Lithic Technological Organization and Hafting in Early Villages

Colin P. Quinn, Nathan Goodale, William Andrefsky Jr., Ian Kuijt, and Bill Finlayson

Hafting is an important part of lithic technology that can increase our understanding of socioeconomic behavior in the past. In this article, we develop a holistic approach to studying hafting by using the concept of curation within a broader assessment of lithic technological organization in early villages. Early villages were loci of socioeconomic transformation as part of the shift from mobile foraging to more sedentary cultivation lifeways. We suggest that an examination of hafting can provide new insights into how early villagers negotiated technological requirements, economic decision making, and social interactions in these novel contexts. As a case study, we develop a curation index and apply it to an archaeological context of hafted and unhafted pointed tools from the early Neolithic village of Dhra', Jordan. This curation index allows for a discussion of the technological, economic, and social dimensions of hafting strategies at Dhra'. The presence of multiple hafting traditions within early Neolithic villages of Southwest Asia is evidence of persistent social segmentation despite food storage and ritual practices that emphasized communal integration. Through the lens of lithic technological organization, we demonstrate that hafting and curation patterns can increase our understanding of technological, economic, and social strategies in early villages.

Keywords: lithic technology, hafting, early villages, curation, technological organization, identity, sedentism, Neolithic, Near East

El enmangue es una parte importante de la tecnología lítica que puede aumentar nuestra comprensión del comportamiento socioeconómico en el pasado. En este trabajo, desarrollamos un enfoque holístico para el estudio de la utilización del concepto de curación dentro de una evaluación más amplia de la organización tecnológica lítica en las aldeas primitivas. Las aldeas tempranas fueron lugares de transformación socioeconómica como parte del cambio de alimentación móvil a formas de vida de cultivos más sedentarios. Sugerimos que la examinación de los acontecimientos del enmangue puede proporcionar nuevos conocimientos sobre cómo los aldeanos negociaron los requisitos para la tecnología, la toma de decisiones económicas y las interacciones sociales en estos nuevos contextos. Como estudio de caso, desarrollamos un índice de curación y lo aplicamos a un contexto arqueológico de las herramientas puntiagudas y sin puntillas de la antigua aldea neolítica de Dhra', Jordania. Este índice de curación permite una discusión de las dimensiones tecnológicas, económicas y sociales de las estrategias de desarrollo en Dhra'. La presencia de múltiples tradiciones de hospedaje en las aldeas neolíticas tempranas del sudoeste de Asia es evidencia de una persistente segmentación social a pesar del almacenamiento de alimentos y las prácticas rituales que enfatizan la integración comunitaria. A través de la lente de la organización tecnológica lítica, demostramos que los patrones de cuidado y curación pueden proporcionar una mejor comprensión de las estrategias tecnológicas, económicas y sociales en las aldeas primitivas.

Palabras clave: tecnología lítica, enmangue, aldeas tempranas, curación, organización tecnológica, socioeconómica, sedentarismo, Neolítico, sudoeste de Asia

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Hafting, defined as the process of attaching stone tools to nonstone shafts or handles, is an important facet in understanding past systems of lithic technological organization. The development of hafting specifically and of composite tools in general has been identified as one of several indicators of human behavioral modernity (Barham 2013; Shea 2006; Wilkins et al. 2012). Hafting changes the socioeconomic choices people made about where and when to move, what resources to procure, and when to discard and when to resharpen tools (see Bettinger et al. 2015; Clarkson et al. 2015; Eren 2012; Kelly 2007). Although normally associated with projectile technologies, many hafted tools, such as knives, drills, scrapers, and sickle blades, are not used as projectiles. Despite hafting's importance, it has remained an undertheorized part of lithic technological organization. In particular, the lack of models for variability in hafting strategies and of quantitative measures for assessing hafting's efficacy has prevented the potential of hafting to inform our understanding of human behavior from becoming fully realized.

Studying the organization of technology provides one path for using hafting and lithic industries to better understand socioeconomic behavior in the past. Building on Binford (1977, 1978, 1979, 1980) and Nelson (1991), Carr and Bradbury (2011, 2018) have outlined how technological strategies, such as stone tool hafting, mediate environmental and demographic conditions; social, economic, and ideological strategies; and decision making around stone tool design and activities. Technological strategies are variable and responsive to the socioeconomic contexts in which they are situated (Hadley and Carr 2015), and technological organization is sensitive not only to subsistence and settlement patterns but also to kinship, politics, and religion (Carr et al. 2012:8). Because the process of hafting stone tools is informed by technological needs, economic restrictions, and social conventions, it can provide unique insights into how people navigated novel socioeconomic contexts in the past.

The emergence of sedentary villages, which occurred in many different places and times across the globe, represents a significant transformation in human socioeconomic organization. In the southern Levant, the establishment of permanent villages approximately 11,000 years ago created a novel context in which existing socioeconomic systems, identities, and strategies underwent significant transformation. There were changes in food and craft production technologies (Bar-Yosef and Kislev 1989): decreasing mobility as a result of increasing sedentism necessitated the development of new conventions for stone procurement and exchange (Bamforth 1990; Odell 1998). Early villages were also locales of population aggregation and growth. In these contexts, people found themselves living in larger numbers, with people they may not have known well, and perhaps they had less ability or incentive to "vote with their feet" to mitigate social tensions.

Early villages are an ideal context in which to study the intersection of technological needs, economic restrictions, and social conventions in hafting technologies. Across the globe, sedentism and population aggregation are associated with the creation of different mechanisms for communal integration (Barrier 2017; Birch 2014). In the southern Levant, sedentism emerged at the same time as community-building integrative mechanisms, such as communal storage (Kuijt and Finlayson 2009); communal architecture like the tower of Jericho in the earliest Neolithic (the Pre-Pottery Neolithic A [PPNA]; Kenyon and Holland 1981); and subsequently in collectivizing rituals such as the complex mortuary practices reflected by skull plastering and cult buildings during the Neolithic (Byrd 1994; Kuijt 1996, 2008; Rollefson 2005). However, the investment in the performance of communal identity indicates the persistence of differences among early villagers. These differences and how they were materialized have not yet been fully explored. We argue that curation approaches to lithic technological organization can help elucidate patterns of social differences within early villages that necessitated these community-integrative mechanisms.

In this article, we explore how lithic technological organization, particularly hafting and curation patterns, near the start of the population aggregation process at the early Neolithic site of Dhra', Jordan, can inform our understanding of technological, economic, and social strategies

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in these early settlements. Our approach combines elements of practice theory and curation methodologies with a broader consideration of lithic technological organization. We use a curation index to compare retouch patterns for hafted and unhafted pointed stone tools. The curation index helps clarify tool function and quantifies if, and how much, hafting economizes lithic raw materials. We also use the curation index to characterize two different hafting traditions for pointed tools in the Dhra' assemblage: el-Khiam and Salibiya points. Through an examination of hafting as part of the lithic technological organization at an early village site, we argue that community-integrative mechanisms co-occurred with technological traditions that maintained social differences while humans made the transition to new sedentary lifeways.

Why People Haft Stone Tools

People haft stone tools for three general, but not mutually exclusive, reasons: technological, economic, and social. First, as a technology, hafting provides an opportunity to create new tools and increase the efficiency of existing tools. Some stone tool functions require hafting. For example, hunting, through thrusting or projectile technologies, requires that stone tools be delivered with speed, force, and accuracy from a distance (Bleed 1986). Many of the studies of the origins of hafting in human history have focused on its technological advantages, often seen through the initial appearance of spears and later as projectile points with the bow and arrow (e.g., Ames et al. 2010; Goodale et al. 2011; Shea 2006). The choice to haft seems straightforward when it is required for the tool to function, although stone tools are not always necessary for effective projectile technology (e.g., Waguespack et al. 2009). The type of haft can also affect the tool's functional efficiency, as Story and colleagues (2019) suggest for fluted and unfluted projectile points. Second, hafted tools are often more efficient than unhafted tools when used for the same activity. For example, a hafted scraper facilitates greater dexterity, increased leverage, and a more comfortable grip that together enable the user to scrape faster, more accurately, and longer (Tomka 2001; although see Clarkson et al. 2015). Small flakes, blades, and tools that are difficult to grip can be used more efficiently when hafted (Clarkson et al. 2015:131). Third, hafting can be adapted to make lithic technologies more flexible. For example, a hafted biface can become a multipurpose tool when used as a knife while in the foreshaft of a spear (Andrefsky 2006).

Researchers have also argued that hafting extends the use-life of stone tools and thereby economizes lithic resources (see Keeley 1982; Odell 1994; Shott 1997; Weedman 2006). Archaeologists argue that economization is linked to risk minimization (Odell 1994), mobility, and resource procurement (Clarkson et al. 2015:132–133; Shott 1986). It is often suggested that predictable access to high-quality tool stone affects the investment in more formal and less expedient technologies such as hafting (Andrews et al. 2015; Goodale et al. 2008; Herzog and Goodale 2019; Oswalt 1976; Shott 1986, 1989). The rate of retouch has also been demonstrated to be influenced by the availability of high-quality raw material (e.g., Smith 2015). Yet hafting does have economic costs that mitigate the benefits of raw material conservation. The costs of hafting, such as the resources necessary for the haft element and the time required to attach the stone to the haft, have rarely been taken into account (cf. Clarkson et al. 2015; Finlayson 1990). Additionally, hafting can increase the transport costs for mobile toolkits (Eren 2012). Clarkson and colleagues (2015) took into account the time of manufacturing a haft in their exploration of the decisions of when to haft, retouch, or discard tools; they argue that archaeologists often overestimate the benefit of hafting to the functional efficiency of tools.

Hafting is also an important medium through which social information can be transferred (Goodale et al. 2015; Lipo et al. 2015; Prentiss et al. 2015; Sinopoli 1991; Weedman 2006; Wiessner 1983). In addition to their utilitarian function, tools can play a social role in communicating individual and communal identities (Weedman 2018; Wobst 1977). Ethnographically, there is clear evidence that stone tool hafts can be a means of social information exchange (Weedman 2006; Wiessner 1983). Hafts, which are commonly made of perishable materials, are often saved and can be passed down to multiple generations as heirlooms (Gould 1980; Lillios 1999). Variability in decoration, form, and the use-life of hafts has been linked to different social identities of individuals, language groups, and ethnicity (Deacon and Deacon 1980; Gould 1980; Larick 1985; Weedman 2006:190; Wiessner 1983). Hafts can enable people to signal difference through color, style, embellishments such as feathers, and ornamentation while using a single homogeneous lithic resource. It is unclear how haft elements, which would normally be hidden when hafted, were involved in social information exchanges. It is possible, however, to distinguish distinct lithic technological learning traditions in the manufacturing of haft elements (see Goodale et al. 2015).

