1.078	-0.239	-0.678
Novice	Unskilled	-1.517	-0.869	-0.511	-0.369	-1.302	-0.794
Novice	Unskilled	N/A	-0.427	-0.752	-0.009	-1.328	-0.738
Novice	Unskilled	-0.009	-0.157	0.148	0.285	0.121	0.245
Novice	Unskilled	N/A	0.629	-0.006	-0.574	-0.317	-0.293
Novice	Unskilled	N/A	N/A	-0.429	N/A	N/A	-0.527
Novice	Unskilled	-0.018	2.054	2.398	2.270	1.413	2.420
Novice	Unskilled	-0.267	-0.255	0.504	-0.273	0.869	0.083
Master	Skilled	-0.441	-0.234	-0.555	0.446	-0.615	-0.248
Master	Skilled	N/A	N/A	N/A	N/A	N/A	-0.018

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	2.00	5.25	0.94	48.50	16.55	3.68
Shatter	Feather	2.25	3.75	1.81	52.34	17.89	3.51
None	Feather	0.91	2.76	1.36	53.77	12.80	1.49
None	Feather	3.24	3.73	1.43	57.64	13.79	3.18
None	Feather	2.32	4.94	1.45	51.16	17.23	3.63
None	Feather	2.11	4.75	1.23	46.05	15.09	2.88
None	Feather	2.04	1.92	0.98	70.95	12.53	1.88
None	Feather	2.26	2.31	0.81	42.89	15.27	1.17
None	Feather	2.58	2.94	0.94	39.30	14.18	1.31
None	Feather	1.69	4.18	0.83	46.64	10.94	1.84
None	Feather	2.45	2.50	0.26	34.04	14.13	1.20
None	Feather	2.35	2.95	0.60	37.32	14.39	1.41
None	Feather	2.13	1.63	0.87	55.62	11.42	1.11

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.644	0.287	-0.555	0.141	-0.332	-0.133
Master	Skilled	-0.495	-0.288	-0.288	0.330	-0.173	-0.157
Master	Skilled	-1.294	-0.667	-0.426	0.400	-0.776	-0.444
Master	Skilled	0.096	-0.296	-0.405	0.589	-0.658	-0.204
Master	Skilled	-0.453	0.168	-0.399	0.272	-0.251	-0.140
Master	Skilled	-0.578	0.095	-0.466	0.021	-0.505	-0.246
Master	Skilled	-0.620	-0.989	-0.543	1.242	-0.808	-0.389
Master	Skilled	-0.489	-0.840	-0.595	-0.134	-0.483	-0.489
Master	Skilled	-0.298	-0.598	-0.555	-0.310	-0.612	-0.469
Master	Skilled	-0.829	-0.123	-0.589	0.050	-0.996	-0.394
Master	Skilled	-0.375	-0.767	-0.764	-0.567	-0.618	-0.485
Master	Skilled	-0.435	-0.595	-0.660	-0.407	-0.587	-0.455
Master	Skilled	-0.566	-1.100	-0.577	0.490	-0.939	-0.498

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB01	Master	Blade	Yes	Multi-faceted	Battering	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	No	Multi-faceted	None	No
SF1	TB01	Master	Blade	No	Multi-faceted	None	No
SF1	TB01	Master	Blade	No	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	No	Multi-faceted	Crushing	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Platform battering	Feather	3.41	3.43	1.31	63.61	14.84	3.34
None	Feather	2.25	5.76	0.91	63.18	13.48	3.56
None	Feather	2.80	1.76	0.79	36.19	10.00	0.69
None	Feather	N/A	N/A	0.79	N/A	N/A	0.67
None	Feather	1.92	2.34	0.61	39.16	7.82	0.69
None	Feather	2.26	1.59	0.58	38.12	6.92	0.40
None	Feather	1.93	3.20	1.09	41.54	11.73	1.03
Hinging	Hinge	2.24	N/A	N/A	N/A	N/A	1.25
Hinging	Hinge	2.17	N/A	N/A	N/A	N/A	1.62
Shatter	Feather	N/A	N/A	0.80	N/A	N/A	0.59
Hinging	Hinge	2.28	4.32	1.58	44.97	12.09	2.34
Hinging	Hinge	2.45	3.22	1.49	46.25	16.12	3.57
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	3.60

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	0.197	-0.411	-0.442	0.882	-0.534	-0.181
Master	Skilled	-0.495	0.482	-0.565	0.861	-0.695	-0.150
Master	Skilled	-0.167	-1.050	-0.601	-0.462	-1.107	-0.558
Master	Skilled	N/A	N/A	-0.601	N/A	N/A	-0.560
Master	Skilled	-0.691	-0.828	-0.657	-0.316	-1.365	-0.558
Master	Skilled	-0.489	-1.116	-0.666	-0.367	-1.472	-0.599
Master	Skilled	-0.686	-0.499	-0.509	-0.200	-0.902	-0.509
Master	Skilled	-0.501	N/A	N/A	N/A	N/A	-0.478
Master	Skilled	-0.542	N/A	N/A	N/A	N/A	-0.425
Master	Skilled	N/A	N/A	-0.598	N/A	N/A	-0.572
Master	Skilled	-0.477	-0.070	-0.359	-0.032	-0.860	-0.323
Master	Skilled	-0.375	-0.491	-0.386	0.031	-0.383	-0.148
Master	Skilled	N/A	N/A	N/A	N/A	N/A	-0.144

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB01	Master	Lateral core trimming	No	Single faceted	Crushing	No
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Single faceted	Crushing	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Hinging	Hinge	2.05	5.08	2.17	41.42	15.71	3.55
None	Hinge	2.36	2.59	1.77	34.05	12.90	1.14
None	Hinge	1.25	3.31	1.48	56.06	22.09	5.66
None	Feather	4.00	4.00	2.00	18.00	28.00	3.00
None	Feather	6.00	4.00	3.00	33.00	48.00	7.00
None	Feather	N/A	N/A	2.00	26.00	32.00	2.00
None	Feather	4.00	3.00	2.00	32.00	22.00	2.00
None	Feather	4.00	4.00	1.00	29.00	25.00	2.00
None	Feather	4.00	4.00	1.00	29.00	25.00	2.00
None	Feather	3.00	5.00	1.00	21.00	31.00	2.00
None	Feather	5.00	5.00	3.00	47.00	33.00	9.00
None	Feather	3.00	3.00	2.00	37.00	21.00	3.00
None	Feather	3.00	3.00	2.00	34.00	19.00	2.00

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.614	0.222	-0.177	-0.206	-0.431	-0.151
Master	Skilled	-0.429	-0.732	-0.300	-0.567	-0.764	-0.494
Master	Skilled	-1.091	-0.457	-0.389	0.512	0.324	0.148
Master	Skilled	0.549	-0.192	-0.230	-1.354	1.024	-0.229
Master	Skilled	1.741	-0.192	0.078	-0.618	3.392	0.339
Master	Skilled	N/A	N/A	-0.230	-0.961	1.498	-0.371
Master	Skilled	0.549	-0.575	-0.230	-0.667	0.314	-0.371
Master	Skilled	0.549	-0.192	-0.537	-0.814	0.669	-0.371
Master	Skilled	0.549	-0.192	-0.537	-0.814	0.669	-0.371
Master	Skilled	-0.047	0.191	-0.537	-1.207	1.379	-0.371
Master	Skilled	1.145	0.191	0.078	0.068	1.616	0.623
Master	Skilled	-0.047	-0.575	-0.230	-0.422	0.195	-0.229
Master	Skilled	-0.047	-0.575	-0.230	-0.569	-0.042	-0.371

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	Double Initiation	No
SF1	TB01	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB01	Master	Lateral core trimming	No	Absent	Crushing	No
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	Crushing	No
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	Crushing	No
SF1	TB01	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	None	Yes
SF1	TB01	Master	Lateral core trimming	No	Single faceted	None	No
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	None	Yes
SF1	TB01	Master	Lateral core trimming	Yes	Multi-faceted	Battering	Yes
SF1	TB01	Master	Profile correction blade	No	Multi-faceted	Crushing	Yes
SF1	TB01	Master	Profile correction blade	Yes	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Platform battering	Hinge	4.00	6.00	3.00	21.00	27.00	2.00
None	Feather	3.00	2.00	2.50	38.00	24.00	2.00
None	Feather	N/A	N/A	1.50	N/A	N/A	1.00
None	Feather	3.00	5.00	2.00	19.00	16.00	1.00
None	Feather	4.00	3.50	2.00	38.00	18.00	2.00
None	Feather	2.00	3.00	1.00	23.00	21.00	1.00
None	Feather	11.00	9.00	3.00	4.00	38.00	11.00
None	Feather	2.00	6.00	3.00	52.00	21.00	6.00
Hinging	Hinge	5.00	4.00	1.50	17.00	23.00	1.00
None	Feather	3.00	9.00	7.50	26.00	38.00	7.00
Platform battering	Feather	3.50	3.50	1.50	35.50	21.00	3.00
None	Feather	N/A	N/A	4.00	N/A	N/A	6.00
None	Feather	3.00	5.00	3.00	74.50	15.00	5.00

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	0.549	0.574	0.078	-1.207	0.906	-0.371
Master	Skilled	-0.047	-0.959	-0.076	-0.373	0.550	-0.371
Master	Skilled	N/A	N/A	-0.383	N/A	N/A	-0.514
Master	Skilled	-0.047	0.191	-0.230	-1.305	-0.397	-0.514
Master	Skilled	0.549	-0.384	-0.230	-0.373	-0.160	-0.371
Master	Skilled	-0.644	-0.575	-0.537	-1.109	0.195	-0.514
Master	Skilled	4.723	1.723	0.078	-2.040	2.208	0.907
Master	Skilled	-0.644	0.574	0.078	0.313	0.195	0.197
Master	Skilled	1.145	-0.192	-0.383	-1.403	0.432	-0.514
Master	Skilled	-0.047	1.723	1.461	-0.961	2.208	0.339
Master	Skilled	0.251	-0.384	-0.383	-0.496	0.195	-0.229
Master	Skilled	N/A	N/A	0.385	N/A	N/A	0.197
Master	Skilled	-0.047	0.191	0.078	1.416	-0.515	0.055

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB01	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF1	TB01	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF1	TB01	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF1	TB01	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB01	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB01	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB01	Master	Partial ridged blade	Yes	Multi-faceted	Crushing	Yes
SF1	TB01	Master	Crested blade	Yes	Multi-faceted	None	Yes
SF1	TB01	Master	Non-initial core tablet	Yes	Multi-faceted	None	No
SF1	TB01	Master	Non-initial core tablet	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Hinging	Hinge	4.00	3.50	2.00	25.00	28.00	2.00
None	Feather	3.00	7.00	8.50	88.00	26.00	15.00
None	Feather	2.00	5.00	3.00	45.00	13.50	3.00
None	Feather	2.00	7.00	11.00	62.00	14.00	6.00
None	Feather	2.00	6.00	7.00	68.00	15.00	7.00
None	Feather	4.00	5.00	8.00	87.00	20.00	10.00
None	Feather	3.00	5.00	7.00	95.00	24.00	17.00
None	Hinge	9.00	15.00	8.00	105.00	2.10	32.00
Hinging	Hinge	2.00	4.00	6.00	53.00	22.00	7.00
None	Feather	5.00	15.00	20.00	77.00	29.00	45.00
None	Feather	2.23	2.93	0.74	39.14	11.96	1.31
None	Feather	3.43	6.02	0.89	74.79	17.77	7.23
None	Feather	2.69	4.55	1.36	65.12	23.67	6.65

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	0.549	-0.384	-0.230	-1.010	1.024	-0.371
Master	Skilled	-0.047	0.957	1.768	2.077	0.787	1.475
Master	Skilled	-0.644	0.191	0.078	-0.030	-0.693	-0.229
Master	Skilled	-0.644	0.957	2.536	0.803	-0.634	0.197
Master	Skilled	-0.644	0.574	1.307	1.097	-0.515	0.339
Master	Skilled	0.549	0.191	1.614	2.028	0.077	0.765
Master	Skilled	-0.047	0.191	1.307	2.421	0.550	1.759
Master	Skilled	3.530	4.022	1.614	2.911	-2.043	3.890
Master	Skilled	-0.644	-0.192	1.000	0.362	0.314	0.339
Master	Skilled	1.145	4.022	5.302	1.538	1.142	5.737
Master	Skilled	-0.378	-0.554	-0.331	-0.832	-0.535	-0.512
Master	Skilled	0.616	0.736	-0.278	0.984	-0.227	0.361
Master	Skilled	0.003	0.122	-0.115	0.491	0.086	0.276

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	Battering	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	No	Multi-faceted	None	No
SF1	TB02	Master	Blade	No	Multi-faceted	None	No
SF1	TB02	Master	Blade	No	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	3.11	3.26	1.72	68.89	12.45	2.45
Platform battering	Feather	2.14	2.81	0.90	61.91	12.46	2.41
None	Feather	2.07	1.16	0.64	56.05	9.51	0.74
None	Feather	2.34	3.15	1.09	37.99	12.28	1.28
None	Feather	2.69	2.12	0.60	30.53	11.67	0.98
None	Feather	1.97	2.24	1.18	53.47	9.74	1.37
None	Feather	2.15	2.80	0.84	53.03	15.09	1.89
Shatter	Feather	3.67	4.44	0.68	61.32	19.38	4.82
Shatter	Feather	2.43	3.91	0.81	72.94	14.30	3.21
Shatter	Feather	2.68	2.55	0.96	54.82	14.81	2.46
Hinging	Hinge	2.26	N/A	N/A	N/A	N/A	1.39
Hinging	Hinge	1.39	N/A	N/A	N/A	N/A	1.40
Hinging	Hinge	3.32	N/A	N/A	N/A	N/A	2.35

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	0.351	-0.417	0.011	0.683	-0.509	-0.344
Master	Skilled	-0.452	-0.604	-0.275	0.328	-0.509	-0.350
Master	Skilled	-0.510	-1.293	-0.365	0.029	-0.665	-0.596
Master	Skilled	-0.286	-0.462	-0.209	-0.890	-0.518	-0.516
Master	Skilled	0.003	-0.892	-0.379	-1.270	-0.550	-0.561
Master	Skilled	-0.593	-0.842	-0.177	-0.102	-0.653	-0.503
Master	Skilled	-0.444	-0.609	-0.296	-0.124	-0.369	-0.426
Master	Skilled	0.814	0.076	-0.352	0.298	-0.141	0.006
Master	Skilled	-0.212	-0.145	-0.306	0.889	-0.411	-0.232
Master	Skilled	-0.005	-0.713	-0.254	-0.033	-0.384	-0.342
Master	Skilled	-0.353	N/A	N/A	N/A	N/A	-0.500
Master	Skilled	-1.073	N/A	N/A	N/A	N/A	-0.499
Master	Skilled	0.525	N/A	N/A	N/A	N/A	-0.358

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB02	Master	Blade	No	Multi-faceted	None	No
SF1	TB02	Master	Blade	No	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	No	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB02	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB02	Master	Blade	No	Absent	Not present	No
SF1	TB02	Master	Blade	No	Absent	Not present	No
SF1	TB02	Master	Blade	No	Absent	Not present	No
SF1	TB02	Master	Blade	No	Absent	Not present	No
SF1	TB02	Master	Blade	No	Absent	Not present	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Hinging	Hinge	2.50	N/A	N/A	N/A	N/A	1.32
Stepping	Step	1.77	N/A	N/A	N/A	N/A	0.90
Hinging	Hinge	1.93	2.99	1.39	27.27	9.98	0.87
Stepping	Step	2.02	N/A	N/A	N/A	N/A	0.99
Hinging	Hinge	1.18	1.70	1.03	30.58	8.05	0.44
None	Feather	N/A	5.61	0.83	55.57	14.04	3.87
None	Feather	N/A	2.63	0.82	43.75	12.24	1.18
None	Feather	N/A	1.42	0.48	45.07	11.00	0.98
Shatter	Feather	N/A	N/A	0.86	N/A	N/A	0.51
Shatter	Feather	N/A	N/A	0.73	N/A	N/A	0.35
Shatter	Feather	N/A	N/A	1.00	N/A	N/A	0.85
Shatter	Hinge	N/A	N/A	1.05	N/A	N/A	0.51
Shatter	Feather	N/A	N/A	1.12	N/A	N/A	3.89

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.154	N/A	N/A	N/A	N/A	-0.510
Master	Skilled	-0.758	N/A	N/A	N/A	N/A	-0.572
Master	Skilled	-0.626	-0.529	-0.104	-1.436	-0.640	-0.577
Master	Skilled	-0.551	N/A	N/A	N/A	N/A	-0.559
Master	Skilled	-1.247	-1.068	-0.230	-1.267	-0.742	-0.640
Master	Skilled	N/A	0.564	-0.299	0.005	-0.425	-0.134
Master	Skilled	N/A	-0.680	-0.303	-0.597	-0.520	-0.531
Master	Skilled	N/A	-1.185	-0.421	-0.530	-0.586	-0.561
Master	Skilled	N/A	N/A	-0.289	N/A	N/A	-0.630
Master	Skilled	N/A	N/A	-0.334	N/A	N/A	-0.653
Master	Skilled	N/A	N/A	-0.240	N/A	N/A	-0.580
Master	Skilled	N/A	N/A	-0.223	N/A	N/A	-0.630
Master	Skilled	N/A	N/A	-0.198	N/A	N/A	-0.131

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB02	Master	Blade	No	Absent	Not present	No
SF1	TB02	Master	Blade	No	Absent	Not present	No
SF1	TB02	Master	Blade	No	Absent	Not present	No
SF1	TB02	Master	Blade	No	Absent	Not present	No
SF1	TB02	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB02	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB02	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB02	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB02	Master	Angle correction	No	Absent	Not present	Yes
SF1	TB02	Master	Angle correction	No	Absent	Not present	Yes
SF1	TB02	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Profile correction blade	No	Absent	Crushing	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	N/A	N/A	1.18	N/A	N/A	1.34
Shatter	Feather	N/A	N/A	1.65	N/A	N/A	2.82
Shatter	Feather	N/A	N/A	0.75	N/A	N/A	1.22
Shatter	Feather	N/A	N/A	0.96	N/A	N/A	1.01
None	Feather	8.64	8.10	1.17	39.48	50.99	16.03
None	Feather	4.36	3.40	1.39	30.87	41.22	3.52
None	Feather	2.84	3.98	0.45	29.63	53.04	3.90
None	Feather	2.26	6.00	2.93	51.46	54.21	15.01
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	7.27
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	7.68
None	Hinge	2.40	2.22	1.63	40.92	12.53	1.52
None	Feather	1.98	3.83	1.38	67.28	16.04	4.03
Shatter	Feather	N/A	N/A	1.51	N/A	N/A	4.25

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	N/A	N/A	-0.177	N/A	N/A	-0.507
Master	Skilled	N/A	N/A	-0.014	N/A	N/A	-0.289
Master	Skilled	N/A	N/A	-0.327	N/A	N/A	-0.525
Master	Skilled	N/A	N/A	-0.254	N/A	N/A	-0.556
Master	Skilled	4.928	1.604	-0.181	-0.814	1.535	1.660
Master	Skilled	1.386	-0.358	-0.104	-1.253	1.017	-0.186
Master	Skilled	0.127	-0.116	-0.432	-1.316	1.644	-0.130
Master	Skilled	-0.353	0.727	0.432	-0.204	1.706	1.509
Master	Skilled	N/A	N/A	N/A	N/A	N/A	0.367
Master	Skilled	N/A	N/A	N/A	N/A	N/A	0.428
Master	Skilled	-0.237	-0.851	-0.021	-0.741	-0.505	-0.481
Master	Skilled	-0.584	-0.179	-0.108	0.601	-0.319	-0.111
Master	Skilled	N/A	N/A	-0.062	N/A	N/A	-0.078

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB02	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Core face rejuvenation	No	Absent	Not present	Yes
SF1	TB02	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB02	Master	Crested blade	Yes	Multi-faceted	None	Yes
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.37	5.00	1.96	67.17	17.46	6.14
None	Feather	2.29	3.48	1.51	73.45	12.70	3.85
None	Feather	2.52	4.53	1.27	57.03	18.11	4.67
None	Feather	2.40	4.58	1.52	66.90	22.10	8.17
None	Feather	2.42	6.23	1.32	75.11	19.17	8.59
Shatter	Hinge	N/A	N/A	1.54	N/A	N/A	6.98
None	Feather	3.56	4.78	2.35	76.11	17.55	6.70
None	Feather	3.56	7.90	3.57	89.51	21.42	14.49
None	Feather	2.74	6.90	2.73	23.47	100.95	18.31
None	Outrepasse	2.39	13.29	19.83	109.96	29.66	42.44
None	Feather	3.23	4.14	0.89	52.14	11.91	2.11
None	Feather	3.33	3.55	1.11	44.76	12.53	2.22
None	Feather	1.91	2.54	0.51	42.38	16.80	1.70

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.262	0.310	0.094	0.596	-0.243	0.201
Master	Skilled	-0.328	-0.325	-0.062	0.915	-0.496	-0.137
Master	Skilled	-0.137	0.114	-0.146	0.079	-0.209	-0.016
Master	Skilled	-0.237	0.134	-0.059	0.582	0.003	0.500
Master	Skilled	-0.220	0.823	-0.129	1.000	-0.153	0.562
Master	Skilled	N/A	N/A	-0.052	N/A	N/A	0.325
Master	Skilled	0.723	0.218	0.230	1.051	-0.239	0.283
Master	Skilled	0.723	1.520	0.655	1.733	-0.033	1.433
Master	Skilled	0.045	1.103	0.363	-1.629	4.185	1.996
Master	Skilled	-0.245	3.770	6.319	2.774	0.404	5.556
Intermediate	Skilled	0.950	-0.151	-0.353	-0.067	-0.686	-0.353
Intermediate	Skilled	1.087	-0.351	-0.264	-0.465	-0.554	-0.338
Intermediate	Skilled	-0.864	-0.694	-0.507	-0.594	0.351	-0.409

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Single faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.43	4.74	0.63	51.08	13.71	3.45
None	Feather	2.62	3.06	0.60	67.29	22.33	6.55
None	Feather	2.50	2.51	1.03	54.77	19.89	3.74
None	Feather	3.75	3.38	1.33	46.68	21.30	3.11
None	Feather	1.91	3.89	0.33	48.95	15.61	2.35
None	Feather	1.59	5.50	1.25	46.11	13.99	2.97
None	Feather	2.27	5.90	1.33	54.74	15.59	3.77
None	Feather	3.76	7.38	1.10	98.81	19.69	11.97
None	Feather	1.81	3.02	0.59	44.97	9.84	1.18
None	Feather	3.43	4.46	0.68	48.74	18.63	3.57
Hinging	Hinge	2.52	4.86	4.45	32.92	12.64	1.70
Hinging	Hinge	2.26	3.23	1.29	36.89	13.55	1.99
None	Feather	2.12	3.73	1.07	51.83	11.15	1.97

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	-0.149	0.053	-0.458	-0.124	-0.304	-0.172
Intermediate	Skilled	0.112	-0.518	-0.470	0.750	1.524	0.247
Intermediate	Skilled	-0.053	-0.705	-0.296	0.075	1.006	-0.133
Intermediate	Skilled	1.665	-0.409	-0.175	-0.362	1.305	-0.218
Intermediate	Skilled	-0.864	-0.236	-0.579	-0.239	0.099	-0.321
Intermediate	Skilled	-1.303	0.311	-0.207	-0.392	-0.245	-0.237
Intermediate	Skilled	-0.369	0.447	-0.175	0.073	0.095	-0.129
Intermediate	Skilled	1.678	0.950	-0.268	2.451	0.964	0.980
Intermediate	Skilled	-1.001	-0.531	-0.474	-0.454	-1.125	-0.479
Intermediate	Skilled	1.225	-0.042	-0.438	-0.250	0.739	-0.156
Intermediate	Skilled	-0.026	0.094	1.088	-1.104	-0.531	-0.409
Intermediate	Skilled	-0.383	-0.460	-0.191	-0.890	-0.338	-0.369
Intermediate	Skilled	-0.575	-0.290	-0.280	-0.084	-0.847	-0.372

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB03	Master	Blade	No	Absent	Not present	No
SF1	TB03	Master	Blade	No	Absent	Not present	No
SF1	TB03	Master	Blade	No	Absent	Not present	No
SF1	TB03	Master	Blade	No	Absent	Not present	No
SF1	TB03	Master	Blade	No	Absent	Not present	No
SF1	TB03	Master	Blade	No	Absent	Not present	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	1.69	2.41	0.54	43.05	9.03	1.03
None	Feather	1.27	1.84	0.64	40.18	7.56	0.56
Shatter	Feather	2.76	5.18	1.45	51.18	13.14	2.25
None	Feather	2.88	1.60	0.27	34.01	8.24	0.45
Shatter	Hinge	1.68	1.47	0.96	32.62	8.36	0.58
Shatter	Feather	2.45	4.14	0.83	59.14	17.90	2.97
Shatter	Hinge	2.47	2.61	2.42	40.93	13.90	1.40
Shatter	Feather	N/A	N/A	0.59	N/A	N/A	2.03
Shatter	Feather	N/A	N/A	0.97	N/A	N/A	1.02
Shatter	Feather	N/A	N/A	0.69	N/A	N/A	0.27
Shatter	Hinge	N/A	N/A	1.38	N/A	N/A	1.79
Shatter	Feather	N/A	N/A	1.12	N/A	N/A	4.64
Shatter	Hinge	N/A	N/A	1.81	N/A	N/A	5.71

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	-1.166	-0.739	-0.494	-0.557	-1.296	-0.499
Intermediate	Skilled	-1.743	-0.932	-0.454	-0.712	-1.608	-0.563
Intermediate	Skilled	0.304	0.203	-0.126	-0.119	-0.425	-0.334
Intermediate	Skilled	0.469	-1.014	-0.604	-1.045	-1.464	-0.578
Intermediate	Skilled	-1.180	-1.058	-0.324	-1.120	-1.438	-0.560
Intermediate	Skilled	-0.122	-0.151	-0.377	0.311	0.584	-0.237
Intermediate	Skilled	-0.094	-0.671	0.267	-0.672	-0.264	-0.449
Intermediate	Skilled	N/A	N/A	-0.474	N/A	N/A	-0.364
Intermediate	Skilled	N/A	N/A	-0.320	N/A	N/A	-0.500
Intermediate	Skilled	N/A	N/A	-0.434	N/A	N/A	-0.602
Intermediate	Skilled	N/A	N/A	-0.154	N/A	N/A	-0.396
Intermediate	Skilled	N/A	N/A	-0.260	N/A	N/A	-0.011
Intermediate	Skilled	N/A	N/A	0.020	N/A	N/A	0.134

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB03	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB03	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB03	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF1	TB03	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB03	Master	Crested blade	Yes	Multi-faceted	None	Yes
SF1	TB03	Master	Corrective non-initial core tablet	No	Absent	Not present	Yes
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.73	6.72	2.37	59.83	18.08	10.02
None	Feather	1.92	4.30	2.16	48.66	11.80	2.83
None	Feather	2.22	5.21	1.75	62.19	23.83	7.63
None	Outrepasse	3.83	11.84	12.39	91.10	20.95	26.56
None	Outrepasse	3.74	15.14	9.36	108.74	22.09	37.36
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	1.77
None	Feather	2.81	3.03	1.65	50.67	15.48	2.28
None	Feather	1.99	1.99	1.37	29.16	7.74	0.61
None	Feather	1.81	2.40	1.31	32.22	11.71	1.02
None	Feather	2.38	3.09	0.44	56.96	12.15	2.02
None	Feather	2.98	1.66	0.46	51.55	9.41	0.78
None	Feather	2.41	3.35	0.63	49.16	15.19	2.01
None	Feather	1.63	3.99	1.19	60.61	14.24	3.55

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	0.263	0.726	0.246	0.348	0.622	0.717
Intermediate	Skilled	-0.850	-0.096	0.161	-0.255	-0.709	-0.256
Intermediate	Skilled	-0.438	0.213	-0.005	0.475	1.842	0.393
Intermediate	Skilled	1.774	2.465	4.302	2.035	1.231	2.954
Intermediate	Skilled	1.651	3.586	3.075	2.987	1.473	4.414
Intermediate	Skilled	N/A	N/A	N/A	N/A	N/A	-0.399
Master	Skilled	0.157	-0.572	0.051	-0.448	-0.416	-0.372
Master	Skilled	-0.563	-1.024	-0.117	-1.657	-1.254	-0.514
Master	Skilled	-0.721	-0.846	-0.153	-1.485	-0.824	-0.479
Master	Skilled	-0.221	-0.546	-0.677	-0.094	-0.777	-0.394
Master	Skilled	0.306	-1.168	-0.665	-0.398	-1.073	-0.499
Master	Skilled	-0.194	-0.433	-0.562	-0.532	-0.447	-0.395
Master	Skilled	-0.879	-0.154	-0.226	0.111	-0.550	-0.264

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	Battering	No
SF1	TB04	Master	Blade	No	Multi-faceted	None	No
SF1	TB04	Master	Blade	No	Multi-faceted	None	No
SF1	TB04	Master	Blade	No	Multi-faceted	None	No
SF1	TB04	Master	Blade	No	Absent	Not present	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	Double Initiation	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	1.91	1.55	1.11	47.30	11.75	1.00
None	Feather	2.59	4.52	0.75	67.57	25.20	7.68
None	Feather	2.57	3.41	0.95	53.66	17.59	3.69
None	Feather	2.17	5.20	1.22	71.12	14.66	5.70
None	Feather	3.11	5.95	1.17	69.05	19.05	7.20
None	Feather	2.67	4.21	0.87	65.00	16.50	4.52
None	Hinge	2.61	3.40	2.11	49.58	15.25	3.03
Platform battering	Feather	2.65	8.11	1.10	71.35	21.99	11.47
Hinging	Hinge	2.45	N/A	N/A	N/A	N/A	1.57
Shatter	Hinge	2.11	N/A	N/A	N/A	N/A	1.79
Hinging	Hinge	1.50	N/A	N/A	N/A	N/A	1.28
None	Feather	N/A	N/A	0.81	N/A	N/A	2.50
None	Feather	2.35	3.70	0.75	41.51	15.11	2.55

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.633	-1.216	-0.274	-0.637	-0.820	-0.481
Master	Skilled	-0.036	0.076	-0.490	0.503	0.636	0.087
Master	Skilled	-0.054	-0.406	-0.370	-0.279	-0.188	-0.252
Master	Skilled	-0.405	0.372	-0.208	0.702	-0.505	-0.081
Master	Skilled	0.421	0.699	-0.238	0.586	-0.030	0.046
Master	Skilled	0.034	-0.058	-0.418	0.358	-0.306	-0.182
Master	Skilled	-0.019	-0.411	0.328	-0.509	-0.441	-0.308
Master	Skilled	0.017	1.638	-0.280	0.715	0.289	0.409
Master	Skilled	-0.159	N/A	N/A	N/A	N/A	-0.432
Master	Skilled	-0.458	N/A	N/A	N/A	N/A	-0.414
Master	Skilled	-0.993	N/A	N/A	N/A	N/A	-0.457
Master	Skilled	N/A	N/A	-0.454	N/A	N/A	-0.353
Master	Skilled	-0.247	-0.280	-0.490	-0.963	-0.456	-0.349

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB04	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB04	Master	Blade	No	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	No	Absent	Crushing	No
SF1	TB04	Master	Blade	No	Absent	Crushing	No
SF1	TB04	Master	Blade	No	Absent	Crushing	No
SF1	TB04	Master	Blade	No	Absent	Not present	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	N/A	1.81	1.52	38.79	10.25	0.59
None	Hinge	N/A	N/A	N/A	N/A	N/A	2.97
None	Feather	N/A	3.49	1.18	41.27	14.59	2.00
Shatter	Hinge	2.24	N/A	N/A	N/A	N/A	6.73
Shatter	Feather	2.20	2.67	0.76	52.64	13.10	2.45
Shatter	Feather	N/A	N/A	0.69	N/A	N/A	2.46
Shatter	Feather	N/A	N/A	0.76	N/A	N/A	0.59
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	2.67
Shatter	Feather	N/A	N/A	1.62	N/A	N/A	2.22
None	Feather	2.80	2.59	0.56	36.25	11.34	1.00
None	Feather	N/A	4.93	0.85	72.22	15.29	3.99
None	Feather	2.28	2.30	1.46	37.48	13.18	1.58
None	Feather	1.82	4.29	0.81	59.08	12.81	2.03

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	N/A	-1.103	-0.027	-1.115	-0.982	-0.515
Master	Skilled	N/A	N/A	N/A	N/A	N/A	-0.313
Master	Skilled	N/A	-0.372	-0.232	-0.976	-0.512	-0.396
Master	Skilled	-0.343	N/A	N/A	N/A	N/A	0.006
Master	Skilled	-0.379	-0.728	-0.484	-0.337	-0.674	-0.357
Master	Skilled	N/A	N/A	-0.526	N/A	N/A	-0.357
Master	Skilled	N/A	N/A	-0.484	N/A	N/A	-0.515
Master	Skilled	N/A	N/A	N/A	N/A	N/A	-0.339
Master	Skilled	N/A	N/A	0.033	N/A	N/A	-0.377
Master	Skilled	0.148	-0.763	-0.604	-1.258	-0.864	-0.481
Master	Skilled	N/A	0.255	-0.430	0.764	-0.437	-0.227
Master	Skilled	-0.308	-0.889	-0.063	-1.189	-0.665	-0.431
Master	Skilled	-0.712	-0.024	-0.454	0.025	-0.705	-0.393

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB04	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Lateral core trimming	Yes	Multi-faceted	None	No
SF1	TB04	Master	Lateral core trimming	Yes	Single faceted	None	No
SF1	TB04	Master	Faceted non-initial core tablet	Yes	Multi-faceted	None	No
SF1	TB04	Master	Profile correction blade	Yes	Absent	Not present	No
SF1	TB04	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB04	Master	Profile correction blade	Yes	Multi-faceted	None	No
SF1	TB04	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB04	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB04	Master	Profile correction blade	Yes	Single faceted	None	Yes
SF1	TB04	Master	Profile correction blade	Yes	Single faceted	None	Yes
SF1	TB04	Master	Core face rejuvenation	Yes	Single faceted	None	No
SF1	TB04	Master	Core face rejuvenation	No	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	1.68	2.35	0.41	39.20	8.81	0.74
None	Feather	2.45	2.57	0.91	34.13	35.67	2.60
None	Feather	3.90	3.13	1.06	41.50	50.85	6.97
None	Feather	9.00	11.88	11.40	109.24	44.63	85.84
Shatter	Feather	N/A	N/A	0.84	N/A	N/A	5.51
None	Feather	1.89	4.25	1.50	75.11	17.66	7.74
None	Feather	2.66	6.82	2.97	93.40	24.25	16.25
None	Feather	2.39	2.93	2.58	75.77	28.20	17.03
None	Feather	2.34	7.60	2.73	72.12	18.84	10.00
None	Feather	2.95	5.67	1.16	64.93	24.76	11.40
None	Feather	3.12	7.79	1.60	63.43	24.08	11.38
None	Feather	2.53	5.29	3.37	59.96	24.51	8.68
Hinging	Hinge	2.95	0.00	N/A	N/A	N/A	6.28

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.835	-0.868	-0.695	-1.092	-1.138	-0.503
Master	Skilled	-0.159	-0.772	-0.394	-1.377	1.770	-0.345
Master	Skilled	1.114	-0.528	-0.304	-0.963	3.413	0.027
Master	Skilled	5.593	3.279	5.914	2.845	2.740	6.728
Master	Skilled	N/A	N/A	-0.436	N/A	N/A	-0.097
Master	Skilled	-0.651	-0.041	-0.039	0.926	-0.180	0.092
Master	Skilled	0.025	1.077	0.845	1.955	0.533	0.815
Master	Skilled	-0.212	-0.615	0.610	0.964	0.961	0.881
Master	Skilled	-0.256	1.416	0.700	0.758	-0.052	0.284
Master	Skilled	0.280	0.577	-0.244	0.354	0.589	0.403
Master	Skilled	0.429	1.499	0.021	0.270	0.515	0.401
Master	Skilled	-0.089	0.411	1.085	0.075	0.562	0.172
Master	Skilled	0.280	-1.890	N/A	N/A	N/A	-0.032

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB04	Master	Core face rejuvenation	Yes	Multi-faceted	Double Initiation	Yes
SF1	TB04	Master	Core face rejuvenation	Yes	Multi-faceted	Double Initiation	No
SF1	TB04	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF1	TB04	Master	Partial ridged blade	No	Multi-faceted	None	Yes
SF1	TB04	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB04	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB04	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB04	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB04	Master	Partial ridged blade	Yes	Absent	Not present	Yes
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.78	4.61	1.35	76.83	23.65	7.38
None	Feather	2.31	7.89	1.31	46.79	22.04	6.97
None	Feather	4.30	6.82	0.90	63.63	30.64	11.70
Shatter	Feather	N/A	N/A	2.22	N/A	N/A	17.23
Shatter	Feather	2.38	4.45	2.57	94.58	27.16	14.52
None	Feather	1.84	4.30	1.74	62.95	11.77	3.03
None	Feather	1.68	4.35	0.84	52.07	14.66	2.97
None	Hinge	3.29	8.12	4.00	74.01	26.49	11.17
Shatter	Hinge	3.29	N/A	N/A	N/A	N/A	3.20
None	Feather	2.18	5.48	1.14	50.19	21.64	5.75
None	Feather	1.64	3.37	0.88	45.72	19.29	2.57
None	Feather	3.20	4.23	0.54	71.75	17.58	4.46
None	Feather	2.79	3.47	0.78	45.11	15.33	3.10

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	0.131	0.116	-0.129	1.023	0.468	0.061
Master	Skilled	-0.282	1.543	-0.153	-0.666	0.294	0.027
Master	Skilled	1.465	1.077	-0.400	0.281	1.225	0.429
Master	Skilled	N/A	N/A	0.394	N/A	N/A	0.898
Master	Skilled	-0.221	0.046	0.604	2.021	0.848	0.668
Master	Skilled	-0.695	-0.019	0.105	0.243	-0.818	-0.308
Master	Skilled	-0.835	0.002	-0.436	-0.369	-0.505	-0.313
Master	Skilled	0.579	1.643	1.464	0.865	0.776	0.383
Master	Skilled	0.579	N/A	N/A	N/A	N/A	-0.294
Master	Skilled	-0.690	0.202	-0.450	-0.843	0.178	-0.426
Master	Skilled	-1.440	-0.725	-0.837	-1.048	-0.232	-0.815
Master	Skilled	0.728	-0.347	-1.345	0.144	-0.531	-0.583
Master	Skilled	0.158	-0.681	-0.987	-1.076	-0.924	-0.750

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	Crushing	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	2.83	3.45	1.52	64.92	19.87	4.19
Hinging	Hinge	2.30	2.82	1.82	41.19	12.89	1.44
None	Feather	1.91	3.48	0.51	49.87	16.56	3.17
None	Feather	3.25	4.25	0.74	61.50	25.77	6.75
Hinging	Hinge	2.26	2.73	1.70	43.46	14.26	2.00
Hinging	Hinge	2.31	2.88	1.94	33.74	14.28	1.51
None	Feather	1.51	2.99	1.24	45.09	14.45	2.23
Hinging	Hinge	3.04	3.38	2.00	45.35	14.77	2.17
None	Feather	1.63	3.02	1.27	35.10	12.52	1.25
None	Feather	N/A	3.64	2.05	81.86	17.15	6.12
None	Feather	N/A	4.53	1.33	78.98	21.66	8.57
None	Feather	3.25	3.11	1.12	49.07	19.80	3.17
Shatter	Feather	1.48	2.42	1.00	46.49	10.57	1.17

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	0.214	-0.690	0.117	-0.169	-0.131	-0.616
Master	Skilled	-0.523	-0.967	0.565	-1.255	-1.350	-0.953
Master	Skilled	-1.065	-0.677	-1.390	-0.858	-0.709	-0.741
Master	Skilled	0.798	-0.338	-1.046	-0.325	0.899	-0.303
Master	Skilled	-0.578	-1.006	0.386	-1.151	-1.111	-0.884
Master	Skilled	-0.509	-0.940	0.744	-1.596	-1.107	-0.944
Master	Skilled	-1.621	-0.892	-0.300	-1.077	-1.078	-0.856
Master	Skilled	0.506	-0.721	0.834	-1.065	-1.022	-0.864
Master	Skilled	-1.454	-0.879	-0.256	-1.534	-1.415	-0.976
Master	Skilled	N/A	-0.606	0.908	0.607	-0.606	-0.380
Master	Skilled	N/A	-0.215	-0.166	0.475	0.181	-0.080
Master	Skilled	0.798	-0.839	-0.479	-0.894	-0.143	-0.741
Master	Skilled	-1.663	-1.142	-0.658	-1.013	-1.755	-0.986

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	No	Absent	Not present	No
SF1	TB05	Master	Blade	No	Absent	Not present	No
SF1	TB05	Master	Blade	No	Absent	Not present	No
SF1	TB05	Master	Blade	No	Absent	Not present	No
SF1	TB05	Master	Blade	No	Absent	Crushing	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.39	3.86	1.38	64.92	20.12	6.31
None	Feather	2.38	4.59	0.95	61.14	21.61	6.62
None	Feather	2.77	7.83	0.80	77.68	22.33	10.32
None	Feather	2.24	5.95	1.15	71.80	20.59	8.24
None	Feather	2.97	5.53	1.30	71.65	19.08	8.26
None	Feather	2.71	4.27	0.74	72.24	23.97	6.28
None	Feather	3.02	5.61	1.41	102.57	27.94	20.14
Shatter	Feather	N/A	N/A	0.57	N/A	N/A	4.30
Shatter	Feather	N/A	N/A	1.26	N/A	N/A	2.69
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	5.80
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	11.87
None	Feather	N/A	N/A	0.86	N/A	N/A	1.98
None	Feather	2.70	4.93	1.19	63.25	21.18	5.85