Curation Indexes, Tool Utility, and Hafting

Curation approaches to lithic technological organization provide one means of exploring the technological, economic, and social dimensions of hafting (Andrefsky 2014; Buchanan et al. 2015; Morales and Vergés 2014). Over the past two decades, curation studies have become an integral part of archaeological approaches to lithic technology (see Andrefsky 2008; Hiscock and Tabrett 2010). Quantifying curation is critical to understanding technological organization (Shott 2018). Following Shott (1996:268), we define curation as the "relationship between maximum and realized utility" in an artifact. *Maximum utility* in stone tools is the total amount of the object that can be effectively worked, whereas *realized utility* is expressed as the portion of the original object that is used. In curation studies, realized utility is equated to the amount of material that has been removed through use and retouch. This quantitative approach has been applied to many different archaeological contexts as researchers have sought to use retouch of tools as a proxy for an estimate of utility (e.g., Andrefsky 2006, 2008, 2009; Connell and Clarkson 2011; Davis and Shea 1998; Eren and Sampson 2009; Eren et al. 2005; Hiscock and Clarkson 2005; Horowitz and McCall 2013; Quinn et al. 2008; Shott 2005; Shott and Seeman 2015; Shott and Sillitoe 2005; Shott and Weedman 2007; Shott et al. 2007).

There are several reasons why curation indexes are an ideal tool for reconstructing the organization of hafting technologies. First, they can help distinguish finished objects from objects that are still in production. Artifacts that lack visible evidence of hafting, such as notches, could be in progress, intentionally unhafted, or hafted in a different way from other tools with notches. If these tools were discarded before completion, we expect curation indexes to indicate that no utility has been realized. In contrast, if curation indexes demonstrate that a significant amount of utility had been realized, then these materials were intentionally unhafted or hafted in a distinct way. As a result, curation approaches can help reveal decision-making strategies regarding when hafting was technologically advantageous or superfluous. Second, indexes can be applied to both hafted and unhafted versions of tools to quantify the amount of utility that is realized for each individual tool. With the use of standardized measurements, curation studies provide a way of measuring realized utility across entire assemblages. Third, curation indexes can demonstrate the presence of different hafting and retouch techniques within assemblages. The co-occurrence of multiple hafting styles is an indicator of social difference and multiple learning traditions. In early settlements where different families and groups began to aggregate in the same place, identifying different learning traditions can provide insight into the challenges of village life. Together, curation indexes provide a critical analytical tool for understanding hafting as part of a broader lithic technological organization in early villages.

Dhra', Jordan: An Early Neolithic Village

We center our discussion of lithic technological organization in early villages at one of the first examples in the world: Dhra', Jordan. The site of Dhra' is located next to Wadi ed-Dhra' in the Jordan Valley and was occupied at approximately 11,000 cal BP during the forager–farmer transition in Southwest Asia (Figure 1; Finlayson et al. 2003; Goodale et al. 2002, 2007; Kuijt and Finlayson 2009). The site had an extensive occupation during the PPNA that covered an area of approximately 1 ha, although with a lower density than later settlements. Excavations directed by Kuijt and Finlayson (in 1994, 2001–2002,

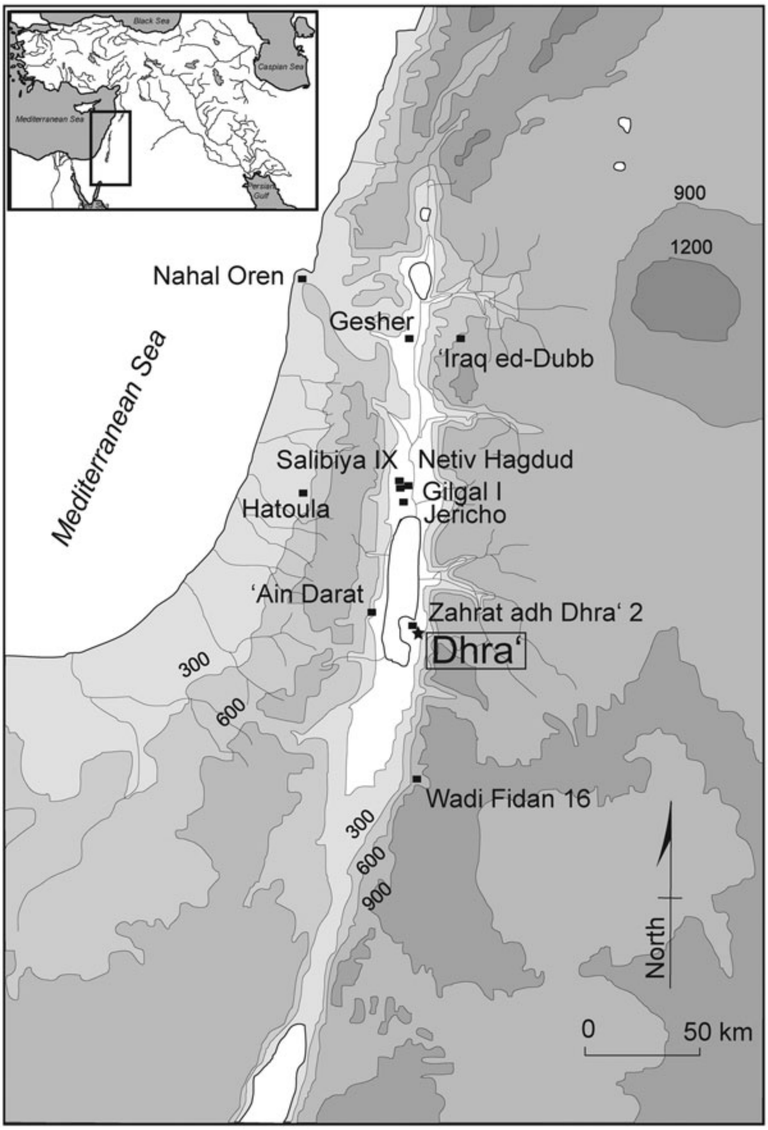

Figure 1. The Southern Levant region in Southwest Asia, depicting Dhra', Jordan, and other early Neolithic sites.

and 2004–2005) uncovered numerous structures, features, faunal remains, paleobotanical evidence, as well as a substantial lithic assemblage of more than one million artifacts attributed to the PPNA occupation (see Finlayson et al. 2003 and Goodale et al. 2002, 2007 for detailed descriptions of the lithic assemblage). Pointed tools of several morphological types—el-Khiam and Salibiya points, awls, and borers—are abundant in the assemblage: it contains more than 1,000 points and 1,500 awls.

Research at Dhra' has made important contributions to our understanding of how early village life affected the organization of the economy and society (Kuijt and Finlayson 2009; Kuijt and Goodale 2009). Among the contributions from research at Dhra' are the earliest evidence of communal storage facilities (Kuijt and Finlayson 2009) and new information about plant cultivation practices on the path to domestication (Goodale et al. 2010; see also Asouti and Fuller 2013), as well as on social and economic decision making and identity in stone tool production (Goodale et al. 2008, 2015; Quinn et al. 2008). Examining how and when Dhra' knappers chose to haft, retouch, and discard stone tools provides a greater understanding of the social, economic, and subsistence strategies associated with the transition from primarily mobile hunter-gatherers to sedentary agriculturalists in Southwest Asia.

Dhra' is an ideal case study for exploring hafting and lithic technological organization. The assemblage contains both hafted and unhafted tools with similar morphologies and retouch techniques, which allows for the development and application of a single curation index to quantify tool use-life and retouch. Unlike other early villages, raw material was not a constraint on Neolithic flintknappers at Dhra'. The site is positioned next to a large, medium- to high-quality flint outcrop (Goodale et al. 2008). Previous research has suggested that raw material availability significantly affected decisions to invest in formal tool technologies, including hafting (Andrefsky 1994; Goodale et al. 2008; Smith 2015). Formal hafted tools conserve raw materials and maximize cutting edges, which are important factors in minimizing risk when the resupply of tool stone is unpredictable or difficult. With less of a need to conserve material, the choices to haft by the residents of Dhra' were likely informed by the full range of possible reasons for hafting stone tools.

Pointed Tools at Dhra'

In this study we focus on three types of early Neolithic pointed tools at Dhra': el-Khiam points, Salibiya points, and awls (Figure 2). These tools share similar morphological characteristics: all are unifacial pointed tools made on blades removed from unidirectional and multidirectional blade cores (Nadel 1997). Most tools have a single dorsal arris, although tools with multiple parallel dorsal arrisses are also found. These tool types primarily differ in their basal finishing. El-Khiam points were retouched at the distal end of the original blade to make the tip. Points were manufactured through unimarginal flaking on both the left and right margins. The unifacial retouch on the tip is present either only on the ventral surface of the original blade, only on the dorsal surface, or in opposed positions (one margin is retouched on the ventral surface and the other on the dorsal surface). The medial section of the tool was originally unretouched, although it became reduced with greater tool resharpening. El-Khiam point notches were usually bimarginally retouched and varied in respect to number, location, and size. The Dhra' lithic assemblage contains el-Khiam points that have from one to eight notches, but a single matching pair of notches is most common. The base of the point, which is the proximal end of the original blade, was most commonly finished. Finished bases were retouched either unimarginally or bimarginally with a noninvasive retouch or an invasive retouch also referred to as couze retouch (Bordes and Fitte 1964). Finished bases can be concave, flat, or convex.

Salibiya points have a similar morphology as el-Khiam points in most respects; however, they lack notches and have been described as having more prominent shoulders (Smith 2005:409). In our view, to be classified as a Salibiya point an object must have all of the characteristics of an el-Khiam point, it must lack notches, and the base must have some form of finishing retouch.

Awls are morphologically similar to both el-Khiam points and Salibiya points. However, the bases on awls are unfinished. In some cases, awls still retain the platform and bulb of force from the original flake removal, unlike both el-Khiam and Salibiya points.