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.398	-0.510	-0.091	-0.169	-0.087	-0.357
Master	Skilled	-0.412	-0.189	-0.733	-0.342	0.173	-0.319
Master	Skilled	0.130	1.235	-0.957	0.415	0.298	0.134
Master	Skilled	-0.606	0.409	-0.435	0.146	-0.005	-0.121
Master	Skilled	0.408	0.224	-0.211	0.139	-0.269	-0.118
Master	Skilled	0.047	-0.330	-1.046	0.166	0.585	-0.361
Master	Skilled	0.478	0.259	-0.047	1.555	1.278	1.335
Master	Skilled	N/A	N/A	-1.300	N/A	N/A	-0.603
Master	Skilled	N/A	N/A	-0.270	N/A	N/A	-0.800
Master	Skilled	N/A	N/A	N/A	N/A	N/A	-0.419
Master	Skilled	N/A	N/A	N/A	N/A	N/A	0.323
Master	Skilled	N/A	N/A	-0.867	N/A	N/A	-0.887
Master	Skilled	0.033	-0.040	-0.375	-0.245	0.098	-0.413

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB05	Master	Blade	No	Absent	Not present	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	No	Absent	Not present	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB05	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB05	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF1	TB05	Master	Core face rejuvenation	Yes	Multi-faceted	Battering	No
SF1	TB05	Master	Core face rejuvenation	No	Absent	Not present	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	0.80
Shatter	Step	2.65	7.19	2.01	94.07	22.63	16.03
Shatter	Hinge	2.31	2.29	2.75	44.97	14.48	1.83
Shatter	Feather	N/A	N/A	1.32	N/A	N/A	11.32
Shatter	Feather	2.94	3.78	0.75	74.34	21.57	6.03
Shatter	Feather	2.78	3.34	0.61	64.36	17.58	3.53
Shatter	Feather	3.07	4.12	1.34	82.45	18.52	7.47
Shatter	Feather	2.12	3.96	0.84	46.15	18.67	3.03
None	Feather	4.18	9.86	2.42	108.23	24.18	23.46
None	Feather	3.54	11.99	1.96	92.34	27.71	21.77
Stepping	Hinge	3.11	7.56	2.21	93.47	28.88	21.02
None	Feather	3.27	6.92	0.84	99.99	38.45	26.82
Shatter	Feather	N/A	N/A	1.44	N/A	N/A	31.50

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	N/A	N/A	N/A	N/A	N/A	-1.031
Master	Skilled	-0.036	0.954	0.849	1.166	0.351	0.832
Master	Skilled	-0.509	-1.200	1.953	-1.082	-1.072	-0.905
Master	Skilled	N/A	N/A	-0.181	N/A	N/A	0.256
Master	Skilled	0.367	-0.545	-1.031	0.262	0.166	-0.391
Master	Skilled	0.144	-0.738	-1.240	-0.194	-0.531	-0.697
Master	Skilled	0.547	-0.395	-0.151	0.634	-0.367	-0.215
Master	Skilled	-0.773	-0.466	-0.897	-1.028	-0.341	-0.758
Master	Skilled	2.090	2.127	1.460	1.814	0.621	1.742
Master	Skilled	1.201	3.063	0.774	1.086	1.238	1.535
Master	Skilled	0.603	1.116	1.147	1.138	1.442	1.443
Master	Skilled	0.825	0.835	-0.897	1.437	3.113	2.153
Master	Skilled	N/A	N/A	-0.002	N/A	N/A	2.726

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF1	TB05	Master	Core face rejuvenation	No	Absent	Not present	Yes
SF1	TB05	Master	Core face rejuvenation	No	Absent	Not present	Yes
SF1	TB05	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB05	Master	Partial ridged blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Partial ridged blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF1	TB05	Master	Partial ridged blade	Yes	Multi-faceted	None	No
SF1	TB05	Master	Crested blade	No	Absent	Not present	Yes
SF1	TB05	Master	Crested blade	No	Absent	Not present	Yes
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	No	Multi-faceted	Not present	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	11.74
Shatter	Feather	1.57	N/A	N/A	N/A	N/A	10.81
Hinging	Hinge	4.97	9.02	2.58	100.66	30.82	28.42
None	Feather	3.58	8.09	2.09	87.18	27.74	20.36
None	Feather	2.28	7.90	2.94	111.32	28.72	28.30
None	Feather	2.79	5.34	1.62	83.96	19.79	8.99
None	Feather	2.45	7.62	1.83	86.22	19.88	15.44
Shatter	Hinge	N/A	N/A	3.37	N/A	N/A	11.33
Shatter	Feather	N/A	N/A	1.63	N/A	N/A	11.55
None	Feather	1.80	3.00	0.80	29.00	11.30	0.80
None	Feather	1.40	2.00	0.50	22.10	6.90	0.25
Platform battering	Feather	N/A	2.20	0.60	N/A	10.80	0.64
None	Feather	1.60	1.40	1.10	29.20	9.60	0.43

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	N/A	N/A	N/A	N/A	N/A	0.307
Master	Skilled	-1.537	N/A	N/A	N/A	N/A	0.194
Master	Skilled	3.188	1.758	1.699	1.467	1.781	2.349
Master	Skilled	1.256	1.349	0.968	0.850	1.243	1.362
Master	Skilled	-0.551	1.265	2.236	1.955	1.414	2.334
Master	Skilled	0.158	0.141	0.267	0.703	-0.145	-0.029
Master	Skilled	-0.314	1.142	0.580	0.806	-0.129	0.760
Master	Skilled	N/A	N/A	2.878	N/A	N/A	0.257
Master	Skilled	N/A	N/A	0.282	N/A	N/A	0.284
Intermediate	Unskilled	-0.934	-0.761	-0.599	-1.145	-0.871	-0.829
Intermediate	Unskilled	-1.118	-1.059	-0.672	-1.482	-1.262	-0.888
Intermediate	Unskilled	N/A	-0.999	-0.647	N/A	-0.915	-0.847
Intermediate	Unskilled	-1.026	-1.237	-0.526	-1.135	-1.022	-0.869

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	Battering	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Blade	Yes	Multi-faceted	Battering	No
SF2	ZM01	Master	Blade	No	Absent	Not present	No
SF2	ZM01	Master	Blade	No	Multi-faceted	None	No
SF2	ZM01	Master	Blade	No	Multi-faceted	Not present	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.00	1.80	1.20	41.10	15.60	1.37
None	Feather	3.30	7.50	2.20	92.00	21.30	15.79
Hinging	Hinge	5.70	6.80	4.90	32.90	12.00	4.97
Hinging	Hinge	3.60	5.30	6.90	51.00	30.10	10.35
None	Feather	2.90	3.00	0.50	63.90	19.00	3.84
None	Feather	3.70	4.30	1.70	63.50	14.70	4.61
None	Feather	3.00	5.40	2.70	61.00	22.50	6.67
None	Outrepasse	3.80	6.30	2.20	50.60	23.10	5.99
None	Feather	3.20	5.20	3.00	67.50	33.60	10.81
Hinging	Hinge	4.40	3.00	1.50	30.40	18.00	2.30
None	Feather	N/A	3.30	1.40	N/A	12.00	3.60
None	Step	2.00	N/A	N/A	N/A	N/A	0.69
None	Feather	N/A	3.60	1.70	N/A	3.30	1.60

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.842	-1.118	-0.502	-0.553	-0.489	-0.769
Intermediate	Unskilled	-0.243	0.576	-0.260	1.936	0.017	0.769
Intermediate	Unskilled	0.863	0.368	0.393	-0.954	-0.809	-0.385
Intermediate	Unskilled	-0.105	-0.078	0.877	-0.069	0.799	0.189
Intermediate	Unskilled	-0.427	-0.761	-0.672	0.562	-0.187	-0.505
Intermediate	Unskilled	-0.059	-0.375	-0.381	0.542	-0.569	-0.423
Intermediate	Unskilled	-0.381	-0.048	-0.139	0.420	0.124	-0.203
Intermediate	Unskilled	-0.013	0.219	-0.260	-0.088	0.177	-0.276
Intermediate	Unskilled	-0.289	-0.108	-0.067	0.738	1.110	0.238
Intermediate	Unskilled	0.264	-0.761	-0.430	-1.076	-0.276	-0.669
Intermediate	Unskilled	N/A	-0.672	-0.454	N/A	-0.809	-0.531
Intermediate	Unskilled	-0.842	N/A	N/A	N/A	N/A	-0.841
Intermediate	Unskilled	N/A	-0.583	-0.381	N/A	-1.582	-0.744

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM01	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM01	Master	Angle correction	Yes	Single faceted	None	Yes
SF2	ZM01	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF2	ZM01	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF2	ZM01	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF2	ZM01	Master	Core face rejuvenation	Yes	Multi-faceted	Battering	Yes
SF2	ZM01	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF2	ZM01	Master	Non-initial core tablet	Yes	Single faceted	None	Yes
SF2	ZM02	Master	Blade	No	Absent	Not present	No
SF2	ZM02	Master	Blade	No	Multi-faceted	None	No
SF2	ZM02	Master	Blade	No	Multi-faceted	None	No
SF2	ZM02	Master	Blade	No	Absent	Not present	No
SF2	ZM02	Master	Blade	No	Absent	Not present	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Hinging	Hinge	4.20	7.50	7.10	79.60	30.00	18.17
None	Feather	6.00	4.00	2.40	35.80	13.30	2.15
None	Outrepasse	2.90	9.40	5.00	92.80	31.80	31.75
None	Feather	2.70	6.00	1.10	47.30	19.90	5.41
None	Feather	4.00	6.70	2.00	46.30	25.90	7.10
Platform battering	Outrepasse	6.70	14.20	5.00	48.30	33.10	24.54
None	Outrepasse	4.00	7.90	20.50	73.00	38.70	23.60
None	Feather	11.30	13.70	2.60	43.30	50.00	26.98
Shatter	Hinge	N/A	3.00	N/A	N/A	N/A	1.37
Shatter	Hinge	5.00	N/A	N/A	N/A	N/A	2.00
Shatter	Hinge	1.50	0.60	N/A	N/A	N/A	0.40
Shatter	Feather	N/A	N/A	1.30	N/A	N/A	4.40
Shatter	Hinge	N/A	2.20	N/A	N/A	N/A	0.53

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	0.172	0.576	0.926	1.330	0.790	1.023
Intermediate	Unskilled	1.001	-0.464	-0.212	-0.812	-0.693	-0.685
Intermediate	Unskilled	-0.427	1.140	0.417	1.975	0.950	2.472
Intermediate	Unskilled	-0.519	0.130	-0.526	-0.250	-0.107	-0.338
Intermediate	Unskilled	0.080	0.338	-0.309	-0.299	0.426	-0.157
Intermediate	Unskilled	1.324	2.567	0.417	-0.201	1.066	1.703
Intermediate	Unskilled	0.080	0.695	4.169	1.007	1.563	1.602
Intermediate	Unskilled	3.443	2.418	-0.163	-0.446	2.567	1.963
Novice	Unskilled	N/A	-0.483	N/A	N/A	N/A	-0.554
Novice	Unskilled	0.126	N/A	N/A	N/A	N/A	-0.478
Novice	Unskilled	-1.109	-1.189	N/A	N/A	N/A	-0.671
Novice	Unskilled	N/A	N/A	-0.654	N/A	N/A	-0.189
Novice	Unskilled	N/A	-0.718	N/A	N/A	N/A	-0.655

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM02	Master	Blade	No	Absent	Not present	No
SF2	ZM02	Master	Blade	No	Absent	Not present	No
SF2	ZM02	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM02	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM02	Master	Profile correction blade	Yes	Single faceted	None	Yes
SF2	ZM02	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF2	ZM02	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF2	ZM03	Master	Blade	Yes	Multi-faceted	Crushing	No
SF2	ZM03	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM03	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM03	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM03	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM03	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Hinge	N/A	1.00	N/A	N/A	N/A	0.15
Shatter	Hinge	N/A	1.90	N/A	N/A	N/A	0.16
None	Outrepasse	3.80	6.80	3.30	77.80	16.00	8.32
None	Feather	2.90	5.60	1.00	59.00	16.20	4.86
Shatter	Feather	2.40	7.60	1.80	68.20	17.30	7.81
Angle	Feather	8.90	6.80	1.40	62.00	20.80	12.42
None	Feather	8.00	10.90	2.30	73.80	31.60	29.14
Shatter	Feather	N/A	3.90	0.80	N/A	13.00	1.90
Shatter	Outrepasse	3.80	6.90	4.40	59.00	17.80	7.28
Shatter	Feather	2.70	3.00	1.10	57.70	16.10	3.70
None	Feather	3.20	4.20	0.70	52.70	15.80	3.35
None	Feather	4.20	7.10	1.70	61.00	22.10	10.54
None	Feather	1.20	2.20	0.90	27.80	10.10	0.58

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	N/A	-1.071	N/A	N/A	N/A	-0.701
Novice	Unskilled	N/A	-0.806	N/A	N/A	N/A	-0.700
Novice	Unskilled	-0.297	0.636	1.724	1.228	-0.668	0.284
Novice	Unskilled	-0.615	0.283	-1.011	-1.167	-0.637	-0.133
Novice	Unskilled	-0.792	0.871	-0.059	0.005	-0.469	0.223
Novice	Unskilled	1.502	0.636	-0.535	-0.785	0.064	0.779
Novice	Unskilled	1.185	1.842	0.535	0.718	1.710	2.795
Novice	Unskilled	N/A	-0.349	-0.619	N/A	-0.813	-0.892
Novice	Unskilled	0.298	1.396	2.352	0.681	0.211	0.757
Novice	Unskilled	-0.467	-0.873	-0.371	0.567	-0.152	-0.340
Novice	Unskilled	-0.119	-0.175	-0.701	0.130	-0.216	-0.447
Novice	Unskilled	0.576	1.513	0.124	0.856	1.127	1.756
Novice	Unskilled	-1.510	-1.338	-0.536	-2.048	-1.431	-1.296

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM03	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF2	ZM03	Master	Core face rejuvenation	Yes	Multi-faceted	Battering	Yes
SF2	ZM04	Master	Blade	No	Single faceted	None	No
SF2	ZM04	Master	Blade	No	Multi-faceted	None	No
SF2	ZM04	Master	Blade	No	Absent	Not present	No
SF2	ZM04	Master	Blade	No	Multi-faceted	Crushing	No
SF2	ZM04	Master	Blade	No	Multi-faceted	None	No
SF2	ZM04	Master	Lateral core trimming	Yes	Multi-faceted	None	Yes
SF2	ZM04	Master	Lateral core trimming	No	Absent	Crushing	Yes
SF2	ZM04	Master	Lateral core trimming	Yes	Single faceted	Battering	Yes
SF2	ZM04	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF2	ZM04	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF2	ZM04	Master	Profile correction blade	Yes	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.70	4.60	1.10	54.20	15.00	4.02
None	Feather	5.80	4.10	1.70	46.10	24.60	7.11
Hinging	Hinge	2.70	4.10	N/A	N/A	18.10	4.41
Hinging	Hinge	1.30	2.80	N/A	N/A	7.70	0.47
Shatter	Feather	N/A	N/A	0.90	N/A	N/A	0.97
Stepping	Step	N/A	4.20	N/A	N/A	17.20	3.59
Shatter	Hinge	2.40	3.90	N/A	N/A	12.30	2.19
None	Outrepasse	8.00	10.00	11.50	46.60	36.50	15.97
None	Feather	N/A	7.40	8.30	N/A	32.70	7.19
None	Feather	8.10	7.00	3.70	35.50	44.40	13.00
Shatter	Feather	5.30	6.00	4.00	46.80	16.40	5.78
Shatter	Outrepasse	3.20	7.00	1.50	59.40	20.00	10.98
Shatter	Feather	3.10	4.90	3.80	48.90	19.00	6.40

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-0.467	0.058	-0.371	0.261	-0.386	-0.242
Novice	Unskilled	1.688	-0.233	0.124	-0.447	1.660	0.705
Novice	Unskilled	-0.458	-0.780	N/A	N/A	-0.434	-0.431
Novice	Unskilled	-0.607	-1.414	N/A	N/A	-1.371	-0.727
Novice	Unskilled	N/A	N/A	-1.045	N/A	N/A	-0.690
Novice	Unskilled	N/A	-0.732	N/A	N/A	-0.515	-0.492
Novice	Unskilled	-0.490	-0.878	N/A	N/A	-0.957	-0.598
Novice	Unskilled	0.106	2.097	1.938	-0.320	1.224	0.441
Novice	Unskilled	N/A	0.829	1.038	N/A	0.881	-0.221
Novice	Unskilled	0.117	0.634	-0.257	-1.531	1.935	0.217
Novice	Unskilled	-0.181	0.146	-0.172	-0.298	-0.587	-0.327
Novice	Unskilled	-0.405	0.634	-0.876	1.076	-0.263	0.065
Novice	Unskilled	-0.415	-0.390	-0.229	-0.069	-0.353	-0.281

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM04	Master	Core face rejuvenation	No	Single faceted	None	Yes
SF2	ZM04	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF2	ZM05	Master	Blade	No	Absent	Not present	No
SF2	ZM05	Master	Blade	No	Multi-faceted	None	No
SF2	ZM05	Master	Blade	No	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	No	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Absent	Not present	No
SF2	ZM05	Master	Blade	No	Multi-faceted	Battering	No
SF2	ZM05	Master	Blade	No	Multi-faceted	None	No
SF2	ZM05	Master	Blade	No	Absent	Not present	No
SF2	ZM05	Master	Blade	No	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Hinge	32.90	N/A	N/A	N/A	N/A	51.51
None	Feather	3.00	5.40	3.20	60.00	27.80	9.15
Shatter	Feather	N/A	N/A	1.00	N/A	N/A	0.30
Shatter	Feather	3.50	5.30	2.00	71.10	18.60	6.99
Shatter	Hinge	3.40	N/A	N/A	N/A	N/A	7.62
Shatter	Feather	3.10	6.00	1.50	65.80	18.10	6.23
Hinging	Hinge	1.90	N/A	N/A	N/A	N/A	1.77
Shatter	Feather	4.20	N/A	N/A	N/A	N/A	4.86
Shatter	Feather	N/A	N/A	0.40	N/A	N/A	6.40
Shatter	Feather	4.90	N/A	N/A	N/A	N/A	15.15
Shatter	Step	4.30	N/A	N/A	N/A	N/A	9.28
Shatter	Feather	N/A	N/A	1.00	N/A	N/A	0.88
Shatter	Hinge	2.10	N/A	N/A	N/A	N/A	0.18

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	2.758	N/A	N/A	N/A	N/A	3.118
Novice	Unskilled	-0.426	-0.146	-0.398	1.142	0.440	-0.073
Intermediate	Unskilled	N/A	N/A	-0.551	N/A	N/A	-0.935
Intermediate	Unskilled	0.210	-0.219	-0.156	0.849	-0.118	0.009
Intermediate	Unskilled	0.135	N/A	N/A	N/A	N/A	0.097
Intermediate	Unskilled	-0.089	0.040	-0.353	0.597	-0.177	-0.099
Intermediate	Unskilled	-0.987	N/A	N/A	N/A	N/A	-0.727
Intermediate	Unskilled	0.734	N/A	N/A	N/A	N/A	-0.292
Intermediate	Unskilled	N/A	N/A	-0.789	N/A	N/A	-0.075
Intermediate	Unskilled	1.257	N/A	N/A	N/A	N/A	1.159
Intermediate	Unskilled	0.809	N/A	N/A	N/A	N/A	0.331
Intermediate	Unskilled	N/A	N/A	-0.551	N/A	N/A	-0.853
Intermediate	Unskilled	-0.838	N/A	N/A	N/A	N/A	-0.952

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM05	Master	Blade	No	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	Battering	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	No	Absent	Not present	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Blade	Yes	Multi-faceted	Battering	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Hinge	3.30	N/A	N/A	N/A	N/A	0.71
Shatter	Feather	2.10	4.50	1.20	53.50	12.70	3.02
None	Feather	3.60	7.20	3.30	81.80	17.20	10.28
None	Feather	2.70	5.70	2.00	76.10	23.90	11.26
None	Feather	1.40	3.30	1.70	54.30	11.00	2.17
None	Feather	2.50	4.20	3.40	47.50	14.60	4.02
None	Feather	2.10	3.70	1.20	43.00	15.20	2.19
None	Feather	2.90	2.10	0.60	24.70	6.40	0.34
None	Feather	1.30	3.20	1.00	42.10	12.10	1.54
Hinging	Hinge	2.00	2.00	1.40	25.50	9.90	0.57
Shatter	Feather	N/A	N/A	0.40	N/A	N/A	0.34
None	Feather	4.20	3.90	1.30	33.60	11.00	1.21
Platform battering	Feather	3.20	5.00	1.40	43.50	17.30	3.43

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	0.060	N/A	N/A	N/A	N/A	-0.877
Intermediate	Unskilled	-0.838	-0.516	-0.472	0.011	-0.817	-0.551
Intermediate	Unskilled	0.285	0.485	0.359	1.358	-0.284	0.472
Intermediate	Unskilled	-0.389	-0.071	-0.156	1.087	0.511	0.611
Intermediate	Unskilled	-1.361	-0.961	-0.274	0.049	-1.019	-0.671
Intermediate	Unskilled	-0.538	-0.627	0.398	-0.274	-0.592	-0.410
Intermediate	Unskilled	-0.838	-0.813	-0.472	-0.489	-0.521	-0.668
Intermediate	Unskilled	-0.239	-1.406	-0.710	-1.360	-1.564	-0.929
Intermediate	Unskilled	-1.436	-0.998	-0.551	-0.531	-0.888	-0.760
Intermediate	Unskilled	-0.912	-1.443	-0.393	-1.322	-1.149	-0.897
Intermediate	Unskilled	N/A	N/A	-0.789	N/A	N/A	-0.929
Intermediate	Unskilled	0.734	-0.739	-0.433	-0.936	-1.019	-0.806
Intermediate	Unskilled	-0.014	-0.331	-0.393	-0.465	-0.272	-0.493

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM05	Master	Lateral core trimming	Yes	Single faceted	None	No
SF2	ZM05	Master	Lateral core trimming	Yes	Single faceted	None	No
SF2	ZM05	Master	Lateral core trimming	Yes	Single faceted	Battering	No
SF2	ZM05	Master	Faceted non-initial core tablet	Yes	Multi-faceted	None	No
SF2	ZM05	Master	Profile correction blade	Yes	Single faceted	None	Yes
SF2	ZM05	Master	Profile correction blade	No	Absent	Not present	Yes
SF2	ZM05	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF2	ZM05	Master	Profile correction blade	Yes	Single faceted	None	Yes
SF2	ZM05	Master	Profile correction blade	Yes	Multi-faceted	Battering	Yes
SF2	ZM05	Master	Profile correction blade	Yes	Multi-faceted	Battering	Yes
SF2	ZM05	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF2	ZM05	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF2	ZM06	Master	Blade	No	Absent	Not present	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	5.20	4.40	1.20	19.90	25.00	2.03
None	Step	4.70	7.00	4.50	18.90	33.50	4.53
None	Feather	2.90	6.00	0.90	34.20	47.10	11.39
None	Feather	8.10	13.80	1.90	80.70	28.80	34.27
Shatter	Outrepasse	2.80	8.40	13.10	87.40	23.00	18.77
None	Feather	N/A	N/A	2.50	N/A	19.80	9.11
None	Feather	1.90	7.50	1.30	82.30	22.80	14.13
None	Outrepasse	3.60	11.10	7.20	54.60	21.60	19.51
None	Feather	2.70	7.60	4.10	55.50	19.00	8.70
Platform battering	Feather	3.30	5.60	1.60	50.90	17.10	5.70
Hinging	Hinge	2.90	6.90	2.70	54.20	21.00	7.97
None	Feather	3.00	7.00	3.60	77.30	23.10	12.60
Shatter	Feather	N/A	N/A	2.90	N/A	N/A	6.84

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	1.482	-0.553	-0.472	-1.588	0.641	-0.691
Intermediate	Unskilled	1.108	0.411	0.834	-1.636	1.649	-0.338
Intermediate	Unskilled	-0.239	0.040	-0.591	-0.907	3.262	0.629
Intermediate	Unskilled	3.652	2.933	-0.195	1.306	1.092	3.855
Intermediate	Unskilled	-0.314	0.930	4.237	1.625	0.404	1.670
Intermediate	Unskilled	N/A	N/A	0.042	N/A	0.025	0.308
Intermediate	Unskilled	-0.987	0.596	-0.433	1.382	0.380	1.015
Intermediate	Unskilled	0.285	1.932	1.902	0.063	0.238	1.774
Intermediate	Unskilled	-0.389	0.634	0.675	0.106	-0.070	0.250
Intermediate	Unskilled	0.060	-0.108	-0.314	-0.113	-0.295	-0.173
Intermediate	Unskilled	-0.239	0.374	0.121	0.044	0.167	0.147
Intermediate	Unskilled	-0.164	0.411	0.478	1.144	0.416	0.800
Intermediate	Unskilled	N/A	N/A	0.129	N/A	N/A	-0.219

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM06	Master	Blade	No	Absent	Not present	No
SF2	ZM06	Master	Blade	No	Absent	Not present	No
SF2	ZM06	Master	Blade	No	Absent	Not present	No
SF2	ZM06	Master	Blade	No	Absent	Not present	No
SF2	ZM06	Master	Blade	Yes	Multi-faceted	Crushing	No
SF2	ZM06	Master	Blade	No	Multi-faceted	None	No
SF2	ZM06	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM06	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM06	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM06	Master	Blade	Yes	Single faceted	None	No
SF2	ZM06	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM06	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM06	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	N/A	N/A	0.60	N/A	N/A	1.83
Shatter	Feather	N/A	N/A	0.90	N/A	N/A	1.25
Shatter	Feather	N/A	N/A	1.20	N/A	N/A	0.53
Shatter	Feather	N/A	N/A	1.30	N/A	N/A	0.98
None	Feather	2.20	2.00	0.90	43.10	12.20	1.01
Stepping	Step	3.90	N/A	N/A	N/A	N/A	2.30
None	Feather	4.20	4.40	1.30	56.00	24.40	6.10
None	Feather	2.30	4.00	1.40	53.50	12.00	3.33
None	Feather	2.00	3.10	1.10	45.60	19.60	2.97
Hinging	Hinge	7.20	6.60	3.30	48.90	19.70	7.89
Shatter	Feather	2.00	5.20	1.30	74.90	15.70	5.16
None	Feather	2.30	6.00	1.40	77.20	23.00	8.99
None	Step	7.90	7.00	2.70	69.20	27.50	14.50

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	N/A	N/A	-0.611	N/A	N/A	-0.311
Intermediate	Unskilled	N/A	N/A	-0.514	N/A	N/A	-0.322
Intermediate	Unskilled	N/A	N/A	-0.418	N/A	N/A	-0.335
Intermediate	Unskilled	N/A	N/A	-0.386	N/A	N/A	-0.327
Intermediate	Unskilled	-0.757	-0.674	-0.514	-1.363	-0.966	-0.326
Intermediate	Unskilled	-0.255	N/A	N/A	N/A	N/A	-0.302
Intermediate	Unskilled	-0.167	-0.428	-0.386	-0.648	0.004	-0.232
Intermediate	Unskilled	-0.728	-0.469	-0.354	-0.786	-0.982	-0.283
Intermediate	Unskilled	-0.816	-0.561	-0.450	-1.225	-0.377	-0.290
Intermediate	Unskilled	0.719	-0.202	0.257	-1.042	-0.369	-0.199
Intermediate	Unskilled	-0.816	-0.346	-0.386	0.401	-0.687	-0.250
Intermediate	Unskilled	-0.728	-0.264	-0.354	0.529	-0.107	-0.179
Intermediate	Unskilled	0.926	-0.161	0.064	0.085	0.251	-0.078

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM06	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM06	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM06	Master	Blade	No	Multi-faceted	None	No
SF2	ZM06	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM06	Master	Faceted non-initial core tablet	Yes	Single faceted	None	No
SF2	ZM06	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF2	ZM06	Master	Crested blade	Yes	Single faceted	None	Yes
SF2	ZM06	Master	Crested blade	Yes	Multi-faceted	Battering	Yes
SF2	ZM07	Master	Blade	Yes	Multi-faceted	Battering	No
SF2	ZM07	Master	Blade	No	Multi-faceted	None	No
SF2	ZM07	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM07	Master	Blade	Yes	Multi-faceted	Battering	No
SF2	ZM07	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	4.70	6.60	2.40	81.00	27.60	13.40
Shatter	Feather	1.90	3.00	0.70	58.40	19.50	2.71
Shatter	Hinge	2.60	N/A	N/A	N/A	N/A	3.34
Shatter	Feather	4.90	6.60	1.40	72.70	26.00	11.12
None	Feather	14.40	41.20	14.30	110.00	65.90	260.01
None	Feather	4.50	6.30	1.60	63.60	27.70	12.17
None	Outrepasse	4.10	8.60	6.90	90.40	21.70	20.44
Platform battering	Feather	9.90	18.00	2.40	70.60	22.70	25.00
None	Feather	3.30	7.40	1.60	62.30	18.70	8.48
Shatter	Hinge	1.80	N/A	N/A	N/A	N/A	1.00
None	Feather	1.50	3.70	1.70	48.60	19.00	4.03
Platform battering	Feather	9.70	7.00	1.60	70.90	25.50	19.26
None	Feather	4.00	6.80	1.90	73.30	25.20	14.24

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.019	-0.202	-0.032	0.739	0.259	-0.098
Intermediate	Unskilled	-0.846	-0.571	-0.579	-0.515	-0.385	-0.295
Intermediate	Unskilled	-0.639	N/A	N/A	N/A	N/A	-0.283
Intermediate	Unskilled	0.040	-0.202	-0.354	0.279	0.131	-0.140
Intermediate	Unskilled	2.845	3.343	3.793	2.348	3.304	4.444
Intermediate	Unskilled	-0.078	-0.233	-0.289	-0.226	0.267	-0.121
Intermediate	Unskilled	-0.196	0.003	1.415	1.261	-0.210	0.032
Intermediate	Unskilled	1.516	0.966	-0.032	0.162	-0.131	0.116
Novice	Unskilled	-0.616	-0.148	-0.361	-0.227	-1.118	-0.442
Novice	Unskilled	-1.043	N/A	N/A	N/A	N/A	-1.041
Novice	Unskilled	-1.128	-1.455	-0.334	-1.069	-1.076	-0.798
Novice	Unskilled	1.204	-0.289	-0.361	0.302	-0.160	0.420
Novice	Unskilled	-0.417	-0.360	-0.281	0.449	-0.202	0.018

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM07	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM07	Master	Blade	Yes	Multi-faceted	Double Initiation	No
SF2	ZM07	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM07	Master	Blade	No	Absent	Not present	No
SF2	ZM07	Master	Blade	No	Absent	Crushing	No
SF2	ZM07	Master	Lateral core trimming	Yes	Single faceted	None	No
SF2	ZM07	Master	Profile correction blade	Yes	Multi-faceted	Battering	Yes
SF2	ZM07	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF2	ZM07	Master	Partial ridged blade	Yes	Multi-faceted	Battering	Yes
SF2	ZM08	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM08	Master	Blade	Yes	Single faceted	Double Initiation	No
SF2	ZM08	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM08	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	7.60	9.00	1.40	57.50	27.30	16.46
Hinging	Hinge	4.20	9.90	3.60	56.60	25.00	15.51
None	Feather	2.80	5.20	1.40	63.40	21.00	7.24
Shatter	Feather	N/A	N/A	2.00	N/A	N/A	0.62
None	Feather	N/A	N/A	0.70	N/A	N/A	0.53
None	Feather	5.10	4.50	0.90	38.00	44.00	6.80
None	Outrepasse	13.70	10.40	4.20	83.10	25.20	29.35
None	Outrepasse	6.40	8.80	15.00	76.10	30.20	38.30
None	Feather	5.50	13.30	2.40	96.10	31.90	34.31
Shatter	Outrepasse	3.60	6.00	7.40	71.10	27.00	12.82
Shatter	Feather	2.50	2.10	1.40	64.90	18.90	3.23
None	Feather	4.30	4.30	1.00	47.20	18.40	3.81
None	Feather	2.70	2.50	0.60	49.90	12.50	1.68

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	0.607	0.418	-0.414	-0.522	0.094	0.196
Novice	Unskilled	-0.360	0.735	0.172	-0.577	-0.231	0.120
Novice	Unskilled	-0.758	-0.925	-0.414	-0.159	-0.794	-0.542
Novice	Unskilled	N/A	N/A	-0.254	N/A	N/A	-1.071
Novice	Unskilled	N/A	N/A	-0.601	N/A	N/A	-1.078
Novice	Unskilled	-0.104	-1.172	-0.548	-1.721	2.447	-0.577
Novice	Unskilled	2.341	0.912	0.332	1.052	-0.202	1.227
Novice	Unskilled	0.265	0.347	3.212	0.622	0.502	1.943
Novice	Unskilled	0.009	1.937	-0.148	1.851	0.742	1.624
Novice	Unskilled	-0.148	0.716	2.555	1.651	0.380	2.343
Novice	Unskilled	-0.878	-1.106	-0.319	1.264	-0.449	-0.399
Novice	Unskilled	0.317	-0.078	-0.511	0.159	-0.501	-0.233
Novice	Unskilled	-0.745	-0.919	-0.703	0.328	-1.105	-0.842

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM08	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM08	Master	Lateral core trimming	Yes	Single faceted	None	No
SF2	ZM08	Master	Lateral core trimming	Yes	Single faceted	None	No
SF2	ZM08	Master	Lateral core trimming	Yes	Single faceted	None	No
SF2	ZM08	Master	Angle correction	Yes	Multi-faceted	None	Yes
SF2	ZM09	Master	Blade	No	Multi-faceted	None	No
SF2	ZM09	Master	Blade	No	Absent	Crushing	No
SF2	ZM09	Master	Blade	No	Multi-faceted	None	No
SF2	ZM09	Master	Blade	Yes	Single faceted	None	No
SF2	ZM09	Master	Blade	Yes	Single faceted	None	No
SF2	ZM09	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM09	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM09	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	2.20	2.00	1.00	47.30	19.00	2.10
None	Feather	5.30	4.50	1.50	30.40	38.00	5.10
None	Feather	6.40	8.20	2.70	24.00	31.60	5.67
None	Feather	5.00	6.60	1.80	29.90	34.00	5.80
None	Feather	2.40	4.00	1.20	37.10	10.20	1.41
Shatter	Step	4.80	N/A	N/A	N/A	N/A	14.33
None	Feather	N/A	N/A	0.60	N/A	N/A	1.79
Shatter	Hinge	5.10	N/A	N/A	N/A	N/A	5.97
None	Feather	16.30	10.80	4.00	84.80	34.00	38.73
None	Feather	15.50	10.60	5.40	79.10	20.40	18.30
None	Feather	1.70	3.60	2.20	62.70	18.00	3.79
None	Feather	5.00	5.90	1.80	51.60	30.00	8.80
None	Feather	7.40	5.80	1.40	61.60	23.50	8.97

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-1.077	-1.153	-0.511	0.166	-0.439	-0.722
Novice	Unskilled	0.981	0.016	-0.271	-0.889	1.506	0.136
Novice	Unskilled	1.711	1.744	0.303	-1.288	0.851	0.299
Novice	Unskilled	0.782	0.997	-0.128	-0.920	1.097	0.336
Novice	Unskilled	-0.944	-0.218	-0.415	-0.471	-1.340	-0.919
Novice	Unskilled	-0.389	N/A	N/A	N/A	N/A	-0.069
Novice	Unskilled	N/A	N/A	-1.130	N/A	N/A	-1.080
Novice	Unskilled	-0.324	N/A	N/A	N/A	N/A	-0.743
Novice	Unskilled	2.085	1.139	1.037	1.421	0.665	1.899
Novice	Unskilled	1.913	1.070	1.929	0.972	-0.959	0.251
Novice	Unskilled	-1.056	-1.323	-0.110	-0.322	-1.245	-0.919
Novice	Unskilled	-0.346	-0.537	-0.365	-1.197	0.187	-0.515
Novice	Unskilled	0.170	-0.571	-0.620	-0.408	-0.589	-0.501

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM09	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM09	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM09	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF2	ZM09	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF2	ZM09	Master	Core face rejuvenation	Yes	Multi-faceted	Battering	Yes
SF2	ZM10	Master	Blade	No	Absent	Not present	No
SF2	ZM10	Master	Blade	No	Multi-faceted	None	No
SF2	ZM10	Master	Blade	No	Multi-faceted	None	No
SF2	ZM10	Master	Blade	No	Absent	Not present	No
SF2	ZM10	Master	Blade	No	Absent	Not present	No
SF2	ZM10	Master	Blade	No	Absent	Not present	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	Crushing	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Hinge	4.50	6.40	2.10	56.80	21.80	7.02
None	Feather	3.00	3.80	0.60	50.10	22.60	4.12
None	Feather	2.90	6.80	4.10	76.00	35.70	23.37
None	Outrepasse	7.10	9.40	1.00	81.70	43.60	35.82
None	Feather	6.00	11.60	2.90	63.40	34.70	26.36
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	2.00
Hinging	Hinge	2.90	N/A	N/A	N/A	N/A	2.42
Shatter	Step	2.70	N/A	N/A	N/A	N/A	3.31
Shatter	Feather	N/A	N/A	1.40	N/A	N/A	2.62
Shatter	Feather	N/A	N/A	1.00	N/A	N/A	0.34
Shatter	Feather	N/A	N/A	0.70	N/A	N/A	6.39
Shatter	Feather	3.70	2.70	1.60	52.80	20.90	3.57
Shatter	Feather	1.30	2.40	2.10	48.90	22.00	3.27

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	-0.454	-0.366	-0.174	-0.787	-0.792	-0.658
Novice	Unskilled	-0.776	-1.255	-1.130	-1.315	-0.696	-0.892
Novice	Unskilled	-0.798	-0.229	1.101	0.727	0.868	0.660
Novice	Unskilled	0.106	0.660	-0.875	1.177	1.811	1.664
Novice	Unskilled	-0.131	1.412	0.336	-0.267	0.749	0.901
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.502
Intermediate	Unskilled	0.014	N/A	N/A	N/A	N/A	-0.384
Intermediate	Unskilled	-0.177	N/A	N/A	N/A	N/A	-0.135
Intermediate	Unskilled	N/A	N/A	-0.146	N/A	N/A	-0.328
Intermediate	Unskilled	N/A	N/A	-0.588	N/A	N/A	-0.966
Intermediate	Unskilled	N/A	N/A	-0.920	N/A	N/A	0.726
Intermediate	Unskilled	0.778	-0.458	0.075	0.049	0.966	-0.063
Intermediate	Unskilled	-1.513	-0.635	0.628	-0.200	1.181	-0.147

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	Crushing	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	Crushing	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	Crushing	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	Crushing	No
SF2	ZM10	Master	Blade	Yes	Single faceted	None	No
SF2	ZM10	Master	Blade	No	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	2.40	3.50	1.60	58.50	14.30	3.47
Shatter	Feather	2.30	2.90	1.20	59.70	10.80	2.42
Shatter	Hinge	3.10	3.80	2.40	59.80	20.90	5.38
Shatter	Feather	1.80	2.50	1.40	40.20	14.70	1.35
Shatter	Feather	3.00	4.40	0.60	63.30	12.40	4.55
Hinging	Hinge	N/A	2.20	1.90	33.60	13.10	1.35
None	Feather	N/A	4.00	1.60	46.10	21.00	4.12
None	Feather	N/A	3.30	1.10	60.70	14.00	2.48
None	Feather	N/A	5.80	1.50	72.60	23.00	10.14
None	Feather	4.50	7.80	3.00	73.90	19.40	12.89
Shatter	Step	2.60	N/A	N/A	N/A	N/A	0.21
None	Feather	4.80	4.20	1.10	46.80	15.60	3.19
None	Step	3.20	4.80	3.60	69.30	19.70	7.64

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.463	0.013	0.075	0.413	-0.320	-0.091
Intermediate	Unskilled	-0.559	-0.340	-0.367	0.490	-1.002	-0.384
Intermediate	Unskilled	0.205	0.190	0.960	0.496	0.966	0.444
Intermediate	Unskilled	-1.036	-0.576	-0.146	-0.756	-0.242	-0.684
Intermediate	Unskilled	0.110	0.544	-1.030	0.720	-0.690	0.212
Intermediate	Unskilled	N/A	-0.752	0.407	-1.178	-0.554	-0.684
Intermediate	Unskilled	N/A	0.308	0.075	-0.379	0.986	0.091
Intermediate	Unskilled	N/A	-0.104	-0.478	0.554	-0.378	-0.368
Intermediate	Unskilled	N/A	1.368	-0.035	1.314	1.375	1.776
Intermediate	Unskilled	1.542	2.546	1.623	1.397	0.674	2.545
Intermediate	Unskilled	-0.272	N/A	N/A	N/A	N/A	-1.003
Intermediate	Unskilled	1.828	0.426	-0.478	-0.334	-0.066	-0.169
Intermediate	Unskilled	0.301	0.779	2.286	1.103	0.732	1.076