As with many prehistoric lithic assemblages, Neolithic researchers have previously used the pointed tool typology, based on artifact morphology, to define regional chronology and culture-history (see Kuijt 2001; Nadel 1997). Many curation studies in the past have challenged morphological typologies on the basis that the different forms represent multiple steps in a single type of artifact's reduction sequence, rather than multiple discrete types (e.g., see Binford and Binford's 1966 discussion of Bordes 1961; also see Andrefsky 2006; Fellner 1995; Goring-Morris 1996; McPherron 1995, 2003; Neeley and Barton 1994). As an alternative to the existing Neolithic pointed tool typology, Salibiya points may simply be unfinished el-Khiam points and awls may be unfinished Salibiya points. It is

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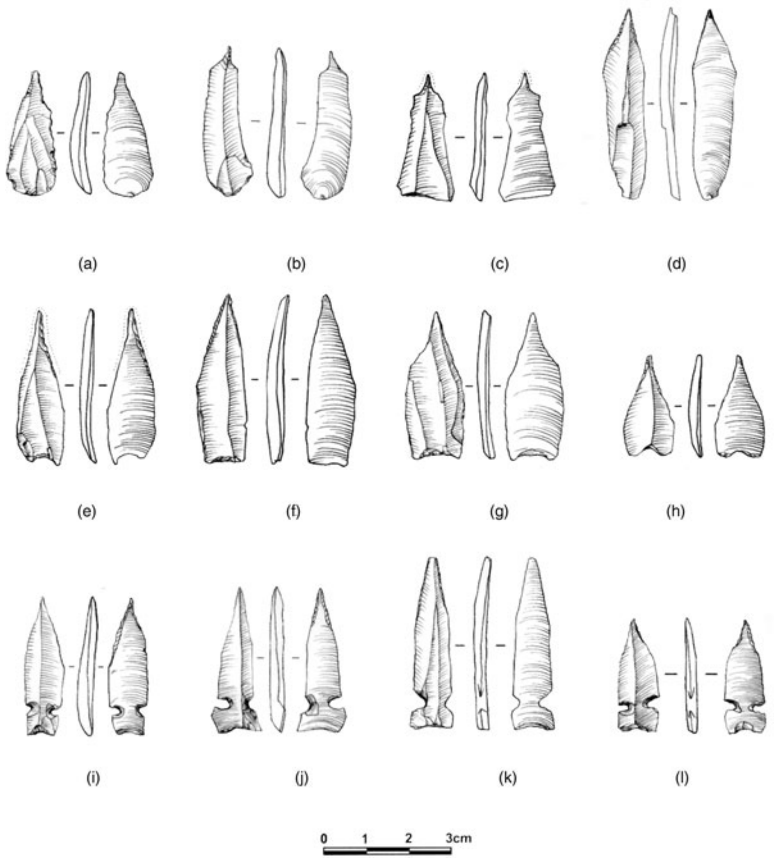

Figure 2. Artifact illustrations showing typological variations in (a–d) awls, (e–h) Salibiya points, and (i–l) el-Khiam points (illustration by Eric Carlson).

possible that awls, Salibiya points, and el-Khiam points could correspond to different production stages of one target tool type (in this case, el-Khiam points). At least some awls may be unfinished tools, which would have then been basally retouched (represented by Salibiya points) and ultimately notched (producing finished el-Khiam points). The methods developed to measure curation, combined with use-wear analysis, also allow us to evaluate these alternative typologies. As we show, retouch patterns indicate that the existing typological categories are discrete types of finished tools.

The Function of Pointed Tools at Dhra'

It is often assumed that hafted pointed tools were exclusively used as projectiles for hunting or warfare (Andrefsky 2006). Thus, Neolithic researchers have generally assumed that el-Khaim and Salibiya points were exclusively used for hunting (e.g., Nadel 1997), replacing earlier compound microlithics. Although villagers at Dhra' were beginning to invest in cultivating, processing, and storing wild cereals, animal management practices were still in their infancy and hunting remained a major activity (Makarewicz 2013; Tchernov 1997, 2004). However, as many researchers now know, function does not always follow form. We deliberately refer to these artifacts as *pointed tools* and not as *projectile points* for a reason. The commonly used term "projectile point" may imply a function for which a tool or tool category may not have been used. Function must be demonstrated, not assumed, for any stone tool category.

There is strong evidence that the pointed tools recovered during excavations at Dhra' were not primarily used as projectiles. There is only one impact fracture in the assemblage of more than 800 el-Khiam points (Finlayson et al. 2003). The near absence of impact fractures suggests that any pointed tools at Dhra' that were used and damaged during hunting were discarded away from the houses and activity areas excavated within the village.

Instead of projectiles, the pointed tools recovered in the excavations at Dhra' were multipurpose perforators, as primarily indicated by the abundance of points at various retouch stages within the settlement (Goodale and Smith 2001; Goodale et al. 2002; Smith 2005). Experimental work has demonstrated that wear, breakage, and retouch patterns of el-Khiam points are consistent with leatherworking (Quinn et al. 2008). A random sample of 55 broken el-Khiam points have breakage patterns that are consistent with use as a punctuation tool for working soft materials such as leather ($n = 50$) and transverse breaks ($n = 5$) that indicate rotational use akin to a drill (Quinn et al. 2008). Based on morphological similarities, it is likely that Salibiya points and awls were also used in this fashion. Given that the pointed tools were not all hafted onto arrow shafts, hafting is not a technological requirement for the primary function of the pointed tools in the Dhra' assemblage: it is a choice.

Identifying Hafting in the Dhra' Pointed Tool Assemblage

There are many macroscopic (see Andrefsky 2006) and microscopic means (see Rots 2003; 2010; Rots et al. 2001, 2006) to determine whether a given tool or tool type was hafted: these include morphological preparation of the base (e.g., notching, fluting) or use-wear related to basal preparation or wear once in the haft (e.g., abrasion). Drawing on both macroscopic and microscopic evidence, we suggest that two tool types, the el-Khiam points and Salibiya points, were normally hafted, but that awls were unhafted.

Previous microwear studies have looked at intentional abrasion, as well as other markers of hafting, on the bases of these artifacts and equated the presence of these microwear patterns to hafting (Smith 2005:342–404). Smith's study of a small subset of the Dhra' assemblage found that 64.9% (24 of 37) of the el-Khiam points had microwear signatures potentially related to hafting. Only one of the four Salibiya points and one of the eight awls analyzed had hafting microwear, both markedly lower rates than of the el-Khiam points.

Some pointed tools also have morphological attributes consistent with hafting. Most el-Khiam points at Dhra' have two notches, which suggests that these points were manufactured with hafting in mind. Salibiya points have a form of basal retouch consistent with creating a base that is conducive for hafting. In contrast, awls lack morphological attributes consistent with hafting; instead, they have unretouched or unfinished bases that lack notches and often still have the bulb of force present, making it difficult to secure the tool in a haft.

Together, the evidence suggests that el-Khiam and Salibiya points were made to be suitable for hafting, whereas awls were not. Even though these categories were likely not rigid, the retouch patterns described later provide quantitative support both for the existing typology that distinguishes these three types of pointed tools and for the pattern that el-Khiam and Salibiya were normally hafted whereas awls were not.

The Pointed Tool Curation Index (PTCI)

The goal of the Pointed Tool Curation Index (PTCI) is to quantify the amount of raw material used as pointed tools were reduced in length throughout their use-life. Experimental research demonstrates that. during reduction, el-Khiam points, Salibiya points, and awls lost mass lengthwise rather than horizontally (width; Quinn 2006; Quinn et al. 2008). Because the tools were all made on unifacial blades, were likely used for similar functions, and were retouched in a similar manner, we can apply a single curation index to all three tool types.

To develop an equation for the PTCI it was important to estimate original blade length for the pointed tools. It has been demonstrated that flake and blade characteristics often conform allometrically (Buchanan 2006; Clarkson and Hiscock 2011; Davis and Shea 1998; Dibble 1997; Dibble and Pelcin 1995; Eren 2013; Muller and Clarkson 2014; Pelcin 1996, 1998; Quinn et al. 2008; Shott and Weedman 2007; Shott et al.

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2000). In other words, the measured value on one variable may positively or negatively correlate with the value of other variables on the original flake blank. However, this is not a simple relationship for all chipped stone technology. For instance, flake or blade mass may be predicted by the exterior striking platform angle, but this can vary depending on the force applied (Pelcin 1997) and the type of percussion used (hard or soft; Shott et al. 2000). Other factors such as differences in raw material (Bradbury et al. 2008) and in flinknapper production techniques have been shown to introduce significant differences in flake characteristics (Whittaker 1987; Williams and Andrefsky 2011). In an effort to reduce the blade character differences in our equation, we randomly selected an assemblage of blade blanks produced at the quarry area from Dhra' to develop a measure of original blade length.

Experimental work using raw material from the Dhra' quarry has been unsuccessful in fully replicating blade morphology (see Quinn et al. 2008). We claim that a sample of blade blanks from Dhra' more closely approximates blade size and shape characteristics than an experimentally replicated assemblage, especially because we are not completely sure how blades were removed (force, angle, percussor density, etc.) at the site. One possible reason why we have not been able to replicate the blade removal process is because there are several reduction techniques represented in the assemblage, a characteristic of early settlements in which people might have been coming together for only part of the year and representing several different learning traditions for core-reduction strategies (see Goodale et al. [2008] for the overall core-reduction sequence variability). Because the village sits on the lithic raw material source and there are few if any constraints on raw materials, it is also likely that other members of the village, such as children, were engaging in the lithic technology enterprise, producing further variability in the assemblage.

We selected 103 blade blanks from Dhra' that were not included in our analysis of points and awls. Presumably, the people who produced the blade blanks could have been the same individuals who made and used the tools included in this study. We selected blade blanks that matched the characteristics of pointed tools at Dhra': they were complete, not curved, and within the mean range of thickness values of the points and awls. The Dhra' assemblage is characterized by the production of blades, many of which were used expediently or not at all (Goodale et al. 2007). Given the size of the lithic assemblage at Dhra' (more than one million pieces), we should not consider these blades to be rejects that were passed over and not selected to become pointed tools. Instead, it is more likely that blades for pointed tools were selected from among the extremely large quantity of available blades. Consequently, many of the blades in our sample may well have been selected to manufacture pointed tools if they were needed. The benefit of using archaeological, rather than experimental, samples for allometric calculations is an established best-case scenario (see Muller et al. 2018:723).