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	Crushing	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Blade	Yes	Multi-faceted	None	No
SF2	ZM10	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF3	JC01	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC01	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC01	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC01	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC01	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	4.30	4.90	1.70	74.40	23.00	9.54
None	Feather	1.90	2.40	1.10	44.00	9.30	1.19
None	Feather	3.90	2.40	0.90	39.80	15.70	1.35
None	Feather	1.60	2.00	1.00	35.30	13.50	1.17
None	Feather	N/A	2.10	0.60	32.70	9.00	0.52
None	Feather	1.20	1.20	0.70	29.30	6.90	0.25
None	Feather	2.70	0.90	0.50	27.60	9.40	0.44
None	Outrepasse	3.80	6.30	4.00	75.40	22.10	12.45
None	Feather	3.00	4.20	2.30	45.80	18.80	4.99
None	Feather	4.40	7.00	1.40	104.60	27.00	20.55
Hinging	Hinge	5.70	9.00	8.00	114.90	25.90	36.22
None	Feather	5.50	6.50	1.80	88.80	30.00	13.42
None	Feather	4.90	10.20	2.00	108.30	21.60	22.14

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	1.351	0.838	0.186	1.429	1.375	1.608
Intermediate	Unskilled	-0.940	-0.635	-0.478	-0.513	-1.294	-0.729
Intermediate	Unskilled	0.969	-0.635	-0.699	-0.782	-0.047	-0.684
Intermediate	Unskilled	-1.227	-0.870	-0.588	-1.069	-0.476	-0.734
Intermediate	Unskilled	N/A	-0.811	-1.030	-1.235	-1.352	-0.916
Intermediate	Unskilled	-1.609	-1.341	-0.920	-1.453	-1.762	-0.991
Intermediate	Unskilled	-0.177	-1.518	-1.141	-1.561	-1.274	-0.938
Intermediate	Unskilled	0.874	1.663	2.729	1.493	1.200	2.422
Novice	Unskilled	-0.994	-1.371	-0.668	-1.506	-1.278	-1.708
Novice	Unskilled	-0.485	-0.667	-1.025	0.857	0.076	-0.135
Novice	Unskilled	-0.014	-0.163	1.589	1.271	-0.105	1.449
Novice	Unskilled	-0.086	-0.792	-0.866	0.222	0.572	-0.856
Novice	Unskilled	-0.304	0.138	-0.787	1.006	-0.815	0.026

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF3	JC01	Master	Core face rejuvenation	Yes	Multi-faceted	Battering	Yes
SF3	JC01	Master	Core face rejuvenation	Yes	Single faceted	Battering	Yes
SF3	JC01	Master	Crested blade	Yes	Multi-faceted	Battering	Yes
SF3	JC02	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC02	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC02	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF3	JC03	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC04	Master	Blade	No	Absent	Not present	No
SF3	JC04	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC04	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC04	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC04	Master	Blade	No	Multi-faceted	Crushing	No
SF3	JC04	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	9.70	10.00	4.40	74.40	31.60	23.20
Angle	Feather	10.00	14.00	5.00	59.70	36.60	32.78
Angle	Feather	2.70	16.30	7.00	69.70	20.80	21.77
None	Hinge	6.30	7.60	4.80	55.40	23.40	12.47
None	Feather	5.90	9.00	1.80	70.80	27.00	11.80
None	Hinge	10.00	8.10	5.50	60.40	37.00	17.82
None	Feather	5.50	4.70	1.30	58.00	22.30	6.49
None	Feather	N/A	4.00	1.10	N/A	14.70	2.43
None	Feather	4.00	3.30	3.00	65.20	19.60	4.74
None	Feather	4.00	6.10	2.30	94.80	19.00	11.56
None	Feather	5.10	6.60	1.90	89.30	24.60	13.18
None	Feather	N/A	3.50	1.80	62.30	26.00	4.30
Hinging	Hinge	2.90	1.90	1.60	30.60	17.00	1.36

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	1.438	0.088	0.163	-0.357	0.836	0.133
Novice	Unskilled	1.547	1.094	0.401	-0.947	1.662	1.102
Novice	Unskilled	-1.102	1.673	1.193	-0.546	-0.948	-0.011
Novice	Unskilled	-0.487	-0.893	0.390	-0.866	-0.814	-0.473
Novice	Unskilled	-0.664	1.081	-1.136	1.095	-0.303	-0.676
Novice	Unskilled	1.150	-0.188	0.746	-0.229	1.116	1.149
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Intermediate	Unskilled	N/A	0.019	-0.683	N/A	-0.851	-0.665
Intermediate	Unskilled	0.299	-0.378	0.828	0.314	0.307	-0.097
Intermediate	Unskilled	0.299	1.210	0.272	1.481	0.165	1.582
Intermediate	Unskilled	1.533	1.494	-0.046	1.264	1.489	1.981
Intermediate	Unskilled	N/A	-0.265	-0.126	0.200	1.820	-0.205
Intermediate	Unskilled	-0.935	-1.172	-0.285	-1.050	-0.307	-0.929

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF3	JC04	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC04	Master	Blade	Yes	Multi-faceted	Double Initiation	No
SF3	JC04	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC04	Master	Profile correction blade	Yes	Single faceted	Crushing	Yes
SF3	JC04	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF3	JC04	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF3	JC05	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC05	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC05	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC05	Master	Blade	No	Multi-faceted	None	No
SF3	JC05	Master	Blade	Yes	Multi-faceted	None	No
SF3	JC05	Master	Blade	Yes	Multi-faceted	Battering	No
SF3	JC05	Master	Blade	No	Multi-faceted	Crushing	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Hinging	Hinge	3.00	2.40	1.00	4.50	11.60	1.03
None	Feather	3.60	2.00	0.70	64.60	16.80	2.21
None	Feather	2.90	1.80	1.00	39.30	13.00	0.97
None	Feather	N/A	4.80	1.00	56.00	18.40	6.34
None	Outrepasse	3.00	5.00	5.10	60.10	20.70	5.36
None	Feather	5.10	6.20	3.00	62.90	18.20	8.11
Hinging	Hinge	7.50	9.00	8.00	49.40	32.00	15.03
Hinging	Hinge	2.90	4.80	2.00	51.60	21.50	5.52
Hinging	Hinge	4.70	6.40	4.00	55.00	39.20	10.59
Hinging	Feather	3.60	5.00	N/A	N/A	23.20	7.46
None	Feather	3.10	7.00	5.00	103.10	36.90	26.61
None	Feather	4.00	7.00	2.20	73.90	25.80	14.65
None	Feather	N/A	4.30	1.00	70.10	38.40	10.77

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.822	-0.889	-0.762	-2.079	-1.584	-1.010
Intermediate	Unskilled	-0.150	-1.116	-1.001	0.290	-0.355	-0.719
Intermediate	Unskilled	-0.935	-1.229	-0.762	-0.707	-1.253	-1.025
Intermediate	Unskilled	N/A	0.473	-0.762	-0.049	0.024	0.297
Intermediate	Unskilled	-0.822	0.586	2.499	0.113	0.567	0.056
Intermediate	Unskilled	1.533	1.267	0.828	0.223	-0.024	0.733
Novice	Unskilled	2.418	-0.087	2.226	-0.919	-0.142	-0.316
Novice	Unskilled	-1.058	-0.710	-0.700	-0.837	-1.339	-0.595
Novice	Unskilled	0.302	-0.473	0.275	-0.712	0.678	-0.446
Novice	Unskilled	-0.529	-0.680	N/A	N/A	-1.145	-0.538
Novice	Unskilled	-0.907	-0.384	0.763	1.069	0.416	0.023
Novice	Unskilled	-0.227	-0.384	-0.603	-0.012	-0.849	-0.327
Novice	Unskilled	N/A	-0.784	-1.188	-0.153	0.587	-0.441

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF3	JC05	Master	Lateral core trimming	Yes	Single faceted	None	Yes
SF3	JC05	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF3	JC05	Master	Crested blade	Yes	Single faceted	None	Yes
SF3	JC05	Master	Crested blade	Yes	Multi-faceted	None	Yes
SF3	JC05	Master	Crested blade	Yes	Multi-faceted	Crushing	No
SF3	JCO5	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	Battering	No
SF4	PSK2-01	Master	Blade	No	Multi-faceted	None	No
SF4	PSK2-01	Master	Blade	No	Absent	Not present	No
SF4	PSK2-01	Master	Blade	Yes	Single faceted	None	No
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-01	Master	Blade	No	Absent	Not present	No
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	4.30	6.00	2.00	35.50	45.40	7.71
None	Feather	5.30	8.90	2.00	69.00	35.90	25.81
None	Feather	4.90	28.00	5.50	128.10	48.00	130.78
None	Feather	4.00	16.10	3.40	90.00	24.30	26.35
None	Feather	3.00	12.50	2.70	90.80	28.40	28.52
None	Feather	4.00	3.90	1.30	48.40	21.60	5.17
None	Feather	6.30	6.30	1.80	71.60	35.70	18.59
None	Step	3.00	3.50	N/A	N/A	10.00	1.87
Shatter	Feather	N/A	N/A	2.80	N/A	13.50	4.81
None	Feather	7.10	8.30	2.40	101.60	37.30	40.29
None	Step	2.30	6.00	5.20	85.60	31.30	21.00
Shatter	Step	N/A	5.80	4.50	N/A	21.00	10.00
None	Feather	3.90	2.00	0.80	49.50	19.80	2.43

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	0.000	-0.532	-0.700	-1.433	1.384	-0.531
Novice	Unskilled	0.755	-0.101	-0.700	-0.193	0.302	0.000
Novice	Unskilled	0.453	2.734	1.006	1.994	1.681	3.077
Novice	Unskilled	-0.227	0.967	-0.018	0.584	-1.020	0.016
Novice	Unskilled	-0.982	0.433	-0.359	0.613	-0.553	0.079
Novice	Unskilled	N/A	N/A	N/A	N/A	N/A	N/A
Intermediate	Unskilled	0.543	-0.036	-0.509	-0.061	1.411	0.259
Intermediate	Unskilled	-0.849	-0.758	N/A	N/A	-1.935	-1.187
Intermediate	Unskilled	N/A	N/A	0.094	N/A	-1.479	-0.933
Intermediate	Unskilled	0.880	0.480	-0.147	1.680	1.619	2.137
Intermediate	Unskilled	-1.144	-0.113	1.540	0.752	0.838	0.468
Intermediate	Unskilled	N/A	-0.165	1.118	N/A	-0.503	-0.484
Intermediate	Unskilled	-0.469	-1.145	-1.111	-1.343	-0.659	-1.139

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-01	Master	Blade	No	Absent	Not present	Yes
SF4	PSK2-01	Master	Blade	Yes	Single faceted	None	No
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	Battering	No
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-01	Master	Blade	No	Absent	Not present	No
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-01	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-01	Master	Crested blade	Yes	Single faceted	None	Yes
SF4	PSK2-01	Master	Crested blade	Yes	Single faceted	None	Yes
SF4	PSK2-02	Master	Blade	No	Absent	Not present	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	8.30	6.00	2.00	76.10	24.90	14.03
None	Feather	3.70	5.00	1.10	57.70	26.90	8.01
Stepping	Feather	N/A	10.30	1.90	79.60	24.40	15.54
None	Feather	5.50	4.20	1.90	48.20	18.70	3.85
None	Feather	2.40	3.70	0.80	48.10	17.70	28.10
None	Feather	7.00	7.50	2.10	81.40	38.90	31.17
None	Feather	2.50	2.00	1.30	56.20	21.90	2.78
None	Step	N/A	5.10	3.00	N/A	22.20	8.03
Hinging	Hinge	5.50	7.50	3.20	88.70	26.70	20.35
Stepping	Step	2.00	3.70	7.40	83.00	22.70	8.00
None	Feather	6.30	10.50	2.40	92.90	28.30	30.40
Angle	Feather	9.40	18.50	3.00	69.50	30.50	27.00
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	12.26

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	1.386	-0.113	-0.388	0.200	0.005	-0.135
Intermediate	Unskilled	-0.554	-0.371	-0.931	-0.867	0.265	-0.656
Intermediate	Unskilled	N/A	0.996	-0.449	0.403	-0.060	-0.005
Intermediate	Unskilled	0.205	-0.578	-0.449	-1.418	-0.802	-1.016
Intermediate	Unskilled	-1.102	-0.707	-1.111	-1.424	-0.932	1.082
Intermediate	Unskilled	0.838	0.274	-0.328	0.508	1.827	1.348
Intermediate	Unskilled	-1.060	-1.145	-0.810	-0.954	-0.386	-1.108
Intermediate	Unskilled	N/A	-0.345	0.214	N/A	-0.347	-0.654
Intermediate	Unskilled	0.205	0.274	0.335	0.931	0.239	0.412
Intermediate	Unskilled	-1.271	-0.707	2.865	0.601	-0.282	-0.657
Intermediate	Unskilled	0.543	1.048	-0.147	1.175	0.447	1.281
Intermediate	Unskilled	1.850	3.112	0.214	-0.183	0.734	0.987
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.519

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF4	PSK2-02	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-02	Master	Blade	Yes	Single faceted	None	No
SF4	PSK2-02	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-02	Master	Blade	No	Absent	Not present	No
SF4	PSK2-02	Master	Blade	No	Multi-faceted	Crushing	No
SF4	PSK2-02	Master	Blade	Yes	Single faceted	None	No
SF4	PSK2-02	Master	Blade	Yes	Multi-faceted	None	No
SF4	PSK2-02	Master	Blade	Yes	Single faceted	None	No
SF4	PSK2-02	Master	Blade	Yes	Multi-faceted	Battering	Yes
SF4	PSK2-02	Master	Profile correction blade	Yes	Single faceted	None	Yes
SF4	PSK2-02	Master	Core face rejuvenation	No	Multi-faceted	None	Yes
SF4	PSK2-02	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF4	PSK2-02	Master	Partial ridged blade	Yes	Single faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	6.89	2.16	1.71	42.70	14.61	2.64
None	Feather	3.35	5.69	1.76	64.00	29.04	10.24
None	Feather	3.27	6.14	2.39	94.45	31.69	21.53
Shatter	Feather	N/A	N/A	1.69	N/A	N/A	1.98
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	2.62
None	Feather	11.41	13.46	3.87	89.54	36.24	49.59
None	Hinge	6.31	9.05	4.83	65.06	21.65	14.72
None	Feather	2.61	6.93	3.90	87.70	27.08	12.89
Platform battering	Feather	5.57	8.30	1.58	84.89	31.14	18.67
None	Outrepasse	12.46	19.99	15.60	84.89	28.34	53.74
Shatter	Hinge	3.88	N/A	N/A	N/A	N/A	18.01
None	Feather	4.69	9.53	5.50	110.46	32.71	34.25
None	Outrepasse	5.90	14.46	3.98	104.10	28.14	49.49

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	0.266	-1.441	-0.635	-1.974	-2.205	-1.053
Intermediate	Unskilled	-0.830	-0.754	-0.622	-0.925	0.160	-0.631
Intermediate	Unskilled	-0.855	-0.667	-0.465	0.575	0.594	-0.005
Intermediate	Unskilled	N/A	N/A	-0.640	N/A	N/A	-1.090
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-1.054
Intermediate	Unskilled	1.666	0.756	-0.096	0.333	1.340	1.553
Intermediate	Unskilled	0.086	-0.101	0.143	-0.873	-1.051	-0.383
Intermediate	Unskilled	-1.060	-0.513	-0.089	0.242	-0.161	-0.484
Intermediate	Unskilled	-0.143	-0.247	-0.667	0.104	0.504	-0.164
Intermediate	Unskilled	1.991	2.025	2.829	0.104	0.045	1.783
Intermediate	Unskilled	-0.666	N/A	N/A	N/A	N/A	-0.200
Intermediate	Unskilled	-0.415	-0.008	0.310	1.364	0.761	0.701
Intermediate	Unskilled	-0.041	0.950	-0.069	1.050	0.012	1.547

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF5	PSK3-01	Master	Blade	Yes	Multi-faceted	Double Initiation	No
SF5	PSK3-01	Master	Blade	No	Absent	Not present	No
SF5	PSK3-01	Master	Blade	No	Absent	Not present	No
SF5	PSK3-01	Master	Blade	No	Absent	Not present	No
SF5	PSK3-01	Master	Blade	No	Absent	Not present	No
SF5	PSK3-01	Master	Blade	No	Absent	Not present	No
SF5	PSK3-01	Master	Blade	No	Absent	Not present	No
SF5	PSK3-01	Master	Blade	Yes	Multi-faceted	None	No
SF5	PSK3-01	Master	Blade	Yes	Single faceted	None	No
SF5	PSK3-01	Master	Blade	Yes	Multi-faceted	None	No
SF5	PSK3-01	Master	Blade	Yes	Multi-faceted	None	No
SF5	PSK3-01	Master	Blade	Yes	Multi-faceted	None	No
SF5	PSK3-01	Master	Profile correction blade	No	Absent	Not present	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	4.87	5.50	2.02	65.59	31.70	12.74
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	4.86
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	6.84
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	10.00
Shatter	Feather	N/A	N/A	1.33	N/A	N/A	2.02
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	1.98
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	14.82
None	Feather	4.38	5.72	1.66	78.57	33.88	13.41
None	Hinge	6.33	N/A	N/A	N/A	N/A	28.54
None	Feather	3.62	7.20	2.16	85.59	30.30	18.81
None	Feather	2.90	2.34	1.10	38.72	16.75	1.64
None	Feather	1.66	1.61	0.77	35.87	9.83	0.54
Shatter	Outrepasse	N/A	N/A	5.83	N/A	N/A	19.69

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	0.672	0.495	-0.287	0.080	0.374	-0.002
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.739
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.554
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.258
Intermediate	Unskilled	N/A	N/A	-0.512	N/A	N/A	-1.005
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-1.008
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	0.192
Intermediate	Unskilled	0.346	0.598	-0.404	0.682	0.560	0.060
Intermediate	Unskilled	1.642	N/A	N/A	N/A	N/A	1.475
Intermediate	Unskilled	-0.160	1.290	-0.241	1.007	0.255	0.565
Intermediate	Unskilled	-0.638	-0.985	-0.587	-1.164	-0.901	-1.040
Intermediate	Unskilled	-1.463	-1.326	-0.694	-1.296	-1.491	-1.143
Intermediate	Unskilled	N/A	N/A	0.955	N/A	N/A	0.648

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF5	PSK3-01	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF5	PSK3-01	Master	Core face rejuvenation	No	Absent	Not present	Yes
SF5	PSK3-01	Master	Core face rejuvenation	No	Absent	Not present	Yes
SF5	PSK3-02	Master	Blade	No	Absent	Not present	No
SF5	PSK3-02	Master	Blade	No	Absent	Crushing	No
SF5	PSK3-02	Master	Blade	No	Absent	Not present	No
SF5	PSK3-02	Master	Blade	No	Multi-faceted	None	No
SF5	PSK3-02	Master	Blade	No	Absent	Not present	No
SF5	PSK3-02	Master	Blade	No	Absent	Not present	No
SF5	PSK3-02	Master	Blade	No	Absent	Crushing	No
SF5	PSK3-02	Master	Blade	No	Absent	Not present	No
SF5	PSK3-02	Master	Blade	No	Absent	Not present	No
SF5	PSK3-02	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	3.26	4.29	2.75	78.80	41.42	15.39
Shatter	Feather	N/A	N/A	0.82	N/A	N/A	12.59
Shatter	Outrepasse	N/A	N/A	10.56	N/A	N/A	40.34
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	4.26
Shatter	Step	N/A	N/A	N/A	N/A	N/A	9.59
Shatter	Feather	N/A	N/A	0.67	N/A	N/A	13.79
Shatter	Hinge	3.37	N/A	N/A	N/A	N/A	29.51
Shatter	Feather	N/A	N/A	1.46	N/A	N/A	2.00
Shatter	Feather	N/A	N/A	1.06	N/A	N/A	3.17
Hinging	Hinge	N/A	N/A	N/A	N/A	N/A	7.88
Shatter	Feather	N/A	N/A	1.58	N/A	N/A	9.00
Shatter	Feather	N/A	N/A	0.85	N/A	N/A	8.00
Hinging	Hinge	6.43	4.90	1.03	55.95	19.52	6.52

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.399	-0.072	-0.049	0.692	1.203	0.246
Intermediate	Unskilled	N/A	N/A	-0.678	N/A	N/A	-0.016
Intermediate	Unskilled	N/A	N/A	2.497	N/A	N/A	2.579
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.474
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.298
Intermediate	Unskilled	N/A	N/A	-0.464	N/A	N/A	-0.159
Intermediate	Unskilled	-0.462	N/A	N/A	N/A	N/A	0.359
Intermediate	Unskilled	N/A	N/A	-0.257	N/A	N/A	-0.549
Intermediate	Unskilled	N/A	N/A	-0.362	N/A	N/A	-0.510
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.354
Intermediate	Unskilled	N/A	N/A	-0.225	N/A	N/A	-0.318
Intermediate	Unskilled	N/A	N/A	-0.417	N/A	N/A	-0.351
Intermediate	Unskilled	0.394	-0.116	-0.370	-0.966	-0.867	-0.399

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF5	PSK3-02	Master	Blade	No	Absent	Crushing	No
SF5	PSK3-02	Master	Blade	Yes	Multi-faceted	None	No
SF5	PSK3-02	Master	Blade	Yes	Multi-faceted	None	No
SF5	PSK3-02	Master	Blade	Yes	Multi-faceted	None	No
SF5	PSK3-02	Master	Blade	Yes	Multi-faceted	None	No
SF5	PSK3-02	Master	Blade	Yes	Multi-faceted	None	No
SF5	PSK3-02	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF5	PSK3-02	Master	Non-initial core tablet	Yes	Single faceted	None	No
SF6	PSK4-01	Intermediate	Lateral core trimming	Yes	Single faceted	None	Yes
SF6	PSK4-01	Intermediate	Lateral core trimming	Yes	Multi-faceted	None	No
SF6	PSK4-01	Intermediate	Lateral core trimming	Yes	Single faceted	None	No
SF6	PSK4-01	Intermediate	Lateral core trimming	Yes	Single faceted	None	No
SF6	PSK4-01	Intermediate	Core face rejuvenation	Yes	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	N/A	3.28	1.84	60.35	20.89	4.29
None	Feather	4.38	6.01	3.52	96.28	28.68	18.48
None	Feather	2.01	2.10	1.56	41.34	14.72	1.51
Shatter	Feather	4.01	4.34	0.39	79.09	32.15	9.40
None	Feather	3.14	3.30	1.39	90.89	25.97	9.82
None	Feather	4.69	3.67	1.01	85.91	38.35	19.25
None	Feather	3.19	6.36	2.39	115.78	56.39	47.36
Hinging	Hinge	13.97	13.72	15.38	134.89	53.62	131.38
None	Feather	10.85	27.07	4.45	24.10	51.03	21.15
None	Feather	2.67	11.99	1.23	34.63	47.22	12.01
None	Feather	5.87	9.28	1.76	27.24	36.44	7.57
None	Feather	9.58	12.01	1.36	23.48	44.24	7.97
None	Outrepasse	3.55	6.46	2.51	76.09	46.35	26.27

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	N/A	-0.587	-0.157	-0.817	-0.773	-0.473
Intermediate	Unskilled	-0.179	0.207	0.284	0.399	-0.243	-0.005
Intermediate	Unskilled	-0.842	-0.930	-0.231	-1.460	-1.193	-0.565
Intermediate	Unskilled	-0.283	-0.279	-0.538	-0.183	-0.007	-0.304
Intermediate	Unskilled	-0.526	-0.581	-0.275	0.216	-0.428	-0.290
Intermediate	Unskilled	-0.093	-0.473	-0.375	0.048	0.415	0.021
Intermediate	Unskilled	-0.512	0.309	-0.013	1.058	1.643	0.948
Intermediate	Unskilled	2.503	2.449	3.400	1.705	1.454	3.721
Novice	Unskilled	1.310	2.066	1.199	-0.911	1.323	0.230
Novice	Unskilled	-1.351	-0.164	-0.959	-0.499	0.716	-0.579
Novice	Unskilled	-0.310	-0.565	-0.604	-0.788	-1.004	-0.972
Novice	Unskilled	0.897	-0.161	-0.872	-0.935	0.240	-0.936
Novice	Unskilled	-1.065	-0.982	-0.101	1.124	0.577	0.684

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF6	PSK4-01	Intermediate	Crested blade	No	Absent	Not present	No
SF6	PSK4-01	Intermediate	Non-initial core tablet	Yes	Single faceted	None	No
SF6	PSK4-01	Intermediate	Non-initial core tablet	Yes	Single faceted	None	No
SF6	PSK4-02	Intermediate	Blade	Yes	Single faceted	None	No
SF6	PSK4-02	Intermediate	Blade	Yes	Multi-faceted	Battering	No
SF6	PSK4-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF6	PSK4-02	Intermediate	Blade	No	Absent	Not present	No
SF6	PSK4-02	Intermediate	Angle correction	Yes	Multi-faceted	None	Yes
SF6	PSK4-02	Intermediate	Profile correction blade	Yes	Single faceted	None	Yes
SF6	PSK4-02	Intermediate	Profile correction blade	Yes	Multi-faceted	None	Yes
SF6	PSK4-02	Intermediate	Profile correction blade	Yes	Single faceted	None	Yes
SF6	PSK4-02	Intermediate	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF6	PSK4-02	Intermediate	Core face rejuvenation	Yes	Single faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Outrepasse	N/A	N/A	5.10	N/A	N/A	7.48
None	Feather	6.45	9.52	1.50	66.20	40.42	30.34
None	Outrepasse	8.79	15.38	3.38	79.85	33.43	35.59
Hinging	Hinge	7.86	3.75	2.60	62.07	17.93	5.54
None	Feather	4.23	2.79	3.92	68.41	21.38	4.22
None	Feather	2.20	3.80	1.41	74.07	26.28	6.81
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	1.12
None	Outrepasse	3.53	5.16	8.45	75.90	44.85	14.64
None	Feather	11.99	6.36	2.26	65.15	32.10	16.85
None	Feather	2.96	8.16	2.55	88.40	25.61	15.55
Hinging	Hinge	8.34	9.73	7.15	65.92	34.92	32.21
None	Feather	3.70	6.66	1.22	75.10	44.37	22.89
None	Feather	7.99	6.79	3.29	75.55	39.61	23.71

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Novice	Unskilled	N/A	N/A	1.634	N/A	N/A	-0.980
Novice	Unskilled	-0.121	-0.530	-0.778	0.737	-0.369	1.044
Novice	Unskilled	0.640	0.337	0.482	1.272	-1.484	1.508
Intermediate	Unskilled	0.612	-1.004	-0.771	-0.503	-1.610	-0.839
Intermediate	Unskilled	-0.685	-1.202	-0.358	-0.232	-1.282	-0.886
Intermediate	Unskilled	-1.411	-0.994	-1.144	0.009	-0.815	-0.794
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.997
Intermediate	Unskilled	-0.936	-0.714	1.061	0.087	0.954	-0.515
Intermediate	Unskilled	2.089	-0.467	-0.878	-0.371	-0.261	-0.436
Intermediate	Unskilled	-1.139	-0.097	-0.787	0.621	-0.879	-0.483
Intermediate	Unskilled	0.784	0.226	0.654	-0.339	0.008	0.111
Intermediate	Unskilled	-0.875	-0.405	-1.203	0.053	0.908	-0.221
Intermediate	Unskilled	0.659	-0.379	-0.555	0.072	0.455	-0.192

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF6	PSK4-02	Intermediate	Crested blade	Yes	Multi-faceted	None	No
SF6	PSK4-02	Intermediate	Initial core tablet	Yes	Single faceted	None	No
SF6	PSK4-02	Intermediate	Non-initial core tablet	Yes	Single faceted	None	No
SF6	PSK4-02	Intermediate	Corrective non-initial core tablet	Yes	Single faceted	None	Yes
SF7	PSK5-01	Intermediate	Blade	No	Absent	Not present	No
SF7	PSK5-01	Intermediate	Blade	Yes	Single faceted	None	No
SF7	PSK5-01	Intermediate	Blade	Yes	Single faceted	None	No
SF7	PSK5-01	Intermediate	Blade	Yes	Single faceted	Crushing	No
SF7	PSK5-01	Intermediate	Blade	Yes	Single faceted	None	No
SF7	PSK5-01	Intermediate	Blade	Yes	Multi-faceted	Battering	No
SF7	PSK5-01	Intermediate	Blade	Yes	Single faceted	Battering	No
SF7	PSK5-01	Intermediate	Profile correction blade	Yes	Single faceted	None	No
SF7	PSK5-01	Intermediate	Non-initial core tablet	Yes	Single faceted	Battering	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Outrepasse	6.40	14.72	6.04	10.40	30.46	46.20
Hinging	Hinge	7.21	13.88	8.21	95.75	38.52	52.60
Shatter	Feather	8.24	11.64	7.61	99.82	54.52	64.81
None	Outrepasse	5.26	18.75	11.09	103.59	42.33	100.10
Shatter	Feather	N/A	N/A	2.04	N/A	N/A	2.97
Hinging	Hinge	4.40	4.43	3.51	35.92	10.45	1.71
None	Feather	9.17	3.68	1.52	51.06	23.92	5.60
Hinging	Hinge	2.15	3.30	1.36	32.27	10.86	0.97
None	Feather	3.33	6.16	1.61	64.61	23.71	9.51
Platform battering	Hinge	3.66	3.75	2.30	52.14	15.43	3.71
None	Feather	5.00	4.06	1.25	40.15	15.24	2.98
None	Feather	6.53	7.32	0.73	65.18	29.68	15.44
None	Feather	11.69	22.35	5.56	78.30	44.15	64.61

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	0.090	1.253	0.306	-2.707	-0.417	0.610
Intermediate	Unskilled	0.380	1.081	0.986	0.934	0.351	0.838
Intermediate	Unskilled	0.748	0.620	0.798	1.108	1.875	1.273
Intermediate	Unskilled	-0.317	2.083	1.888	1.269	0.714	2.531
Novice	Unskilled	N/A	N/A	-0.114	N/A	N/A	-0.443
Novice	Unskilled	-0.415	-0.383	0.877	-1.028	-0.989	-0.505
Novice	Unskilled	1.061	-0.500	-0.464	-0.087	0.197	-0.313
Novice	Unskilled	-1.111	-0.559	-0.572	-1.255	-0.953	-0.541
Novice	Unskilled	-0.746	-0.113	-0.404	0.756	0.179	-0.120
Novice	Unskilled	-0.644	-0.489	0.061	-0.020	-0.551	-0.406
Novice	Unskilled	-0.229	-0.441	-0.646	-0.765	-0.567	-0.442
Novice	Unskilled	0.244	0.069	-0.996	0.791	0.705	0.172
Novice	Unskilled	1.840	2.416	2.258	1.606	1.980	2.599

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF7	PSK5-02	Intermediate	Blade	Yes	Single faceted	None	No
SF7	PSK5-02	Intermediate	Blade	Yes	Single faceted	None	No
SF7	PSK5-02	Intermediate	Blade	Yes	Single faceted	None	No
SF7	PSK5-02	Intermediate	Blade	Yes	Single faceted	None	No
SF7	PSK5-02	Intermediate	Blade	Yes	Single faceted	None	No
SF7	PSK5-02	Intermediate	Blade	No	Absent	Not present	No
SF7	PSK5-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF7	PSK5-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF7	PSK5-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF7	PSK5-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF7	PSK5-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF7	PSK5-02	Intermediate	Blade	Yes	Multi-faceted	Crushing	No
SF7	PSK5-02	Intermediate	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Overshot	Outrepasse	8.81	7.10	8.60	82.39	30.27	22.80
Shatter	Feather	3.95	4.29	3.05	77.84	25.88	11.58
Shatter	Feather	3.60	5.60	1.00	89.54	27.40	10.23
None	Feather	4.52	3.90	0.78	56.38	26.37	8.43
None	Feather	2.49	4.65	1.31	58.16	26.46	5.97
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	3.55
Shatter	Feather	3.03	2.81	1.38	59.49	21.31	3.79
None	Feather	1.79	3.23	0.55	53.28	18.86	3.41
None	Feather	8.40	7.76	2.78	67.95	19.48	11.99
None	Feather	1.79	2.69	1.17	28.24	9.89	0.72
None	Feather	1.75	2.93	2.05	37.95	16.01	2.44
None	Feather	4.55	3.68	0.96	58.79	16.12	4.28
None	Feather	6.38	5.05	1.86	50.19	30.39	8.83

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	0.772	0.049	1.398	1.069	0.431	0.246
Intermediate	Unskilled	-0.374	-0.417	-0.086	0.813	-0.019	-0.228
Intermediate	Unskilled	-0.457	-0.200	-0.634	1.471	0.137	-0.285
Intermediate	Unskilled	-0.240	-0.482	-0.693	-0.394	0.031	-0.361
Intermediate	Unskilled	-0.718	-0.357	-0.551	-0.294	0.040	-0.465
Intermediate	Unskilled	N/A	N/A	N/A	N/A	N/A	-0.568
Intermediate	Unskilled	-0.591	-0.662	-0.532	-0.219	-0.487	-0.558
Intermediate	Unskilled	-0.883	-0.593	-0.754	-0.569	-0.738	-0.574
Intermediate	Unskilled	0.675	0.158	-0.158	0.256	-0.674	-0.211
Intermediate	Unskilled	-0.883	-0.682	-0.588	-1.977	-1.657	-0.687
Intermediate	Unskilled	-0.893	-0.642	-0.353	-1.431	-1.030	-0.615
Intermediate	Unskilled	-0.233	-0.518	-0.645	-0.259	-1.019	-0.537
Intermediate	Unskilled	0.199	-0.291	-0.404	-0.742	0.443	-0.344

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF7	PSK5-02	Intermediate	Profile correction blade	Yes	Multi-faceted	None	Yes
SF7	PSK5-02	Intermediate	Non-initial core tablet	Yes	Single faceted	None	No
SF7	PSK5-02	Intermediate	Non-initial core tablet	Yes	Single faceted	None	Yes
SF8	PSK6-01	Intermediate	Blade	No	Multi-faceted	None	No
SF8	PSK6-01	Intermediate	Blade	Yes	Multi-faceted	None	No
SF8	PSK6-01	Intermediate	Blade	Yes	Multi-faceted	None	No
SF8	PSK6-01	Intermediate	Blade	Yes	Multi-faceted	None	No
SF8	PSK6-01	Intermediate	Blade	Yes	Multi-faceted	None	No
SF8	PSK6-01	Intermediate	Blade	Yes	Multi-faceted	None	No
SF8	PSK6-01	Intermediate	Profile correction blade	Yes	Multi-faceted	None	Yes
SF8	PSK6-01	Intermediate	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF8	PSK6-01	Intermediate	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF8	PSK6-01	Intermediate	Core face rejuvenation	Yes	Multi-faceted	Battering	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	5.22	7.48	4.66	70.12	34.45	23.44
Hinging	Hinge	8.76	15.94	14.06	91.77	44.17	71.28
Hinging	Hinge	18.01	24.98	6.35	68.77	43.92	78.87
Shatter	Step	2.85	N/A	N/A	N/A	N/A	1.38
Hinging	Hinge	6.57	4.24	1.75	30.05	16.35	2.01
None	Feather	1.30	2.66	0.63	25.38	13.96	0.82
None	Feather	2.97	2.72	0.93	33.96	11.25	1.17
None	Feather	2.37	1.98	1.24	35.85	21.22	1.58
None	Feather	2.25	1.74	0.59	34.43	14.99	0.99
None	Feather	3.50	8.66	2.38	73.24	34.69	23.34
None	Feather	3.35	7.21	2.85	71.62	35.26	16.52
None	Feather	3.15	7.90	2.06	61.37	27.06	11.75
None	Feather	3.47	8.30	1.70	60.75	40.40	20.03

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.075	0.112	0.345	0.378	0.859	0.273
Intermediate	Unskilled	0.760	1.514	2.858	1.596	1.854	2.296
Intermediate	Unskilled	2.940	3.012	0.797	0.303	1.829	2.617
Intermediate	Unskilled	-0.466	N/A	N/A	N/A	N/A	-0.684
Intermediate	Unskilled	0.617	-0.520	-0.364	-1.075	-0.898	-0.656
Intermediate	Unskilled	-0.917	-0.767	-0.791	-1.289	-1.101	-0.708
Intermediate	Unskilled	-0.431	-0.757	-0.677	-0.896	-1.332	-0.693
Intermediate	Unskilled	-0.605	-0.873	-0.559	-0.809	-0.484	-0.675
Intermediate	Unskilled	-0.640	-0.910	-0.806	-0.874	-1.014	-0.701
Intermediate	Unskilled	-0.276	0.168	-0.124	0.906	0.661	0.286
Intermediate	Unskilled	-0.320	-0.058	0.055	0.831	0.710	-0.015
Intermediate	Unskilled	-0.378	0.050	-0.246	0.361	0.013	-0.226
Intermediate	Unskilled	-0.285	0.112	-0.383	0.333	1.147	0.140

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF8	PSK6-01	Intermediate	Non-initial core tablet	Yes	Single faceted	None	No
SF8	PSK6-01	Intermediate	Non-initial core tablet	Yes	Single faceted	None	No
SF8	PSK6-02	Intermediate	Blade	No	Multi-faceted	None	No
SF8	PSK6-02	Intermediate	Blade	Yes	Multi-faceted	Crushing	No
SF8	PSK6-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF8	PSK6-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF8	PSK6-02	Intermediate	Blade	Yes	Single faceted	Battering	No
SF8	PSK6-02	Intermediate	Non-initial core tablet	Yes	Single faceted	None	No
SF8	PSK6-02	Intermediate	Non-initial core tablet	Yes	Single faceted	None	No
SF9	PSK1-01	Intermediate	Blade	Yes	Single faceted	None	No
SF9	PSK1-01	Intermediate	Core face rejuvenation	Yes	Single faceted	None	Yes
SF9	PSK1-01	Intermediate	Initial core tablet	Yes	Single faceted	None	No
SF9	PSK1-02	Intermediate	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	13.63	22.54	7.90	77.26	42.29	70.03
Overshot	Outrepasse	7.99	15.42	7.74	84.48	38.57	52.77
Hinging	Hinge	3.12	N/A	N/A	N/A	N/A	1.79
None	Feather	4.54	3.37	2.10	60.43	23.15	5.44
None	Feather	1.66	1.89	0.78	49.19	16.43	1.37
None	Feather	2.87	4.19	1.61	57.36	18.66	5.13
Platform battering	Feather	4.70	4.76	1.62	78.64	30.67	15.12
None	Feather	14.44	23.30	3.46	96.63	36.28	88.48
Hinging	Hinge	6.57	13.25	6.65	58.73	25.86	27.55
None	Feather	3.02	2.20	0.87	31.45	8.22	0.45
Overshot	Outrepasse	12.29	11.72	9.26	109.28	88.36	143.77
None	Outrepasse	27.06	23.82	39.66	123.79	80.76	292.00
None	Feather	3.41	4.01	2.47	65.54	15.85	4.39

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	2.671	2.332	1.979	1.090	1.307	2.347
Intermediate	Unskilled	1.030	1.222	1.918	1.421	0.991	1.585
Novice	Unskilled	-0.536	N/A	N/A	N/A	N/A	-0.604
Novice	Unskilled	-0.204	-0.614	-0.284	-0.365	-0.272	-0.487
Novice	Unskilled	-0.877	-0.792	-0.905	-1.007	-1.175	-0.617
Novice	Unskilled	-0.594	-0.515	-0.514	-0.540	-0.875	-0.497
Novice	Unskilled	-0.167	-0.446	-0.510	0.674	0.738	-0.178
Novice	Unskilled	2.109	1.789	0.356	1.701	1.492	2.165
Novice	Unskilled	0.270	0.577	1.857	-0.462	0.092	0.219
Novice	Unskilled	-0.916	-0.958	-0.771	-1.142	-1.150	-0.994
Novice	Unskilled	-0.151	-0.079	-0.359	0.425	0.661	-0.011
Novice	Unskilled	1.067	1.037	1.130	0.717	0.489	1.006
Intermediate	Unskilled	-0.357	-0.654	-0.039	0.156	-0.890	-0.599

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF9	PSK1-02	Intermediate	Blade	Yes	Single faceted	None	No
SF9	PSK1-02	Intermediate	Blade	No	Absent	Crushing	No
SF9	PSK1-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF9	PSK1-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF9	PSK1-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF9	PSK1-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF9	PSK1-02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF9	PSK1-02	Intermediate	Blade	Yes	Multi-faceted	None	Yes
SF9	PSK1-02	Intermediate	Blade	No	Absent	None	No
SF9	PSK1-02	Intermediate	Blade	No	Absent	Crushing	No
SF9	PSK1-02	Intermediate	Blade	No	Absent	Crushing	No
SF9	PSK1-02	Intermediate	Blade	Yes	Single faceted	None	No
SF9	PSK1-02	Intermediate	Profile correction blade	Yes	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.58	2.59	0.82	46.48	15.68	2.26
Shatter	Feather	N/A	N/A	5.53	N/A	42.91	66.90
None	Feather	2.27	2.34	0.71	36.89	12.52	1.37
None	Feather	2.83	1.72	0.72	31.83	12.36	0.79
None	Feather	3.36	2.44	1.01	42.90	14.87	1.64
None	Feather	3.07	4.01	2.83	89.74	26.51	8.03
None	Feather	3.44	7.09	1.64	61.22	24.77	8.86
None	Feather	6.41	5.34	4.54	76.26	35.31	18.31
None	Feather	N/A	N/A	1.14	N/A	N/A	4.16
Shatter	Outrepasse	N/A	N/A	8.04	N/A	23.37	7.80
Shatter	Feather	N/A	N/A	1.44	N/A	41.49	17.00
None	Feather	3.88	9.36	3.24	73.00	27.60	21.03
Shatter	Feather	3.33	5.89	1.08	68.66	14.66	6.37