The thickness of the blade blank was taken below the bulb of force, because it is often removed during tool manufacture. For each blade we recorded the maximum length below the bulb of force, perpendicular to the striking platform. There is a strong linear relationship between the length and thickness of blades below the bulb of force ($F = 285.48$, $df = 1$, $p < 0.0001$, $r^2 = 0.739$; Figure 3). This regression value is significantly higher than other regression values used for predicting allometric relationships on stone tools based on flake dimensions, such as by Blades (2003; $r^2 = 0.462$) and Goldstein

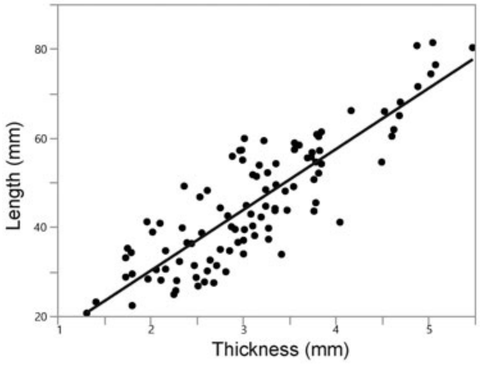

Figure 3. Regression analysis showing the estimation of blade length based on thickness. The best fit line estimates that blade length = (13.661 × blade thickness) + 3.015. ($r^2 = 0.739$; $p < 0.0001$).

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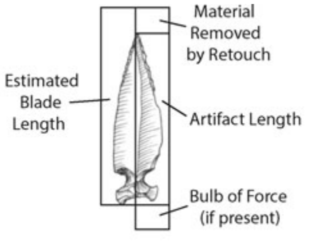
(2014; $r^2 = 0.518$). Muller and colleagues (2018) demonstrate that using multiple measurements of thickness can increase the strength of the predictive relationship between blade thickness and length. However, because of the way in which Dhra' points are retouched, the location of thickness measurements would change throughout the use-life of a tool. Consequently, we are unable to apply this approach here. For this assemblage, blade thickness can provide a reasonable approximation of original blade length, below the bulb of force, using the best-fit regression equation:

Estimated Blade Length = 13.661 × (Thickness) + 3.015

The estimated blade length serves as the measurement of maximum potential for each tool. With this estimation, we can generate the PTCI, a measure of the ratio of realized to maximum potential for these tools (see equation in Figure 4).

The artifact length, or the unused part of the blade, is measured from base to tip (Figure 4). Because some of the pointed tools, particularly awls, still have their bulb of force present on the finished tool, we must subtract the length from the striking platform to below the bulb of force. This standardizes the length measurement for those tools that have had their bulb of force removed during basal preparation. For artifacts without a bulb of force, which are the majority of the pointed tool assemblage, this value is 0. This step ensures that the PTCI is standardized for all specimens regardless of the presence of a bulb of force and platform. The difference in the numerator becomes the dividend, which is then divided by the estimated blade length. Dividing



$$\text{PTCI} = \frac{\text{(Estimated Blade Length - Artifact Length - Bulf of Force)}}{\text{Estimated Blade Length}}$$

Figure 4. Schematic illustration showing key measurements for calculating the PTCI.

by the estimated blade length, the quotient of the equation becomes standardized between the values of 0 and 1. The PTCI values are standardized between 0 (the minimum amount of curation) and 1 (a point that has realized all potential utility). Because of possible slight errors in estimating the original blade length from blade thickness, points can have negative dividends. In these cases (24 of 118 in the archaeological sample), the value is rounded up to the lowest possible curation score of 0. The PTCI can only be calculated on complete points, because snapped or otherwise damaged points would affect the unused blade length while not representing retouch intensity.

Applying the Pointed Tool Curation Index to the Dhra' Assemblage

The pointed tools from the Dhra' excavations used in this analysis included el-Khiam points ($n = 78$; Table 1), Salibiya points ($n = 15$; Table 2), and awls ($n = 25$; Tables 3 and 4). Salibiya and el-Khiam points averaged a similar PTCI value of 0.22 and 0.21, respectively. Awls averaged a PTCI value of only 0.12.[1] The PTCI for each pointed tool type at Dhra' forms a bimodal distribution (Figure 5). We interpret the two modes as distinguishing between points that were discarded with little or no resharpening and those that were resharpened more intensively. The break in modes across different point types occurred at approximately the PTCI value of 0.10. Seventy-four percent (58 of 78) of el-Khiam points and 80% (12 of 15) of Salibiya points were more intensively resharpened before discard (those with PTCI values above 0.10) compared to only 44% (11 of 25) of awls. As a result, hafted tools were more intensively resharpened more often than unhafted tools (Fisher's Exact Test, $p < .01$). Additionally, no awls have a PTCI value over 0.32 (0 of 25), compared to 20% (3 of 15) of Salibiya points and 21% (16 of 78) el-Khiam points. In the Dhra' assemblage, the most intensively retouched point had a PTCI valued of 0.51. However, very few points were resharpened this intensively. Only 3 of the 118 points in the Dhra' assemblage had PTCI values above 0.40.

Table 1. Sample of Data for Khiam Points Used in the Study.

Artifact ID	Length	Thickness	Estimated Length	PTCI Value
4929	27.85	1.28	20.5	0
4648	19.67	1.04	17.22	0
5088	38.88	2.57	38.12	0
4737	37.18	2.48	36.89	0
4385	34.94	2.32	34.71	0
4711	25.38	1.65	25.56	0.007
4829	43.53	3.07	44.95	0.032
4651	33.42	2.38	35.53	0.059
4830	28.22	2.05	31.02	0.090
4446	39.29	2.99	43.86	0.104
4977	35.29	2.7	39.9	0.116
4369	29.81	2.29	34.3	0.131
4781	29.5	2.37	35.39	0.166
4554	32.71	2.71	40.04	0.183
4452	32.46	2.73	40.31	0.195
4815	37.18	3.22	47.0	0.209
4974	27.93	2.39	35.66	0.217
4625	30.69	2.67	39.39	0.223
4950	22.27	1.89	28.83	0.228
5046	29.27	2.57	38.12	0.232
4866	24.01	2.08	31.43	0.236
5194	29.05	2.61	38.67	0.249
5125	26.29	2.36	35.25	0.254
5089	19.0	1.69	26.1	0.272
4456	19.41	1.77	27.19	0.286
5174	35.47	3.43	49.87	0.289
4581	26.65	2.55	37.85	0.296
4409	32.09	3.14	45.91	0.301
4529	23.6	2.27	34.03	0.306
5035	18.68	1.76	27.06	0.310
4968	19.61	1.89	28.83	0.320
4401	30.1	3.05	44.68	0.328
5126	33.48	3.48	50.56	0.338
5094	22.19	2.25	33.75	0.343
4951	32.7	3.44	50.01	0.349
4565	37.93	4.11	59.16	0.359
4672	23.62	2.65	39.22	0.398
4643	25.61	3.14	45.91	0.442
4622	16.71	2.27	34.03	0.509

Notes: Sample showing 50% of total artifacts used and both minimum and maximum PTCI values. All dimension measurements are in mm.

Table 2. Data for Salibiya Points Used in the Study.

Artifact ID	Length	Thickness	Estimated Length	PTCI Value
5026	54.55	1.88	28.7	0
4605	47.41	2.54	37.71	0
4731	30.14	1.95	29.65	0
4363	33.51	2.92	42.91	0.219
4652	22.4	1.89	28.83	0.223
4645	31.74	2.82	41.54	0.236
5067	31.04	2.81	41.40	0.250
4808	45.39	4.22	60.66	0.252
4412	23.49	2.09	31.57	0.256
4539	21.59	1.92	29.24	0.262
4988	32.42	3.03	44.41	0.270
4791	32.23	3.07	44.95	0.283
4844	24.79	2.45	36.48	0.321
4955	35.17	3.80	54.93	0.360
4694	30.88	3.44	50.01	0.383

Notes: Data represent 100% of the sample. All dimension measurements are in mm.

These data demonstrate that awls were not resharpened as often, or as intensively, as el-Khiam points and Salibiya points. Because el-Khiam and Salibiya points were hafted while awls were not, we interpret this to mean that Dhra' knappers took hafting into account when they made decisions on when to discard and when to resharpen tools. As we discuss later, although hafting would have had the practical result of conserving raw material, the motivations behind choices to resharpen or discard were likely more complex at Dhra'.

The size of the Dhra' abandoned pointed tools also reflects differences in hafting techniques. If size is a determining factor in the decision to rejuvenate or discard a pointed tool, we would expect handheld tools to be discarded when they became too small to hold and use effectively (see Clarkson et al. 2015:131). Our data support this expectation: the awls were longer when discarded than the two hafted pointed tool types (see Table 4). Salibiya points were longer than el-Khiam points when discarded, even though both have similar PTCI values. This suggests that Dhra' knappers chose slightly larger blades to make Salibiya points. This is further supported when we compare the average estimation of original blade size for Salibiya points (40.20 mm) and el-Khiam points (35.65 mm). We suggest that the Salibiya points, to compensate for the lack of notches. needed to be longer to create a stable haft. If this is true, it is likely that the amount of usable bit exposed was very similar for el-Khiam and Salibiya points—although this is nearly impossible to measure without having microwear hafting evidence on all of the points or without the hafting material being in situ, which is not preserved at Dhra'. This conclusion indicates that the sequence of awl,

Table 3. Data for Awl Tools Used in the Study.

Artifact ID	Length	Length of Bulb	Length	Thickness w/o Bulb	Estimated Length	PTCI Value
4373	67.17	5.78	61.39	3.66	53.01	0
4954	29.67		29.67	1.77	27.19	0
5058	23.23		23.23	1.37	21.73	0
4642	36.48		36.48	2.28	34.16	0
4779	65.42	6.67	58.75	3.81	55.06	0
4644	39.90		39.90	2.64	39.08	0
4708	62.94	5.54	57.40	3.91	56.43	0
4967	27.36	2.00	25.36	1.62	25.15	0
4624	29.36		29.36	1.92	29.24	0
4518	51.95	3.17	48.78	3.38	49.19	0.008
4970	28.18		28.18	1.90	28.97	0.027
4723	43.68	2.80	40.88	2.95	43.31	0.056
4969	29.26		29.26	2.13	32.11	0.089
4850	28.19		28.19	2.06	31.16	0.095
4980	31.37		31.37	2.42	36.07	0.130
4865	47.29		47.29	3.88	56.02	0.156
4687	36.26	4.88	31.38	2.75	40.58	0.227
5128	25.14	1.95	23.19	2.00	30.34	0.236
4862	28.00	3.69	24.31	2.14	32.25	0.246
4969	30.08		30.08	2.75	40.58	0.259
4353	33.80		33.80	3.15	46.05	0.266
4610	24.05		24.05	2.18	32.8	0.267
4842	36.10		36.10	3.46	50.28	0.282
4740	35.24		35.24	3.47	50.42	0.301
5114	36.33	7.49	28.84	2.87	42.22	0.317

Notes: Data represent 100% of the sample. All dimension measurements are in mm.

Salibiya, and El-Khiam point is not a reduction sequence, but reflects the production of different tool forms for the same task.

Discussion

Applying a curation index to the pointed tool assemblage at Dhra' provides insights into the organization of lithic technology in this early village. Dhra' knappers were quick to discard both hafted and unhafted tools, though they did retouch hafted tools more intensively than unhafted tools. At Dhra', according to the PTCI, hafted tools were nearly twice as intensively retouched as unhafted tools. These results fall in line with suggestions by previous researchers that hafting economizes raw material (e.g., Keeley 1982).

Although hafting did economize on raw materials, there is little other evidence to suggest that this was a primary motivation for Dhra' knappers, especially given the abundance of available raw material and the enormous overproduction of blanks. In contrast, the costs of acquiring and

Table 4. Comparison of PTCI Values, Average Length at Discard, and Average Estimated Original Blade Length for Each Artifact Type.

Artifact Type	PTCI			Average Artifact Length	Average Estimated Length
	Average	Minimum	Maximum		
Awl ($n = 25$)	0.12	0	0.32	35.30	37.06
Salibiya ($n = 15$)	0.22	0	0.38	33.12	39.52
el-Khiam ($n = 78$)	0.21	0	0.51	28.65	35.59

Note: All dimension measurements are in mm.

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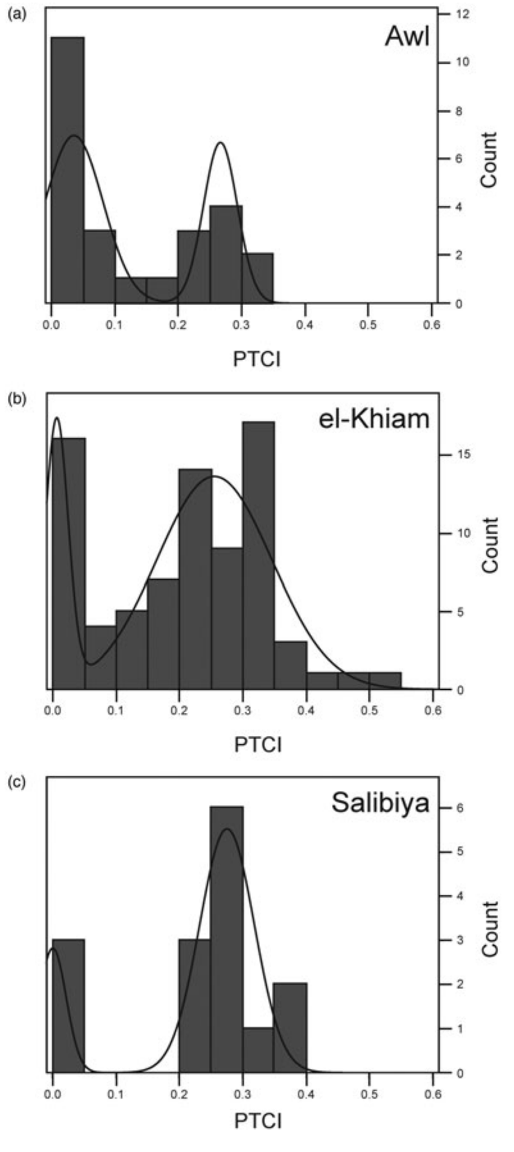

Figure 5. Distribution of Dhra' PTCI values for (a) awls, (b) el-Khiam points, and (c) Salibiya points.

assembling handles and shafts, binding, and mastic likely informed Neolithic peoples' choices to retouch hafted tools more often than unhafted tools. The curation index does not take into account these costs when measuring utility. In any event, because no hafts were preserved at Dhra', we are currently unable to calculate the costs associated with their manufacture. It is likely, however, that the haft represented a more significant investment in time and used less abundant resources than the pointed lithic tools themselves, which were expediently manufactured on locally available stone.

Most hafted points, although used more economically than unhafted points, were discarded with most of their potential utility remaining. Even though manufacturing hafts required time and resources, it appears that Dhra' tool users did not attempt to maximize the utility of pointed tools already in the hafts. The retouch patterns indicate that Dhra' knappers preferred to curate and retool the more costly hafts using quickly manufactured unifacial pointed tools.

This leads to the question of why hafted tools were discarded with their potential utility remaining. The acquisition costs of raw material would have been very low because of the site's position next to a highly abundant flint deposit. With easy and predictable access to tool stone, raw material conservation was probably not a significant concern for Dhra' knappers. There are many archaeological and ethnographic examples of formal tools being made using local materials when they are abundant and the need to economize raw material is low (Andrefsky 1994; Daniel 2001).

The PTCI helps us understand the intersection of hafting technologies and lithic technological organization. As previous studies have concluded, the pointed tool assemblage at Dhra' was used in activities other than hunting (Quinn et al. 2008; Smith 2005). It is likely that pointed tools used for hunting were discarded away from the village. Experimental research has demonstrated that hafting Neolithic pointed tools was not functionally necessary for leatherworking, but would have increased manual dexterity while using the tool (Quinn et al. 2008). In completing leatherworking tasks, hafting increased performance efficiency up to a certain point, after which point or bit replacement would have been more functionally effective. For instance, hafted points on drill handles might pierce thick hides more quickly than unhafted points. However, after a few resharpening episodes the overall length of the tool was reduced in a manner that rendered it less effective. This could also account for the lower mean blade length at the time of discard for the hafted tools (see Table 4). Similar retouch patterns for the two hafted point types, el-Khiam and Salibiya, suggest they are not two steps in a production sequence but were used to complete the same tasks, and there was no functional difference between them.

The evolutionary history of flintknapping and hafting demonstrates that they are learned behaviors. Given their similar function and contemporaneous occurrence in time and space, the stylistic differences between el-Khiam and Salibiya points can be best explained as resulting from being manufactured by knappers from different learning traditions. The difference in learning tradition approaches may be partly a result of different paths of information transmission, such as from parents (vertical transmission), other experienced knappers within a society (oblique transmission), or their peers (horizontal transmission; Boyd and Richerson 1985). The morphological consistencies within each type and the significant morphological differences between the two hafting styles, primarily the presence (el-Khiam) or absence (Salibiya) of notches, suggest that the haft element morphology distinguishes the two types and would not have been modified, even when intensively retouched. Based on previous morphometric analysis at Dhra', Goodale and colleagues (2015) have argued that artifact form is a product of both the form of transmission and the knapping kits used in production.

We suggest that lithic technology is one arena in which different social identities can be identified among the people who came together to live in this early Neolithic community. Flintknapping and hafting in extramural activity areas would have been a social activity (Figure 6). As the products of distinct learning traditions, the different practices of making and hafting stone tools maintained differences between the identities of individuals who manufactured el-Khiam and Salibiya points. The different haft lengths for el-Khiam and Salibiya points would likely have resulted in hafts that were visibly different to community members, even though the haft element on the stone tool itself would have been covered. By choosing to manufacture either el-Khiam or Salibiya points, people at Dhra' asserted, or passively marked, their group affiliation within a community as part of a society where people were spending more time together in larger settlements. These groups were likely the precursors of the households and lineages that would come to characterize villages later in the Neolithic (Makarewicz and Finlayson 2018). It has been argued that early villages in the southern Levant show a marked delineation of space for certain activities (Kuijt and Goodale 2009). The delineation of space may be one way people at Dhra' maintained distinct manufacturing traditions of Salibiya and El-Khiam points.

Archaeologists have documented efforts by early Neolithic communities to create social cohesion among peoples who were living newly sedentary lives (e.g., Kuijt and Goring-Morris 2002). The traditional ways of mitigating tension among these communities would have been to vote with their feet (Kelly 2007; Woodburn 1988), but life in the village would have likely required different mechanisms. Mortuary practices in the early Neolithic in the southern Levant reflect an emphasis on creating and maintaining communal equality through ancestor veneration (Kuijt 1996). Grain storage at Dhra' occurred in specialized buildings, where access would have been highly visible, maintaining an ethos of communal sharing (Finlayson 2010; Kuijt and Finlayson 2009). As communities became larger and more permanent through the course of the early Neolithic, the investment in new communal institutions that transcended lineage-based identities would have required significant resources, effort, and intention to mitigate social tensions.

These community-building activities would have been necessary if early villages were characterized by social segmentation. The presence of two distinct hafting traditions at Dhra' suggests that social difference was reinforced through the practice of tool making. Previous work has also documented the investment in personal adornment items as costly signals to mark social difference within the Dhra' community (Quinn 2006). Excavations at Dhra' located multiple shared grain buildings and multiple food production structures, indicating that food sharing at Dhra' was confined to subgroups within the community. These social differences, which were practiced in daily life, would have made communal integration activities, such as mortuary practices, critical to the continued existence of the village

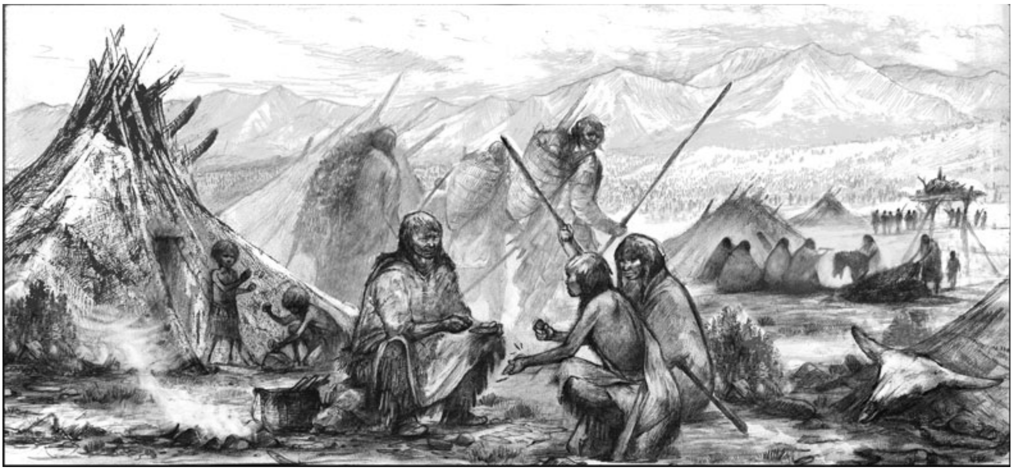

Figure 6. Artist reconstruction of flintknapping as a social activity. Stone tool production was an activity in which social information exchange likely played a crucial role in early village societies during the transition to agriculture-based economies (illustration by Eric Carlson).