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.683	-1.112	-0.891	-0.967	-0.904	-0.710
Intermediate	Unskilled	N/A	N/A	1.541	N/A	1.276	2.645
Intermediate	Unskilled	-0.805	-1.192	-0.948	-1.532	-1.157	-0.756
Intermediate	Unskilled	-0.585	-1.392	-0.943	-1.830	-1.169	-0.786
Intermediate	Unskilled	-0.377	-1.160	-0.793	-1.178	-0.968	-0.742
Intermediate	Unskilled	-0.491	-0.654	0.147	1.581	-0.037	-0.410
Intermediate	Unskilled	-0.346	0.340	-0.468	-0.099	-0.176	-0.367
Intermediate	Unskilled	0.821	-0.225	1.030	0.787	0.668	0.123
Intermediate	Unskilled	N/A	N/A	-0.726	N/A	N/A	-0.611
Intermediate	Unskilled	N/A	N/A	2.837	N/A	-0.288	-0.422
Intermediate	Unskilled	N/A	N/A	-0.571	N/A	1.163	0.055
Intermediate	Unskilled	-0.173	1.072	0.358	0.595	0.051	0.264
Intermediate	Unskilled	-0.389	-0.047	-0.757	0.339	-0.985	-0.497

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF9	PSK1-02	Intermediate	Profile correction blade	Yes	Multi-faceted	Battering	Yes
SF9	PSK1-02	Intermediate	Core face rejuvenation	Yes	Single faceted	None	Yes
SF9	PSK1-02	Intermediate	Core face rejuvenation	Yes	Single faceted	None	Yes
SF9	PSK1-02	Intermediate	Crested blade	Yes	Single faceted	None	No
SF9	PSK1-02	Intermediate	Crested blade	Yes	Single faceted	None	No
SF10	FDP04	Master	Blade	No	Multi-faceted	Crushing	No
SF10	FDP04	Master	Blade	No	Multi-faceted	Crushing	No
SF10	FDP04	Master	Blade	No	Absent	Not present	No
SF10	FDP04	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP04	Master	Blade	Yes	Multi-faceted	Double Initiation	No
SF10	FDP04	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP04	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP04	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Platform battering	Outrepasse	2.92	10.50	3.98	56.15	25.76	12.66
None	Feather	8.80	7.66	2.94	75.46	34.55	27.48
None	Feather	11.20	10.78	2.73	82.22	59.56	66.11
None	Feather	4.50	8.78	0.71	72.90	29.45	15.67
None	Feather	2.80	8.03	2.80	64.25	28.19	12.00
None	Feather	N/A	N/A	0.83	N/A	N/A	0.62
None	Feather	N/A	N/A	0.59	N/A	N/A	1.03
Shatter	Feather	N/A	N/A	1.53	N/A	N/A	2.97
Shatter	Feather	3.56	4.79	1.29	53.28	12.76	3.02
Hinging	Hinge	4.48	11.22	5.79	89.79	26.83	27.17
None	Feather	5.47	6.50	3.00	102.63	23.47	16.43
None	Hinge	4.50	3.64	1.83	33.21	15.36	2.99
None	Feather	3.18	4.40	0.98	41.63	11.86	2.14

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.550	1.440	0.740	-0.398	-0.097	-0.170
Intermediate	Unskilled	1.759	0.524	0.204	0.740	0.607	0.599
Intermediate	Unskilled	2.702	1.530	0.095	1.138	2.609	2.604
Intermediate	Unskilled	0.071	0.885	-0.948	0.589	0.199	-0.014
Intermediate	Unskilled	-0.597	0.643	0.131	0.080	0.098	-0.204
Intermediate	Skilled	N/A	N/A	-0.794	N/A	N/A	-0.372
Intermediate	Skilled	N/A	N/A	-0.892	N/A	N/A	-0.369
Intermediate	Skilled	N/A	N/A	-0.508	N/A	N/A	-0.351
Intermediate	Skilled	-0.401	-0.410	-0.606	-0.382	-0.716	-0.350
Intermediate	Skilled	-0.136	0.205	1.235	0.481	0.285	-0.130
Intermediate	Skilled	0.148	-0.246	0.093	0.784	0.046	-0.228
Intermediate	Skilled	-0.131	-0.520	-0.385	-0.857	-0.531	-0.351
Intermediate	Skilled	-0.510	-0.447	-0.733	-0.658	-0.780	-0.358

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP04	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP04	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP04	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP04	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP04	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP04	Master	Lateral core trimming	Yes	Single faceted	None	No
SF10	FDP04	Master	Faceted non-initial core tablet	Yes	Multi-faceted	None	No
SF10	FDP04	Master	Faceted non-initial core tablet	Yes	Single faceted	None	No
SF10	FDP04	Master	Angle correction	Yes	Multi-faceted	None	Yes
SF10	FDP04	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF10	FDP04	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	FDP04	Master	Crested blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	3.06	5.63	2.08	78.03	17.04	7.41
None	Feather	3.99	5.79	1.48	45.22	18.85	4.34
None	Feather	2.76	1.89	0.57	37.16	12.36	0.84
None	Feather	1.87	2.11	1.15	34.49	11.82	0.77
None	Feather	2.12	1.93	0.68	27.94	8.92	0.54
None	Feather	4.81	3.40	1.69	23.32	29.07	2.02
Hinging	Hinge	13.41	20.14	8.20	117.78	63.47	202.16
Shatter	Outrepasse	14.08	44.92	7.40	182.37	45.94	466.46
Shatter	Step	5.83	10.07	6.85	82.74	21.73	17.24
Hinging	Hinge	4.59	6.03	2.67	47.77	17.94	9.23
Shatter	Feather	3.17	6.45	1.91	66.51	17.27	6.89
None	Feather	3.36	15.37	4.91	116.94	33.36	55.00
None	Feather	2.20	5.50	1.70	61.40	19.10	6.22

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	-0.544	-0.329	-0.283	0.203	-0.412	-0.310
Intermediate	Skilled	-0.277	-0.314	-0.528	-0.573	-0.283	-0.338
Intermediate	Skilled	-0.630	-0.687	-0.901	-0.763	-0.745	-0.370
Intermediate	Skilled	-0.886	-0.666	-0.663	-0.827	-0.783	-0.371
Intermediate	Skilled	-0.814	-0.683	-0.856	-0.981	-0.990	-0.373
Intermediate	Skilled	-0.042	-0.542	-0.442	-1.091	0.444	-0.360
Intermediate	Skilled	2.427	1.058	2.221	1.142	2.892	1.465
Intermediate	Skilled	2.620	3.426	1.893	2.669	1.645	3.874
Intermediate	Skilled	0.251	0.095	1.668	0.314	-0.078	-0.221
Intermediate	Skilled	-0.105	-0.291	-0.042	-0.513	-0.348	-0.294
Intermediate	Skilled	-0.513	-0.251	-0.352	-0.070	-0.395	-0.315
Intermediate	Skilled	-0.458	0.602	0.875	1.122	0.750	0.123
Intermediate	Skilled	-0.536	0.212	0.752	0.497	-0.071	0.066

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	No	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	No	Absent	Not present	No
SF10	FDP15	Master	Blade	Yes	Single faceted	Battering	No
SF10	FDP15	Master	Blade	No	Multi-faceted	None	No
SF10	FDP15	Master	Blade	No	Multi-faceted	None	No
SF10	FDP15	Master	Blade	No	Absent	Not present	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	3.10	5.00	1.20	77.40	26.70	11.24
Shatter	Feather	2.30	5.50	1.30	32.10	15.80	2.57
None	Feather	2.30	3.90	0.80	44.70	17.00	2.58
None	Feather	3.40	4.80	0.60	53.90	18.00	4.20
None	Feather	2.20	4.00	1.70	47.20	14.00	2.76
None	Feather	1.40	3.10	0.90	37.10	9.50	1.24
None	Feather	12.00	9.50	2.50	57.70	27.80	18.82
None	Feather	1.90	3.20	0.70	40.80	15.20	1.89
Shatter	Feather	N/A	N/A	1.60	N/A	N/A	0.79
Platform battering	Feather	3.30	5.50	1.40	45.00	15.00	3.83
Shatter	Hinge	3.90	N/A	N/A	N/A	N/A	1.49
Shatter	Hinge	2.80	N/A	N/A	N/A	N/A	2.01
Shatter	Feather	N/A	N/A	0.80	N/A	N/A	0.46

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	-0.052	-0.034	-0.076	1.716	1.517	1.051
Intermediate	Skilled	-0.483	0.212	0.090	-1.737	-0.760	-0.649
Intermediate	Skilled	-0.483	-0.574	-0.738	-0.777	-0.509	-0.647
Intermediate	Skilled	0.109	-0.132	-1.069	-0.075	-0.300	-0.330
Intermediate	Skilled	-0.536	-0.525	0.752	-0.586	-1.136	-0.612
Intermediate	Skilled	-0.967	-0.966	-0.572	-1.356	-2.076	-0.910
Intermediate	Skilled	4.737	2.174	2.076	0.215	1.747	2.538
Intermediate	Skilled	-0.698	-0.917	-0.903	-1.074	-0.885	-0.783
Intermediate	Skilled	N/A	N/A	0.586	N/A	N/A	-0.998
Intermediate	Skilled	0.056	0.212	0.255	-0.754	-0.927	-0.402
Intermediate	Skilled	0.378	N/A	N/A	N/A	N/A	-0.861
Intermediate	Skilled	-0.214	N/A	N/A	N/A	N/A	-0.759
Intermediate	Skilled	N/A	N/A	-0.738	N/A	N/A	-1.063

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP15	Master	Blade	No	Absent	Not present	No
SF10	FDP15	Master	Blade	No	Absent	Not present	No
SF10	FDP15	Master	Blade	No	Absent	Not present	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	N/A	N/A	0.60	N/A	N/A	1.82
Shatter	Feather	N/A	N/A	1.20	N/A	N/A	6.69
Shatter	Feather	N/A	N/A	1.60	N/A	N/A	3.53
None	Feather	2.10	4.00	1.20	59.40	19.10	3.75
None	Feather	2.10	4.40	1.00	56.20	17.50	3.99
None	Feather	3.30	4.70	1.60	72.00	25.20	9.56
None	Feather	2.60	3.90	1.30	67.80	18.00	5.97
Shatter	Feather	3.40	6.10	0.80	59.10	21.10	7.34
Shatter	Feather	2.00	1.60	0.80	46.30	14.70	1.12
None	Feather	2.00	3.40	0.60	44.20	30.40	5.67
None	Hinge	2.70	4.60	3.20	38.60	18.00	2.60
None	Feather	2.60	5.90	1.10	56.70	21.30	6.27
None	Feather	2.70	2.40	0.80	35.10	14.70	1.11

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	N/A	N/A	-1.069	N/A	N/A	-0.796
Intermediate	Skilled	N/A	N/A	-0.076	N/A	N/A	0.159
Intermediate	Skilled	N/A	N/A	0.586	N/A	N/A	-0.461
Intermediate	Skilled	-0.590	-0.525	-0.076	0.344	-0.071	-0.418
Intermediate	Skilled	-0.590	-0.328	-0.407	0.100	-0.405	-0.371
Intermediate	Skilled	0.056	-0.181	0.586	1.305	1.204	0.721
Intermediate	Skilled	-0.321	-0.574	0.090	0.984	-0.300	0.017
Intermediate	Skilled	0.109	0.506	-0.738	0.321	0.347	0.286
Intermediate	Skilled	-0.644	-1.702	-0.738	-0.655	-0.990	-0.934
Intermediate	Skilled	-0.644	-0.819	-1.069	-0.815	2.290	-0.041
Intermediate	Skilled	-0.267	-0.230	3.235	-1.242	-0.300	-0.643
Intermediate	Skilled	-0.321	0.408	-0.241	0.138	0.389	0.076
Intermediate	Skilled	-0.267	-1.310	-0.738	-1.508	-0.990	-0.936

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP15	Master	Angle correction	Yes	Multi-faceted	None	Yes
SF10	FDP15	Master	Profile correction blade	No	Absent	Not present	Yes
SF10	FDP15	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	FDP15	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	FDP15	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF10	FDP15	Master	Crested blade	Yes	Multi-faceted	None	Yes
SF10	FDP17	Master	Blade	No	Absent	Not present	No
SF10	FDP17	Master	Blade	No	Multi-faceted	None	No
SF10	FDP17	Master	Blade	No	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	4.00	5.60	0.80	52.70	24.00	8.63
None	Feather	3.10	4.10	1.30	50.30	21.00	5.19
None	Feather	3.30	3.60	1.20	64.50	19.50	5.56
None	Feather	2.40	3.80	0.70	56.10	17.20	2.97
Shatter	Feather	3.10	4.60	0.40	61.90	15.50	3.64
Shatter	Feather	N/A	N/A	0.70	N/A	N/A	11.55
None	Feather	3.10	10.10	2.20	72.40	21.10	17.42
None	Feather	4.70	8.20	1.40	83.30	27.90	20.71
None	Feather	5.80	7.10	2.00	46.60	19.00	9.24
None	Feather	3.30	8.90	1.90	71.20	20.40	13.17
Shatter	Feather	N/A	N/A	0.70	N/A	N/A	0.48
Hinging	Hinge	2.10	N/A	N/A	N/A	N/A	0.37
Hinging	Hinge	2.60	N/A	N/A	N/A	N/A	1.03

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	0.432	0.261	-0.738	-0.167	0.953	0.539
Intermediate	Skilled	-0.052	-0.475	0.090	-0.350	0.326	-0.136
Intermediate	Skilled	0.056	-0.721	-0.076	0.733	0.013	-0.063
Intermediate	Skilled	-0.429	-0.623	-0.903	0.093	-0.467	-0.571
Intermediate	Skilled	-0.052	-0.230	-1.400	0.535	-0.823	-0.440
Intermediate	Skilled	N/A	N/A	-0.903	N/A	N/A	1.112
Intermediate	Skilled	-0.052	2.469	1.580	1.335	0.347	2.263
Intermediate	Skilled	0.809	1.536	0.255	2.166	1.768	2.908
Intermediate	Skilled	1.401	0.997	1.249	-0.632	-0.091	0.659
Intermediate	Skilled	0.056	1.880	1.083	1.244	0.201	1.429
Intermediate	Unskilled	N/A	N/A	-1.023	N/A	N/A	-1.399
Intermediate	Unskilled	-0.736	N/A	N/A	N/A	N/A	-1.466
Intermediate	Unskilled	-0.206	N/A	N/A	N/A	N/A	-1.064

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Blade	Yes	Single faceted	None	No
SF10	FDP17	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP17	Master	Angle correction	Yes	Multi-faceted	None	Yes
SF10	FDP17	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.20	3.20	0.60	48.40	16.10	2.39
Hinging	Hinge	2.80	4.40	1.50	37.30	22.00	3.24
None	Feather	2.90	4.00	1.30	45.30	13.30	2.20
None	Feather	2.70	5.60	1.40	52.90	25.40	6.21
None	Feather	3.20	4.20	1.50	55.00	18.10	4.37
None	Feather	3.10	3.60	0.90	49.00	17.50	3.49
None	Feather	2.20	4.80	0.90	49.00	18.90	3.29
None	Feather	2.40	3.80	0.90	43.50	14.40	2.79
None	Feather	3.30	1.80	0.70	36.80	15.70	1.27
None	Hinge	1.60	2.30	1.20	38.00	17.80	2.47
None	Feather	5.90	6.70	1.80	45.00	21.20	6.03
None	Hinge	2.30	6.70	1.60	41.80	15.10	2.72
None	Feather	2.50	5.40	0.80	47.30	13.80	2.35

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	-0.630	-0.803	-1.279	0.584	-0.317	-0.235
Intermediate	Unskilled	0.007	0.030	1.023	-1.406	1.287	0.282
Intermediate	Unskilled	0.113	-0.248	0.512	0.028	-1.078	-0.351
Intermediate	Unskilled	-0.099	0.863	0.767	1.391	2.212	2.091
Intermediate	Unskilled	0.431	-0.109	1.023	1.767	0.227	0.971
Intermediate	Unskilled	0.325	-0.526	-0.512	0.692	0.064	0.435
Intermediate	Unskilled	-0.630	0.307	-0.512	0.692	0.445	0.313
Intermediate	Unskilled	-0.418	-0.387	-0.512	-0.295	-0.779	0.008
Intermediate	Unskilled	0.537	-1.775	-1.023	-1.496	-0.425	-0.918
Intermediate	Unskilled	-1.266	-1.428	0.256	-1.281	0.146	-0.187
Intermediate	Unskilled	3.295	1.626	1.790	-0.026	1.070	1.982
Intermediate	Unskilled	-0.524	1.626	1.279	-0.599	-0.588	-0.034
Intermediate	Unskilled	-0.312	0.724	-0.767	0.387	-0.942	-0.260

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP17	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	FDP19	Master	Blade	No	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	Crushing	No
SF10	FDP19	Master	Blade	Yes	Single faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	Crushing	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	Double Initiation	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.90	4.50	0.70	42.70	12.40	2.50
Shatter	Hinge	8.95	N/A	N/A	N/A	N/A	11.17
None	Feather	2.73	4.92	1.17	58.52	22.65	6.03
None	Feather	1.18	4.38	1.50	64.73	21.73	5.03
None	Feather	3.03	3.91	1.30	45.79	17.58	3.61
Shatter	Feather	2.13	2.18	1.03	47.74	11.43	1.24
None	Feather	2.64	3.63	0.98	62.48	17.47	2.67
None	Hinge	1.93	1.72	1.16	45.07	14.38	1.03
None	Feather	3.29	4.49	1.54	65.01	14.48	4.49
None	Feather	2.14	2.80	0.84	51.36	11.42	N/A
None	Feather	3.54	3.85	1.20	38.74	14.83	2.35
None	Feather	2.93	2.43	0.40	32.65	12.67	1.14
None	Feather	2.67	2.86	0.66	38.31	8.46	1.00

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Unskilled	0.113	0.099	-1.023	-0.438	-1.322	-0.168
Intermediate	Skilled	4.380	N/A	N/A	N/A	N/A	1.191
Intermediate	Skilled	-0.143	0.503	-0.086	0.447	1.028	0.308
Intermediate	Skilled	-1.270	0.246	0.431	0.815	0.888	0.136
Intermediate	Skilled	0.075	0.023	0.117	-0.307	0.257	-0.108
Intermediate	Skilled	-0.580	-0.799	-0.306	-0.191	-0.679	-0.515
Intermediate	Skilled	-0.209	-0.110	-0.384	0.682	0.240	-0.270
Intermediate	Skilled	-0.725	-1.017	-0.102	-0.349	-0.230	-0.551
Intermediate	Skilled	0.264	0.298	0.494	0.832	-0.215	0.043
Intermediate	Skilled	-0.572	-0.504	-0.604	0.023	-0.681	N/A
Intermediate	Skilled	0.446	-0.006	-0.039	-0.725	-0.162	-0.325
Intermediate	Skilled	0.002	-0.680	-1.294	-1.085	-0.490	-0.532
Intermediate	Skilled	-0.187	-0.476	-0.886	-0.750	-1.131	-0.557

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP19	Master	Blade	Yes	Single faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	Crushing	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	No	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.25	2.11	0.64	52.57	14.60	1.58
None	Feather	4.18	4.17	1.27	73.76	19.09	6.13
None	Feather	2.38	2.83	0.58	49.19	12.60	1.51
None	Feather	4.04	5.33	2.02	51.44	15.55	3.73
None	Feather	1.96	2.87	0.68	55.63	10.20	1.33
None	Feather	2.63	2.56	0.79	50.36	12.39	1.26
None	Hinge	4.27	4.69	2.10	46.93	17.62	4.58
None	Feather	2.21	4.59	1.39	56.28	14.51	3.01
None	Feather	3.26	3.24	1.10	55.11	18.96	3.31
None	Feather	2.45	2.46	1.10	43.74	12.03	1.48
None	Feather	2.97	2.50	0.56	37.87	13.09	1.27
None	Feather	2.58	2.40	0.90	40.02	10.62	0.99
None	Hinge	1.49	N/A	N/A	N/A	N/A	0.58

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	-0.492	-0.832	-0.917	0.095	-0.197	-0.457
Intermediate	Skilled	0.911	0.146	0.070	1.350	0.486	0.325
Intermediate	Skilled	-0.398	-0.490	-1.011	-0.105	-0.501	-0.469
Intermediate	Skilled	0.809	0.697	1.246	0.028	-0.052	-0.087
Intermediate	Skilled	-0.703	-0.471	-0.855	0.276	-0.866	-0.500
Intermediate	Skilled	-0.216	-0.618	-0.682	-0.036	-0.533	-0.512
Intermediate	Skilled	0.977	0.393	1.372	-0.239	0.263	0.059
Intermediate	Skilled	-0.521	0.346	0.258	0.315	-0.210	-0.211
Intermediate	Skilled	0.242	-0.295	-0.196	0.245	0.466	-0.160
Intermediate	Skilled	-0.347	-0.666	-0.196	-0.428	-0.588	-0.474
Intermediate	Skilled	0.031	-0.647	-1.043	-0.776	-0.426	-0.510
Intermediate	Skilled	-0.252	-0.694	-0.510	-0.649	-0.802	-0.558
Intermediate	Skilled	-1.045	N/A	N/A	N/A	N/A	-0.629

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Blade	No	Multi-faceted	None	No
SF10	FDP19	Master	Blade	No	Absent	Not present	No
SF10	FDP19	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP19	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	FDP19	Master	Profile correction blade	No	Multi-faceted	None	Yes
SF10	FDP19	Master	Profile correction blade	No	Multi-faceted	None	Yes
SF10	FDP19	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF10	FDP19	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF10	FDP19	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF10	FDP19	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.08	2.16	0.84	24.74	9.13	0.53
None	Feather	3.34	1.06	0.57	33.76	9.87	0.56
None	Hinge	1.94	1.71	0.96	22.28	8.86	0.46
None	Feather	2.35	2.65	1.31	28.07	7.71	0.60
Shatter	Feather	N/A	N/A	1.00	N/A	N/A	0.46
Hinging	Hinge	2.36	2.24	0.74	24.46	9.95	0.58
None	Feather	2.74	9.06	0.98	71.16	20.16	11.00
Shatter	Hinge	2.79	N/A	N/A	N/A	N/A	8.44
Hinging	Hinge	1.93	N/A	N/A	N/A	N/A	2.29
None	Feather	3.71	7.38	3.53	61.88	29.82	12.60
None	Feather	2.36	5.60	0.95	69.60	30.72	9.55
None	Feather	2.93	5.38	1.36	44.66	23.41	4.02
None	Feather	2.55	5.21	1.79	71.92	15.33	5.02

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	-0.616	-0.808	-0.604	-1.554	-1.029	-0.637
Intermediate	Skilled	0.300	-1.331	-1.027	-1.020	-0.916	-0.632
Intermediate	Skilled	-0.718	-1.022	-0.416	-1.700	-1.070	-0.649
Intermediate	Skilled	-0.420	-0.576	0.133	-1.357	-1.245	-0.625
Intermediate	Skilled	N/A	N/A	-0.353	N/A	N/A	-0.649
Intermediate	Skilled	-0.412	-0.770	-0.761	-1.571	-0.904	-0.629
Intermediate	Skilled	-0.136	2.469	-0.384	1.196	0.649	1.162
Intermediate	Skilled	-0.100	N/A	N/A	N/A	N/A	0.722
Intermediate	Skilled	-0.725	N/A	N/A	N/A	N/A	-0.335
Intermediate	Skilled	0.569	1.671	3.613	0.647	2.119	1.437
Intermediate	Skilled	-0.412	0.826	-0.431	1.104	2.255	0.913
Intermediate	Skilled	0.002	0.721	0.211	-0.374	1.143	-0.038
Intermediate	Skilled	-0.274	0.640	0.886	1.241	-0.086	0.134

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP19	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	FDP19	Master	Crested blade	Yes	Multi-faceted	None	Yes
SF10	FDP19	Master	Crested blade	No	Absent	Not present	Yes
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Single faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	No	Absent	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	2.41	4.57	1.67	63.23	16.62	3.97
None	Feather	6.83	11.22	1.88	104.83	36.33	34.17
Shatter	Feather	N/A	N/A	2.84	N/A	N/A	4.79
None	Feather	3.30	6.00	2.00	78.00	22.00	9.27
None	Feather	3.10	4.90	1.70	73.00	15.00	5.25
None	Feather	4.00	5.80	4.20	78.50	21.80	10.46
None	Feather	5.00	6.60	1.80	71.00	23.30	12.02
None	Feather	2.50	4.60	1.40	56.00	14.20	2.58
None	Feather	1.80	2.70	1.00	39.00	15.60	1.47
None	Feather	2.90	3.20	0.90	59.40	12.10	2.33
Shatter	Hinge	N/A	N/A	1.30	N/A	N/A	1.61
None	Feather	1.90	1.80	0.80	51.00	13.00	1.25
None	Feather	2.90	2.70	0.80	40.80	14.20	1.81

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	-0.376	0.336	0.697	0.727	0.111	-0.046
Intermediate	Skilled	2.838	3.495	1.027	3.191	3.109	5.143
Intermediate	Skilled	N/A	N/A	2.532	N/A	N/A	0.095
Master	Skilled	0.491	1.144	0.923	1.843	1.423	1.540
Master	Skilled	0.279	0.569	0.552	1.529	-0.002	0.478
Master	Skilled	1.233	1.039	3.642	1.874	1.382	1.854
Master	Skilled	2.294	1.458	0.675	1.404	1.687	2.267
Master	Skilled	-0.358	0.412	0.181	0.463	-0.164	-0.227
Master	Skilled	-1.100	-0.582	-0.313	-0.604	0.120	-0.521
Master	Skilled	0.066	-0.320	-0.437	0.676	-0.592	-0.293
Master	Skilled	N/A	N/A	0.057	N/A	N/A	-0.484
Master	Skilled	-0.994	-1.052	-0.561	0.149	-0.409	-0.579
Master	Skilled	0.066	-0.582	-0.561	-0.491	-0.164	-0.431

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	No	Absent	Not present	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	No	Absent	Not present	No
SF10	FDP21	Master	Blade	No	Absent	Not present	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	No	Absent	Not present	No
SF10	FDP21	Master	Blade	No	Absent	Not present	No
SF10	FDP21	Master	Blade	No	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.50	3.30	1.00	65.40	15.00	2.86
None	Hinge	2.60	3.20	1.50	49.00	12.30	2.12
Shatter	Feather	N/A	N/A	1.40	N/A	N/A	6.03
None	Feather	3.70	4.70	1.10	74.40	24.70	9.70
Shatter	Feather	N/A	N/A	0.50	N/A	N/A	1.60
Shatter	Hinge	N/A	N/A	N/A	N/A	N/A	0.40
None	Feather	2.50	5.30	1.30	64.70	22.80	8.26
Shatter	Feather	N/A	N/A	1.00	N/A	N/A	0.28
Shatter	Feather	N/A	N/A	0.60	N/A	N/A	0.61
Shatter	Hinge	4.60	N/A	N/A	N/A	N/A	1.03
None	Outrepasse	3.40	7.40	2.00	82.00	23.70	15.38
None	Feather	4.90	4.30	1.20	36.30	14.00	2.53
None	Feather	3.90	3.50	0.90	57.60	19.70	5.63

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.358	-0.268	-0.313	1.052	-0.002	-0.153
Master	Skilled	-0.252	-0.320	0.305	0.023	-0.551	-0.349
Master	Skilled	N/A	N/A	0.181	N/A	N/A	0.684
Master	Skilled	0.915	0.464	-0.190	1.617	1.972	1.654
Master	Skilled	N/A	N/A	-0.931	N/A	N/A	-0.486
Master	Skilled	N/A	N/A	N/A	N/A	N/A	-0.803
Master	Skilled	-0.358	0.778	0.057	1.008	1.586	1.273
Master	Skilled	N/A	N/A	-0.313	N/A	N/A	-0.835
Master	Skilled	N/A	N/A	-0.808	N/A	N/A	-0.748
Master	Skilled	1.869	N/A	N/A	N/A	N/A	-0.637
Master	Skilled	0.597	1.876	0.923	2.094	1.769	3.154
Master	Skilled	2.188	0.255	-0.066	-0.774	-0.205	-0.241
Master	Skilled	1.127	-0.164	-0.437	0.563	0.955	0.578

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	No	Absent	Not present	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	No	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	Double Initiation	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.50	2.20	0.70	36.00	12.30	1.02
Shatter	Feather	N/A	N/A	0.80	N/A	N/A	0.89
None	Feather	2.40	4.00	0.90	54.20	14.30	2.72
None	Feather	4.10	3.50	0.90	45.40	12.40	3.16
None	Feather	2.70	2.70	1.40	46.20	15.10	2.00
None	Feather	2.10	4.20	0.90	45.30	10.70	1.58
None	Feather	2.30	2.00	0.90	42.90	10.70	1.02
None	Feather	2.50	3.10	1.10	42.50	11.00	1.45
Shatter	Hinge	2.80	N/A	N/A	N/A	N/A	2.62
None	Feather	2.20	2.70	2.60	41.00	10.10	1.35
None	Feather	2.30	3.10	0.60	40.00	13.40	1.61
None	Feather	3.00	3.30	0.90	46.50	14.20	2.30
None	Feather	2.30	3.40	0.90	53.00	13.00	2.25

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.358	-0.843	-0.684	-0.792	-0.551	-0.640
Master	Skilled	N/A	N/A	-0.561	N/A	N/A	-0.674
Master	Skilled	-0.464	0.098	-0.437	0.350	-0.144	-0.190
Master	Skilled	1.339	-0.164	-0.437	-0.203	-0.531	-0.074
Master	Skilled	-0.146	-0.582	0.181	-0.152	0.019	-0.381
Master	Skilled	-0.782	0.203	-0.437	-0.209	-0.877	-0.492
Master	Skilled	-0.570	-0.948	-0.437	-0.359	-0.877	-0.640
Master	Skilled	-0.358	-0.373	-0.190	-0.385	-0.816	-0.526
Master	Skilled	-0.040	N/A	N/A	N/A	N/A	-0.217
Master	Skilled	-0.676	-0.582	1.664	-0.479	-0.999	-0.552
Master	Skilled	-0.570	-0.373	-0.808	-0.541	-0.327	-0.484
Master	Skilled	0.173	-0.268	-0.437	-0.134	-0.164	-0.301
Master	Skilled	-0.570	-0.216	-0.437	0.274	-0.409	-0.315

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	3.70	3.90	0.90	53.80	19.00	4.28
None	Feather	3.20	6.30	1.30	63.20	25.30	8.25
None	Feather	4.00	3.70	0.70	51.50	20.60	4.63
None	Feather	2.60	3.10	1.40	46.70	18.10	2.79
None	Feather	2.00	4.30	1.60	49.80	13.40	2.88
None	Feather	1.50	7.30	1.00	57.40	17.80	4.60
Hinging	Hinge	2.00	3.00	1.30	32.70	14.30	1.28
Hinging	Hinge	3.60	3.30	1.20	28.30	11.20	1.25
None	Feather	2.40	1.90	0.70	26.50	12.30	0.82
None	Feather	2.40	2.60	0.70	35.80	9.80	0.97
None	Feather	1.40	2.30	0.70	40.40	8.50	0.65
None	Feather	1.90	1.80	0.70	28.40	10.00	0.44
None	Feather	2.00	2.60	0.70	41.20	9.20	0.80

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	0.915	0.046	-0.437	0.325	0.812	0.222
Master	Skilled	0.385	1.301	0.057	0.914	2.094	1.271
Master	Skilled	1.233	-0.059	-0.684	0.180	1.138	0.314
Master	Skilled	-0.252	-0.373	0.181	-0.121	0.629	-0.172
Master	Skilled	-0.888	0.255	0.428	0.074	-0.327	-0.148
Master	Skilled	-1.418	1.824	-0.313	0.550	0.568	0.306
Master	Skilled	-0.888	-0.425	0.057	-1.000	-0.144	-0.571
Master	Skilled	0.809	-0.268	-0.066	-1.276	-0.775	-0.579
Master	Skilled	-0.464	-1.000	-0.684	-1.389	-0.551	-0.692
Master	Skilled	-0.464	-0.634	-0.684	-0.805	-1.060	-0.653
Master	Skilled	-1.524	-0.791	-0.684	-0.516	-1.324	-0.737
Master	Skilled	-0.994	-1.052	-0.684	-1.269	-1.019	-0.793
Master	Skilled	-0.888	-0.634	-0.684	-0.466	-1.182	-0.698

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No
SF10	FDP21	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.00	1.40	0.50	37.50	8.40	0.47
None	Feather	2.00	1.10	0.30	24.70	6.00	0.20
None	Feather	2.40	1.80	0.60	30.00	12.90	0.87
None	Feather	2.50	2.70	0.60	36.80	12.20	1.19
None	Feather	2.50	1.70	0.50	24.70	10.50	0.43
None	Feather	2.20	2.40	1.00	28.70	9.10	0.73
None	Feather	2.10	3.00	0.50	38.00	13.10	1.40
None	Feather	2.50	2.40	0.80	32.70	15.00	1.12
None	Feather	3.00	3.80	0.90	34.90	12.10	1.50
None	Feather	1.50	2.20	0.50	38.90	8.90	0.73
None	Feather	2.10	1.70	0.50	31.30	10.20	0.62
None	Feather	2.80	3.70	1.00	32.80	17.20	2.50
None	Feather	3.80	3.60	0.90	29.20	11.30	1.27

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.888	-1.262	-0.931	-0.698	-1.345	-0.785
Master	Skilled	-0.888	-1.419	-1.179	-1.502	-1.833	-0.856
Master	Skilled	-0.464	-1.052	-0.808	-1.169	-0.429	-0.679
Master	Skilled	-0.358	-0.582	-0.808	-0.742	-0.571	-0.595
Master	Skilled	-0.358	-1.105	-0.931	-1.502	-0.917	-0.795
Master	Skilled	-0.676	-0.739	-0.313	-1.251	-1.202	-0.716
Master	Skilled	-0.782	-0.425	-0.931	-0.667	-0.388	-0.539
Master	Skilled	-0.358	-0.739	-0.561	-1.000	-0.002	-0.613
Master	Skilled	0.173	-0.007	-0.437	-0.861	-0.592	-0.513
Master	Skilled	-1.418	-0.843	-0.931	-0.610	-1.243	-0.716
Master	Skilled	-0.782	-1.105	-0.931	-1.087	-0.978	-0.745
Master	Skilled	-0.040	-0.059	-0.313	-0.993	0.446	-0.249
Master	Skilled	1.021	-0.111	-0.437	-1.219	-0.755	-0.574

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP21	Master	Blade	Yes	Single faceted	None	No
SF10	FDP21	Master	Blade	No	Multi-faceted	None	No
SF10	FDP21	Master	Blade	No	Absent	Not present	No
SF10	FDP21	Master	Angle correction	No	Multi-faceted	None	Yes
SF10	FDP21	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	FDP21	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	FDP21	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	FDP21	Master	Core face rejuvenation	Yes	Single faceted	None	Yes
SF10	FDP21	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF10	FDP21	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	FDP21	Master	Partial ridged blade	No	Absent	Not present	Yes
SF10	FDP21	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	FDP21	Master	Crested blade	Yes	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	1.70	2.70	0.60	32.30	13.70	0.85
Shatter	Hinge	2.60	N/A	N/A	N/A	N/A	1.37
Shatter	Feather	N/A	N/A	1.00	N/A	N/A	1.62
Shatter	Hinge	2.10	N/A	N/A	N/A	N/A	2.01
None	Feather	3.10	5.40	1.90	67.00	15.90	6.74
None	Feather	3.00	3.60	1.80	71.60	16.80	5.37
None	Hinge	2.90	3.10	3.90	62.80	14.00	4.00
None	Feather	6.20	7.80	2.80	49.00	22.10	9.13
None	Feather	4.40	4.70	1.80	66.10	23.30	9.16
None	Hinge	4.00	9.60	1.70	48.80	23.20	9.12
Shatter	Feather	N/A	N/A	2.50	N/A	N/A	5.03
None	Feather	2.20	4.50	2.40	68.70	13.20	3.73
None	Feather	4.50	10.50	4.10	83.30	26.60	20.75

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-1.206	-0.582	-0.808	-1.025	-0.266	-0.684
Master	Skilled	-0.252	N/A	N/A	N/A	N/A	-0.547
Master	Skilled	N/A	N/A	-0.313	N/A	N/A	-0.481
Master	Skilled	-0.782	N/A	N/A	N/A	N/A	-0.378
Master	Skilled	0.279	0.830	0.799	1.153	0.182	0.872
Master	Skilled	0.173	-0.111	0.675	1.441	0.365	0.510
Master	Skilled	0.066	-0.373	3.271	0.889	-0.205	0.148
Master	Skilled	3.566	2.085	1.912	0.023	1.443	1.503
Master	Skilled	1.657	0.464	0.675	1.096	1.687	1.511
Master	Skilled	1.233	3.026	0.552	0.011	1.667	1.500
Master	Skilled	N/A	N/A	1.541	N/A	N/A	0.420
Master	Skilled	-0.676	0.359	1.417	1.259	-0.368	0.076
Master	Skilled	1.763	3.497	3.518	2.176	2.359	4.573

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	FDP21	Master	Crested blade	Yes	Multi-faceted	None	Yes
SF10	DE01	Novice	Blade	No	Single faceted	None	No
SF10	DE01	Novice	Blade	No	Absent	Not present	No
SF10	DE01	Novice	Lateral core trimming	Yes	Single faceted	None	Yes
SF10	DE01	Novice	Corrective non-initial core tablet	Yes	Single faceted	None	Yes
SF10	DE01	Novice	Corrective non-initial core tablet	Yes	Multi-faceted	None	Yes
SF10	DE01	Novice	Corrective non-initial core tablet	Yes	Multi-faceted	Crushing	Yes
SF10	DE01	Novice	Corrective non-initial core tablet	Yes	Single faceted	Crushing	Yes
SF10	DE01	Novice	Faceted non-initial core tablet	Yes	Single faceted	None	Yes
SF10	DE02	Intermediate	Faceted non-initial core tablet	Yes	Single faceted	None	Yes
SF10	DE02	Intermediate	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	DE02	Intermediate	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	DE02	Intermediate	Core face rejuvenation	Yes	Multi-faceted	None	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.60	6.50	2.00	69.00	19.70	7.50
Shatter		2.84	N/A	N/A	N/A	N/A	0.26
Shatter	Feather	N/A	N/A	0.75	N/A	N/A	0.37
None	Feather	3.17	3.69	0.66	20.33	27.50	1.97
None	Feather	5.57	12.94	5.72	63.95	20.23	16.01
None	Outrepasse	3.29	9.35	16.68	50.17	13.61	9.79
None	Feather	3.54	11.63	1.50	74.76	11.01	10.31
Shatter	Feather	8.07	9.51	1.23	69.04	14.15	10.99
None	Outrepasse	3.64	22.87	6.10	94.29	18.37	28.34
Shatter	Feather	13.92	18.87	2.30	106.54	35.37	81.39
None	Feather	3.07	3.40	1.23	44.73	10.54	1.38
None	Feather	1.92	2.21	0.85	45.75	10.93	1.01
None	Feather	3.16	2.41	0.81	43.85	17.58	1.97

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.252	1.405	0.923	1.278	0.955	1.072
Novice	Unskilled	-0.777	N/A	N/A	N/A	N/A	-1.005
Novice	Unskilled	N/A	N/A	-0.677	N/A	N/A	-0.993
Novice	Unskilled	-0.602	-1.258	-0.692	-1.668	1.686	-0.824
Novice	Unskilled	0.673	0.201	0.183	0.074	0.463	0.662
Novice	Unskilled	-0.538	-0.365	2.078	-0.476	-0.651	0.004
Novice	Unskilled	-0.405	-0.006	-0.547	0.506	-1.088	0.059
Novice	Unskilled	2.001	-0.340	-0.594	0.278	-0.560	0.131
Novice	Unskilled	-0.352	1.768	0.248	1.286	0.150	1.967
Intermediate	Skilled	4.177	4.063	3.714	3.699	3.511	4.627
Intermediate	Skilled	0.030	-0.034	1.061	-0.007	-0.585	-0.237
Intermediate	Skilled	-0.410	-0.349	0.118	0.054	-0.520	-0.259
Intermediate	Skilled	0.064	-0.296	0.019	-0.060	0.576	-0.201

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	DE02	Intermediate	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF10	DE02	Intermediate	Profile correction blade	No	Multi-faceted	None	Yes
SF10	DE02	Intermediate	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	DE02	Intermediate	Crested blade	Yes	Multi-faceted	Crushing	Yes
SF10	DE02	Intermediate	Blade	No	Absent	None	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	No	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.78	2.79	0.64	35.44	16.60	1.47
Shatter		5.88	N/A	N/A	N/A	N/A	14.23
None	Feather	3.10	2.85	1.01	54.81	21.33	4.55
None	Feather	2.34	6.76	1.24	46.41	14.64	3.72
Shatter	Feather	N/A	N/A	0.66	N/A	N/A	0.58
None	Feather	2.41	2.70	0.82	47.36	8.50	0.97
None	Feather	2.18	2.62	0.84	47.30	8.60	0.97
None	Feather	1.32	1.62	0.43	40.41	13.23	0.87
None	Feather	1.73	2.60	0.60	35.99	14.40	1.55
None	Feather	2.19	1.19	0.63	27.25	9.55	0.40
None	Feather	2.55	3.09	0.51	42.82	15.89	1.75
Shatter	Hinge	1.68	N/A	N/A	N/A	N/A	0.35
None	Feather	2.09	1.86	0.57	26.00	10.17	0.53