(Makarewicz and Finlayson 2018). As time went on, however, persistent segmentation became a fault line along which future fracturing of collective identities and increased competition among lineages occurred (Kuijt 2000).

Conclusion

In this article, we suggest that lithic technological organization at the early Neolithic site of Dhra', Jordan, particularly hafting and curation patterns, informs our understanding of socioeconomic strategies in early villages. This study shows that curation studies can provide quantitative data to monitor different patterns of retouch between and within hafted and unhafted tool types. At Dhra', villagers hafted pointed tools in two distinct ways, despite the tools being used for similar tasks. These distinct hafting types indicate the maintenance of distinct learning traditions within this early village.

This case study contributes to a growing understanding of social dynamics in early villages worldwide. When people start settling down and aggregate at increasingly larger scales, the situation creates novel socioeconomic contexts (Birch 2014; Birch and Thompson 2018; Gyucha 2019). Archaeologists across the globe have demonstrated that there are numerous integrative mechanisms in these contexts, including through architecture (e.g., Lee and Bale 2016), rituals in public gathering spaces (e.g., Barrier and Kassabaum 2018), monument construction (e.g., Parker Pearson 2012), feasting (e.g., Potter 2000), mortuary rituals (e.g., Henry 2017), and warfare and alliance building (e.g., Birch 2012). Through lithic technological organization and hafting, we have demonstrated how early villagers at Dhra' practiced social difference in their daily lives. The persistence of distinct learning traditions in stone tool manufacture underscores how social segmentation persisted despite deliberate efforts through communal storage, ritual, and collective action to integrate early villages.

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Data Availability Statement. Digital copies of the data in this study can be acquired from the corresponding author.

Note

1. The PTCI value for awls is not affected by whether a bulb of force is present or has been removed. To make these tools comparable with hafted tools without bulbs of force, we accounted for the bulb length by subtracting it when calculating the PTCI. Of the awls, the 15 without a visible bulb of force had a PTCI value of 0.12, and the 10 with a visible bulb of force had a PTCI value of 0.11. The similarity in these measures supports our assumption that Dhra' knappers would have removed the platform directly below the bulb to conserve raw material, meaning that any distinct variation across tool types is more likely attributed to different retouch patterns than to production patterns.

References Cited

Ames, Kenneth, Kristen Fuld, and Sara Davis
2010 Dart and Arrow Points on the Columbia Plateau of Western North America. *American Antiquity* 75:287–325.

Andrefsky, William, Jr.
1994 Raw-Material Availability and the Organization of Technology. *American Antiquity* 59:21–34.
2006 Experimental and Archaeological Verification of an Index of Retouch for Hafted Bifaces. *American Antiquity* 71:743–757.
2009 The Analysis of Stone Tool Procurement, Production, and Maintenance. *Journal of Archaeological Research* 17:65–103.
2014 Debris, Debitage, or Tools: Unmodified Flakes and Cutting Efficiency. In *Lithics in the West: Using Lithic Analysis to Solve Archaeological Problems in Western North America*, edited by Douglas MacDonald, William Andrefsky Jr., and Pei-Lin Yu, pp. 3–16. University of Montana Press, Missoula.

Andrefsky, William, Jr. (editor)
2008 *Lithic Technology: Measures of Production, Use, and Curation*. Cambridge University Press, Cambridge.

Andrews, Brian N., Edward J. Knell, and Metin I. Eren
2015 The Three Lives of a Uniface. *Journal of Archaeological Science* 54:228–236.

Asouti, Eleni, and Dorian Q. Fuller
2013 A Contextual Approach to the Emergence of Agriculture in Southwest Asia: Reconstructing Early Neolithic Plant-Food Production. *Current Anthropology* 54:299–345.

Bamforth, Douglas B.
1990 Settlement, Raw Material, and Lithic Procurement in the Central Mojave Desert. *Journal of Anthropological Archaeology* 9:70–104.

Barham, Lawrence
2013 *From Hand to Handle: The First Industrial Revolution*. Oxford University Press, Oxford.

Barrier, Casey R.
2017 Town Aggregation and Abandonment during the Era of Urban Transformations in the Cahokia Region: Bayesian Modeling of the Washausen Mound-Town. *Journal of Archaeological Science: Reports* 11:523–535.

Barrier, Casey R., and Megan C. Kassabaum
2018 Gathering in the Late Woodland: Plazas and Gathering Places as Everyday Space. In *Investigating the Ordinary: Everyday Matters in Southeast Archaeology*, edited by Sarah E. Price and Philip J. Carr, pp. 164–184. University Press of Florida, Gainesville.

Bar-Yosef, Ofer, and Mordechai E. Kislev
1989 Early Farming Communities in the Jordan Valley. In *Foraging and Farming: The Evolution of Plant Domestication*, edited by David R. Harris and Gordon C. Hillman, pp. 632–642. Hyman, London.

Bettinger, Robert L., Raven Garvey, and Shannon Tushingham
2015 *Hunter-Gatherers: Archaeology and Evolutionary Theory*. 2nd ed. Springer, New York.

Binford, Lewis R.
1977 Forty-Seven Trips. In *Stone Tools as Cultural Markers: Change, Evolution and Complexity*, edited by R. V. S. Wright, pp. 24–36. Australian Institute of Aboriginal Studies, Canberra.
1978 *Nunamiut Ethnoarchaeology*. : Academic Press, New York.
1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35:255–273.
1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 15:4–20.

Binford, Lewis R., and Sally R. Binford
1966 A Preliminary Analysis of Functional Variability in the Mousterian of Levallois Facies. *American Anthropologist* 68:238–295.

Birch, Jennifer
2012 Coalescent Communities: Settlement Aggregation and Social Integration in Iroquoian Ontario. *American Antiquity* 77:646–670.

Birch, Jennifer (editor)
2014 *From Prehistoric Villages to Cities: Settlement Aggregation and Community Transformation*. Routledge, New York.

Birch, Jennifer, and Victor D. Thompson (editors)
2018 *The Archaeology of Villages in Eastern North America*. University Press of Florida, Gainesville.

Blades, Brooke S.
2003 End Scraper Reduction and Hunter-Gatherer Mobility. *American Antiquity* 68:141–156.

Bleed, Peter
1986 The Optimal Design of Hunting Weapons: Maintainability or Reliability. *American Antiquity* 51:737–747.

Bordes, François H.
1961 Mousterian Cultures in France. *Science* 134 (3482):803–810.

Bordes, François H., and P. Fitte
1964 Microlithes du Magdalénien Supérieur de la Gare de Couze. In *Miscelanea en homanaje al Abate Henri Brieul (1877–1961) 1*, edited by Eduardo Ripoll Perello, pp. 259–367. Instituto de Prehistoria y Arquelogia, Barcelona.

Boyd, Robert, and Peter J. Richerson
1985 *Culture and the Evolutionary Process*. University of Chicago Press, Chicago.

Bradbury, Andrew P., Philip J. Carr, and D. Randall Cooper
2008 Raw Material and Retouched Flakes. In *Lithic*

Technology: Measures of Production, Use, and Curation, edited by William Andrefsky Jr., pp. 233–254. Cambridge University Press, Cambridge.

Buchanan, Briggs
2006 An Analysis of Folsom Projectile Point Resharpening Using Quantitative Comparisons of Form and Allometry. *Journal of Archaeological Science* 33:185–199.

Buchanan, Briggs, Metin I. Eren, Matthew T. Boulanger, and Michael J. O'Brien
2015 Size, Shape, Scars, and Spatial Patterning: A Quantitative Assessment of Late Pleistocene (Clovis) Point Resharpening. *Journal of Archaeological Science: Reports* 3:11–21.

Byrd, Brian F.
1994 Public and Private, Domestic and Corporate: The Emergence of the Southwest Asian Village. *American Antiquity* 59:639–666.

Carr, Philip J., and Andrew P. Bradbury
2011 Learning from Lithics: A Perspective on the Foundation and Future of the Organization of Technology. *PaleoAnthropology* 2011:305–319.
2018 Stone Tool Life Meets Everyday Life. In *Investigating the Ordinary: Everyday Matters in Southeast Archaeology*, edited by Sarah E. Price and Philip J. Carr, pp. 124–141. University Press of Florida, Gainesville.

Carr, Philip J., Andrew P. Bradbury, and Sarah E. Price
2012 Lithic Studies in the Southeast: Retrospective and Future Potential. In *Contemporary Lithic Analysis in the Southeast: Problems, Solutions, and Interpretations*, edited by Philip J. Carr, Andrew P. Bradbury, and Sarah E. Price, pp. 1–12. University of Alabama Press, Tuscaloosa.

Clarkson, Chris, Michael Haslam, and Clair Harris
2015 When to Retouch, Haft, or Discard? Modeling Optimal Use/Maintenance Schedules in Lithic Tool Use. In *Lithic Technological Systems and Evolutionary Theory*, edited by Nathan Goodale and William Andrefsky Jr., pp. 117–138. Cambridge University Press, Cambridge.

Clarkson, Chris, and Peter Hiscock
2011 Estimating Original Flake Mass from 3D Scans of Platform Area. *Journal of Archaeological Science* 38:1062–1068.

Connell, Kate, and Chris Clarkson
2011 Scraper Reduction Continuums and Efficient Tool Use: A Functional Analysis of Scrapers at Different Stages of Reduction. In *Keeping Your Edge: Recent Approaches to the Organization of Stone Artefact Technology*, edited by Ben Marwick and Alex Mackay, pp. 45–56. Archaeopress, Oxford.

Daniel, I. Randolph, Jr.
2001 Stone Raw Material Availability and Early Archaic Settlement in the Southeastern United States. *American Antiquity* 66:237–265.

Davis, Zachary J., and John J. Shea
1998 Quantifying Lithic Curation: An Experimental Test of Dibble and Pelcin's Original Flake-Tool Mass Predictor. *Journal of Archaeological Science* 25:603–610.

Deacon, H. J., and Janette Deacon
1980 The Hafting, Function, and Distribution of Small Convex Scrapers with an Example from Boomplaas Cave. *South African Archaeological Bulletin* 35:31–37.

Dibble, Harold L.
1997 Platform Variability and Flake Morphology: A Comparison of Experimental and Archaeological Data and Implications for Interpreting Prehistoric Lithic Technological Strategies. *Lithic Technology* 22:150–170.

Dibble, Harold L., and Andrew Pelcin
1995 The Effect of Hammer Mass and Velocity on Flake Mass. *Journal of Archaeological Science* 22:429–439.

Eren, Metin I.
2012 Were Unifacial tools Regularly Hafted by Clovis Foragers in the North American Lower Great Lakes Region? An Empirical Test of Edge Class Richness and Attribute Frequency among Distal, Proximal, and Lateral Tool-Sections. *Journal of Ohio Archaeology* 2:1–15.
2013 The Technology of Stone Age Colonization: An Empirical, Regional-Scale Examination of Clovis Unifacial Stone Tool Reduction, Allometry, and Edge Angle from the North American Lower Great Lakes Region. *Journal of Archaeological Science* 40:2101–2112.

Eren, Metin I., Manuel Dominguez-Rodrigo, Steven L. Kuhn, Daniel S. Adler, Ian Le, and Ofer Bar-Yosef
2005 Defining and Measuring Reduction in Unifacial Stone Tools. *Journal of Archaeological Science* 32:1190–1201.

Eren, Metin I., and C. Garth Sampson
2009 Kuhn's Geometric Index of Unifacial Stone Tool Reduction (GIUR): Does It Measure Missing Flake Mass? *Journal of Archaeological Science* 36:1243–1247.

Fellner, Robert
1995 Technology or Typology? A Response to Neeley & Barton. *Antiquity* 69:381–383.

Finlayson, Bill
1990 Lithic Exploitation during the Mesolithic in Scotland. *Scottish Archaeological Review* 7:41–57.
2010 Archaeology, Evidence and Anthropology: Circular Arguments in the Transition from Foraging to Farming. In *The Principle of Sharing: Segregation and Construction of Social Identities at the Transition from Foraging to Farming*, edited by Marion Benz, pp. 19–34. Ex Oriente, Berlin.

Finlayson, Bill, Ian Kuijt, Trina Arpin, Meredith Chesson, Sam Dennis, Nathan Goodale, Seji Kadowaki, Lisa Maher, Sam Smith, Mark Schurr, and Jode McKay
2003 Dhra' Excavation Project, 2002: Interim Report. *Levant* 35:1–38.

Goldstein, Steven T.
2014 Quantifying Endscraper Reduction in the Context of Obsidian Exchange among Early Pastoralists in Southwestern Kenya. *Lithic Technology* 39:3–19.

Goodale, Nathan, William Andrefsky Jr., Curtis Osterhoudt, Laura Cueni, and Ian Kuijt
2015 Cultural Transmission and the Production of Material Goods: Evolutionary Pattern through Measuring Morphology. In *Lithic Technological Systems and Evolutionary Theory*, edited by Nathan Goodale and William Andrefsky Jr., pp. 239–252. Cambridge University Press, Cambridge.

Goodale, Nathan, George T. Jones, and Charlotte Beck
2011 Natural Selection and Material Culture. *Evolution: Education and Outreach* 4:427–434.

Goodale, Nathan, Ian Kuijt, and Bill Finlayson
2002 Results from the 2001 Excavations at Dhra', Jordan: Chipped Stone Technology, Typology, and Intra-Assemblage Variability. *Paléorient* 28(1):125–140.
2007 Chipped Stone Variability: An Overview of the PPNA Lithic Assemblage from Dhra', Jordan. In *Systémes*

Techniques et Communautés du Neolithique Précéramique au Proche-Orient, edited by Laurence Astruc, Didier Binder, and François Briois, pp. 63–74. Association pour la Promotion et la Diffusion des Connaissances Archéologiques, Antibes.

Goodale, Nathan, Ian Kuijt, Shane MacFarlan, Curtis Osterhoudt, and Bill Finlayson
2008 Lithic Core Reduction Techniques: Modeling Expected Diversity. In *Lithic Technology: Measures of Production, Use, and Curation*, edited by William Andrefsky Jr., pp. 317–336. Cambridge University Press, Cambridge.

Goodale, Nathan, Heather Otis, William Andrefsky Jr., Ian Kuijt, Bill Finlayson, and Ken Bart
2010 Sickle Blade Life-History and the Transition to Agriculture: An Early Neolithic Case Study from Southwest Asia. *Journal of Archaeological Science* 37:1192–1201.

Goodale, Nathan, and Samuel J. Smith
2001 Pre-Pottery Neolithic A Projectile Points at Dhra': Preliminary Thoughts on Form, Function, and Site Interpretation. *Neo-Lithics* 2(1):1–5.

Goring-Morris, Nigel A.
1996 Square Pegs into Round Holes: A Critique of Neely and Barton. *Antiquity* 70:130–135.

Gould, R. A.
1980 *Living Archaeology*. Cambridge University Press, Cambridge.

Gyucha, Attila (editor)
2019 *Coming Together: Comparative Approaches to Population Aggregation and Early Urbanization*. Institute for European and Mediterranean Archaeology Distinguished Monograph Series. SUNY Press, Albany.

Hadley, Alison M., and Philip J. Carr
2015 Archaic Chert Beads and Craft Specialization: Application of an Organization of Technology Model. In *Exploring Southeastern Archaeology*, edited by Patricia Galloway and Evan Peacock, pp. 71–98. University Press of Mississippi, Jackson.

Henry, Edward R.
2017 Building Bundles, Building Memories: Processes of Remembering in Adena-Hopewell Societies of Eastern North America. *Journal of Archaeological Method and Theory* 24:188–228.

Herzog, Nicole, and Nathan Goodale
2019 Human Behavioral Ecology and Technological Decision-Making. In *Handbook of Evolutionary Research in Archaeology*, edited by Anna M. Prentiss, pp. 295–309. Springer, New York.

Hiscock, Peter, and Chris Clarkson
2005 Experimental Evaluation of Kuhn's Geometric Index of Reduction and the Flat-Flake Problem. *Journal of Archaeological Science* 32:1015–1022.

Hiscock, Peter, and Amy Tabrett
2010 Generalization, Inference and the Quantification of Lithic Reduction. *World Archaeology* 42:545–561.

Horowitz, Rachel A., and Grant S. McCall
2013 Evaluating Indices of Curation for Archaic North American Bifacial Projectile Points. *Journal of Field Archaeology* 39:347–361.

Keeley, Lawrence H.
1982 Hafting and Retooling: Effects on the Archaeological Record. *American Antiquity* 47:798–809.

Kelly, Robert L.
2007 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lifeways*. Percheron Press, Clinton Corners, New York.

Kenyon, Kathleen M., and T. A. Holl and (editors)
1981 *Excavations at Jericho, Vol. 3: The Architecture and Stratigraphy of the Tell*. British School of Archaeology at Jerusalem, London.

Kuijt, Ian
1996 Negotiating Equality through Ritual: A Consideration of Late Natufian and Pre-Pottery Neolithic A Period Mortuary Practices. *Journal of Anthropological Archaeology* 15:313–336.
2000 Keeping the Peace: Ritual, Skull Caching and Community Integration in the Levantine Neolithic. In *Life in Neolithic Farming Communities: Social Organization, Identity, and Differentiation*, edited by Ian Kuijt, pp. 137–163. Kluwer Academic/Plenum Press, New York.
2001 Lithic Inter-Assemblage Variability and Culture-Historical Sequences: A Consideration of the Pre-Pottery Neolithic A Occupation of Dhra', Jordan. *Paléorient* 27(1):107–125.
2008 The Regeneration of Life: Neolithic Structures of Symbolic Remembering and Forgetting. *Current Anthropology* 49:171–197.

Kuijt, Ian, and Bill Finlayson
2009 Evidence for Food Storage and Predomestication Granaries 11,000 Years Ago in the Jordan Valley. *Proceedings of the National Academy of Sciences* 106 (27):10966–10970.

Kuijt, Ian, and Nathan Goodale
2009 Daily Practice and the Organization of Space at the Dawn of Agriculture: A Case Study from the Near East. *American Antiquity* 74:403–422.

Kuijt, Ian, and Nigel Goring-Morris
2002 Foraging, Farming, and Social Complexity in the Pre-Pottery Neolithic of the Southern Levant: A Review and Synthesis. *Journal of World Prehistory* 16:361–440.

Larick, Roy
1985 Spears, Style, and Time among Maa-Speaking Pastoralists. *Journal of Anthropological Archaeology* 4:206–220.

Lee, Rachel, and Martin T. Bale
2016 Social Change and Household Geography in the Mumun Period South Korea. *Journal of Anthropological Research* 72:178–199.

Lillios, Katina T.
1999 Objects of Memory: The Ethnography and Archaeology of Heirlooms. *Journal of Archaeological Method and Theory* 6:235–262.

Lipo, Carl P., Terry L. Hunt, and Brooke Hundtoft
2015 An Analysis of Stylistic Variability of Stemmed Obsidian Tools (*MATA'A*) on Rapa Nui (Easter Island). In *Lithic Technological Systems and Evolutionary Theory*, edited by Nathan Goodale and William Andrefsky Jr., pp. 225–238. Cambridge University Press, Cambridge.

Makarewicz, Cheryl A.
2013 More than Meat: Diversity in Caprine Harvesting Strategies and the Emergence of Complex Production Systems during the Late PPNB. *Levant* 45:236–261.

Makarewicz, Cheryl A., and Bill Finlayson
2018 Constructing Community in the Neolithic of Southern Jordan: Quotidian Practice in Communal Architecture. *PLoS ONE* 13(6):e0193712.

McPherron, Shannon P.
1995 A Re-Examination of the British Biface Data. *Lithics* 16:47–63.

2003 Technological and Typological Variability in the Bifaces from Tabun Cave, Israel. In *Multiple Approaches to the Study of Bifacial Technology*, edited by Marie Soressi and Harold L. Dibble, pp. 55–75. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Morales, Juan I., and Josep M. Vergès
2014 Technological Behaviors in Paleolithic Foragers: Testing the Role of Resharpening in the Assemblage Organization. *Journal of Archaeological Science* 49:302–316.