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	-0.081	-0.195	-0.402	-0.564	0.415	-0.231
Intermediate	Skilled	1.104	N/A	N/A	N/A	N/A	0.544
Intermediate	Skilled	0.041	-0.179	0.515	0.597	1.195	-0.044
Intermediate	Skilled	-0.250	0.856	1.086	0.094	0.091	-0.095
Intermediate	Skilled	N/A	N/A	-0.353	N/A	N/A	-0.285
Intermediate	Skilled	-0.223	-0.219	0.044	0.151	-0.921	-0.262
Intermediate	Skilled	-0.311	-0.240	0.094	0.147	-0.905	-0.262
Intermediate	Skilled	-0.639	-0.505	-0.923	-0.266	-0.141	-0.268
Intermediate	Skilled	-0.483	-0.245	-0.502	-0.531	0.052	-0.226
Intermediate	Skilled	-0.307	-0.619	-0.427	-1.055	-0.748	-0.296
Intermediate	Skilled	-0.169	-0.116	-0.725	-0.121	0.298	-0.214
Intermediate	Skilled	-0.502	N/A	N/A	N/A	N/A	-0.299
Intermediate	Skilled	-0.345	-0.441	-0.576	-1.130	-0.646	-0.288

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	Crushing	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	00
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	No	Multi-faceted	Not present	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	No
SF10	DE02	Intermediate	Blade	Yes	Multi-faceted	None	Yes
SF10	DE03	Master	Lateral core trimming	Yes	Single faceted	None	Yes
SF10	DE03	Master	Partial ridged blade	No	Multi-faceted	Crushing	Yes
SF10	DE03	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	DE03	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	DE03	Master	Partial ridged blade	Yes	Multi-faceted	None	Yes
SF10	DE03	Master	Partial ridged blade	No	Absent	Not present	Yes

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	1.11	1.70	0.56	35.42	10.15	0.58
None	Feather	2.26	2.91	0.77	60.05	12.15	2.48
None	Feather	3.08	2.62	0.70	40.75	11.02	1.03
None	Feather	N/A	N/A	0.53	N/A	N/A	0.79
None	Feather	2.74	3.04	0.71	33.15	17.44	1.30
None	Feather	2.13	3.06	0.88	43.93	11.68	1.54
None	Feather	2.20	2.24	0.36	38.95	11.94	1.20
Hinging	Hinge	1.63	6.10	1.65	15.88	33.86	2.26
Shatter	Feather	1.62	7.94	2.57	87.45	22.71	11.35
Shatter	Feather	2.28	7.15	1.38	92.42	20.21	13.83
None	Feather	1.48	4.62	1.09	50.20	16.27	4.01
None	Feather	3.48	5.72	1.20	48.89	17.72	4.33
Shatter	Feather	N/A	N/A	2.96	N/A	N/A	9.97

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Intermediate	Skilled	-0.720	-0.484	-0.601	-0.565	-0.649	-0.285
Intermediate	Skilled	-0.280	-0.163	-0.080	0.911	-0.319	-0.170
Intermediate	Skilled	0.033	-0.240	-0.254	-0.246	-0.506	-0.258
Intermediate	Skilled	N/A	N/A	-0.675	N/A	N/A	-0.273
Intermediate	Skilled	-0.097	-0.129	-0.229	-0.701	0.553	-0.242
Intermediate	Skilled	-0.330	-0.124	0.193	-0.055	-0.397	-0.227
Intermediate	Skilled	-0.303	-0.341	-1.097	-0.353	-0.354	-0.248
Master	Skilled	-1.028	1.069	0.120	-1.768	4.204	-0.151
Master	Skilled	-1.039	1.921	0.610	2.794	1.882	2.865
Master	Skilled	-0.276	1.555	-0.023	3.111	1.362	3.688
Master	Skilled	-1.201	0.384	-0.178	0.420	0.542	0.430
Master	Skilled	1.112	0.893	-0.119	0.336	0.843	0.536
Master	Skilled	N/A	N/A	0.818	N/A	N/A	2.407

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	DE03	Master	Partial ridged blade	No	Absent	Not present	Yes
SF10	DE03	Master	Corrective non-initial core tablet	Yes	Multi-faceted	None	Yes
SF10	DE03	Master	Faceted non-initial core tablet	Yes	Single faceted	Crushing	Yes
SF10	DE03	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	DE03	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	DE03	Master	Core face rejuvenation	Yes	Multi-faceted	Crushing	Yes
SF10	DE03	Master	Profile correction blade	Yes	Multi-faceted	None	Yes
SF10	DE03	Master	Core face rejuvenation	Yes	Multi-faceted	None	Yes
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	No	Absent	Not present	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	N/A	N/A	2.50	N/A	N/A	4.51
None	Outrepasse	4.12	11.44	11.27	56.56	16.96	10.43
None	Feather	6.22	7.93	1.14	38.88	13.85	4.61
None	Feather	3.99	9.26	1.44	73.34	21.50	11.25
None	Feather	3.95	5.62	1.88	75.23	21.38	9.03
None	Feather	2.34	5.43	1.18	47.81	17.03	4.64
None	Outrepasse	2.83	5.27	10.91	51.88	14.46	4.74
None	Feather	2.35	5.90	1.66	51.27	11.80	2.33
Shatter	Feather	2.76	3.58	0.73	48.00	14.51	2.15
None	Feather	N/A	N/A	1.17	N/A	N/A	1.14
None	Feather	2.62	2.42	1.05	33.20	11.21	1.01
None	Feather	2.11	2.61	0.66	42.00	12.89	1.52
None	Feather	2.16	1.73	1.11	30.21	10.96	0.70

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	N/A	N/A	0.573	N/A	N/A	0.595
Master	Skilled	1.852	3.542	5.243	0.825	0.685	2.560
Master	Skilled	4.280	1.917	-0.151	-0.302	0.038	0.629
Master	Skilled	1.701	2.533	0.009	1.895	1.630	2.832
Master	Skilled	1.655	0.847	0.243	2.015	1.605	2.095
Master	Skilled	-0.207	0.759	-0.130	0.267	0.700	0.639
Master	Skilled	0.360	0.685	5.051	0.527	0.165	0.672
Master	Skilled	-0.195	0.977	0.126	0.488	-0.389	-0.128
Master	Skilled	0.279	-0.098	-0.369	0.279	0.175	-0.188
Master	Skilled	N/A	N/A	-0.135	N/A	N/A	-0.523
Master	Skilled	0.117	-0.635	-0.199	-0.664	-0.512	-0.566
Master	Skilled	-0.473	-0.547	-0.407	-0.103	-0.162	-0.397
Master	Skilled	-0.415	-0.955	-0.167	-0.854	-0.564	-0.669

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	DE03	Master	Blade	No	Absent	Not present	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Single faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	No	Absent	Not present	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
Shatter	Feather	N/A	N/A	1.60	N/A	N/A	1.49
None	Feather	1.94	1.77	0.72	30.60	15.23	0.89
None	Feather	1.93	4.51	1.93	33.81	10.37	1.24
None	Feather	2.44	3.10	1.26	40.28	17.08	1.13
None	Feather	2.26	4.27	0.79	39.41	12.16	2.33
None	Feather	3.98	3.61	0.96	43.94	15.28	2.60
Shatter	Feather	N/A	N/A	0.70	N/A	N/A	3.01
None	Feather	2.75	3.82	2.73	40.77	12.27	2.14
None	Feather	3.78	2.29	1.13	41.35	14.31	1.49
None	Feather	1.97	1.67	0.30	30.47	11.36	0.70
None	Feather	1.15	2.16	0.90	30.02	12.87	0.73
None	Feather	2.32	3.43	1.23	38.54	10.75	1.13
None	Feather	3.49	3.22	0.81	66.64	21.73	4.41

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	N/A	N/A	0.094	N/A	N/A	-0.407
Master	Skilled	-0.669	-0.936	-0.375	-0.830	0.325	-0.606
Master	Skilled	-0.681	0.333	0.269	-0.625	-0.687	-0.489
Master	Skilled	-0.091	-0.320	-0.087	-0.213	0.710	-0.526
Master	Skilled	-0.299	0.222	-0.338	-0.268	-0.314	-0.128
Master	Skilled	1.690	-0.084	-0.247	0.021	0.335	-0.038
Master	Skilled	N/A	N/A	-0.385	N/A	N/A	0.098
Master	Skilled	0.267	0.013	0.695	-0.181	-0.291	-0.191
Master	Skilled	1.458	-0.695	-0.157	-0.144	0.134	-0.407
Master	Skilled	-0.634	-0.983	-0.598	-0.838	-0.481	-0.669
Master	Skilled	-1.583	-0.756	-0.279	-0.867	-0.166	-0.659
Master	Skilled	-0.230	-0.167	-0.103	-0.323	-0.608	-0.526
Master	Skilled	1.123	-0.265	-0.327	1.468	1.678	0.562

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	No	Multi-faceted	None	No
SF10	DE03	Master	Blade	No	Multi-faceted	None	No
SF10	DE03	Master	Blade	No	Multi-faceted	None	No
SF10	DE03	Master	Blade	No	Multi-faceted	None	No
SF10	DE03	Master	Blade	No	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	No	Absent	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	2.17	6.82	0.90	61.15	15.69	6.15
Shatter	Hinge	2.17	N/A	N/A	N/A	N/A	0.39
Shatter	Hinge	3.20	N/A	N/A	N/A	N/A	0.99
Hinging	Hinge	2.16	N/A	N/A	N/A	N/A	0.64
Shatter	Hinge	2.95	N/A	N/A	N/A	N/A	1.13
Shatter	Hinge	2.24	N/A	N/A	N/A	N/A	1.44
Hinging	Hinge	1.80	3.42	0.95	38.73	12.32	1.40
Shatter	Feather	N/A	N/A	0.89	N/A	N/A	0.19
None	Feather	1.89	1.23	0.49	33.07	6.22	0.30
Hinging	Hinge	2.07	2.23	1.50	25.72	9.89	0.73
None	Feather	2.85	1.91	0.48	37.66	11.36	0.79
None	Feather	3.02	2.06	0.71	24.71	9.90	0.62
None	Feather	1.81	1.14	1.00	34.77	13.25	1.13

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-0.403	1.403	-0.279	1.118	0.421	1.140
Master	Skilled	-0.403	N/A	N/A	N/A	N/A	-0.771
Master	Skilled	0.788	N/A	N/A	N/A	N/A	-0.572
Master	Skilled	-0.415	N/A	N/A	N/A	N/A	-0.689
Master	Skilled	0.499	N/A	N/A	N/A	N/A	-0.526
Master	Skilled	-0.322	N/A	N/A	N/A	N/A	-0.423
Master	Skilled	-0.831	-0.172	-0.252	-0.311	-0.281	-0.436
Master	Skilled	N/A	N/A	-0.284	N/A	N/A	-0.838
Master	Skilled	-0.727	-1.186	-0.497	-0.672	-1.551	-0.801
Master	Skilled	-0.519	-0.723	0.041	-1.141	-0.787	-0.659
Master	Skilled	0.383	-0.871	-0.503	-0.380	-0.481	-0.639
Master	Skilled	0.580	-0.802	-0.380	-1.205	-0.785	-0.695
Master	Skilled	-0.819	-1.228	-0.226	-0.564	-0.087	-0.526

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	Double Initiation	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	Double Initiation	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	0.97	0.91	0.71	20.75	5.24	0.11
None	Feather	2.22	1.92	0.87	22.80	8.24	0.36
None	Feather	2.46	2.40	0.50	31.75	12.55	0.98
None	Feather	2.40	4.12	0.79	53.26	17.42	3.24
None	Feather	1.75	1.31	0.56	29.87	5.86	0.20
None	Feather	2.85	4.71	0.45	46.57	13.69	2.71
None	Feather	2.67	2.07	0.51	29.46	7.43	0.42
None	Feather	2.80	2.62	1.18	36.43	13.09	1.52
None	Feather	2.75	2.60	0.62	45.28	13.77	2.50
None	Feather	2.15	3.88	1.15	39.87	13.45	1.79
None	Feather	1.60	2.94	0.90	56.90	10.29	1.73
None	Feather	2.69	2.93	0.61	33.37	10.41	1.14
None	Feather	3.18	4.37	1.03	35.85	11.95	2.01

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	-1.791	-1.334	-0.380	-1.457	-1.755	-0.864
Master	Skilled	-0.345	-0.867	-0.295	-1.327	-1.130	-0.781
Master	Skilled	-0.068	-0.644	-0.492	-0.756	-0.233	-0.576
Master	Skilled	-0.137	0.152	-0.338	0.615	0.781	0.174
Master	Skilled	-0.889	-1.149	-0.460	-0.876	-1.626	-0.835
Master	Skilled	0.383	0.425	-0.519	0.188	0.004	-0.002
Master	Skilled	0.175	-0.797	-0.487	-0.902	-1.299	-0.762
Master	Skilled	0.325	-0.543	-0.130	-0.458	-0.120	-0.397
Master	Skilled	0.267	-0.552	-0.428	0.106	0.021	-0.071
Master	Skilled	-0.426	0.041	-0.146	-0.239	-0.046	-0.307
Master	Skilled	-1.062	-0.394	-0.279	0.847	-0.703	-0.327
Master	Skilled	0.198	-0.399	-0.433	-0.653	-0.678	-0.523
Master	Skilled	0.765	0.268	-0.210	-0.495	-0.358	-0.234

Knapper Code	Core Code	Reported Skill Level	Removal Type	Complete Piece (Y/N)	Platform Type	Platform Damage	Corrective Element (Y/N)
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	Crushing	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No
SF10	DE03	Master	Blade	Yes	Multi-faceted	None	No

Error Present	Termination Type	Proximal Thickness (mm)	Medial Thickness (mm)	Distal Thickness (mm)	Total Length (mm)	Total Width (mm)	Mass (g)
None	Feather	3.03	2.26	0.77	49.35	15.41	2.00
None	Feather	1.55	3.75	0.94	54.14	8.15	1.69
None	Feather	2.71	3.75	1.06	52.07	13.34	2.79
None	Feather	3.33	5.35	1.43	67.35	16.83	5.68
None	Feather	2.43	4.21	1.06	50.33	14.15	2.87
None	Feather	1.77	3.01	0.51	46.06	10.82	1.12
None	Feather	1.38	1.56	0.74	27.16	8.76	0.33
None	Feather	2.15	2.48	0.94	35.36	11.57	1.02

Assigned Skill	Skilled/ Unskilled	Z-Score Proximal Thickness	Z-Score Medial Thickness	Z-Score Distal Thickness	Z-Score Total Length	Z-Score Total Width	Z-Score Mass
Master	Skilled	0.591	-0.709	-0.348	0.366	0.363	-0.237
Master	Skilled	-1.120	-0.019	-0.258	0.671	-1.149	-0.340
Master	Skilled	0.221	-0.019	-0.194	0.539	-0.068	0.025
Master	Skilled	0.938	0.722	0.003	1.513	0.658	0.984
Master	Skilled	-0.103	0.194	-0.194	0.428	0.100	0.051
Master	Skilled	-0.866	-0.362	-0.487	0.156	-0.593	-0.529
Master	Skilled	-1.317	-1.033	-0.364	-1.049	-1.022	-0.791
Master	Skilled	-0.426	-0.607	-0.258	-0.526	-0.437	-0.562

Aggragate Analysis of Experimental Debitage						
Knapper Code	Core Code	Georgetown Flint Quality	Edwards Plateau Flint Quality	Reported Skill Level	Produced Core Count	Core Type
US1	A01	Fine		Novice	1	Incomplete flake core
US1	A02		Medium	Novice	1	Incomplete flake core
US1	A03		Fine	Novice	1	Incomplete flake core
US1	A04		Medium	Novice	2	Incomplete flake core
US1	A05		Medium	Novice	1	Incomplete flake core
US1	A06		Medium	Novice	1	Incomplete flake core
US1	A07	Fine		Novice	1	Exhausted flake core
US1	A08		Medium	Novice	1	Exhausted flake core
US1	A09		Medium	Novice	1	Incomplete flake core
US1	A10		Fine	Novice	1	Exhausted flake core
US2	B01	Fine		Novice	0	No core
US2	B01b	Fine		Novice	1	Incomplete flake core
US2	B02a		Fine	Novice	0	No core
US2	B02b		Fine	Novice	0	No core
US2	B02c		Fine	Novice	0	No core
US2	B02d		Fine	Novice	1	Incomplete flake core
US2	B03		Fine	Novice	1	Incomplete flake core
US2	B04a	Fine		Novice	0	No core
US2	B04b	Fine		Novice	0	No core
US2	B04c	Fine		Novice	0	No core
US2	B04d	Fine		Novice	1	Exhausted flake core
US2	B05		Medium	Novice	1	Incomplete flake core
US2	B06		Fine	Novice	1	Incomplete flake core
US2	B07a		Medium	Novice	0	No core
US2	B07b		Medium	Novice	1	Exhausted flake core
US3	C01	Fine		Novice	2	Incomplete flake core
US3	C01a	Fine		Novice	0	No core
US3	C01b	Fine		Novice	1	Incomplete flake core
US3	C02	Fine		Novice	1	Incomplete flake core
US3	C03		Medium	Novice	1	Incomplete flake core
US3	C04		Fine	Novice	1	Incomplete flake core
US3	C05		Fine	Novice	1	Incomplete flake core
US3	C06		Fine	Novice	1	Incomplete flake core
US3	C07a	Fine		Novice	1	Incomplete flake core
US3	C08	Fine		Novice	1	Exhausted flake core
US3	C09	Fine		Novice	1	Exhausted flake core
US3	C10	Fine		Novice	1	Exhausted flake core
US3	C11		Coarse	Novice	1	Prepared blade core
US3	C12	Fine		Novice	1	Exhausted flake core
US3	C13		Medium	Novice	1	Incomplete flake core
US4	D01	Fine		Novice	1	Exhausted flake core

Counts			Platform Preperation		Terminations			
Flakes N=	Blades N=	Core Trimming Elements N=	Single Faceted Platforms N=	Multi-Faceted Platforms N=	Feathered N=	Hinge N=	Step N=	Outrepasse N=
51	0	0	46	1	40	11	0	0
19	0	0	16	1	16	3	0	0
94	0	0	84	6	80	11	3	0
77	0	0	54	18	65	10	2	0
12	0	0	8	1	11	1	0	0
45	0	0	23	9	38	6	0	1
67	0	0	48	7	59	8	0	0
34	2	0	28	8	28	4	4	0
56	0	0	54	1	44	12	0	0
70	0	0	55	7	63	7	0	0
64	1	0	43	18	55	9	1	0
151	4	0	125	22	144	7	4	0
8	0	0	5	0	7	1	0	0
37	0	0	30	5	35	1	1	0
20	3	0	13	8	18	4	0	1
18	0	0	17	0	13	5	0	0
44	0	0	26	6	39	2	3	0
167	2	0	123	27	164	2	3	N/A
33	0	0	27	6	33	0	0	0
33	2	0	27	5	35	0	0	0
18	0	0	16	2	18	0	0	0
62	0	0	50	8	54	4	4	0
76	2	0	59	15	75	2	1	0
41	6	0	36	3	46	1	0	0
43	0	0	25	15	33	9	0	1
114	0	3	97	9	114	2	0	1
124	0	0	110	4	106	18	0	0
55	0	0	36	8	36	19	0	0
150	1	0	73	28	134	16	1	0
91	0	0	55	15	78	12	1	0
113	0	4	59	46	94	17	6	0
57	1	0	33	9	49	8	1	0
72	2	3	53	11	75	1	1	0
53	0	0	38	3	50	3	0	0
153	0	0	119	22	145	8	0	0
173	8	2	84	58	138	41	3	1
151	6	0	118	39	117	40	0	0
91	4	6	65	23	81	16	4	0
48	0	0	29	12	21	25	2	0
71	0	1	44	16	56	14	2	0
139	0	0	97	19	107	24	4	4

Platform Damage				Blade Regularity		
Battering N=	Crushing N=	Escelant de Bulb N=	Sequencial Blades (Y/N)	Irregular N=	Regular N=	Extremely Regular N=
5	3	0	No	0	0	0
9	0	0	No	0	0	0
12	0	0	No	0	0	0
14	5	0	No	0	0	0
1	0	0	No	0	0	0
6	1	0	No	0	0	0
15	3	0	No	0	0	0
6	0	0	No	2	0	0
16	0	0	No	0	0	0
7	0	1	No	0	0	0
21	2	2	No	1	0	0
26	8	2	No	4	0	0
1	1	0	No	0	0	0
1	1	2	No	0	0	0
3	0	2	Yes	3	0	0
5	0	0	No	0	0	0
3	0	0	No	0	0	0
15	12	3	No	2	0	0
1	1	0	No	0	0	0
0	0	0	No	2	0	0
0	0	1	No	0	0	0
14	0	0	No	0	0	0
6	0	0	Yes	1	1	0
8	1	0	Yes	4	2	0
10	0	0	No	0	0	0
6	1	1	No	0	0	0
26	2	3	No	0	0	0
25	6	0	No	0	0	0
30	0	0	No	0	0	0
15	0	2	No	0	0	0
5	0	1	No	0	0	0
6	3	0	No	0	1	0
11	0	0	No	1	1	0
7	1	0	No	0	0	0
11	3	1	No	0	0	0
42	4	1	Yes	6	2	0
43	3	0	No	0	0	0
16	7	2	Yes	4	0	0
5	0	0	No	0	0	0
13	4	1	No	0	0	0
14	1	1	No	0	0	0

Z-Scores			Platform Preperation		Terminations	
Z-Score Flakes	Z-Score Blades	Z-Score Core Trimming Elements	Z-Score Single Faceted	Z-Score Multi-Faceted	Z-Score Feathered	Z-Score Hinge
-0.456	-0.469	-0.562	-0.153	-0.547	-0.563	0.104
-1.114	-0.469	-0.562	-1.071	-0.547	-1.061	-0.764
0.429	-0.469	-0.562	1.011	-0.364	0.265	0.104
0.079	-0.469	-0.562	0.092	0.076	-0.046	-0.005
-1.258	-0.469	-0.562	-1.316	-0.547	-1.164	-0.980
-0.579	-0.469	-0.562	-0.857	-0.254	-0.605	-0.438
-0.126	-0.469	-0.562	-0.092	-0.327	-0.170	-0.221
-0.805	-0.242	-0.562	-0.704	-0.291	-0.812	-0.655
-0.353	-0.469	-0.562	0.092	-0.547	-0.481	0.212
-0.065	-0.469	-0.562	0.123	-0.327	-0.087	-0.330
-0.188	-0.356	-0.562	-0.245	0.076	-0.253	-0.113
1.602	-0.016	-0.562	2.266	0.222	1.591	-0.330
-1.340	-0.469	-0.562	-1.408	-0.584	-1.247	-0.980
-0.744	-0.469	-0.562	-0.643	-0.400	-0.667	-0.980
-1.093	-0.129	-0.562	-1.163	-0.291	-1.019	-0.655
-1.134	-0.469	-0.562	-1.041	-0.584	-1.123	-0.547
-0.600	-0.469	-0.562	-0.765	-0.364	-0.584	-0.872
1.931	-0.242	-0.562	2.205	0.405	2.005	-0.872
-0.826	-0.469	-0.562	-0.734	-0.364	-0.708	-1.089
-0.826	-0.242	-0.562	-0.734	-0.400	-0.667	-1.089
-1.134	-0.469	-0.562	-1.071	-0.510	-1.019	-1.089
-0.229	-0.469	-0.562	-0.030	-0.291	-0.273	-0.655
0.059	-0.242	-0.562	0.245	-0.034	0.162	-0.872
-0.661	0.210	-0.562	-0.459	-0.474	-0.439	-0.980
-0.620	-0.469	-0.562	-0.796	-0.034	-0.708	-0.113
0.840	-0.469	0.147	1.409	-0.254	0.970	-0.872
1.046	-0.469	-0.562	1.807	-0.437	0.804	0.863
-0.373	-0.469	-0.562	-0.459	-0.291	-0.646	0.971
1.581	-0.356	-0.562	0.674	0.442	1.384	0.646
0.367	-0.469	-0.562	0.123	-0.034	0.224	0.212
0.820	-0.469	0.384	0.245	1.101	0.555	0.754
-0.332	-0.356	-0.562	-0.551	-0.254	-0.377	-0.221
-0.024	-0.242	0.147	0.062	-0.181	0.162	-0.980
-0.414	-0.469	-0.562	-0.398	-0.474	-0.356	-0.764
1.643	-0.469	-0.562	2.082	0.222	1.612	-0.221
2.054	0.437	-0.089	1.011	1.540	1.467	3.357
1.602	0.210	-0.562	2.052	0.844	1.032	3.248
0.367	-0.016	0.857	0.429	0.259	0.286	0.646
-0.517	-0.469	-0.562	-0.673	-0.144	-0.957	1.622
-0.044	-0.469	-0.326	-0.214	0.002	-0.232	0.429
1.355	-0.469	-0.562	1.409	0.112	0.825	1.513

Terminations		Platform Damage		Blade Regularity		
Z-Score Step	Z-Score Outrepasse	Z-Score Battering	Z-Score Crushing	Z-Score Irregular	Z-Score Regular	Z-Score Extremely Regular
-0.891	-0.672	-0.323	0.528	-0.595	-0.389	-0.251
-0.891	-0.672	0.210	-0.835	-0.595	-0.389	-0.251
0.919	-0.672	0.610	-0.835	-0.595	-0.389	-0.251
0.316	-0.672	0.877	1.437	-0.595	-0.389	-0.251
-0.891	-0.672	-0.857	-0.835	-0.595	-0.389	-0.251
-0.891	0.274	-0.190	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	1.010	0.528	-0.595	-0.389	-0.251
1.523	-0.672	-0.190	-0.835	0.186	-0.389	-0.251
-0.891	-0.672	1.144	-0.835	-0.595	-0.389	-0.251
-0.891	-0.672	-0.057	-0.835	-0.595	-0.389	-0.251
-0.288	-0.672	1.811	0.074	-0.204	-0.389	-0.251
1.523	-0.672	2.478	2.800	0.967	-0.389	-0.251
-0.891	-0.672	-0.857	-0.381	-0.595	-0.389	-0.251
-0.288	-0.672	-0.857	-0.381	-0.595	-0.389	-0.251
-0.891	0.274	-0.590	-0.835	0.577	-0.389	-0.251
-0.891	-0.672	-0.323	-0.835	-0.595	-0.389	-0.251
0.919	-0.672	-0.590	-0.835	-0.595	-0.389	-0.251
0.919	N/A	1.010	4.618	0.186	-0.389	-0.251
-0.891	-0.672	-0.857	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	-0.990	-0.835	0.186	-0.389	-0.251
-0.891	-0.672	-0.990	-0.835	-0.595	-0.389	-0.251
1.523	-0.672	0.877	-0.835	-0.595	-0.389	-0.251
-0.288	-0.672	-0.190	-0.835	-0.204	-0.166	-0.251
-0.891	-0.672	0.077	-0.381	0.967	0.057	-0.251
-0.891	0.274	0.344	-0.835	-0.595	-0.389	-0.251
-0.891	0.274	-0.190	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	2.478	0.074	-0.595	-0.389	-0.251
-0.891	-0.672	2.344	1.892	-0.595	-0.389	-0.251
-0.288	-0.672	3.011	-0.835	-0.595	-0.389	-0.251
-0.288	-0.672	1.010	-0.835	-0.595	-0.389	-0.251
2.730	-0.672	-0.323	-0.835	-0.595	-0.389	-0.251
-0.288	-0.672	-0.190	0.528	-0.595	-0.166	-0.251
-0.288	-0.672	0.477	-0.835	-0.204	-0.166	-0.251
-0.891	-0.672	-0.057	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	0.477	0.528	-0.595	-0.389	-0.251
0.919	0.274	4.612	0.983	1.748	0.057	-0.251
-0.891	-0.672	4.745	0.528	-0.595	-0.389	-0.251
1.523	-0.672	1.144	2.346	0.967	-0.389	-0.251
0.316	-0.672	-0.323	-0.835	-0.595	-0.389	-0.251
0.316	-0.672	0.744	0.983	-0.595	-0.389	-0.251
1.523	3.113	0.877	-0.381	-0.595	-0.389	-0.251

Clustering Analysis			
K-Means Cluster (3 Clusters)	K-Means Cluster Distance From Center	Two-Step Cluster Analysis	K-Means Cluster (2 Clusters)
Novice	1.195	Unskilled	Unskilled
Novice	1.467	Unskilled	Unskilled
Novice	1.453	Unskilled	Unskilled
Novice	1.808	Unskilled	Unskilled
Novice	1.843	Unskilled	Unskilled
Novice	1.113	Unskilled	Unskilled
Novice	1.443	Unskilled	Unskilled
Novice	2.007	Unskilled	Unskilled
Novice	1.655	Unskilled	Unskilled
Novice	1.274	Unskilled	Unskilled
Novice	1.811	Unskilled	Unskilled
Novice	4.302	Unskilled	Unskilled
Novice	1.702	Unskilled	Unskilled
Novice	1.483	Unskilled	Unskilled
Novice	1.761	Unskilled	Unskilled
Novice	1.429	Unskilled	Unskilled
Novice	1.738	Unskilled	Unskilled
Novice	5.007	N/A	Unskilled
Novice	1.742	Unskilled	Unskilled
Novice	1.997	Unskilled	Unskilled
Novice	1.967	Unskilled	Unskilled
Novice	2.103	Unskilled	Unskilled
Novice	1.303	Unskilled	Unskilled
Novice	1.983	Unskilled	Unskilled
Novice	1.279	Unskilled	Unskilled
Novice	1.370	Unskilled	Unskilled
Novice	2.717	Unskilled	Unskilled
Novice	3.262	Unskilled	Unskilled
Novice	3.221	Unskilled	Unskilled
Novice	1.357	Unskilled	Unskilled
Novice	3.418	Unskilled	Unskilled
Novice	0.826	Unskilled	Unskilled
Novice	1.416	Unskilled	Unskilled
Novice	1.266	Unskilled	Unskilled
Novice	1.277	Unskilled	Unskilled
Novice	6.495	Unskilled	Unskilled
Novice	5.922	Unskilled	Unskilled
Novice	3.614	Unskilled	Unskilled
Novice	1.957	Unskilled	Unskilled
Novice	1.416	Unskilled	Unskilled
Novice	2.442	Unskilled	Unskilled

Aggragate Analysis of Experimental Debitage						
Knapper Code	Core Code	Georgetown Flint Quality	Edwards Plateau Flint Quality	Reported Skill Level	Produced Core Count	Core Type
US4	D02	Fine		Novice	1	Exhausted flake core
US4	D03	Fine		Novice	1	Incomplete flake core
US4	D04	Fine		Novice	2	Incomplete flake core
US4	D05	Fine		Novice	1	Incomplete flake core
US4	D06	Fine		Novice	1	Prepared blade core
US4	D07	Fine		Novice	1	Exhausted flake core
US4	D08	Fine		Novice	1	Exhausted flake core
US4	D09	Fine		Novice	2	Incomplete flake core
US4	D10	Fine		Novice	1	Exhausted flake core
US4	D11	Fine		Novice	1	Exhausted flake core
US4	D12	Fine		Novice	1	Incomplete flake core
US5	E01	Fine		Novice	1	Incomplete flake core
US5	E02		Medium	Novice	2	Incomplete flake core
US5	E03		Fine	Novice	0	No core
US5	E03a		Fine	Novice	1	Incomplete flake core
US5	E04		Fine	Novice	1	Incomplete flake core
US5	E05		Medium	Novice	1	Incomplete flake core
US5	E06	Fine		Novice	1	Incomplete flake core
US5	E07		Fine	Novice	1	Exhausted flake core
US5	E08		Medium	Novice	1	Exhausted flake core
US5	E09	Fine		Novice	1	Exhausted flake core
US5	E10a		Medium	Novice	0	No core
US5	E10b		Medium	Novice	1	Incomplete flake core
US5	E11		Fine	Novice	0	No core
US6	F01		Medium	Novice	1	Incomplete flake core
US6	F02	Fine		Novice	1	Exhausted flake core
US6	F03	Fine		Novice	1	Incomplete flake core
US6	F04	Fine		Novice	1	Incomplete flake core
US6	F05	Fine		Novice	1	Incomplete flake core
US6	F06		Fine	Novice	1	Incomplete flake core
US6	F07	Fine		Novice	2	Incomplete flake core
US6	F08	Fine		Novice	1	Exhausted flake core
US6	F09	Fine		Novice	2	Exhausted flake core
US6	F10		Medium	Novice	2	Incomplete flake core
US6	F11	Fine		Novice	1	Exhausted flake core
US6	F12	Fine		Novice	0	No core
US6	F13		Fine	Novice	1	Incomplete flake core
US7	G02		Fine	Novice	1	Incomplete flake core
US7	G03		Fine	Novice	1	Incomplete flake core
US7	G04	Fine		Novice	1	Incomplete flake core
US7	G05	Medium		Novice	1	Incomplete flake core

Counts			Platform Preperation		Terminations			
Flakes N=	Blades N=	Core Trimming Elements N=	Single Faceted Platforms N=	Multi-Faceted Platforms N=	Feathered N=	Hinge N=	Step N=	Outrepasse N=
89	1	4	57	12	82	7	2	3
58	0	4	39	8	31	27	1	3
95	1	0	49	19	75	13	4	4
130	3	2	58	32	109	22	1	3
82	3	4	59	17	64	23	0	2
74	2	6	41	6	69	10	0	3
69	1	3	40	7	64	6	1	2
198	8	10	128	35	187	25	0	4
184	11	16	133	50	173	34	3	1
123	3	5	84	15	112	13	3	3
126	0	2	74	14	107	16	4	1
146	0	0	112	10	117	21	5	3
68	0	0	45	2	58	6	4	0
21	0	0	19	1	14	6	1	0
16	0	0	9	0	10	4	1	1
132	0	0	121	3	106	24	2	0
60	0	0	41	0	47	10	3	0
55	0	0	41	3	41	12	2	0
52	0	0	38	3	43	8	1	0
88	0	0	56	5	75	13	0	0
178	1	0	148	9	139	36	4	0
17	0	1	15	2	16	2	0	0
58	0	3	40	10	47	14	0	0
24	0	4	18	4	22	4	0	2
44	0	1	44	0	40	5	0	0
135	0	3	105	10	92	45	0	1
124	0	3	101	7	98	29	0	0
95	0	1	85	3	72	24	0	0
113	1	0	87	6	87	24	1	2
19	0	0	17	0	14	5	0	0
75	0	9	71	6	59	21	1	3
139	0	12	109	17	108	41	0	2
99	1	1	76	18	75	24	0	2
129	1	1	114	7	99	29	3	0
136	1	1	122	7	101	33	2	2
124	0	0	76	20	99	25	0	0
41	3	0	23	14	28	14	1	1
30	0	0	28	1	27	2	1	0
20	0	0	17	0	19	1	0	0
75	0	0	66	4	65	9	0	1
37	0	0	30	5	27	5	5	0

Platform Damage				Blade Regularity		
Battering N=	Crushing N=	Escelant de Bulb N=	Sequencial Blades (Y/N)	Irregular N=	Regular N=	Extremely Regular N=
18	5	0	No	1	0	0
13	4	0	No	0	0	0
16	2	0	No	1	0	0
14	6	3	No	3	0	0
18	1	0	No	1	2	0
7	2	2	No	2	0	0
8	1	1	No	1	0	0
17	2	1	Yes	4	4	0
23	6	3	No	6	4	0
11	5	2	No	3	0	0
10	3	4	No	0	0	0
24	9	1	No	0	0	0
5	1	1	No	0	0	0
0	0	0	No	0	0	0
1	0	0	No	0	0	0
15	3	0	No	0	0	0
13	3	1	No	0	0	0
9	0	0	No	0	0	0
8	1	0	No	0	0	0
20	0	1	No	0	0	0
31	4	4	No	0	1	0
3	1	0	No	0	0	0
8	1	0	No	0	0	0
1	2	1	No	0	0	0
12	0	0	No	0	0	0
10	3	3	No	0	0	0
4	1	1	No	0	0	0
3	0	1	No	0	0	0
8	7	4	No	1	0	0
2	0	0	No	0	0	0
10	2	3	No	0	0	0
17	2	2	No	0	0	0
14	3	2	No	1	0	0
7	0	2	No	1	0	0
17	2	1	No	1	0	0
8	0	0	No	0	0	0
4	1	1	No	3	0	0
1	0	0	No	0	0	0
1	1	0	No	0	0	0
6	5	2	No	0	0	0
2	1	1	No	0	0	0

Z-Scores			Platform Preperation		Terminations	
Z-Score Flakes	Z-Score Blades	Z-Score Core Trimming Elements	Z-Score Single Faceted	Z-Score Multi-Faceted	Z-Score Feathered	Z-Score Hinge
0.326	-0.356	0.384	0.184	-0.144	0.307	-0.330
-0.312	-0.469	0.384	-0.367	-0.291	-0.750	1.839
0.450	-0.356	-0.562	-0.061	0.112	0.162	0.321
1.170	-0.129	-0.089	0.215	0.588	0.866	1.297
0.182	-0.129	0.384	0.245	0.039	-0.066	1.405
0.018	-0.242	0.857	-0.306	-0.364	0.037	-0.005
-0.085	-0.356	0.147	-0.336	-0.327	-0.066	-0.438
2.568	0.437	1.803	2.358	0.698	2.482	1.622
2.280	0.777	3.222	2.511	1.247	2.192	2.598
1.026	-0.129	0.620	1.011	-0.034	0.928	0.321
1.087	-0.469	-0.089	0.705	-0.071	0.825	0.646
1.499	-0.469	-0.562	1.868	-0.217	1.032	1.188
-0.106	-0.469	-0.562	-0.183	-0.510	-0.191	-0.438
-1.073	-0.469	-0.562	-0.979	-0.547	-1.102	-0.438
-1.176	-0.469	-0.562	-1.286	-0.584	-1.185	-0.655
1.211	-0.469	-0.562	2.143	-0.474	0.804	1.513
-0.270	-0.469	-0.562	-0.306	-0.584	-0.418	-0.005
-0.373	-0.469	-0.562	-0.306	-0.474	-0.543	0.212
-0.435	-0.469	-0.562	-0.398	-0.474	-0.501	-0.221
0.306	-0.469	-0.562	0.153	-0.400	0.162	0.321
2.157	-0.356	-0.562	2.970	-0.254	1.487	2.815
-1.155	-0.469	-0.326	-1.102	-0.510	-1.061	-0.872
-0.312	-0.469	0.147	-0.336	-0.217	-0.418	0.429
-1.011	-0.469	0.384	-1.010	-0.437	-0.936	-0.655
-0.600	-0.469	-0.326	-0.214	-0.584	-0.563	-0.547
1.272	-0.469	0.147	1.654	-0.217	0.514	3.790
1.046	-0.469	0.147	1.531	-0.327	0.638	2.056
0.450	-0.469	-0.326	1.041	-0.474	0.099	1.513
0.820	-0.356	-0.562	1.103	-0.364	0.410	1.513
-1.114	-0.469	-0.562	-1.041	-0.584	-1.102	-0.547
0.038	-0.469	1.566	0.613	-0.364	-0.170	1.188
1.355	-0.469	2.276	1.776	0.039	0.845	3.357
0.532	-0.356	-0.326	0.766	0.076	0.162	1.513
1.149	-0.356	-0.326	1.929	-0.327	0.659	2.056
1.293	-0.356	-0.326	2.174	-0.327	0.700	2.489
1.046	-0.469	-0.562	0.766	0.149	0.659	1.622
-0.661	-0.129	-0.562	-0.857	-0.071	-0.812	0.429
-0.888	-0.469	-0.562	-0.704	-0.547	-0.833	-0.872
-1.093	-0.469	-0.562	-1.041	-0.584	-0.998	-0.980
0.038	-0.469	-0.562	0.460	-0.437	-0.046	-0.113
-0.744	-0.469	-0.562	-0.643	-0.400	-0.833	-0.547

Terminations		Platform Damage		Blade Regularity		
Z-Score Step	Z-Score Outrepasse	Z-Score Battering	Z-Score Crushing	Z-Score Irregular	Z-Score Regular	Z-Score Extremely Regular
0.316	2.166	1.411	1.437	-0.204	-0.389	-0.251
-0.288	2.166	0.744	0.983	-0.595	-0.389	-0.251
1.523	3.113	1.144	0.074	-0.204	-0.389	-0.251
-0.288	2.166	0.877	1.892	0.577	-0.389	-0.251
-0.891	1.220	1.411	-0.381	-0.204	0.057	-0.251
-0.891	2.166	-0.057	0.074	0.186	-0.389	-0.251
-0.288	1.220	0.077	-0.381	-0.204	-0.389	-0.251
-0.891	3.113	1.277	0.074	0.967	0.504	-0.251
0.919	0.274	2.077	1.892	1.748	0.504	-0.251
0.919	2.166	0.477	1.437	0.577	-0.389	-0.251
1.523	0.274	0.344	0.528	-0.595	-0.389	-0.251
2.127	2.166	2.211	3.255	-0.595	-0.389	-0.251
1.523	-0.672	-0.323	-0.381	-0.595	-0.389	-0.251
-0.288	-0.672	-0.990	-0.835	-0.595	-0.389	-0.251
-0.288	0.274	-0.857	-0.835	-0.595	-0.389	-0.251
0.316	-0.672	1.010	0.528	-0.595	-0.389	-0.251
0.919	-0.672	0.744	0.528	-0.595	-0.389	-0.251
0.316	-0.672	0.210	-0.835	-0.595	-0.389	-0.251
-0.288	-0.672	0.077	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	1.677	-0.835	-0.595	-0.389	-0.251
1.523	-0.672	3.144	0.983	-0.595	-0.166	-0.251
-0.891	-0.672	-0.590	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	0.077	-0.381	-0.595	-0.389	-0.251
-0.891	1.220	-0.857	0.074	-0.595	-0.389	-0.251
-0.891	-0.672	0.610	-0.835	-0.595	-0.389	-0.251
-0.891	0.274	0.344	0.528	-0.595	-0.389	-0.251
-0.891	-0.672	-0.457	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	-0.590	-0.835	-0.595	-0.389	-0.251
-0.288	1.220	0.077	2.346	-0.204	-0.389	-0.251
-0.891	-0.672	-0.723	-0.835	-0.595	-0.389	-0.251
-0.288	2.166	0.344	0.074	-0.595	-0.389	-0.251
-0.891	1.220	1.277	0.074	-0.595	-0.389	-0.251
-0.891	1.220	0.877	0.528	-0.204	-0.389	-0.251
0.919	-0.672	-0.057	-0.835	-0.204	-0.389	-0.251
0.316	1.220	1.277	0.074	-0.204	-0.389	-0.251
-0.891	-0.672	0.077	-0.835	-0.595	-0.389	-0.251
-0.288	0.274	-0.457	-0.381	0.577	-0.389	-0.251
-0.288	-0.672	-0.857	-0.835	-0.595	-0.389	-0.251
-0.891	-0.672	-0.857	-0.381	-0.595	-0.389	-0.251
-0.891	0.274	-0.190	1.437	-0.595	-0.389	-0.251
2.127	-0.672	-0.723	-0.381	-0.595	-0.389	-0.251