Muller, Antoine, and Chris Clarkson
2014 Estimating Original Flake Mass on Blades Using 3D Platform Area: Problems and Prospects. *Journal of Archaeological Science* 52:31–38.

Muller, Antoine, Chris Clarkson, Douglas Baird, and Andrew Fairbairn
2018 Reduction Intensity of Backed Blades: Blank Consumption, Regularity and Efficiency at the Early Neolithic Site of Boncuklu, Turkey. *Journal of Archaeological Science: Reports* 21:721–732.

Nadel, Daniel
1997 The Chipped Stone Industry of Netiv Hagdud. In *An Early Neolithic Village in the Jordan Valley, Part I: The Archaeology of Netiv Hagdud*, edited by Ofer Bar-Yosef and Avi Gopher, pp. 71–150. American School of Prehistoric Research Bulletin 43. Peabody Museum Press, Cambridge, Massachusetts.

Neeley, Michael P., and C. Michael Barton
1994 A New Approach to Interpreting Late Pleistocene Microlith Industries in Southwest Asia. *Antiquity* 68:275–288.

Nelson, Margaret C.
1991 The Study of Technological Organization. *Archaeological Method and Theory* 3:57–100.

Odell, George H.
1994 Prehistoric Hafting and Mobility in the North American Midcontinent: Examples from Illinois. *Journal of Anthropological Archaeology* 13:51–73.
1998 Investigating Correlates of Sedentism and Domestication in Prehistoric North America. *American Antiquity* 63:551–571.

Oswalt, Wendell H.
1976 *An Anthropological Analysis of Food-Getting Technology*. Wiley, New York.

Parker Pearson, Michael
2012 *Stonehenge: Exploring the Greatest Stone Age Mystery*. Simon & Schuster, New York.

Pelcin, Andrew W.
1996 Controlled Experiments in the Production of Flake Attributes. PhD dissertation, Department of Anthropology, University of Pennsylvania, Philadelphia.
1997 The Effect of Core Surface Morphology on Flake Attributes: Evidence from a Controlled Experiment. *Journal of Archaeological Science* 24:749–756.
1998 The Threshold Effect on Platform Width: A Reply to Davis and Shea. *Journal of Archaeological Science* 25:615–620.

Potter, James M.
2000 Pots, Parties, and Politics: Communal Feasting in the American Southwest. *American Antiquity* 65:471–492.

Prentiss, Anna Marie, Nathan Goodale, Lucille E. Harris, and Nicole Crossland
2015 Evolution of the Slate Tool Industry at Bridge River, British Columbia. In *Lithic Technological Systems and Evolutionary Theory*, edited by Nathan Goodale and William Andrefsky Jr., pp. 267–292. Cambridge University Press, Cambridge.

Quinn, Colin P.
2006 Vital Signs: Costly Signaling and Personal Adornment in the Near Eastern Neolithic. Master's thesis, Department of Anthropology, Washington State University, Pullman.

Quinn, Colin P., William Andrefsky Jr., Ian Kuijt, and Bill Finalyson
2008 Perforation with Stone Tools and Retouch Intensity: A Neolithic Case Study. In *Lithic Technology: Measures of Production, Use, and Curation*, edited by William Andrefsky Jr., pp. 150–174. Cambridge University Press, Cambridge.

Rollefson, Gary O.
2005 Early Neolithic Ritual Centres in the Southern Levant. *Neo-Lithics* 2(5):3–13.

Rots, Veerle
2003 Towards an Understanding of Hafting: The Macro- and Microscopic Evidence. *Antiquity* 77:805–815.
2010 *Prehension and Hafting Traces on Flint Tools: A Methodology*. Leuven University Press, Leuven.

Rots, Veerle, Lous Pirnay, Philippe Pirson, and Odette Baudoux
2006 Blind Tests Shed Light on Possibilities and Limitations for Identifying Stone Tool Prehension and Hafting. *Journal of Archaeological Science* 33:935–952.

Rots, Veerle, Lous Pirnay, Philippe Pirson, Odette Baudoux, and Pierre M. Vermeersch
2001 Experimental Hafting Traces: Identification and Characteristics. *Notae Praehistoricae* 21:129–137.

Shea, John J.
2006 The Origins of Lithic Projectile Point Technology: Evidence from Africa, the Levant, and Europe. *Journal of Archaeological Science* 33:823–846.

Shott, Michael J.
1986 Technological Organization and Settlement Mobility: An Ethnographic Examination. *Journal of Archaeological Research* 42:15–51.
1989 On Tool-Class Use Lives and the Formation of Archaeological Assemblages. *American Antiquity* 54:9–30.
1996 An Exegesis of the Curation Concept. *Journal of Anthropological Research* 52:259–280.
1997 Stones and Shafts Redux: The Metric Discrimination of Chipped-Stone Dart and Arrow Points. *American Antiquity* 62:86–101.
2005 The Reduction Thesis and Its Discontents: Overview of the Volume. In *Lithics 'Down Under': Australian Perspectives on Lithic Reduction, Use and Classification*, edited by Christopher Clarkson and Lara Lamb, pp. 109–125. British Archaeological Reports, Oxford.
2018 The Costs and Benefits of Technological Organization: Hunter-Gatherer Lithic Industries and Beyond. In *Lithic Technological Organization and Paleoenvironmental Change*, edited by Erick Robinson and Frédéric Sellet, pp. 321–333. Springer, New York.

Shott, Michael J., Andrew P. Bradbury, Philip J. Carr, and George H. Odell
2000 Flake Size from Platform Attributes: Predictive and Empirical Approaches. *Journal of Archaeological Science* 27:877–894.

Shott, Michael J., David A. Hunzicker, and Bob Patten
2007 Pattern and Allometric Measurement of Reduction in Experimental Folsom Bifaces. *Lithic Technology* 32:203–217.

Shott, Michael J., and Mark F. Seeman
2015 Curation and Recycling: Estimating Paleoindian Endscraper Curation Rates at Nobles Pond, Ohio, USA. *Quaternary International* 361:319–331.
Shott, Michael J., and Paul Sillitoe
2005 Use Life and Curation in New Guinea Experimental Used Flakes. *Journal of Archaeological Science* 32:653–663.
Shott, Michael J., and Kathryn J. Weedman
2007 Measuring Reduction in Stone Tools: An Ethnoarchaeological Study of Gamo Hidescrapers from Ethiopia. *Journal of Archaeological Science* 34:1016–1035.
Sinopoli, Carla M.
1991 Style in Arrows: A Study of an Ethnographic Collection from the Western United States. In *Foragers in Context: Long-Term, Regional and Historical Perspectives in Hunter-Gatherer Studies*, edited by Preston T. Miracle, Lynne E. Fisher, and Jody Brown, pp. 63–87. Michigan Discussions in Anthropology Vol. 10. University of Michigan, Ann Arbor.
Smith, Geoffrey M.
2015 Modeling the Influences of Raw Material Availability and Functional Efficiency on Obsidian Projectile Point Curation: A Great Basin Example. *Journal of Archaeological Science: Reports* 3:112–121.
Smith, Samuel J.
2005 A Comparative Analysis of the Form and Function of Chipped Stone Artefacts from Wadi Faynan 16 and Dhra': Implications for the Description and Interpretation of Early Neolithic Chipped Stone Variability. PhD dissertation, School of Human and Environmental Science, University of Reading, Reading.
Story, Brett A., Metin I. Eren, Kaitlyn Thomas, Briggs Buchanan, and David J. Meltzer
2019 Why Are Clovis Fluted Points More Resilient than Non-Fluted Lanceolate Points? A Quantitative Assessment of Breakage Patterns between Experimental Models. *Archaeometry* 61:1–13.
Tchernov, Eitan
1997 The Fauna of Netiv Hagdud: A Summary. In *An Early Neolithic Village in the Jordan Valley, Part I: The Archaeology of Netiv Hagdud*, edited by Ofer Bar-Yosef and Avi Gopher, pp. 237–245. American School of Prehistoric Research Bulletin 43. Peabody Museum Press, Cambridge, Massachusetts.
2004 *An Early Neolithic Village in the Jordan Valley, Part II: The Fauna of Netiv Hagdud*. American School of Prehistoric Research Bulletin 44. Peabody Museum Press, Cambridge, Massachusetts.
Tomka, Steven A.
2001 The Effect of Processing Requirements on Reduction Strategies and Tool Form: A New Perspective. In *Lithic Debitage: Context, Form, Meaning*, edited by William Andrefsky , Jr., pp. 207–224. University of Utah Press, Salt Lake City.
Waguespack, Nicole M., Todd A. Surovell, Allen Denoyer, Alice Dallow, Adam Savage, Jamie Hyneman, and Dan Tapster
2009 Making a Point: Wood- versus Stone-Tipped Projectiles. *Antiquity* 83:786–800.
Weedman, Kathryn J.
2006 An Ethnoarchaeological Study of Hafting and Stone Tool Diversity among the Gamo of Ethiopia. *Journal of Archaeological Method and Theory* 13:189–238.
2018 *The Lives of Stone Tools: Crafting the Status, Skill, and Identity of Flintknappers*. University of Arizona Press, Tucson.
Whittaker, John C.
1987 Individual Variation as an Approach to Economic Organization: Projectile Points at Grasshopper Pueblo, Arizona. *Journal of Field Archaeology* 14:466–479.
Wiessner, Polly
1983 Style and Social Information in Kalahari San Projectile Points. *American Antiquity* 48:253–276.
Wilkins, Jayne, Benjamin J. Schoville, Kyle S. Brown, and Michael Chazan
2012 Evidence for Early Hafted Hunting Technology. *Science* 338(6109):942–946.
Williams, Justin, and William Andrefsky Jr.
2011 Debitage Variability among Multiple Flint Knappers. *Journal of Archaeological Science* 38:865–872.
Wobst, H. Martin
1977 Stylistic Behavior and Information Exchange. In *Papers for the Director: Research Essays in Honor of James B. Griffin*, edited by Charles E. Cleland, pp. 317–342. Anthropology Papers 61. Museum of Anthropology. University of Michigan, Ann Arbor.
Woodburn, James
1988 African Hunter-Gatherer Social Organization: Is It Best Understood as a Product of Encapsulation? In *Hunter-Gatherers, Vol. I: History, Evolution, and Social Change*, edited by Tim Ingold, David Riches, and James Woodburn, pp. 31–64. Berg, Oxford.

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