Clustering Analysis			
K-Means Cluster (3 Clusters)	K-Means Cluster Distance From Center	Two-Step Cluster Analysis	K-Means Cluster (2 Clusters)
Novice	2.153	Unskilled	Unskilled
Novice	2.336	Unskilled	Unskilled
Novice	2.013	Unskilled	Unskilled
Novice	2.778	Unskilled	Unskilled
Novice	2.296	Unskilled	Unskilled
Novice	1.491	Unskilled	Unskilled
Novice	0.731	Unskilled	Unskilled
Intermediate	3.246	Unskilled	Unskilled
Intermediate	4.996	Skilled	Unskilled
Novice	2.258	Unskilled	Unskilled
Novice	1.882	Unskilled	Unskilled
Novice	4.672	Unskilled	Unskilled
Novice	1.806	Unskilled	Unskilled
Novice	1.512	Unskilled	Unskilled
Novice	1.507	Unskilled	Unskilled
Novice	1.969	Unskilled	Unskilled
Novice	1.422	Unskilled	Unskilled
Novice	1.041	Unskilled	Unskilled
Novice	0.661	Unskilled	Unskilled
Novice	2.039	Unskilled	Unskilled
Novice	4.596	Unskilled	Unskilled
Novice	1.464	Unskilled	Unskilled
Novice	1.120	Unskilled	Unskilled
Novice	1.591	Unskilled	Unskilled
Novice	1.438	Unskilled	Unskilled
Novice	3.971	Unskilled	Unskilled
Novice	2.371	Unskilled	Unskilled
Novice	2.056	Unskilled	Unskilled
Novice	2.855	Unskilled	Unskilled
Novice	1.591	Unskilled	Unskilled
Novice	2.240	Unskilled	Unskilled
Novice	4.482	Unskilled	Unskilled
Novice	2.020	Unskilled	Unskilled
Novice	2.436	Unskilled	Unskilled
Novice	2.802	Unskilled	Unskilled
Novice	2.085	Unskilled	Unskilled
Novice	1.272	Unskilled	Unskilled
Novice	1.605	Unskilled	Unskilled
Novice	1.702	Unskilled	Unskilled
Novice	1.772	Unskilled	Unskilled
Novice	2.471	Unskilled	Unskilled

Aggragate Analysis of Experimental Debitage						
Knapper Code	Core Code	Georgetown Flint Quality	Edwards Plateau Flint Quality	Reported Skill Level	Produced Core Count	Core Type
US7	G06	Fine		Novice	1	Incomplete flake core
US7	G07	Fine		Novice	1	Incomplete flake core
US7	G08	Fine		Novice	1	Incomplete flake core
US7	G09	Medium		Novice	1	Incomplete flake core
US7	G10		Medium	Novice	1	Incomplete flake core
US7	G11	Fine		Novice	1	Incomplete flake core
US8	H01	Fine		Novice	1	Incomplete flake core
US8	H02	Fine		Novice	1	Exhausted flake core
US8	H03	Fine		Novice	1	Exhausted flake core
US8	H04		Medium	Novice	1	Exhausted flake core
US8	H05	Coarse		Novice	1	Incomplete flake core
US8	H06	Medium		Novice	2	Exhausted flake core
US8	H07		Fine	Novice	1	Exhausted flake core
US8	H08		Fine	Novice	1	Exhausted flake core
US8	H09		Fine	Novice	1	Exhausted flake core
US8	H10		Fine	Novice	1	Exhausted flake core
US8	H11a	Fine		Novice	1	Prepared blade core
US8	H11b	Fine		Novice	0	No core
US9	I01	Fine		Novice	1	Exhausted flake core
US9	I02	Medium		Novice	1	Incomplete flake core
US9	I03	Fine		Novice	1	Incomplete flake core
US9	I04	Medium		Novice	1	Incomplete flake core
US9	I05		Fine	Novice	1	Incomplete flake core
US9	I06		Fine	Novice	1	Incomplete flake core
US9	I07	Fine		Novice	1	Incomplete flake core
US9	I08	Fine		Novice	1	Exhausted flake core
US9	I09	Fine		Novice	1	Exhausted flake core
US9	I10	Fine		Novice	1	Prepared blade core
US9	I11	Fine		Novice	1	Incomplete flake core
US10	J01	Medium		Novice	1	Incomplete flake core
US10	J01a	Medium		Novice	1	Incomplete flake core
US10	J02		Fine	Novice	1	Incomplete flake core
US10	J03		Fine	Novice	1	Incomplete flake core
US10	J04			Novice	1	Incomplete flake core
US10	J05		Fine	Novice	1	Incomplete flake core
US10	J06	Fine		Novice	1	Prepared blade core
US10	J06a	Fine		Novice	1	Exhausted flake core
US10	J07	Fine		Novice	1	Incomplete flake core
US10	J08	Fine		Novice	1	Incomplete flake core
US10	J09	Fine		Novice	1	Incomplete flake core
US11	K01	Fine		Novice	1	Incomplete flake core

Counts			Platform Preperation		Terminations			
Flakes N=	Blades N=	Core Trimming Elements N=	Single Faceted Platforms N=	Multi-Faceted Platforms N=	Feathered N=	Hinge N=	Step N=	Outrepasse N=
36	0	0	36	0	30	4	0	2
16	0	0	16	0	14	2	0	0
23	0	0	19	1	19	2	2	0
28	0	1	29	0	22	7	0	0
39	0	0	33	2	35	2	2	0
7	0	0	7	0	7	0	0	0
127	0	0	110	2	98	25	4	0
102	0	2	2	4	96	7	0	1
104	0	0	88	2	93	10	1	0
71	0	1	61	4	59	6	6	1
85	1	0	77	7	78	5	3	0
33	0	1	32	1	28	2	1	3
69	0	0	61	3	64	4	1	0
73	2	1	70	2	54	14	7	1
41	0	3	43	1	41	3	0	0
72	1	0	68	2	68	5	0	0
48	1	2	38	9	40	10	0	1
74	1	1	62	4	59	17	0	0
43	0	0	43	0	31	10	1	1
62	0	1	58	0	48	12	3	0
159	1	2	157	6	132	29	1	0
29	0	0	29	0	27	1	1	0
32	0	0	32	0	30	2	0	0
32	1	0	29	3	28	4	1	0
75	1	0	70	2	57	19	0	0
86	1	0	77	7	72	12	1	2
122	2	0	111	4	95	28	1	0
30	1	0	30	1	23	6	1	1
93	1	1	89	4	79	14	0	2
26	0	0	25	1	16	10	0	0
24	0	0	22	0	20	4	0	0
13	0	0	13	0	12	1	0	0
23	0	0	23	0	21	2	0	0
71	0	2	66	3	64	6	3	0
28	0	0	26	1	27	0	1	0
53	3	3	45	8	46	10	2	1
91	3	0	87	4	75	16	2	1
67	0	0	51	10	45	15	7	0
57	1	0	51	6	53	5	0	0
66	2	0	62	5	58	8	1	1
70	0	1	63	2	59	8	2	2

Platform Damage				Blade Regularity		
Battering N=	Crushing N=	Escelant de Bulb N=	Sequencial Blades (Y/N)	Irregular N=	Regular N=	Extremely Regular N=
1	1	0	No	0	0	0
1	0	0	No	0	0	0
0	0	0	No	0	0	0
3	2	1	No	0	0	0
5	0	0	No	0	0	0
0	0	0	No	0	0	0
20	5	0	No	0	0	0
8	4	2	No	0	0	0
7	2	3	No	0	0	0
3	1	1	No	0	0	0
9	4	1	No	0	1	0
2	1	1	No	0	0	0
4	0	3	No	0	0	0
3	1	1	No	1	1	0
4	0	0	No	0	0	0
10	0	0	No	1	0	0
2	2	0	No	1	0	0
6	1	1	No	1	0	0
4	1	0	No	0	0	0
3	1	0	No	0	0	0
27	0	0	No	0	0	0
4	0	0	No	0	0	0
7	1	0	No	0	0	0
4	1	0	No	0	0	0
11	1	1	No	1	0	0
14	4	0	No	1	0	0
13	5	1	No	2	0	0
2	1	1	No	1	0	0
9	2	1	No	1	0	0
11	2	0	No	0	0	0
6	1	1	No	0	0	0
3	0	0	No	0	0	0
1	2	0	No	0	0	0
2	2	0	No	0	0	0
0	1	0	No	0	0	0
11	1	2	No	3	0	0
8	2	0	Yes	3	0	0
7	1	0	No	0	0	0
2	0	0	No	0	1	0
7	0	0	No	2	0	0
3	0	2	No	0	0	0

Z-Scores			Platform Preperation		Terminations	
Z-Score Flakes	Z-Score Blades	Z-Score Core Trimming Elements	Z-Score Single Faceted	Z-Score Multi-Faceted	Z-Score Feathered	Z-Score Hinge
-0.764	-0.469	-0.562	-0.459	-0.584	-0.771	-0.655
-1.176	-0.469	-0.562	-1.071	-0.584	-1.102	-0.872
-1.032	-0.469	-0.562	-0.979	-0.547	-0.998	-0.872
-0.929	-0.469	-0.326	-0.673	-0.584	-0.936	-0.330
-0.702	-0.469	-0.562	-0.551	-0.510	-0.667	-0.872
-1.361	-0.469	-0.562	-1.347	-0.584	-1.247	-1.089
1.108	-0.469	-0.562	1.807	-0.510	0.638	1.622
0.594	-0.469	-0.089	-1.500	-0.437	0.597	-0.330
0.635	-0.469	-0.562	1.133	-0.510	0.534	-0.005
-0.044	-0.469	-0.326	0.306	-0.437	-0.170	-0.438
0.244	-0.356	-0.562	0.796	-0.327	0.224	-0.547
-0.826	-0.469	-0.326	-0.581	-0.547	-0.812	-0.872
-0.085	-0.469	-0.562	0.306	-0.474	-0.066	-0.655
-0.003	-0.242	-0.326	0.582	-0.510	-0.273	0.429
-0.661	-0.469	0.147	-0.245	-0.547	-0.543	-0.764
-0.024	-0.356	-0.562	0.521	-0.510	0.017	-0.547
-0.517	-0.356	-0.089	-0.398	-0.254	-0.563	-0.005
0.018	-0.356	-0.326	0.337	-0.437	-0.170	0.754
-0.620	-0.469	-0.562	-0.245	-0.584	-0.750	-0.005
-0.229	-0.469	-0.326	0.215	-0.584	-0.398	0.212
1.766	-0.356	-0.089	3.246	-0.364	1.342	2.056
-0.908	-0.469	-0.562	-0.673	-0.584	-0.833	-0.980
-0.846	-0.469	-0.562	-0.581	-0.584	-0.771	-0.872
-0.846	-0.356	-0.562	-0.673	-0.474	-0.812	-0.655
0.038	-0.356	-0.562	0.582	-0.510	-0.211	0.971
0.264	-0.356	-0.562	0.796	-0.327	0.099	0.212
1.005	-0.242	-0.562	1.837	-0.437	0.576	1.947
-0.888	-0.356	-0.562	-0.643	-0.547	-0.916	-0.438
0.408	-0.356	-0.326	1.164	-0.437	0.244	0.429
-0.970	-0.469	-0.562	-0.796	-0.547	-1.061	-0.005
-1.011	-0.469	-0.562	-0.888	-0.584	-0.978	-0.655
-1.237	-0.469	-0.562	-1.163	-0.584	-1.143	-0.980
-1.032	-0.469	-0.562	-0.857	-0.584	-0.957	-0.872
-0.044	-0.469	-0.089	0.460	-0.474	-0.066	-0.438
-0.929	-0.469	-0.562	-0.765	-0.547	-0.833	-1.089
-0.414	-0.129	0.147	-0.183	-0.291	-0.439	-0.005
0.367	-0.129	-0.562	1.103	-0.437	0.162	0.646
-0.126	-0.469	-0.562	0.000	-0.217	-0.460	0.538
-0.332	-0.356	-0.562	0.000	-0.364	-0.294	-0.547
-0.147	-0.242	-0.562	0.337	-0.400	-0.191	-0.221
-0.065	-0.469	-0.326	0.368	-0.510	-0.170	-0.221

Terminations		Platform Damage		Blade Regularity		
Z-Score Step	Z-Score Outrepasse	Z-Score Battering	Z-Score Crushing	Z-Score Irregular	Z-Score Regular	Z-Score Extremely Regular
-0.891	1.220	-0.857	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	-0.857	-0.835	-0.595	-0.389	-0.251
0.316	-0.672	-0.990	-0.835	-0.595	-0.389	-0.251
-0.891	-0.672	-0.590	0.074	-0.595	-0.389	-0.251
0.316	-0.672	-0.323	-0.835	-0.595	-0.389	-0.251
-0.891	-0.672	-0.990	-0.835	-0.595	-0.389	-0.251
1.523	-0.672	1.677	1.437	-0.595	-0.389	-0.251
-0.891	0.274	0.077	0.983	-0.595	-0.389	-0.251
-0.288	-0.672	-0.057	0.074	-0.595	-0.389	-0.251
2.730	0.274	-0.590	-0.381	-0.595	-0.389	-0.251
0.919	-0.672	0.210	0.983	-0.595	-0.166	-0.251
-0.288	2.166	-0.723	-0.381	-0.595	-0.389	-0.251
-0.288	-0.672	-0.457	-0.835	-0.595	-0.389	-0.251
3.334	0.274	-0.590	-0.381	-0.204	-0.166	-0.251
-0.891	-0.672	-0.457	-0.835	-0.595	-0.389	-0.251
-0.891	-0.672	0.344	-0.835	-0.204	-0.389	-0.251
-0.891	0.274	-0.723	0.074	-0.204	-0.389	-0.251
-0.891	-0.672	-0.190	-0.381	-0.204	-0.389	-0.251
-0.288	0.274	-0.457	-0.381	-0.595	-0.389	-0.251
0.919	-0.672	-0.590	-0.381	-0.595	-0.389	-0.251
-0.288	-0.672	2.611	-0.835	-0.595	-0.389	-0.251
-0.288	-0.672	-0.457	-0.835	-0.595	-0.389	-0.251
-0.891	-0.672	-0.057	-0.381	-0.595	-0.389	-0.251
-0.288	-0.672	-0.457	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	0.477	-0.381	-0.204	-0.389	-0.251
-0.288	1.220	0.877	0.983	-0.204	-0.389	-0.251
-0.288	-0.672	0.744	1.437	0.186	-0.389	-0.251
-0.288	0.274	-0.723	-0.381	-0.204	-0.389	-0.251
-0.891	1.220	0.210	0.074	-0.204	-0.389	-0.251
-0.891	-0.672	0.477	0.074	-0.595	-0.389	-0.251
-0.891	-0.672	-0.190	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	-0.590	-0.835	-0.595	-0.389	-0.251
-0.891	-0.672	-0.857	0.074	-0.595	-0.389	-0.251
0.919	-0.672	-0.723	0.074	-0.595	-0.389	-0.251
-0.288	-0.672	-0.990	-0.381	-0.595	-0.389	-0.251
0.316	0.274	0.477	-0.381	0.577	-0.389	-0.251
0.316	0.274	0.077	0.074	0.577	-0.389	-0.251
3.334	-0.672	-0.057	-0.381	-0.595	-0.389	-0.251
-0.891	-0.672	-0.723	-0.835	-0.595	-0.166	-0.251
-0.288	0.274	-0.057	-0.835	0.186	-0.389	-0.251
0.316	1.220	-0.590	-0.835	-0.595	-0.389	-0.251

Clustering Analysis			
K-Means Cluster (3 Clusters)	K-Means Cluster Distance From Center	Two-Step Cluster Analysis	K-Means Cluster (2 Clusters)
Novice	1.540	Unskilled	Unskilled
Novice	1.794	Unskilled	Unskilled
Novice	1.718	Unskilled	Unskilled
Novice	1.198	Unskilled	Unskilled
Novice	1.394	Unskilled	Unskilled
Novice	1.977	Unskilled	Unskilled
Novice	3.188	Unskilled	Unskilled
Novice	1.402	Unskilled	Unskilled
Novice	0.567	Unskilled	Unskilled
Novice	2.958	Unskilled	Unskilled
Novice	1.590	Unskilled	Unskilled
Novice	1.318	Unskilled	Unskilled
Novice	1.274	Unskilled	Unskilled
Novice	3.533	Unskilled	Unskilled
Novice	1.584	Unskilled	Unskilled
Novice	1.348	Unskilled	Unskilled
Novice	1.175	Unskilled	Unskilled
Novice	1.221	Unskilled	Unskilled
Novice	0.860	Unskilled	Unskilled
Novice	1.345	Unskilled	Unskilled
Novice	3.384	Unskilled	Unskilled
Novice	1.484	Unskilled	Unskilled
Novice	1.354	Unskilled	Unskilled
Novice	1.042	Unskilled	Unskilled
Novice	1.435	Unskilled	Unskilled
Novice	1.366	Unskilled	Unskilled
Novice	2.618	Unskilled	Unskilled
Novice	1.084	Unskilled	Unskilled
Novice	0.965	Unskilled	Unskilled
Novice	1.047	Unskilled	Unskilled
Novice	1.249	Unskilled	Unskilled
Novice	1.728	Unskilled	Unskilled
Novice	1.610	Unskilled	Unskilled
Novice	1.416	Unskilled	Unskilled
Novice	1.657	Unskilled	Unskilled
Novice	1.194	Unskilled	Unskilled
Novice	1.241	Unskilled	Unskilled
Novice	3.499	Unskilled	Unskilled
Novice	1.565	Unskilled	Unskilled
Novice	1.054	Unskilled	Unskilled
Novice	1.204	Unskilled	Unskilled

Aggragate Analysis of Experimental Debitage						
Knapper Code	Core Code	Georgetown Flint Quality	Edwards Plateau Flint Quality	Reported Skill Level	Produced Core Count	Core Type
US11	K02		Medium	Novice	1	Incomplete flake core
US11	K02a		Medium	Novice	0	No core
US11	K03	Fine		Novice	1	Incomplete flake core
US11	K03a	Fine		Novice	0	No core
US11	K04	Fine		Novice	1	Exhausted flake core
US11	K05	Fine		Novice	2	Incomplete flake core
US11	K06		Fine	Novice	1	Exhausted flake core
US11	K07		Medium	Novice	1	Incomplete flake core
US11	K08		Medium	Novice	1	Incomplete flake core
US11	K08a		Medium	Novice	0	No core
US11	K09	Fine		Novice	1	Incomplete flake core
US12	L01	Fine		Novice	1	Incomplete flake core
US12	L02	Fine		Novice	1	Incomplete flake core
US12	L03	Fine		Novice	1	Prepared blade core
US12	L04		Medium	Novice	1	Incomplete flake core
US12	L05	Fine		Novice	1	Incomplete flake core
US12	L06		Medium	Novice	1	Prepared blade core
US12	L07a		Fine	Novice	1	Incomplete flake core
US12	L07b		Fine	Novice	1	Incomplete flake core
US12	L08a		Medium	Novice	1	Incomplete flake core
US12	L08b		Medium	Novice	1	Incomplete flake core
US12	L08c		Coarse	Novice	1	Incomplete flake core
US12	L09			Novice	1	Incomplete flake core
US12	L10		Fine	Novice	1	Prepared blade core
US12	L11a	Fine		Novice	1	Prepared blade core
US12	L11b	Fine		Novice	1	Incomplete flake core
US13	PSK7-01	Fine		Novice	2	Exhausted flake core
US13	PSK7-02	Fine		Novice	2	Exhausted flake core
SF1	TB01	Fine		Master	1	Exhausted blade core
SF1	TB02	Fine		Master	1	Exhausted flake core
SF1	TB03	Fine		Master	1	Exhausted blade core
SF1	TB04	Fine		Master	1	Exhausted blade core
SF1	TB05		Fine	Master	1	Exhausted blade core
SF2	ZM01		Fine	Master	1	Exhausted blade core
SF2	ZM02		Coarse	Master	1	Incomplete flake core
SF2	ZM03		Coarse	Master	1	Exhausted blade core
SF2	ZM04		Coarse	Master	1	Exhausted blade core
SF2	ZM05		Coarse	Master	1	Prepared blade core
SF2	ZM06		Medium	Master	1	Prepared blade core
SF2	ZM07		Medium	Master	1	Exhausted blade core
SF2	ZM08		Fine	Master	1	Exhausted blade core

Counts			Platform Preperation		Terminations			
Flakes N=	Blades N=	Core Trimming Elements N=	Single Faceted Platforms N=	Multi-Faceted Platforms N=	Feathered N=	Hinge N=	Step N=	Outrepasse N=
33	0	0	32	1	31	2	0	0
15	0	0	15	0	15	0	0	0
93	0	0	86	2	79	12	2	0
52	0	1	46	1	35	18	0	0
81	1	1	77	3	71	11	1	0
84	1	4	82	3	78	8	3	0
46	2	0	46	1	42	5	1	0
35	0	0	32	0	30	2	3	0
60	0	0	49	7	55	3	2	0
13	0	0	6	5	11	2	0	0
22	1	0	21	0	21	2	0	0
106	2	2	98	9	98	10	2	0
59	1	4	57	5	57	5	2	0
105	2	4	83	16	100	7	1	3
46	0	0	34	5	38	6	1	1
36	2	5	38	4	35	6	1	1
67	6	6	46	27	69	4	5	1
67	0	0	45	19	62	2	1	2
64	0	2	49	11	59	4	3	0
51	2	3	42	10	43	11	2	0
44	1	1	40	4	38	4	4	0
43	1	3	35	9	41	3	3	0
119	2	1	92	17	94	24	4	0
141	0	3	96	30	131	10	3	0
95	5	2	75	25	90	8	3	1
115	6	1	109	21	112	8	2	0
91	4	1	37	16	80	14	2	0
90	7	2	43	12	91	7	1	0
70	31	33	28	90	117	17	0	0
114	35	19	57	73	151	13	1	3
55	26	8	24	48	83	4	1	1
138	34	21	61	99	173	14	4	2
131	38	13	30	125	153	26	3	0
47	18	8	24	28	65	3	1	4
10	9	3	6	10	19	1	0	2
18	6	2	4	11	23	1	1	1
19	6	7	14	6	28	1	2	1
108	24	12	29	34	135	5	1	3
18	17	4	11	23	34	3	1	1
30	10	4	20	21	38	3	1	2
22	5	4	13	12	28	1	1	1

Platform Damage				Blade Regularity		
Battering N=	Crushing N=	Escelant de Bulb N=	Sequencial Blades (Y/N)	Irregular N=	Regular N=	Extremely Regular N=
6	2	0	No	0	0	0
0	0	0	No	0	0	0
10	3	2	No	0	0	0
18	0	0	No	0	0	0
9	1	0	No	1	0	0
1	3	0	No	1	0	0
7	0	0	No	1	0	0
6	0	0	No	0	0	0
10	0	0	No	0	0	0
3	0	0	No	0	0	0
3	1	0	No	1	0	0
21	4	7	No	2	0	0
3	0	1	No	1	0	0
5	2	3	No	2	0	0
0	0	0	No	0	0	0
1	0	0	No	2	0	0
3	0	2	Yes	3	3	0
3	3	0	No	0	0	0
5	2	1	No	0	0	0
4	1	1	No	2	0	0
2	0	0	No	1	0	0
3	1	0	No	1	0	0
12	0	0	No	2	0	0
10	1	0	No	0	0	0
4	5	0	Yes	3	2	0
11	6	1	No	6	0	0
7	5	3	No	4	0	0
8	10	1	No	0	7	0
4	8	0	Yes	5	19	7
3	5	0	Yes	7	15	14
0	0	0	Yes	3	11	10
2	7	0	Yes	2	14	18
3	3	0	Yes	3	14	21
4	0	1	Yes	9	6	3
1	0	0	Yes	1	5	3
1	0	0	Yes	2	4	0
0	1	0	Yes	2	3	1
3	0	0	Yes	3	15	6
3	2	0	Yes	6	5	6
5	0	1	Yes	3	7	0
0	0	0	Yes	2	2	1

Z-Scores			Platform Preperation		Terminations	
Z-Score Flakes	Z-Score Blades	Z-Score Core Trimming Elements	Z-Score Single Faceted	Z-Score Multi-Faceted	Z-Score Feathered	Z-Score Hinge
-0.826	-0.469	-0.562	-0.581	-0.547	-0.750	-0.872
-1.196	-0.469	-0.562	-1.102	-0.584	-1.081	-1.089
0.408	-0.469	-0.562	1.072	-0.510	0.244	0.212
-0.435	-0.469	-0.326	-0.153	-0.547	-0.667	0.863
0.162	-0.356	-0.326	0.796	-0.474	0.079	0.104
0.223	-0.356	0.384	0.949	-0.474	0.224	-0.221
-0.558	-0.242	-0.562	-0.153	-0.547	-0.522	-0.547
-0.785	-0.469	-0.562	-0.581	-0.584	-0.771	-0.872
-0.270	-0.469	-0.562	-0.061	-0.327	-0.253	-0.764
-1.237	-0.469	-0.562	-1.377	-0.400	-1.164	-0.872
-1.052	-0.356	-0.562	-0.918	-0.584	-0.957	-0.872
0.676	-0.242	-0.089	1.439	-0.254	0.638	-0.005
-0.291	-0.356	0.384	0.184	-0.400	-0.211	-0.547
0.655	-0.242	0.384	0.980	0.002	0.679	-0.330
-0.558	-0.469	-0.562	-0.520	-0.400	-0.605	-0.438
-0.764	-0.242	0.620	-0.398	-0.437	-0.667	-0.438
-0.126	0.210	0.857	-0.153	0.405	0.037	-0.655
-0.126	-0.469	-0.562	-0.183	0.112	-0.108	-0.872
-0.188	-0.469	-0.089	-0.061	-0.181	-0.170	-0.655
-0.456	-0.242	0.147	-0.275	-0.217	-0.501	0.104
-0.600	-0.356	-0.326	-0.336	-0.437	-0.605	-0.655
-0.620	-0.356	0.147	-0.490	-0.254	-0.543	-0.764
0.943	-0.242	-0.326	1.256	0.039	0.555	1.513
1.396	-0.469	0.147	1.378	0.515	1.322	-0.005
0.450	0.097	-0.089	0.735	0.332	0.472	-0.221
0.861	0.210	-0.326	1.776	0.185	0.928	-0.221
0.367	-0.016	-0.326	-0.428	0.002	0.265	0.429
0.347	0.324	-0.089	-0.245	-0.144	0.493	-0.330
-0.065	3.041	7.242	-0.704	2.712	1.032	0.754
0.840	3.494	3.931	0.184	2.089	1.736	0.321
-0.373	2.475	1.330	-0.826	1.174	0.327	-0.655
1.334	3.381	4.404	0.306	3.041	2.192	0.429
1.190	3.834	2.512	-0.643	3.993	1.777	1.730
-0.538	1.569	1.330	-0.826	0.442	-0.046	-0.764
-1.299	0.550	0.147	-1.377	-0.217	-0.998	-0.980
-1.134	0.210	-0.089	-1.439	-0.181	-0.916	-0.980
-1.114	0.210	1.093	-1.132	-0.364	-0.812	-0.980
0.717	2.249	2.276	-0.673	0.661	1.405	-0.547
-1.134	1.456	0.384	-1.224	0.259	-0.688	-0.764
-0.888	0.663	0.384	-0.949	0.185	-0.605	-0.764
-1.052	0.097	0.384	-1.163	-0.144	-0.812	-0.980

Terminations		Platform Damage		Blade Regularity		
Z-Score Step	Z-Score Outrepasse	Z-Score Battering	Z-Score Crushing	Z-Score Irregular	Z-Score Regular	Z-Score Extremely Regular
-0.891	-0.672	-0.190	0.074	-0.595	-0.389	-0.251
-0.891	-0.672	-0.990	-0.835	-0.595	-0.389	-0.251
0.316	-0.672	0.344	0.528	-0.595	-0.389	-0.251
-0.891	-0.672	1.411	-0.835	-0.595	-0.389	-0.251
-0.288	-0.672	0.210	-0.381	-0.204	-0.389	-0.251
0.919	-0.672	-0.857	0.528	-0.204	-0.389	-0.251
-0.288	-0.672	-0.057	-0.835	-0.204	-0.389	-0.251
0.919	-0.672	-0.190	-0.835	-0.595	-0.389	-0.251
0.316	-0.672	0.344	-0.835	-0.595	-0.389	-0.251
-0.891	-0.672	-0.590	-0.835	-0.595	-0.389	-0.251
-0.891	-0.672	-0.590	-0.381	-0.204	-0.389	-0.251
0.316	-0.672	1.811	0.983	0.186	-0.389	-0.251
0.316	-0.672	-0.590	-0.835	-0.204	-0.389	-0.251
-0.288	2.166	-0.323	0.074	0.186	-0.389	-0.251
-0.288	0.274	-0.990	-0.835	-0.595	-0.389	-0.251
-0.288	0.274	-0.857	-0.835	0.186	-0.389	-0.251
2.127	0.274	-0.590	-0.835	0.577	0.281	-0.251
-0.288	1.220	-0.590	0.528	-0.595	-0.389	-0.251
0.919	-0.672	-0.323	0.074	-0.595	-0.389	-0.251
0.316	-0.672	-0.457	-0.381	0.186	-0.389	-0.251
1.523	-0.672	-0.723	-0.835	-0.204	-0.389	-0.251
0.919	-0.672	-0.590	-0.381	-0.204	-0.389	-0.251
1.523	-0.672	0.610	-0.835	0.186	-0.389	-0.251
0.919	-0.672	0.344	-0.381	-0.595	-0.389	-0.251
0.919	0.274	-0.457	1.437	0.577	0.057	-0.251
0.316	-0.672	0.477	1.892	1.748	-0.389	-0.251
0.316	-0.672	-0.057	1.437	0.967	-0.389	-0.251
-0.288	-0.672	0.077	3.709	-0.595	1.174	-0.251
-0.891	-0.672	-0.457	2.800	1.358	3.853	2.061
-0.288	2.166	-0.590	1.437	2.139	2.960	4.372
-0.288	0.274	-0.990	-0.835	0.577	2.067	3.051
1.523	1.220	-0.723	2.346	0.186	2.737	5.692
0.919	-0.672	-0.590	0.528	0.577	2.737	6.683
-0.288	3.113	-0.457	-0.835	2.920	0.950	0.740
-0.891	1.220	-0.857	-0.835	-0.204	0.727	0.740
-0.288	0.274	-0.857	-0.835	0.186	0.504	-0.251
0.316	0.274	-0.990	-0.381	0.186	0.281	0.080
-0.288	2.166	-0.590	-0.835	0.577	2.960	1.730
-0.288	0.274	-0.590	0.074	1.748	0.727	1.730
-0.288	1.220	-0.323	-0.835	0.577	1.174	-0.251
-0.288	0.274	-0.990	-0.835	0.186	0.057	0.080

Clustering Analysis			
K-Means Cluster (3 Clusters)	K-Means Cluster Distance From Center	Two-Step Cluster Analysis	K-Means Cluster (2 Clusters)
Novice	1.327	Unskilled	Unskilled
Novice	1.977	Unskilled	Unskilled
Novice	0.911	Unskilled	Unskilled
Novice	2.000	Unskilled	Unskilled
Novice	0.499	Unskilled	Unskilled
Novice	1.646	Unskilled	Unskilled
Novice	1.084	Unskilled	Unskilled
Novice	1.651	Unskilled	Unskilled
Novice	1.272	Unskilled	Unskilled
Novice	1.646	Unskilled	Unskilled
Novice	1.477	Unskilled	Unskilled
Novice	2.112	Unskilled	Unskilled
Novice	1.408	Unskilled	Unskilled
Novice	1.042	Unskilled	Unskilled
Novice	1.493	Unskilled	Unskilled
Novice	1.679	Unskilled	Unskilled
Intermediate	2.789	Unskilled	Unskilled
Novice	1.382	Unskilled	Unskilled
Novice	1.314	Unskilled	Unskilled
Novice	1.005	Unskilled	Unskilled
Novice	2.074	Unskilled	Unskilled
Novice	1.521	Unskilled	Unskilled
Novice	2.480	Unskilled	Unskilled
Novice	1.442	Unskilled	Unskilled
Novice	2.242	Unskilled	Unskilled
Novice	2.971	Unskilled	Unskilled
Novice	2.088	Unskilled	Unskilled
Novice	4.123	Unskilled	Unskilled
Master	5.099	Skilled	Skilled
Master	2.515	Skilled	Skilled
Intermediate	3.505	Skilled	Skilled
Master	3.024	Skilled	Skilled
Master	3.258	Skilled	Skilled
Intermediate	1.964	Skilled	Unskilled
Novice	2.484	Unskilled	Unskilled
Novice	1.946	Unskilled	Unskilled
Novice	2.287	Unskilled	Unskilled
Intermediate	3.231	Skilled	Skilled
Intermediate	1.853	Skilled	Unskilled
Intermediate	1.997	Unskilled	Unskilled
Novice	1.976	Unskilled	Unskilled

Aggragate Analysis of Experimental Debitage						
Knapper Code	Core Code	Georgetown Flint Quality	Edwards Plateau Flint Quality	Reported Skill Level	Produced Core Count	Core Type
SF2	ZM09		Medium	Master	1	Exhausted blade core
SF2	ZM10		Fine	Master	1	Prepared blade core
SF3	JC01		Coarse	Master	1	Exhausted blade core
SF3	JC02		Coarse	Master	1	Prepared blade core
SF3	JC03		Medium	Master	1	Prepared blade core
SF3	JC04	Fine		Master	1	Exhausted blade core
SF3	JC05		Fine	Master	1	Incomplete flake core
SF9	PSK1-01	Fine		Intermediate	1	Exhausted flake core
SF9	PSK1-2	Fine		Intermediate	1	Exhausted blade core
SF4	PSK2-01	Fine		Master	1	Exhausted blade core
SF4	PSK2-02	Fine		Master	1	Exhausted blade core
SF5	PSK3-01	Fine		Master	1	Exhausted blade core
SF5	PSK3-02	Fine		Master	1	Exhausted blade core
SF6	PSK4-01	Fine		Intermediate	1	Exhausted flake core
SF6	PSK4-02	Fine		Intermediate	1	Prepared blade core
SF7	PSK5-01	Fine		Intermediate	1	Incomplete flake core
SF7	PSK5-02	Fine		Intermediate	1	Prepared blade core
SF8	PSK6-02	Fine		Intermediate	1	Incomplete flake core
SF8	PSK6-01	Fine		Intermediate	1	Incomplete flake core
SF10	FDP04	Fine		Master	1	Prepared blade core
SF10	FDP15		Medium	Master	1	Prepared blade core
SF10	FDP17		Medium	Master	1	Exhausted blade core
SF10	FDP19	Fine		Master	1	Exhausted blade core
SF10	DE01	Fine		Novice	1	Prepared blade core
SF10	DE02	Fine		Intermediate	1	Prepared blade core
SF10	DE03	Fine		Master	1	Exhausted blade core

Counts			Platform Preperation		Terminations			
Flakes N=	Blades N=	Core Trimming Elements N=	Single Faceted Platforms N=	Multi-Faceted Platforms N=	Feathered N=	Hinge N=	Step N=	Outrepasse N=
13	10	3	10	14	23	1	1	1
24	28	1	14	33	46	3	3	1
9	4	3	6	7	14	2	0	0
1	3	1	1	4	3	2	0	0
9	1	0	7	2	7	1	0	2
25	10	3	5	32	32	5	0	1
34	7	5	16	10	42	2	2	0
60	1	2	55	3	48	9	2	4
85	13	6	78	19	98	2	3	1
36	17	2	30	18	48	4	3	0
44	10	4	20	19	47	11	0	0
151	12	4	58	42	143	18	4	2
86	16	2	24	23	91	9	4	0
91	0	8	60	36	85	10	2	2
40	4	10	32	16	46	5	0	3
73	7	2	59	20	74	6	2	0
74	13	3	58	24	74	8	7	1
84	5	2	58	26	81	8	2	0
100	6	6	56	36	92	13	6	1
295	13	7	73	148	298	15	1	1
164	29	6	54	91	186	12	0	1
119	11	3	29	43	126	6	0	1
149	38	10	29	68	178	17	2	0
33	2	5	16	7	23	1	0	2
119	14	8	37	73	104	5	0	0
224	51	15	53	156	267	20	2	1

Platform Damage				Blade Regularity		
Battering N=	Crushing N=	Escelant de Bulb N=	Sequencial Blades (Y/N)	Irregular N=	Regular N=	Extremely Regular N=
1	0	0	Yes	3	6	1
0	3	0	Yes	4	13	11
3	1	0	Yes	1	2	1
0	0	0	Yes	1	2	0
0	0	0	No	1	0	0
2	0	0	Yes	4	4	2
3	3	0	Yes	2	4	1
1	6	0	No	1	0	0
1	3	2	Yes	10	3	0
2	0	1	Yes	7	10	0
0	3	1	No	5	5	0
5	2	3	Yes	3	9	0
0	3	0	Yes	4	7	0
7	6	3	No	0	0	0
1	2	1	Yes	4	0	0
9	5	0	No	7	0	0
2	0	1	Yes	11	2	0
1	2	1	No	2	3	0
0	1	2	No	6	0	0
6	2	4	Yes	1	11	1
4	1	0	Yes	6	17	6
6	0	0	Yes	6	5	0
2	3	0	Yes	16	13	2
2	4	0	No	2	0	0
1	5	2	Yes	6	8	0
7	2	2	Yes	16	24	11

Z-Scores			Platform Preperation		Terminations	
Z-Score Flakes	Z-Score Blades	Z-Score Core Trimming Elements	Z-Score Single Faceted	Z-Score Multi-Faceted	Z-Score Feathered	Z-Score Hinge
-1.237	0.663	0.147	-1.255	-0.071	-0.916	-0.980
-1.011	2.702	-0.326	-1.132	0.625	-0.439	-0.764
-1.320	-0.016	0.147	-1.377	-0.327	-1.102	-0.872
-1.484	-0.129	-0.326	-1.531	-0.437	-1.330	-0.872
-1.320	-0.356	-0.562	-1.347	-0.510	-1.247	-0.980
-0.990	0.663	0.147	-1.408	0.588	-0.729	-0.547
-0.805	0.324	0.620	-1.071	-0.217	-0.522	-0.872
-0.270	-0.356	-0.089	0.123	-0.474	-0.398	-0.113
0.244	1.003	0.857	0.827	0.112	0.638	-0.872
-0.764	1.456	-0.089	-0.643	0.076	-0.398	-0.655
-0.600	0.663	0.384	-0.949	0.112	-0.418	0.104
1.602	0.890	0.384	0.215	0.954	1.570	0.863
0.264	1.343	-0.089	-0.826	0.259	0.493	-0.113
0.367	-0.469	1.330	0.276	0.735	0.369	-0.005
-0.682	-0.016	1.803	-0.581	0.002	-0.439	-0.547
-0.003	0.324	-0.089	0.245	0.149	0.141	-0.438
0.018	1.003	0.147	0.215	0.295	0.141	-0.221
0.223	0.097	-0.089	0.215	0.368	0.286	-0.221
0.552	0.210	0.857	0.153	0.735	0.514	0.321
4.564	1.003	1.093	0.674	4.835	4.781	0.538
1.869	2.815	0.857	0.092	2.748	2.461	0.212
0.943	0.777	0.147	-0.673	0.991	1.218	-0.438
1.560	3.834	1.803	-0.673	1.906	2.295	0.754
-0.826	-0.242	0.620	-1.071	-0.327	-0.916	-0.980
0.943	1.116	1.330	-0.428	2.089	0.762	-0.547
3.103	5.306	2.985	0.062	5.128	4.139	1.080

Terminations		Platform Damage		Blade Regularity		
Z-Score Step	Z-Score Outrepasse	Z-Score Battering	Z-Score Crushing	Z-Score Irregular	Z-Score Regular	Z-Score Extremely Regular
-0.288	0.274	-0.857	-0.835	0.577	0.950	0.080
0.919	0.274	-0.990	0.528	0.967	2.514	3.381
-0.891	-0.672	-0.590	-0.381	-0.204	0.057	0.080
-0.891	-0.672	-0.990	-0.835	-0.204	0.057	-0.251
-0.891	1.220	-0.990	-0.835	-0.204	-0.389	-0.251
-0.891	0.274	-0.723	-0.835	0.967	0.504	0.410
0.316	-0.672	-0.590	0.528	0.186	0.504	0.080
0.316	3.113	-0.857	1.892	-0.204	-0.389	-0.251
0.919	0.274	-0.857	0.528	3.310	0.281	-0.251
0.919	-0.672	-0.723	-0.835	2.139	1.844	-0.251
-0.891	-0.672	-0.990	0.528	1.358	0.727	-0.251
1.523	1.220	-0.323	0.074	0.577	1.620	-0.251
1.523	-0.672	-0.990	0.528	0.967	1.174	-0.251
0.316	1.220	-0.057	1.892	-0.595	-0.389	-0.251
-0.891	2.166	-0.857	0.074	0.967	-0.389	-0.251
0.316	-0.672	0.210	1.437	2.139	-0.389	-0.251
3.334	0.274	-0.723	-0.835	3.701	0.057	-0.251
0.316	-0.672	-0.857	0.074	0.186	0.281	-0.251
2.730	0.274	-0.990	-0.381	1.748	-0.389	-0.251
-0.288	0.274	-0.190	0.074	-0.204	2.067	0.080
-0.891	0.274	-0.457	-0.381	1.748	3.407	1.730
-0.891	0.274	-0.190	-0.835	1.748	0.727	-0.251
0.316	-0.672	-0.723	0.528	5.654	2.514	0.410
-0.891	1.220	-0.723	0.983	0.186	-0.389	-0.251
-0.891	-0.672	-0.857	1.437	1.748	1.397	-0.251
0.316	0.274	-0.057	0.074	5.654	4.970	3.381

Clustering Analysis			
K-Means Cluster (3 Clusters)	K-Means Cluster Distance From Center	Two-Step Cluster Analysis	K-Means Cluster (2 Clusters)
Intermediate	2.210	Unskilled	Unskilled
Intermediate	3.982	Skilled	Skilled
Novice	1.587	Unskilled	Unskilled
Novice	1.853	Unskilled	Unskilled
Novice	1.887	Unskilled	Unskilled
Intermediate	2.034	Unskilled	Unskilled
Novice	1.982	Unskilled	Unskilled
Novice	2.202	Unskilled	Unskilled
Intermediate	2.492	Unskilled	Unskilled
Intermediate	1.991	Unskilled	Unskilled
Intermediate	2.015	Unskilled	Unskilled
Intermediate	2.101	Unskilled	Unskilled
Intermediate	2.025	Unskilled	Unskilled
Novice	2.751	Unskilled	Unskilled
Novice	2.819	Unskilled	Unskilled
Intermediate	2.853	Unskilled	Unskilled
Intermediate	4.065	Unskilled	Unskilled
Novice	1.534	Unskilled	Unskilled
Intermediate	3.215	Unskilled	Unskilled
Intermediate	4.562	Skilled	Skilled
Intermediate	3.785	Skilled	Skilled
Intermediate	1.900	Unskilled	Unskilled
Intermediate	5.283	Skilled	Skilled
Novice	2.084	Unskilled	Unskilled
Intermediate	2.520	Skilled	Unskilled
Master	4.768	Skilled	Skilled

Appendix J: Statistical outputs of Kharaneh IV assemblage.

On the following page, the statistical outputs of all of the Lithic Concentrations are shown. Each piece of debitage is analyzed separately.

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
546877	BT58.014	Lateral Core Trimming	Yes	Multi-Faceted	None	Yes
546877	BT58.014	Lateral Core Trimming	Yes	Single Faceted	None	Yes
546877	BT58.014	Lateral Core Trimming	Yes	Single Faceted	None	No
546877	BT58.014	Lateral Core Trimming	Yes	Multi-Faceted	None	No
546877	BT58.014	Lateral Core Trimming	Yes	Single Faceted	None	No
546877	BT58.014	Lateral Core Trimming	No	Multi-Faceted	None	No
546877	BT58.014	Lateral Core Trimming	Yes	Single Faceted	None	No
546877	BT58.014	Lateral Core Trimming	No	Absent	Not Present	No
546877	BT58.014	Lateral Core Trimming	Yes	Multi-Faceted	None	No
546877	BT58.014	Lateral Core Trimming	Yes	Multi-Faceted	None	No
546877	BT58.014	Profile Correction Blade	Yes	Single Faceted	None	Yes
546877	BT58.014	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
546877	BT58.014	Profile Correction Blade	Yes	Multi-Faceted	None	Yes

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	2.24	1.84	0.52	17.42	22.14	0.026
None	Feather	2.63	2.62	0.9	16.7	27.77	0.88
None	Feather	4.41	3.38	0.46	12.35	28.51	0.031
None	Feather	2.36	1.79	0.57	20.33	22.92	0.84
None	Feather	2.16	5.03	0.75	12.82	22.48	1.03
None	Feather	1.97	1.68	0.58	12.85	N/A	0.38
None	Feather	1.97	2.68	0.81	10.54	31.77	0.89
Shatter	Feather	N/A	0.94	0.45	15.67	11.28	0.21
None	Feather	1.05	0.96	0.58	12.57	16.19	0.16
None	Feather	0.93	0.75	0.58	13.39	14.24	0.18
None	Feather	2.13	5.21	1.05	46.65	16.34	3.49
None	Feather	1.09	3.27	0.65	40.46	8.38	1.27
None	Feather	1	2.7	0.24	37.38	6.9	0.67

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
546877	BT58.014	Profile Correction Blade	Yes	Single Faceted	None	Yes
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Partial Ridged Blade	Yes	Multi-Faceted	None	Yes
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	1.35	2.54	0.86	40.16	9.32	1.21
Shatter	N/A	1.31	N/A	N/A	N/A	N/A	0.16
Shatter	Feather	1.61	1.95	0.4	39.65	6.65	0.46
Shatter	Feather	N/A	N/A	0.55	N/A	N/A	0.3
Shatter	Feather	N/A	N/A	0.4	N/A	N/A	0.22
Shatter	Feather	N/A	N/A	0.33	N/A	N/A	0.11
Shatter	Feather	N/A	N/A	0.67	N/A	N/A	0.11
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.07
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.16
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.34
Shatter	N/A	0.63	N/A	N/A	N/A	N/A	0.13
Shatter	N/A	0.79	N/A	N/A	N/A	N/A	0.09
Hinging	Hinge	1.54	2.32	1.74	26.47	5.5	0.35
Hinging	Hinge	1.32	1.03	0.9	22.28	5.85	0.15
None	Feather	0.77	1.91	0.74	39.41	5.48	0.53
Shatter	Hinge	2.78	N/A	N/A	N/A	N/A	5.75
Shatter	Feather	0.9	1.57	0.65	41.99	7.87	0.59
None	Feather	1.04	2.11	0.7	37.3	7.88	0.43

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	1.6	1.91	0.82	43.1	8.5	0.79
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.11
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.47
Shatter	Feather	N/A	N/A	0.67	N/A	N/A	0.11
Shatter	Feather	N/A	N/A	0.56	N/A	N/A	0.09
Shatter	Feather	N/A	N/A	0.67	N/A	N/A	0.64
Shatter	Feather	N/A	N/A	0.67	N/A	N/A	0.21
Shatter	Feather	N/A	N/A	0.5	N/A	N/A	0.12
Stepping	Step	0.88	1.18	1.58	27.31	4.54	0.21
None	Feather	1.2	1.17	0.58	43.64	7.84	0.62
None	Feather	1.72	1.94	0.6	38.41	5.72	0.55
None	Feather	2.55	1.7	0.64	31.56	5.77	0.45
None	Feather	1.01	1.49	0.84	25.67	8.32	0.37
None	Feather	0.68	2	0.86	32.85	5.86	0.36
None	Feather	0.65	0.8	0.73	15.74	5.73	0.1
None	Feather	0.85	1.6	0.7	26.02	5.55	0.22
Shatter	N/A	1.18	N/A	N/A	N/A	N/A	0.13
Shatter	N/A	0.9	N/A	N/A	N/A	N/A	0.08
Shatter	N/A	1.29	N/A	N/A	N/A	N/A	0.26

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Lateral Core Trimming	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Lateral Core Trimming	Yes	Single Faceted	None	No
546877	BT58.014	Lateral Core Trimming	Yes	Single Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	N/A	1.61	N/A	N/A	N/A	N/A	0.11
Shatter	N/A	0.75	N/A	N/A	N/A	N/A	0.1
Shatter	N/A	1.09	N/A	N/A	N/A	N/A	0.17
Shatter	N/A	1.09	N/A	N/A	N/A	N/A	0.21
Shatter	Feather	N/A	N/A	0.76	N/A	N/A	0.11
Shatter	Feather	N/A	N/A	0.58	N/A	N/A	0.15
Shatter	Feather	N/A	N/A	0.49	N/A	N/A	0.14
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.17
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.73
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.07
None	Feather	2.06	2.93	0.74	38.47	6.99	0.75
None	Feather	1.33	1.14	0.65	13.06	17.58	0.3
Shatter	Feather	N/A	N/A	1.46	N/A	N/A	0.49
None	Feather	0.94	2	0.88	31.6	6.62	0.35
None	Feather	4.32	2.81	0.86	13.55	29.66	0.97
None	Feather	1.41	2.91	0.49	14.42	28.64	0.8

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
546877	BT58.014	Lateral Core Trimming	Yes	Single Faceted	None	No
546877	BT58.014	Lateral Core Trimming	Yes	Multi-Faceted	None	No
546877	BT58.014	Partial Ridged Blade	No	Absent	Not Present	Yes
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
546877	BT58.014	Partial Ridged Blade	No	Absent	Not Present	Yes
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Lateral Core Trimming	Yes	Single Faceted	None	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No
546877	BT58.014	Blade	Yes	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	3.51	6.02	0.7	12.67	24.53	1.57
None	Feather	1.54	0.97	0.52	13	18.07	0.26
Shatter	Feather	N/A	N/A	1.75	N/A	N/A	1.19
None	Feather	1.05	1.95	0.95	27.31	6.36	0.3
None	Feather	2.88	3.78	2.37	44.14	7.14	1.59
Shatter	Feather	N/A	N/A	1.19	N/A	N/A	1.19
Shatter	N/A	1.46	N/A	N/A	N/A	N/A	0.7
None	Feather	0.96	1.84	0.87	43.89	6.32	0.69
None	Feather	2.8	6.26	0.79	13.42	28.7	1.82
Shatter	Feather	N/A	N/A	1.28	N/A	N/A	0.69
None	Feather	1.86	2.63	1.35	41.15	9.33	1
None	Feather	1.92	3.66	1.01	41.48	10.62	1.5
None	Feather	1.35	1.54	0.84	30.16	4.6	0.28
Shatter	Step	0.84	N/A	N/A	N/A	N/A	0.13
None	Feather	1.01	1.38	0.92	27.28	4.97	0.24
None	Feather	0.86	1.25	0.46	27.52	4.36	0.19
None	Feather	0.8	1.33	0.71	26.5	4.93	0.18

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
546877	BT58.014	Blade	No	Absent	Not Present	No
546877	BT58.014	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Lateral Core Trimming	Yes	Single Faceted	None	Yes
545169	AY72.043	Lateral Core Trimming	No	Multi-Faceted	None	Yes
545169	AY72.043	Lateral Core Trimming	Yes	Multi-Faceted	None	Yes
545169	AY72.043	Lateral Core Trimming	Yes	Multi-Faceted	None	Yes
545169	AY72.043	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
545169	AY72.043	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
545169	AY72.043	Partial Ridged Blade	Yes	Multi-Faceted	None	Yes
545169	AY72.043	Partial Ridged Blade	Yes	Multi-Faceted	Crushing	Yes
545169	AY72.043	Partial Ridged Blade	Yes	Multi-Faceted	None	Yes
545169	AY72.043	Partial Ridged Blade	No	Absent	Not Present	Yes
545169	AY72.043	Blade	Yes	Multi-Faceted	Battering	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	Step	0.97	N/A	N/A	N/A	N/A	0.15
Shatter	N/A	1.02	N/A	N/A	N/A	N/A	0.12
Shatter	Feather	N/A	N/A	0.43	N/A	N/A	0.14
Shatter	N/A	1.22	N/A	N/A	N/A	N/A	0.16
None	Feather	2.89	6.13	1.06	17.15	22.78	2.03
None	Feather	1.45	1.4	0.37	N/A	N/A	0.39
None	Feather	1.6	2.12	0.75	16.1	20.97	0.7
None	Feather	1.56	1.29	0.48	17	17.34	0.32
None	Outrepasse	2.1	3.92	2.76	45.58	13.67	3.48
None	Outrepasse	1.3	3.57	1.56	44.08	14.41	2.63
Shatter	Outrepasse	2.45	5.25	1.58	47.67	11.42	2.98
None	Outrepasse	2.01	4.23	1.84	41.42	10	2.2
None	Outrepasse	3	4.93	2.11	42.68	9.76	2.43
Shatter	Outrepasse	N/A	N/A	1.11	N/A	N/A	0.99
Shatter	Feather	3.06	3.46	1.41	30.59	11.51	1.37

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Absent	Not Present	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Single Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Absent	Not Present	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	Battering	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	2.02	1.89	0.54	30.3	9.69	0.66
None	Feather	1.75	1.3	1.18	38.31	3.89	0.31
None	Feather	1.36	1.36	0.36	34.62	4.52	0.25
None	Feather	1.81	1.72	0.92	36.76	7.77	0.66
Shatter	N/A	1.02	N/A	N/A	N/A	N/A	0.38
Shatter	Feather	N/A	N/A	0.78	N/A	N/A	0.38
Shatter	N/A	0.78	N/A	N/A	N/A	N/A	0.15
Stepping	Step	2.05	N/A	N/A	N/A	N/A	0.54
Shatter	N/A	1.16	N/A	N/A	N/A	N/A	0.14
Shatter	N/A	1.27	N/A	N/A	N/A	N/A	0.24
Shatter	N/A	0.76	N/A	N/A	N/A	N/A	0.08
Shatter	Feather	N/A	N/A	1.1	N/A	N/A	0.11
None	Feather	1.35	2.41	0.83	27.46	7.96	0.48
None	Feather	0.82	0.55	0.49	21.08	3.75	0.07
None	Feather	1.06	2.01	0.66	26.88	5.14	0.29
None	Feather	1.23	1.62	0.73	28.38	5.13	0.24
None	Feather	1.76	2.39	0.63	36.87	8	1
Hinging	Hinge	1.37	2.77	1.73	33.7	8.94	1.12
None	Feather	1.35	1.34	0.52	35.15	4.84	0.26

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	Yes	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Multi-Faceted	None	No
545169	AY72.043	Blade	No	Absent	Not Present	No
545169	AY72.043	Blade	No	Absent	Not Present	No
545169	AY72.043	Blade	No	Absent	Not Present	No
545169	AY72.043	Blade	No	Absent	Not Present	No
545169	AY72.043	Blade	No	Multi-Faceted	Not Present	No
545212	AY72.212	Blade	No	Absent	Not Present	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	1.53	1.47	0.98	28.43	7.88	0.38
None	Feather	1.55	2.78	1.5	32.56	8.34	0.8
None	Feather	1.03	1.06	0.78	32.75	7.76	0.39
None	Feather	1.27	0.91	0.77	20.71	5.32	0.17
Shatter	N/A	1.09	N/A	N/A	N/A	N/A	0.18
Shatter	N/A	1.49	N/A	N/A	N/A	N/A	0.54
Shatter	N/A	1.72	N/A	N/A	N/A	N/A	0.35
Shatter	N/A	0.84	N/A	N/A	N/A	N/A	0.11
Shatter	N/A	1.32	N/A	N/A	N/A	N/A	0.25
Shatter	N/A	0.94	N/A	N/A	N/A	N/A	0.04
Shatter	N/A	1.47	N/A	N/A	N/A	N/A	0.24
Shatter	N/A	1.1	N/A	N/A	N/A	N/A	0.1
Shatter	N/A	1.19	N/A	N/A	N/A	N/A	0.1
Shatter	Feather	N/A	N/A	0.91	N/A	N/A	0.21
Shatter	N/A	N/A	N/A	0.7	N/A	N/A	0.17
Shatter	Feather	N/A	N/A	0.52	N/A	N/A	0.22
Shatter	Feather	N/A	N/A	0.5	N/A	N/A	0.13
Shatter	Feather	N/A	N/A	0.61	N/A	N/A	0.17
Shatter	Feather	N/A	N/A	1.52	N/A	N/A	0.55

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545212	AY72.212	Blade	Yes	Multi-Faceted	None	No
545212	AY72.212	Blade	Yes	Multi-Faceted	None	No
545212	AY72.212	Blade	Yes	Multi-Faceted	None	No
545157	AY73.043	Blade	Yes	Multi-Faceted	None	No
545157	AY73.043	Blade	Yes	Multi-Faceted	None	No
545157	AY73.043	Blade	No	Multi-Faceted	None	No
545157	AY73.043	Blade	No	Multi-Faceted	None	No
545157	AY73.043	Blade	No	Multi-Faceted	None	No
545157	AY73.043	Blade	No	Multi-Faceted	None	No
545157	AY73.043	Blade	No	Absent	Not Present	No
545157	AY73.043	Blade	No	Absent	Not Present	No
545157	AY73.043	Blade	No	Absent	Not Present	No
0840743	AY72.041	Blade	Yes	Single Faceted	None	No
0840743	AY72.041	Blade	Yes	Multi-Faceted	None	No
0840743	AY72.041	Blade	Yes	Multi-Faceted	None	No
0840743	AY72.041	Blade	No	Multi-Faceted	None	No
0840743	AY72.041	Blade	No	Multi-Faceted	None	No
0840541	R/52/60.P3	Blade	No	Multi-Faceted	None	No
545184	AY72.043	Blade	No	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	1.74	2.34	0.73	31.33	6.5	0.52
None	Feather	1.38	1.79	0.6	25.89	7.62	0.31
None	Feather	1.6	1.94	0.7	28.89	7.58	0.46
None	Feather	1.49	1.01	0.34	15.26	5.84	0.11
None	Feather	1.94	1.71	0.45	24.82	7.33	0.31
Shatter	Feather	1.58	N/A	N/A	N/A	N/A	0.22
Shatter	N/A	2.33	N/A	N/A	N/A	N/A	0.85
Shatter	N/A	1.39	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	1.25	N/A	N/A	N/A	N/A	0.11
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.05
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.14
None	Feather	1.8	3.65	1.59	40.41	11.78	1.45
None	Feather	1.69	1.96	0.64	32.7	10	0.75
None	Feather	1.46	1.05	0.45	35.98	6.19	0.32
Shatter	N/A	0.69	N/A	N/A	N/A	N/A	0.07
Shatter	N/A	1.25	N/A	N/A	N/A	N/A	0.14
Shatter	Hinge	1.42	N/A	N/A	N/A	N/A	1.8
Shatter	N/A	1.61	N/A	N/A	N/A	N/A	0.12

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545184	AY72.043	Blade	No	Multi-Faceted	None	No
545184	AY72.043	Blade	No	Absent	Not Present	No
545184	AY72.043	Blade	No	Absent	Not Present	No
545149	AY73.043	Blade	Yes	Multi-Faceted	None	No
545149	AY73.043	Blade	No	Absent	Not Present	No
545149	AY73.043	Blade	No	Absent	Not Present	No
545149	AY73.043	Blade	No	Absent	Not Present	No
0840820	AV72.143	Blade	No	Multi-Faceted	None	No
545184	AY72.043	Lateral Core Trimming	Yes	Single Faceted	None	No
545184	AY72.043	Blade	Yes	Multi-Faceted	None	No
545184	AY72.043	Blade	Yes	Multi-Faceted	None	No
545184	AY72.043	Blade	Yes	Multi-Faceted	None	No
545184	AY72.043	Blade	No	Multi-Faceted	None	No
545210	AY72.043	Lateral Core Trimming	Yes	Single Faceted	None	Yes
545210	AY72.043	Lateral Core Trimming	Yes	Single Faceted	None	Yes
545210	AY72.043	Blade	Yes	Multi-Faceted	None	No
545210	AY72.043	Blade	Yes	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	N/A	1.55	N/A	N/A	N/A	N/A	0.22
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.2
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.2
None	Feather	0.78	1.07	0.74	29.04	5.83	0.18
Shatter	Feather	N/A	N/A	0.62	N/A	N/A	0.45
Shatter	N/A	N/A	N/A	0.73	N/A	N/A	0.15
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.05
Shatter	N/A	1.26	N/A	N/A	N/A	N/A	0.12
None	Feather	1.91	2.54	0.66	17.88	28.15	1.49
None	Feather	2.07	2.65	0.75	38.28	11.44	1
Hinging	Hinge	1.77	2.13	2.27	23.84	10.57	0.69
None	Feather	1.28	0.88	0.45	16.73	5	0.1
Shatter	N/A	1.07	N/A	N/A	N/A	N/A	0.07
None	Feather	5.47	8.85	0.75	27.47	34.05	6.3
None	Feather	1.62	2.31	0.65	14.2	18.85	0.44
None	Feather	1.29	1.69	0.56	25.96	7.3	0.34
None	Feather	1.65	1.69	0.64	17.86	3.96	0.14

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545210	AY72.043	Blade	No	Multi-Faceted	Not Present	No
545210	AY72.043	Blade	No	Multi-Faceted	None	No
0840823	AV74.088	Core Face Rejuvenation	Yes	Multi-Faceted	None	Yes
0840707	AY74.088	Lateral Core Trimming	Yes	Single Faceted	None	Yes
0840707	AY74.088	Blade	Yes	Multi-Faceted	None	No
0840707	AY74.088	Partial Ridged Blade	No	Absent	Not Present	Yes
0840707	AY74.088	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Crested Blade	No	Absent	Not Present	Yes
545204	AX72.208	Lateral Core Trimming	Yes	Single Faceted	None	Yes
545204	AX72.208	Lateral Core Trimming	Yes	Single Faceted	None	Yes
545204	AX72.208	Lateral Core Trimming	No	Absent	Not Present	Yes
545204	AX72.208	Lateral Core Trimming	No	Absent	Crushing	Yes
545204	AX72.208	Lateral Core Trimming	No	Absent	Crushing	Yes
545204	AX72.208	Lateral Core Trimming	Yes	Multi-Faceted	None	Yes
545204	AX72.208	Lateral Core Trimming	Yes	Multi-Faceted	None	Yes

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	N/A	1.72	N/A	N/A	N/A	N/A	0.19
Shatter	N/A	1.49	N/A	N/A	N/A	N/A	0.23
None	Feather	1.87	2.76	1.38	38.43	17.63	2.03
None	Feather	2.07	1.99	0.94	15.73	23.92	0.59
None	Feather	1.3	2.44	0.84	31.07	6.27	0.47
Shatter	Feather	N/A	N/A	0.72	N/A	N/A	0.4
None	Feather	1.6	2.23	0.85	29.68	11.6	0.7
Shatter	Feather	N/A	N/A	0.84	N/A	N/A	1.85
None	Feather	4.1	4.26	0.72	27	44.09	6.28
None	Feather	4.35	6.09	1.76	26.74	29.82	6.03
Shatter	Feather	N/A	N/A	0.98	N/A	N/A	0.49
None	Feather	N/A	N/A	0.94	N/A	N/A	0.65
None	Feather	N/A	N/A	0.64	N/A	N/A	0.22
None	Feather	1.48	2.5	0.99	23.98	27.73	2.12
None	Feather	2.19	3.35	1.09	23.81	31.37	2.41

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545204	AX72.208	Lateral Core Trimming	Yes	Multi-Faceted	None	Yes
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Corrective Non-Initial Core Tablet	Yes	Multi-Faceted	None	Yes
545204	AX72.208	Core Face Rejuvenation	Yes	Multi-Faceted	None	Yes
545204	AX72.208	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
545204	AX72.208	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
545204	AX72.208	Profile Correction Blade	Yes	Multi-Faceted	Battering	Yes
545204	AX72.208	Partial Ridged Blade	Yes	Multi-Faceted	None	Yes
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Partial Ridged Blade	Yes	Multi-Faceted	None	Yes
545204	AX72.208	Core Face Rejuvenation	Yes	Multi-Faceted	None	Yes

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	5.42	6.42	1.08	23.89	36.91	5.8
None	Feather	1.43	2.52	0.63	33.96	12.94	1.1
Shatter	Feather	N/A	N/A	0.74	N/A	N/A	0.98
None	Feather	3.69	6.14	0.99	37.43	14.22	4
None	Feather	1.48	4.34	1.6	43.9	17.14	2.83
None	Feather	1.49	3.21	0.95	45.58	13.64	2.03
None	Feather	1.25	3.74	1.1	37.28	8.32	1.27
tform batter	Feather	5.14	6.39	1.23	43.7	16.22	5.55
None	Feather	4.12	5.48	2.37	42.35	14.74	4.43
None	Feather	1.4	2.16	1.18	34.52	8.55	0.75
Shatter	Feather	N/A	N/A	0.9	N/A	N/A	0.35
Shatter	Feather	N/A	N/A	1	N/A	N/A	0.42
Stepping	Step	1.64	2.93	2.11	35.19	13.98	1.79
None	Feather	2.26	2.45	0.94	41.47	17.13	1.98

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	Crushing	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	2.4	1.19	0.8	20.06	9.23	0.33
None	Feather	0.8	1.41	0.68	25.53	6.41	0.29
Shatter	N/A	2.22	N/A	N/A	N/A	N/A	0.5
None	Feather	1.64	2.1	1.06	30.36	10.17	0.7
None	Feather	1.67	1.69	0.64	30.69	8.23	0.52
None	Feather	1.23	1.85	0.53	40.32	8.31	0.74
None	Feather	0.91	1.7	0.66	31.27	8.31	0.47
None	Feather	2.75	2.72	0.77	35.32	12.88	1.15
None	Feather	1.71	1.78	0.63	31.17	9.07	0.67
None	Feather	1.3	2.06	0.77	30.51	6.81	0.44
None	Feather	1.81	3.3	0.98	41.72	11.48	1.36
None	Feather	1.52	2.95	1	34.66	8.03	0.76
None	Feather	0.94	2.59	0.77	34.39	7.79	0.62
None	Feather	1.03	1.05	0.5	21.72	7.62	0.14
Shatter	Feather	N/A	N/A	0.86	N/A	N/A	0.41
Shatter	Feather	N/A	N/A	0.58	N/A	N/A	1.02
Shatter	Feather	N/A	N/A	0.58	N/A	N/A	1.02
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.6
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.24

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Absent	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	N/A	1.07	N/A	N/A	N/A	N/A	0.13
Shatter	N/A	1.66	N/A	N/A	N/A	N/A	0.19
Shatter	N/A	0.89	N/A	N/A	N/A	N/A	0.13
Shatter	N/A	0.98	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	0.85	N/A	N/A	N/A	N/A	0.08
Shatter	N/A	0.94	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	1.14	N/A	N/A	N/A	N/A	0.11
Shatter	N/A	1.04	N/A	N/A	N/A	N/A	0.21
Shatter	N/A	1.55	N/A	N/A	N/A	N/A	0.11
Shatter	N/A	2.33	N/A	N/A	N/A	N/A	0.17
Shatter	N/A	1.25	N/A	N/A	N/A	N/A	0.26
Shatter	N/A	1.47	N/A	N/A	N/A	N/A	0.13
Shatter	N/A	1.14	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	1.14	N/A	N/A	N/A	N/A	0.08
Shatter	N/A	1.21	N/A	N/A	N/A	N/A	0.11
Shatter	N/A	1.13	N/A	N/A	N/A	N/A	0.17
Shatter	N/A	1.75	N/A	N/A	N/A	N/A	0.15
Shatter	N/A	2.02	N/A	N/A	N/A	N/A	0.29
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.04

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	None	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	Feather	N/A	N/A	0.72	N/A	N/A	0.19
Shatter	N/A	1.00	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	1.69	N/A	N/A	N/A	N/A	0.17
Shatter	Feather	N/A	N/A	0.97	N/A	N/A	0.13
Shatter	Feather	N/A	N/A	0.36	N/A	N/A	0.19
Shatter	Feather	N/A	N/A	0.61	N/A	N/A	0.12
Shatter	Feather	N/A	N/A	0.62	N/A	N/A	0.07
Shatter	Feather	N/A	N/A	0.42	N/A	N/A	0.14
Shatter	Feather	N/A	N/A	0.47	N/A	N/A	0.21
Shatter	Feather	N/A	N/A	0.47	N/A	N/A	0.15
Shatter	Feather	N/A	N/A	1.03	N/A	N/A	0.19
Shatter	Feather	N/A	N/A	0.41	N/A	N/A	0.04
Shatter	Feather	N/A	N/A	0.64	N/A	N/A	0.09
Shatter	Feather	N/A	N/A	0.63	N/A	N/A	0.07
Shatter	Feather	N/A	N/A	0.6	N/A	N/A	0.1
Shatter	Feather	N/A	N/A	0.71	N/A	N/A	0.1
Shatter	Feather	N/A	N/A	0.57	N/A	N/A	0.2
Shatter	Feather	N/A	N/A	0.83	N/A	N/A	0.08
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.04

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Absent	Crushing	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.1
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.04
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.09
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.16
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.25
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.1
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.24
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.23
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.14
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.22
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.13
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.46
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.07
None	Feather	1.18	0.62	0.35	14.68	4.29	0.05
None	Feather	1.16	1.09	0.63	31.17	7.75	0.26
Shatter	Feather	1.29	0.72	0.51	13.27	4.11	0.03
Shatter	Feather	N/A	N/A	0.54	N/A	N/A	0.09
None	Feather	2.09	1.8	0.73	30.21	8.34	0.54
None	Feather	1.09	1.15	0.63	23.89	6.41	0.2

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Single Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Single Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	Yes	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Multi-Faceted	None	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	1.5	2.15	0.65	24.96	8.5	0.37
None	Feather	1.8	1.31	0.44	24.6	9.68	0.27
None	Feather	1.47	1.13	0.64	32.93	7.01	0.38
None	Feather	1.1	0.62	0.65	26.48	3.64	0.12
None	Feather	2.26	0.79	0.46	17.22	7.51	0.17
None	Feather	0.77	0.92	0.79	16.73	4.7	0.08
None	Feather	1.32	1.77	0.69	32.06	7.52	0.48
None	Feather	2.02	2.06	1.06	33.58	10.91	1
None	Feather	1.71	1.8	0.83	30.35	10.83	0.75
None	Feather	2.01	1.91	0.64	27.13	12.01	0.84
Shatter	N/A	1.14	N/A	N/A	N/A	N/A	0.29
Shatter	N/A	0.96	N/A	N/A	N/A	N/A	0.24
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.26
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.09
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.21
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.13
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.17
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.07

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545204	AX72.208	Blade	No	Absent	Not Present	No
545212	AY72.17	Blade	No	Absent	Not Present	No
545212	AY72.17	Blade	No	Absent	Not Present	No
545212	AY72.17	Blade	Yes	Multi-Faceted	None	No
545212	AY72.17	Profile Correction Blade	Yes	Multi-Faceted	Double Initiation	Yes
545212	AY72.17	Profile Correction Blade	Yes	Multi-Faceted	Double Initiation	Yes
545212	AY72.17	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
545212	AY72.17	Lateral Core Trimming	Yes	Single Faceted	None	Yes
545212	AY72.17	Partial Ridged Blade	Yes	Multi-Faceted	None	Yes
545212	AY72.17	Non-Initial Core Tablet	No	Absent	Not Present	Yes
545212	AY72.17	Blade	Yes	Multi-Faceted	Double Initiation	No
545212	AY72.17	Blade	Yes	Multi-Faceted	None	No
545212	AY72.17	Blade	No	Multi-Faceted	None	No
545212	AY72.17	Blade	No	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.08
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.07
Shatter	Feather	N/A	N/A	0.68	N/A	N/A	0.43
Shatter	Feather	N/A	N/A	0.79	N/A	N/A	0.27
None	Feather	1.3	2.45	1.04	30.64	6.5	0.44
None	Feather	1.55	2.74	0.46	36.61	11.6	1.03
None	Feather	1.05	2.8	1.18	49.61	10.47	1.5
None	Outrepasse	1.47	3.78	1.85	35.55	7.47	1.13
None	Feather	2.7	4.36	0.77	15.12	22.58	1.15
None	Feather	1.25	3.04	1.64	37.16	8.15	1.03
Shatter	Feather	N/A	N/A	1.77	N/A	N/A	5.01
None	Feather	1.52	2.75	0.65	29.41	8.64	0.58
None	Feather	1.79	2.59	0.65	33.25	9.25	0.81
Shatter	N/A	1.4	N/A	N/A	N/A	N/A	0.1
Shatter	N/A	1.33	N/A	N/A	N/A	N/A	0.11

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545212	AY72.17	Blade	No	Multi-Faceted	None	No
545212	AY72.17	Blade	No	Multi-Faceted	Not Present	No
545212	AY72.17	Blade	No	Absent	Not Present	No
545212	AY72.17	Blade	No	Absent	Not Present	No
545212	AY72.17	Blade	No	Absent	Not Present	No
545213	AY72.18	Lateral Core Trimming	Yes	Single Faceted	None	Yes
545213	AY72.18	Lateral Core Trimming	No	Single Faceted	None	Yes
545213	AY72.18	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
545213	AY72.18	Profile Correction Blade	Yes	Multi-Faceted	Double Initiation	Yes
545213	AY72.18	Profile Correction Blade	Yes	Multi-Faceted	Battering	Yes
545213	AY72.18	Blade	No	Multi-Faceted	None	No
545213	AY72.18	Blade	No	Absent	Not Present	No
545213	AY72.18	Blade		Multi-Faceted	None	No
545213	AY72.18	Blade	Yes	Multi-Faceted	None	No
545213	AY72.18	Blade	Yes	Multi-Faceted	None	No
545213	AY72.18	Blade	Yes	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	N/A	1.07	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	1.05	N/A	N/A	N/A	N/A	0.13
Shatter	Feather	N/A	N/A	0.6	N/A	N/A	0.24
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.07
Shatter	Feather	N/A	N/A	0.47	N/A	N/A	0.5
None	Feather	2.28	3.14	0.63	16.59	21.37	1.01
Shatter	Feather	1.81	1.75	1.01	16.47		0.46
None	Feather	1.5	5.52	1.63	51.69	9.58	2.33
None	Feather	1.73	4.13	0.64	44.11	11.73	2.55
tform batter	Outrepasse	1.86	4.67	0.84	40.91	9.74	1.69
Shatter	N/A	1.35	N/A	N/A	N/A	N/A	0.25
Shatter	Feather	N/A	N/A	0.65	N/A	N/A	0.26
None	Feather	1.48	1.84	0.71	36.61	6.17	0.5
None	Feather	1.58	4	0.43	49.59	12.45	2.26
None	Feather	1.17	1.82	0.41	36.29	7.46	0.51
None	Feather	2.19	2.64	1.08	35.72	7.8	0.79

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545213	AY72.18	Blade	Yes	Multi-Faceted	None	No
543087	AV70.26M	Initial Core Tablet	Yes	Multi-Faceted	None	Yes
543087	AV70.26M	Faceted Non-Initial Core Tablet	No	Absent	Not Present	Yes
543087	AV70.26M	Lateral Core Trimming	Yes	Single Faceted	None	Yes
543087	AV70.26M	Partial Ridged Blade	Yes	Multi-Faceted	None	Yes
543087	AV70.26M	Blade	Yes	Multi-Faceted	None	No
543087	AV70.26M	Blade	Yes	Multi-Faceted	None	No
543087	AV70.26M	Blade	No	Absent	Not Present	No
543087	AV70.26M	Blade	Yes	Multi-Faceted	None	No
543087	AV70.26M	Blade	No	Multi-Faceted	None	No
543087	AV70.26M	Blade	No	Multi-Faceted	None	No
543087	AV70.26M	Blade	No	Absent	Not Present	No
543087	AV70.26M	Blade	No	Absent	Not Present	No
543087	AV70.26M	Blade	No	Absent	Not Present	No
545225	AY73.043	Blade	Yes	Multi-Faceted	None	No
545225	AY73.043	Blade	Yes	Multi-Faceted	None	No
545225	AY73.043	Blade	No	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
None	Feather	1.72	1.92	0.95	30.42	6.99	0.43
None	Feather	3.74	5.7	1.55	46.11	18.25	5.02
Shatter	Outrepasse	N/A	N/A	6.99	N/A	N/A	7.28
None	Feather	2.27	1.54	0.85	19.05	23.07	0.82
None	Feather	1.86	3.47	2.36	51.02	14.7	2.97
None	Feather	1.55	1.89	0.79	27.23	3.94	0.32
Shatter	N/A	1.43	N/A	N/A	N/A	N/A	0.28
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.32
Hinging	Hinge	1.77	2.56	1.53	33.53	9.7	0.83
Shatter	N/A	0.97	N/A	N/A	N/A	N/A	0.1
Shatter	N/A	1.98	N/A	N/A	N/A	N/A	1.02
Shatter	Feather	N/A	N/A	0.92	N/A	N/A	0.41
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.12
Shatter	N/A	N/A	N/A	N/A	N/A	N/A	0.08
None	Feather	1.16	2.45	0.42	35	5.01	0.4
None	Feather	1.06	2.74	1.06	34.68	7.27	0.48
Shatter	Hinge	1.62	N/A	N/A	N/A	N/A	0.59

Field Number:	Square and Locus:	Removal Type:	Complete Piece: (Y/N)	Platform Type:	Platform Damage:	Corrective Element:
545225	AY73.043	Blade	No	Absent	Not Present	No
545225	AY73.043	Blade	No	Absent	Not Present	No
545225	AY73.043	Blade	Yes	Single Faceted	None	No
545225	AY73.043	Blade	Yes	Multi-Faceted	None	No
545225	AY73.043	Blade	Yes	Multi-Faceted	None	No
545225	AY73.043	Blade	Yes	Multi-Faceted	None	No
545225	AY73.043	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
545225	AY73.043	Profile Correction Blade	Yes	Multi-Faceted	None	Yes
545225	AY73.043	Partial Ridged Blade	Yes	Multi-Faceted	None	Yes
545225	AY73.043	Blade	No	Multi-Faceted	None	No

Error Present:	Termination Type:	Proximal Thickness: (mm)	Medial Thickness: (mm)	Distal Thickness: (mm)	Total Length: (mm)	Maximum Width: (mm)	Mass: (g)
Shatter	Feather	N/A	N/A	0.55	N/A	N/A	0.25
Shatter	Feather	N/A	N/A	0.72	N/A	N/A	0.09
Hinging	Hinge	1.47	2.66	2.37	24.92	8.2	0.61
None	Feather	1.36	1.4	0.71	28.68	8.1	0.39
None	Feather	1.53	2.38	0.67	37.48	11.88	1.27
None	Feather	1.03	2.25	0.67	34.47	8.56	0.54
None	Feather	1.45	2.09	0.67	44.1	9.34	1
None	Feather	1.87	1.58	0.33	28.73	8.73	0.4
None	Feather	1.13	2.71	0.65	33.14	5.71	0.46
Shatter	N/A	1.78	N/A	N/A	N/A	N/A	0.31

Appendix K

I. Lithic analysis of all excavated Bags that contained Locus 043.

Techno-Typological Analysis by RMU in AY72 Locus 043 Bag 15					
Type	Brown	Grey	Stippled	Misc.	Total
Primary Pieces	7	7	2	7	23
Secondary Flakes	53	59	6	4	122
Secondary Blades	3	8	0	0	11
Initial Core Tablet/Initial Faceted	1	6	0	2	9
Non-Initial Core Tablet	6	0	2	0	8
Core Trimming Elements:	70	80	10	13	173
Crested Blades	0	3	0	0	3
Blades	175	308	39	18	540
Platform Isolation Elements	8	18	1	1	28
Edge Preparation Elements	5	28	3	1	37
Non-initial Corrective Core Tablet	0	5	0	0	5
Angle Correction Elements	1	4	0	0	5
Profile Correction Blades	7	10	7	5	29
Core Face Rejuvenation Elements	14	18	1	0	33
Partial Ridged Blades	5	6	2	0	13
Bottom Partial Ridged Blade	0	0	0	0	0
Core Reduction Totals:	215	400	53	25	693
Flakes	186	362	52	101	701
Lateral Core Trimming	80	64	15	5	164
Chips	0	0	0	300	300
Shatter	0	0	0	0	0
Burnt Shatter	0	0	0	0	0
Sectioned Blade Fragments	0	1	1	3	5
Non-Initial Spontaneous Core Tablet	0	1	0	0	1
Alternate Flakes	2	0	0	0	2
Narrow-Faced Core	4	2	1	0	7
Broad Faced Core	0	0	0	0	0
Sub-pyramidal core	0	0	0	0	0
Opposed Platform Core	0	1	1	0	2
Change of Orientation Core	0	0	0	0	0
Flake Core	0	0	0	0	0
Core on Flake	0	0	0	0	0
Multi-Directional Core	0	0	0	0	0
Core Fragment	0	0	0	1	1
Misc Totals:	272	431	70	410	1183
Non-Geometric Microliths	41	43	18	22	124
Geometric Microliths	3	7	4	5	19
Scrappers	0	1	0	0	1
Burins	0	2	1	0	3
Burin Spalls	4	9	0	0	13
Heavy Duty Tools	0	0	0	0	0
Multi-Tools	1	2	0	0	3
Utilized Tools	0	5	0	0	5
Perforators	0	0	0	0	0
Notches/Denticulates	0	0	0	1	1
Tools Totals:	49	69	23	28	169
N=	606	980	156	476	2218

Techno-Typological Analysis by RMU in AY72 Locus 043 Bag 16					
Type	Brown	Grey	Stippled	Misc	Total
Primary Pieces	6	9	0	0	15
Secondary Flakes	13	46	9	4	72
Secondary Blades	0	5	0	0	5
Initial Core Tablet/Initial Faceted	2	2	0	0	4
Non-Initial Core Tablet	1	0	0	0	1
Core Prep Totals:	22	62	9	4	97
Crested Blades	0	0	0	0	0
Blades	53	191	6	34	284
Platform Isolation Elements	0	13	0	0	13
Edge Preparation Elements	0	14	0	0	14
Non-initial Corrective Core Tablet	0	6	0	0	6
Angle Correction Elements	0	2	0	0	2
Profile Correction Blades	3	8	0	0	11
Core Face Rejuvenation Elements	1	10	0	1	12
Partial Ridged Blades	3	5	0	0	8
Bottom Partial Ridged Blade	0	0	0	0	0
Core Reduction Totals:	60	249	6	35	350
Flakes	69	522	69	178	838
Lateral Core Trimming	26	65	4	1	96
Chips	0	0	0	410	410
Shatter	0	8	0	0	8
Burnt Shatter	0	0	0	29	29
Sectioned Blade Fragments	0	3	0	0	3
Non-Initial Spontaneous Core Tablet	0	0	0	0	0
Alternate Flakes	0	0	0	0	0
Narrow-Faced Core	0	1	0	0	1
Broad Faced Core	0	0	0	0	0
Sub-pyramidal core	0	0	0	0	0
Opposed Platform Core	0	0	0	0	0
Change of Orientation Core	0	0	0	0	0
Flake Core	0	1	0	0	1
Core on Flake	0	0	0	0	0
Multi-Directional Core	0	0	0	0	0
Core Fragment	0	0	0	0	0
Misc Totals:	95	600	73	618	1386
Non-Geometric Microliths	8	30	0	8	46
Geometric Microliths	2	9	0	0	11
Scrappers	0	1	0	0	1
Burins	0	2	0	0	2
Burin Spalls	3	5	0	0	8
Heavy Duty Tools	0	0	0	0	0
Multi-Tools	0	0	0	0	0
Utilized Tools	0	2	0	0	2
Perforators	0	0	0	0	0
Retouched Pieces	2	1	0	0	1
Notches/Denticulates	0	1	0	0	1
Tools Totals:	15	51	0	8	74
N=	192	962	88	665	1907

Techno-Typological Analysis by RMU in AY73 Locus 043 Bag 19				
Type	Brown	Grey	Misc	Total
Primary Pieces	6	13	1	20
Secondary Flakes	15	36	0	51
Secondary Blades	0	3	0	3
Initial Core Tablet/Initial Faceted	1	9	2	12
Non-Initial Core Tablet	0	2	0	2
Core Prep Totals:	22	63	3	88
Crested Blades	1	3	0	4
Blades	87	303	40	430
Platform Isolation Elements	1	10	0	11
Edge Preparation Elements	0	8	0	8
Non-initial Corrective Core Tablet	1	3	0	4
Angle Correction Elements	1	0	1	2
Profile Correction Blades	8	13	0	21
Core Face Rejuvenation Elements	7	16	1	24
Partial Ridged Blades	5	2	0	7
Bottom Partial Ridged Blade	1	0	0	1
Core Reduction Totals:	112	358	42	512
Flakes	132	383	150	665
Lateral Core Trimming	26	30	5	61
Chips	0	0	1610	1610
Shatter	0	1	0	1
Burnt Shatter	0	0	6	6
Sectioned Blade Fragments	0	5	0	5
Non-Initial Spontaneous Core Tablet	0	0	0	0
Alternate Flakes	0	0	0	0
Narrow-Faced Core	0	1	1	2
Broad Faced Core	0	0	0	0
Sub-pyramidal core	0	0	0	0
Opposed Platform Core	0	1	0	1
Change of Orientation Core	0	0	0	0
Flake Core	0	0	0	0
Core on Flake	0	0	0	0
Multi-Directional Core	0	0	0	0
Core Fragment	1	1	0	2
Misc Totals:	159	422	1772	2353
Non-Geometric Microliths	7	52	10	69
Geometric Microliths	1	5	0	6
Scrappers	1	4	0	5
Burins	5	8	0	13
Burin Spalls	2	9	1	12
Heavy Duty Tools	0	0	0	0
Multi-Tools	1	1	2	4
Utilized Tools	1	0	0	1
Perforators	0	4	0	4
Retouched Pieces	0	0	0	0
Notches/Denticulates	1	1	0	2
Tools Totals:	19	84	13	116
N=	312	927	1830	3069

Techno-Typological Analysis by RMU AY73 in Locus 043 Bag 30				
Type	Brown	Grey	Misc	Total
Primary Pieces	35	23	1	59
Secondary Flakes	68	44	0	112
Secondary Blades	7	3	0	10
Initial Core Tablet/Initial Faceted	4	7	0	11
Non-Initial Core Tablet	5	1	0	6
Core Prep Totals:	119	78	1	198
Crested Blades	4	3	0	7
Blades	188	200	32	420
Platform Isolation Elements	3	15	0	18
Edge Preparation Elements	3	12	0	15
Non-initial Corrective Core Tablet	1	2	0	3
Angle Correction Elements	0	0	0	0
Profile Correction Blades	19	27	1	47
Core Face Rejuvenation Elements	12	23	1	36
Partial Ridged Blades	5	7	0	12
Bottom Partial Ridged Blade	0	0	0	0
Core Reduction Totals:	235	289	34	558
Flakes	257	445	93	795
Lateral Core Trimming	64	54	3	121
Chips	0	0	1740	1740
Shatter	0	0	29	29
Burnt Shatter	0	0	182	182
Sectioned Blade Fragments	0	4	0	4
Non-Initial Spontaneous Core Tablet	0	0	0	0
Alternate Flakes	0	0	0	0
Narrow-Faced Core	2	5	0	7
Broad Faced Core	0	0	0	0
Sub-pyramidal core	0	0	0	0
Opposed Platform Core	0	0	0	0
Change of Orientation Core	0	0	0	0
Flake Core	0	2	0	2
Core on Flake	0	0	0	0
Multi-Directional Core	0	0	0	0
Core Fragment	1	2	0	3
Misc Totals:	324	512	2047	2883
Non-Geometric Microliths	26	42	12	80
Geometric Microliths	5	8	0	13
Scrappers	2	6	0	8
Burins	9	7	0	16
Burin Spalls	7	10	0	17
Heavy Duty Tools	2	0	0	2
Multi-Tools	0	2	0	2
Utilized Tools	0	5	0	5
Perforators	1	2	0	3
Retouched Pieces	0	0	0	0
Notches/Denticulates	1	0	0	1
Tools Totals:	53	82	12	147
N=	731	961	2094	3786

Techno-Typological Analysis by RMU in AY73 Locus 043 Bag 32				
Type	Brown	Grey	Misc	Total
Primary Pieces	8	5	3	16
Secondary Flakes	22	19	2	43
Secondary Blades	1	0	0	1
Initial Core Tablet/Initial Faceted	1	4	0	5
Non-Initial Core Tablet	1	4	0	5
Core Prep Totals:	33	32	5	70
Crested Blades	1	3	0	4
Blades	151	168	16	335
Platform Isolation Elements	4	3	0	7
Edge Preparation Elements	5	3	0	8
Non-initial Corrective Core Tablet	0	0	0	0
Angle Correction Elements	0	0	0	0
Profile Correction Blades	2	9	1	12
Core Face Rejuvenation Elements	11	12	1	24
Partial Ridged Blades	6	3	1	10
Bottom Partial Ridged Blade	0	1	0	1
Core Reduction Totals:	180	202	19	401
Flakes	58	149	20	227
Lateral Core Trimming	39	22	3	64
Chips	0	0	1234	1234
Shatter	0	0	27	27
Burnt Shatter	0	0	86	86
Sectioned Blade Fragments	1	1	0	2
Non-Initial Spontaneous Core Tablet	0	0	0	0
Alternate Flakes	0	0	0	0
Narrow-Faced Core	2	1	0	3
Broad Faced Core	0	1	0	1
Sub-pyramidal core	0	0	0	0
Opposed Platform Core	0	0	0	0
Change of Orientation Core	0	0	0	0
Flake Core	1	0	0	1
Core on Flake	0	0	0	0
Multi-Directional Core	0	0	0	0
Core Fragment	0	1	0	1
Misc Totals:	101	175	1370	1646
Non-Geometric Microliths	30	8	13	51
Geometric Microliths	7	8	0	15
Scrappers	0	0	0	0
Burins	2	2	0	4
Burin Spalls	2	3	0	5
Heavy Duty Tools	0	0	0	0
Multi-Tools	0	2	0	2
Utilized Tools	0	1	0	1
Perforators	1	1	1	3
Retouched Pieces	0	0	0	0
Micro Burin	1	0	0	1
Notches/Denticulates	1	1	0	2
Tools Totals:	44	26	14	84
N=	358	435	1408	2201

Techno-Typological Analysis by RMU in AY74 Locus 043 Bag 30				
Type	Brown	Grey	Stippled	Total
Primary Pieces	3	5	0	8
Secondary Flakes	22	17	8	47
Secondary Blades	1	0	0	1
Initial Core Tablet/Initial Faceted	2	0	1	3
Non-Initial Core Tablet	7	2	0	9
Core Prep Totals:	35	24	9	68
Crested Blades	0	2	0	2
Blades	70	120	26	216
Platform Isolation Elements	2	6	0	8
Edge Preparation Elements	4	6	1	11
Non-initial Corrective Core Tablet	0	0	0	0
Angle Correction Elements	0	0	0	0
Profile Correction Blades	14	5	2	21
Core Face Rejuvenation Elements	8	11	2	21
Partial Ridged Blades	1	0	3	4
Bottom Partial Ridged Blade	0	0	0	0
Core Reduction Totals:	99	150	34	283
Flakes	65	122	42	229
Lateral Core Trimming	20	25	11	56
Chips	0	0	310	310
Shatter	0	0	0	0
Burnt Shatter	0	0	50	50
Sectioned Blade Fragments	1	0	0	1
Non-Initial Spontaneous Core Tablet	0	0	0	0
Alternate Flakes	0	0	0	0
Narrow-Faced Core	2	1	0	3
Broad Faced Core	1	2	0	3
Sub-pyramidal core	0	0	0	0
Opposed Platform Core	0	0	0	0
Change of Orientation Core	0	0	0	0
Flake Core	0	0	0	0
Core on Flake	0	0	0	0
Multi-Directional Core	0	0	0	0
Core Fragment	0	1	0	1
Misc Totals:	89	151	413	653
Non-Geometric Microliths	1	0	10	11
Geometric Microliths	0	4	1	5
Scrappers	1	2	1	4
Burins	0	4	0	4
Burin Spalls	1	1	1	3
Heavy Duty Tools	0	0	0	0
Multi-Tools	0	0	0	0
Utilized Tools	1	1	0	2
Perforators	0	0	0	0
Retouched Pieces	0	0	0	0
Micro Burin	0	0	0	0
Notches/Denticulates	0	0	0	0
Tools Totals:	4	12	13	29
N=	227	337	469	1033

II. Lithic analysis of the Lithic Concentrations separated by RMU.

Techno-Typological Analysis: Lithic Concentration 1	
Type	Brown
Primary Pieces	6
Secondary Flakes	1
Secondary Blades	1
Initial Core Tablet/Initial Faceted	0
Non-Initial Core Tablet	0
Core Prep Totals:	8
Crested Blades	1
Blades	88
Platform Isolation Elements	40
Edge Preparation Elements	6
Non-initial Corrective Core Tablet	1
Angle Correction Elements	0
Profile Correction Blades	3
Core Face Rejuvenation Elements	5
Partial Ridged Blades	2
Bottom Partial Ridged Blade	0
Core Reduction Totals:	146
Flakes	85
Lateral Core Trimming	8
Chips	167
Shatter	0
Burnt Shatter	0
Sectioned Blade Fragments	0
Non-Initial Spontaneous Core Tablet	0
Alternate Flakes	0
Narrow-Faced Core	0
Broad Faced Core	0
Sub-pyramidal core	0
Opposed Platform Core	0
Change of Orientation Core	0
Flake Core	1
Core on Flake	0
Multi-Directional Core	0
Core Fragment	0
Misc Totals:	261
Non-Geometric Microliths	18
Geometric Microliths	0
Scrappers	0
Burins	0
Burin Spalls	2
Heavy Duty Tools	0
Multi-Tools	0
Utilized Tools	0
Perforators	0
Retouched Pieces	0
Micro Burin	0
Notches/Denticulates	0
Tools Totals:	20
N=	435

Techno-Typological Analysis: Lithic Concentration 2	
Type	Grey
Primary Pieces	0
Secondary Flakes	0
Secondary Blades	0
Initial Core Tablet/Initial Faceted	0
Non-Initial Core Tablet	0
Core Prep Totals:	0
Crested Blades	0
Blades	10
Platform Isolation Elements	0
Edge Preperation Elements	0
Non-initial Corrective Core Tablet	0
Angle Correction Elements	0
Profile Correction Blades	2
Core Face Rejuvenation Elements	0
Partial Ridged Blades	1
Bottom Partial Ridged Blade	0
Core Reduction Totals:	13
Flakes	3
Lateral Core Trimming	0
Chips	0
Shatter	0
Burnt Shatter	0
Sectioned Blade Fragments	0
Non-Initial Spontanious Core Tablet	0
Alternate Flakes	0
Narrow-Faced Core	0
Broad Faced Core	0
Sub-pyramidal core	0
Opposed Platform Core	0
Change of Orientation Core	0
Flake Core	0
Core on Flake	0
Multi-Directional Core	0
Core Fragment	0
Misc Totals:	3
Non-Geometric Microliths	0
Geometric Microliths	0
Scrappers	0
Burins	1
Burin Spalls	0
Heavy Duty Tools	0
Multi-Tools	0
Utilized Tools	0
Perforators	0
Retouched Pieces	0
Micro Burin	0
Notches/Denticulates	0
Tools Totals:	1
N=	17

Techno-Typological Analysis: Lithic Concentration 3	
Type	Brown
Primary Pieces	0
Secondary Flakes	0
Secondary Blades	0
Initial Core Tablet/Initial Faceted	0
Non-Initial Core Tablet	0
Core Prep Totals:	0
Crested Blades	0
Blades	6
Platform Isolation Elements	0
Edge Preparation Elements	0
Non-initial Corrective Core Tablet	0
Angle Correction Elements	0
Profile Correction Blades	3
Core Face Rejuvenation Elements	0
Partial Ridged Blades	1
Bottom Partial Ridged Blade	0
Core Reduction Totals:	10
Flakes	4
Lateral Core Trimming	2
Chips	0
Shatter	0
Burnt Shatter	0
Sectioned Blade Fragments	0
Non-Initial Spontaneous Core Tablet	0
Alternate Flakes	0
Narrow-Faced Core	0
Broad Faced Core	0
Sub-pyramidal core	0
Opposed Platform Core	0
Change of Orientation Core	0
Flake Core	0
Core on Flake	0
Multi-Directional Core	0
Core Fragment	0
Misc Totals:	6
Non-Geometric Microliths	0
Geometric Microliths	0
Scrappers	0
Burins	0
Burin Spalls	0
Heavy Duty Tools	0
Multi-Tools	0
Utilized Tools	0
Perforators	0
Retouched Pieces	0
Micro Burin	0
Notches/Denticulates	0
Tools Totals:	0
N=	16

Techno-Typological Analysis: Lithic Concentration 4	
Type	Grey
Primary Pieces	0
Secondary Flakes	0
Secondary Blades	0
Initial Core Tablet/Initial Faceted	0
Non-Initial Core Tablet	0
Core Prep Totals:	0
Crested Blades	0
Blades	6
Platform Isolation Elements	2
Edge Preperation Elements	0
Non-initial Corrective Core Tablet	1
Angle Correction Elements	0
Profile Correction Blades	3
Core Face Rejuvenation Elements	0
Partial Ridged Blades	1
Bottom Partial Ridged Blade	0
Core Reduction Totals:	13
Flakes	12
Lateral Core Trimming	1
Chips	0
Shatter	0
Burnt Shatter	0
Sectioned Blade Fragments	0
Non-Initial Spontanious Core Tablet	0
Alternate Flakes	0
Narrow-Faced Core	0
Broad Faced Core	0
Sub-pyramidal core	0
Opposed Platform Core	0
Change of Orientation Core	0
Flake Core	0
Core on Flake	0
Multi-Directional Core	0
Core Fragment	0
Misc Totals:	13
Non-Geometric Microliths	0
Geometric Microliths	0
Scrappers	0
Burins	1
Burin Spalls	2
Heavy Duty Tools	0
Multi-Tools	0
Utilized Tools	0
Perforators	0
Retouched Pieces	0
Micro Burin	0
Notches/Denticulates	0
Tools Totals:	3
N=	29

Techno-Typological Analysis: Lithic Concentration 5				
Type	Brown	Grey	Misc	Total
Primary Pieces	0	0	0	0
Secondary Flakes	1	1	0	2
Secondary Blades	0	0	0	0
Initial Core Tablet/Initial Faceted	2	0	0	2
Non-Initial Core Tablet	0	0	0	0
Core Prep Totals:	3	1	0	4
Crested Blades	0	0	0	0
Blades	6	5	3	14
Platform Isolation Elements	0	0	0	0
Edge Preparation Elements	1	0	0	1
Non-initial Corrective Core Tablet	0	0	0	0
Angle Correction Elements	0	0	0	0
Profile Correction Blades	0	1	0	1
Core Face Rejuvenation Elements	0	0	0	0
Partial Ridged Blades	1	0	0	1
Bottom Partial Ridged Blade	0	0	0	0
Core Reduction Totals:	8	6	3	17
Flakes	20	6	5	31
Lateral Core Trimming	1	0	1	2
Chips	3	0	38	41
Shatter	0	0	0	0
Burnt Shatter	0	0	3	3
Sectioned Blade Fragments	0	0	0	0
Non-Initial Spontaneous Core Tablet	0	0	0	0
Alternate Flakes	0	0	0	0
Narrow-Faced Core	0	0	0	0
Broad Faced Core	0	0	0	0
Sub-pyramidal core	0	0	0	0
Opposed Platform Core	0	0	0	0
Change of Orientation Core	0	0	0	0
Flake Core	0	0	0	0
Core on Flake	0	0	0	0
Multi-Directional Core	0	0	0	0
Core Fragment	0	0	0	0
Misc Totals:	24	6	47	77
Non-Geometric Microliths	2	0	0	2
Geometric Microliths	0	0	1	1
Scrappers	0	0	0	0
Burins	0	0	0	0
Burin Spalls	1	0	0	1
Heavy Duty Tools	0	0	0	0
Multi-Tools	0	0	0	0
Utilized Tools	0	0	0	0
Perforators	0	0	0	0
Retouched Pieces	0	0	0	0
Micro Burin	0	0	0	0
Notches/Denticulates	0	0	0	0
Tools Totals:	3	0	1	4
N=	38	13	51	102

Techno-Typological Analysis: Lithic Concentration 6	
Type	Brown
Primary Pieces	4
Secondary Flakes	0
Secondary Blades	2
Initial Core Tablet/Initial Faceted	0
Non-Initial Core Tablet	0
Core Prep Totals:	6
Crested Blades	0
Blades	60
Platform Isolation Elements	19
Edge Preparation Elements	0
Non-initial Corrective Core Tablet	0
Angle Correction Elements	0
Profile Correction Blades	8
Core Face Rejuvenation Elements	2
Partial Ridged Blades	3
Bottom Partial Ridged Blade	0
Core Reduction Totals:	92
Flakes	19
Lateral Core Trimming	15
Chips	23
Shatter	0
Burnt Shatter	0
Sectioned Blade Fragments	0
Non-Initial Spontaneous Core Tablet	0
Alternate Flakes	0
Narrow-Faced Core	0
Broad Faced Core	0
Sub-pyramidal core	0
Opposed Platform Core	0
Change of Orientation Core	0
Flake Core	0
Core on Flake	0
Multi-Directional Core	0
Core Fragment	0
Misc Totals:	57
Non-Geometric Microliths	1
Geometric Microliths	1
Scrappers	1
Burins	0
Burin Spalls	0
Heavy Duty Tools	0
Multi-Tools	0
Utilized Tools	0
Perforators	0
Retouched Pieces	0
Micro Burin	0
Notches/Denticulates	0
Tools Totals:	3
N=	158

Techno-Typological Analysis: Lithic Concentration 7 (separated by excavation square)							
Type	AY72	AY73	AY74	AV72	AV74	R/52/60.P3	Totals
Primary Pieces	1	0	0	0	0	0	1
Secondary Flakes	5	1	0	0	0	0	6
Secondary Blades	3	0	0	0	0	0	3
Initial Core Tablet/Initial Faceted	0	0	0	0	0	0	0
Non-Initial Core Tablet	0	0	0	0	0	0	0
Core Prep Totals:	9	1	0	0	0	0	10
Crested Blades	0	0	0	0	0	0	0
Blades	53	11	1	0	0	0	65
Platform Isolation Elements	10	2	0	0	0	0	12
Edge Preparation Elements	2	0	0	0	0	0	2
Non-initial Corrective Core Tablet	0	0	0	0	0	0	0
Angle Correction Elements	0	0	0	0	0	0	0
Profile Correction Blades	6	0	0	0	0	0	6
Core Face Rejuvenation Elements	0	0	1	0	1	0	2
Partial Ridged Blades	0	0	1	0	0	0	1
Bottom Partial Ridged Blade	0	0	0	0	0	0	0
Core Reduction Totals:	71	13	3	0	1	0	88
Flakes	60	6	2	0	0	0	68
Lateral Core Trimming	7	0	1	0	0	0	8
Chips	19	0	0	0	0	0	19
Shatter	0	0	0	0	0	0	0
Burnt Shatter	0	0	0	0	0	0	0
Sectioned Blade Fragments	0	0	0	0	0	0	0
Non-Initial Spontaneous Core Tablet	0	0	0	0	0	0	0
Alternate Flakes	0	0	0	0	0	0	0
Narrow-Faced Core	0	0	0	0	0	0	0
Broad Faced Core	0	0	0	0	0	0	0
Sub-pyramidal core	0	0	0	0	0	0	0
Opposed Platform Core	0	0	0	0	0	0	0
Change of Orientation Core	0	0	0	0	0	0	0
Flake Core	0	0	0	0	0	0	0
Core on Flake	0	0	0	0	0	0	0
Multi-Directional Core	0	0	0	0	0	0	0
Core Fragment	0	0	0	0	0	0	0
Misc Totals:	86	6	3	0	0	0	95
Non-Geometric Microliths	2	2	0	1	0	0	5
Geometric Microliths	0	0	0	0	0	0	0
Scrappers	0	0	0	0	0	0	0
Burins	0	0	0	0	0	0	0
Burin Spalls	0	0	0	0	0	0	0
Heavy Duty Tools	0	0	0	0	0	0	0
Multi-Tools	0	0	0	0	0	0	0
Utilized Tools	0	0	0	0	0	0	0
Perforators	0	0	0	0	0	0	0
Retouched Pieces	0	0	0	0	0	0	0
Micro Burin	0	0	0	0	0	0	0
Notches/Denticulates	0	0	0	0	0	1	1
Tools Totals:	2	2	0	1	0	1	6
N=	168	22	6	1	1	1	199

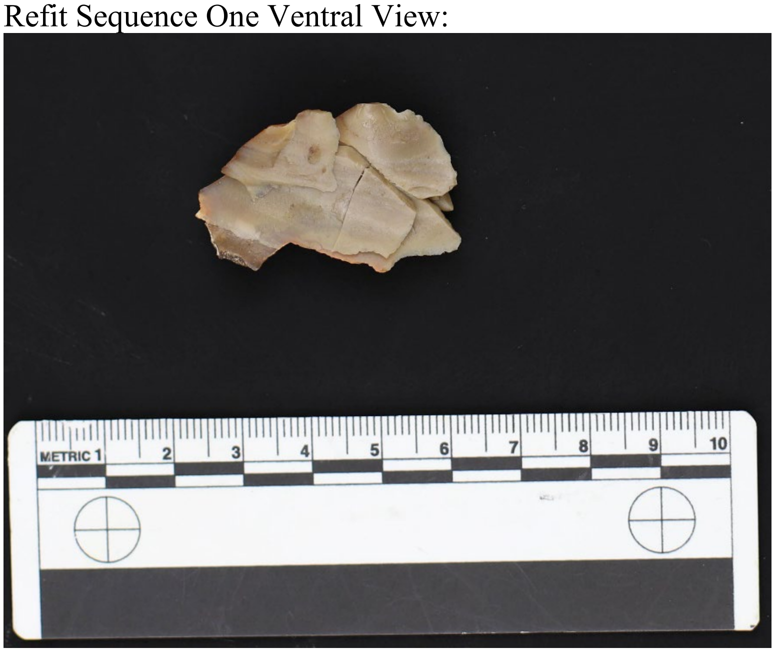
Appendix L

I. Images of refit artifacts from Locus 043 and the Lithic Concentrations

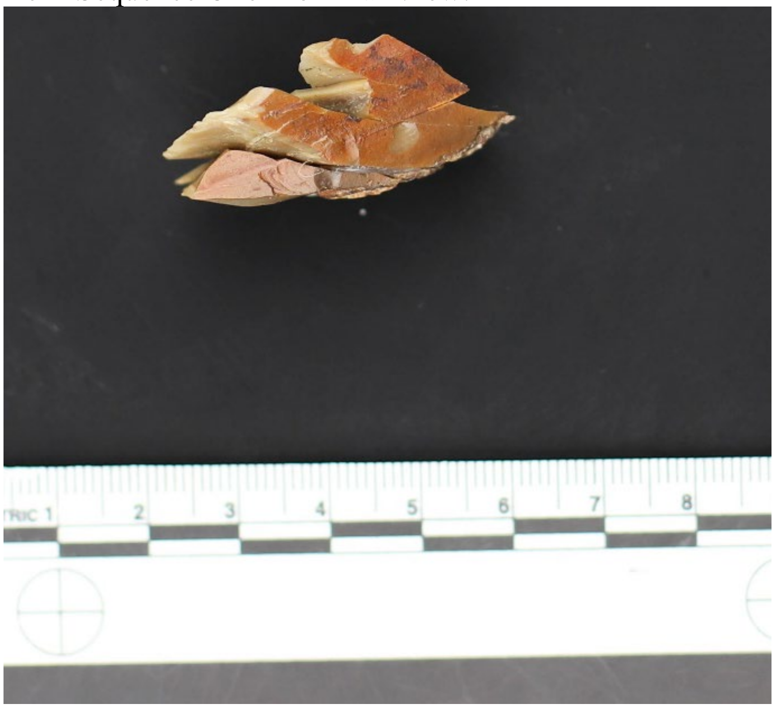
A. Lithic Concentration 1 Refit Sequences: AX72 Locus 208

Refit Sequence One Dorsal View:

Refit Sequence One Ventral View:



Refit Sequence One Proximal View:



Refit Sequence Two Dorsal View:

Refit Sequence Two Ventral View:

Refit Sequence Two Proximal View:

Refit Sequence Three Dorsal View:

Refit Sequence Three Ventral View:

Refit Sequence Three Proximal View:

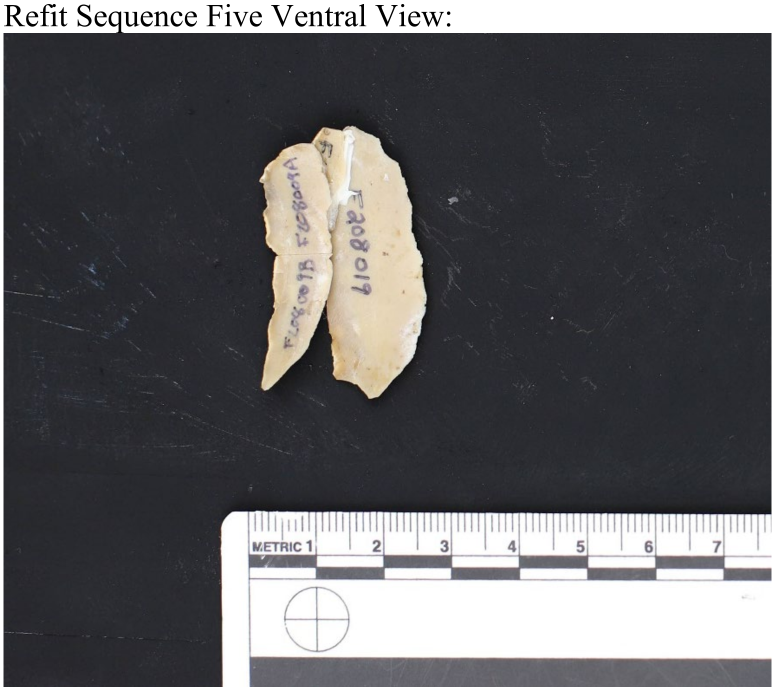
Refit Sequence Four Dorsal View:

Refit Sequence Four Ventral View:

Refit Sequence Four Proximal View:

Refit Sequence Five Dorsal View:

Refit Sequence Five Ventral View:



Refit Sequence Five Proximal View:

Refit Sequence Six Dorsal View:

Refit Sequence Six Ventral View:

Refit Sequence Six Proximal View:

Refit Sequence Seven Dorsal View:

Refit Sequence Seven Ventral View:

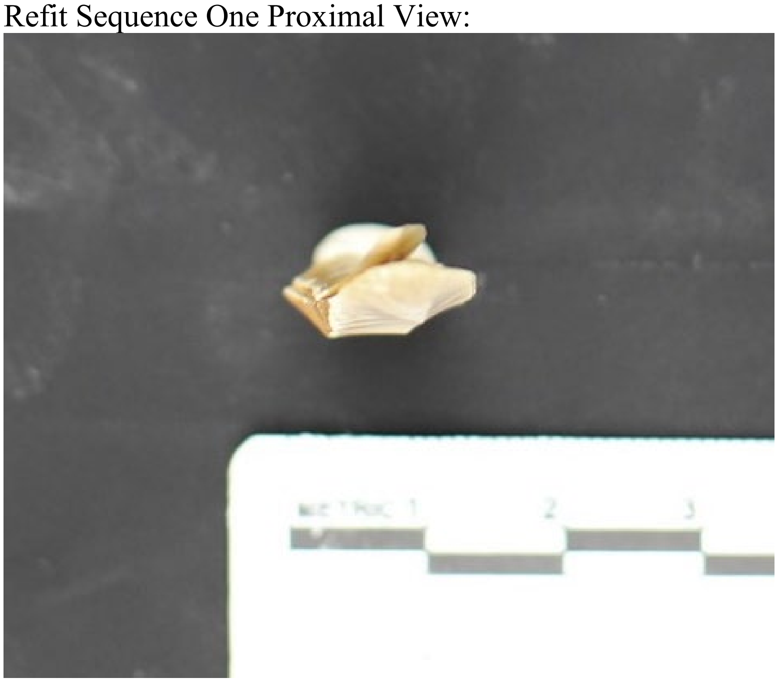
Refit Sequence Seven Proximal View:

B. Lithic Concentration 2 Refit Sequences: AX72 Locus 208

Refit Sequence One Dorsal View:

Refit Sequence One Ventral View:

Refit Sequence One Proximal View:



C. Lithic Concentration 6 Refit Sequences: BT58 Locus 014

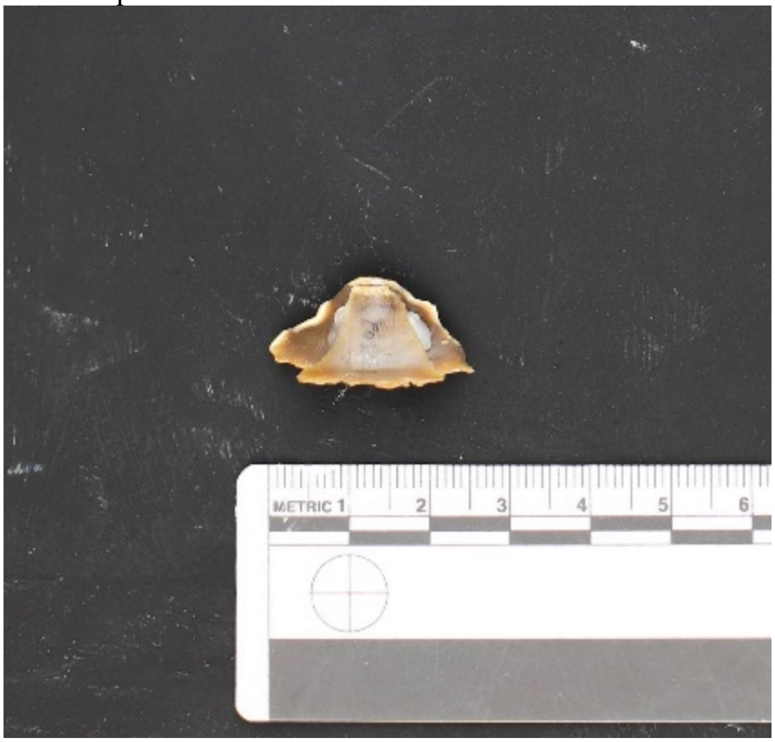
Refit Sequence One Dorsal View:

Refit Sequence One Ventral View:

Refit Sequence One Proximal View:

Refit Sequence Two Dorsal View:

Refit Sequence Two Ventral View:



Refit Sequence Two Proximal View:

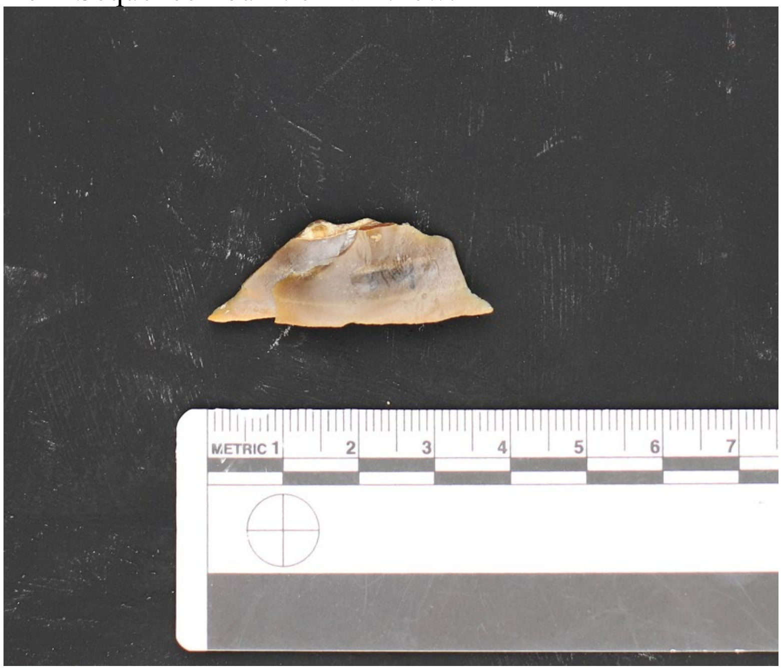
Refit Sequence Three Dorsal View:

Refit Sequence Three Ventral View:

Refit Sequence Three Proximal View:

Refit Sequence Four Dorsal View:

Refit Sequence Four Ventral View:



Refit Sequence Four Proximal View:

Refit Sequence Five Dorsal View:

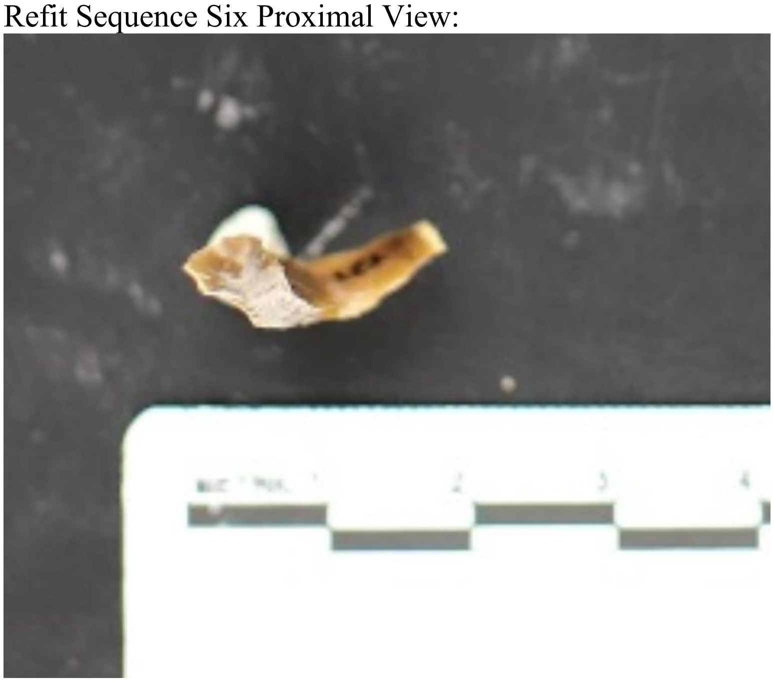
Refit Sequence Five Ventral View:

Refit Sequence Five Proximal View:

Refit Sequence Six Dorsal View:

Refit Sequence Six Ventral View:

Refit Sequence Six Proximal View:



Refit Sequence Seven Dorsal View:

Refit Sequence Seven Ventral View:

Refit Sequence Seven Proximal View:

Refit Sequence Eight Dorsal View:

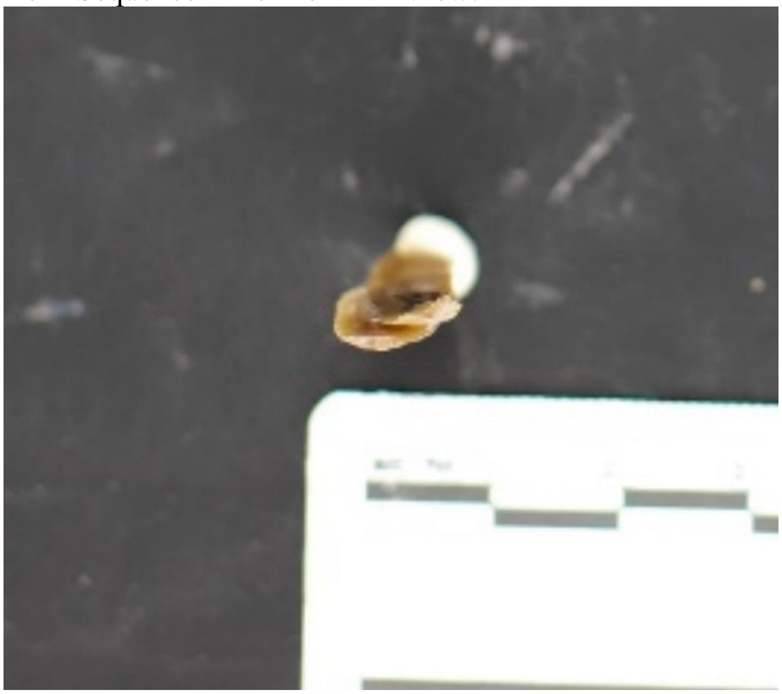
Refit Sequence Eight Ventral View:

Refit Sequence Eight Proximal View:

Refit Sequence Nine Dorsal View:

Refit Sequence Nine Ventral View:

Refit Sequence Nine Proximal View:



Refit Sequence Ten Dorsal View:

Refit Sequence Ten Ventral View:

Refit Sequence Ten Proximal View:

Refit Sequence Eleven Dorsal View:

Refit Sequence Eleven Ventral View:

Refit Sequence Eleven Proximal View:

Refit Sequence Twelve Dorsal View:

Refit Sequence Twelve Ventral View:

Refit Sequence Twelve Proximal View:

Refit Sequence Thirteen Dorsal View:

Refit Sequence Thirteen Ventral View:

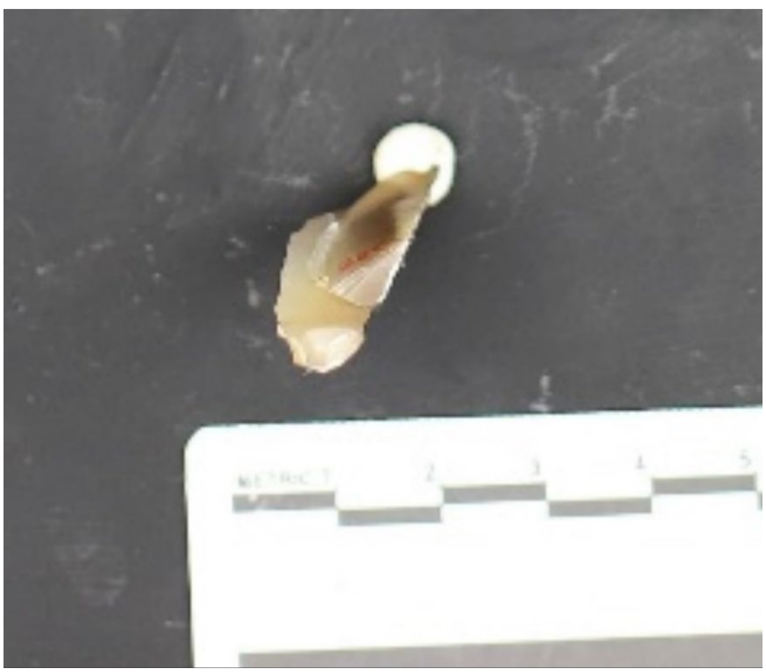
Refit Sequence Thirteen Proximal View:

D. Lithic Concentration 7 Refit Sequences

Refit Sequence One Dorsal View:

Refit Sequence One Ventral View:

Refit Sequence One Proximal View:



Refit Sequence Two Dorsal View:

Refit Sequence Two Ventral View:

Refit Sequence Two Proximal View: