A codebook for summarizing presence or absence of stone tool-making techniques reported in the literature v.1.1

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Contents

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1 Version details:

This report was generated on 2024-05-07 15:42:06.50439 The current Git commit details are:

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## Local:    V.2.0-development C:/Users/Jon Paige/Desktop/Procedural.unit.codebook
## Remote:   V.2.0-development @ origin (https://github.com/jnpaige/Procedural.unit.codebook.git)
## Head:     [d369d9b] 2024-05-07: More edits to background
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I made this codebook while working on ways of quantifying variation in tool-making sequences across the archaeological record. In this case the unit of analysis is the technique, or procedural unit (Perreault et al., 2013). I coded procedural units as present or absent across archaeological assemblages, based on published reports describing those assemblages. Most systematic, comparative work on lithic technology has focused on units of analysis that are more consistent, and replicable across assemblages. For example flake and biface measurements, and shape variation can be very consistent between studies. Other aspects of lithic technology, like chaînes opératoire or reduction sequences that we are interested in, are not as easy to analyze statistically. Similarity and dissimilarity in them is difficult to quantify systematically because they represent qualitative data conveyed through prose descriptions, tables of artifact counts, and illustrations of individual artifacts and schematics of those sequences. How sequences are reported might vary by the research tradition of the analyst, and how I interpret those reports is also shaped by the tradition I am a part of. This is a big hurdle to making systematic comparisons of technology across many assemblages (Reynolds, 2018). Reliably extracting the presence or absence of procedural units from the complex descriptions of stone tool technologies is a similar problem to that faced by scientists who code interview transcripts, and other texts. There are limits to human abilities to make sense of complex information, and individual scientists may use their own heuristics, and prior experience to collapse and make sense of that information. Those heuristics, and mental shortcuts introduce bias and error into the analysis (Hruschka et al., 2004; MacQueen et al., 1998; Tversky & Kahneman, 1974). One way to reduce this error is to give clear definitions of each procedural unit. Clear definitions, however, are not enough. If I gave a careful definition of the procedural unit "core tablet", there may be many forms that could be accomodated into that definition that I had not taken into account.

Likewise, other researchers may have different standards by which they would count a" core tablet" as being present in an assemblage. Some may be happy to find flakes that have the features of a core tablet, and count them as core tablets. Others may only count flakes with those features if there are also cores with negative removals consistent with core tablet removals. Others may have very different ideas of what the features of a core tablet are, and slightly different interpretations of those features themselves. The problem with using only definitions, is that it does not give enough guidance on what forms do not meet that definition, and when we should code “core tablet“ as present. Social scientists at the Center for Disease Control encountered similar problems while coding interview transcripts and other texts for qualitative analysis. Their solution was to develop codebooks with explicit inclusion, and exclusion criteria. This codebook follows a format developed at the CDC to ensure reliability in coding texts (MacQueen et al., 1998). Each procedural unit has a short, and longer definition (if needed). Additionally, each also has inclusion criteria. These inclusion criteria describe what features need to be present in a report for us to count the procedural unit as present. Each also has exclusion criteria. These describe what features in the text would be grounds to count the procedural unit as absent. For example, many procedural units only make sense to count as present if hierarchical core reduction is present. So, one exclusion criteria for those procedural units would be the absence of any evidence for hierarchical core reduction. Each entry may also include typical, and atypical examples of the procedural unit. These may be illustrations, or text examples. These two help to further outline when it is appropriate to code a procedural unit as present. Finally, there is a “close, but no“ entry, which outlines what kinds of cases might be confused with the procedural unit. Some of these inclusion criteria are more exhaustive than others, especially in cases where I noticed that I came to different conclusions about how a procedural unit should be coded multiple times while double checking data. Whether or not you agree with all the definitions, and coding criteria, you should be able to come closer to the same conclusions about how to code the presence or absence of any of these procedural units if you follow the standards outlined in the codebook than would be the case without reporting the criteria I employed. The codebook should evolve over time, as new logical inconsistencies or points of confusion are discovered. However, whatever version was used to code the data that then ends up in a final analysis, should be archived and made available to readers. This version of the codebook does not have example illustrations for procedural units to avoid copyright issues, but references to the illustrations are retained.

2 V.1.1 Notes

This modified version helps solve some issues with the first version. The main issue is the lack of metadata in the dataset describing what particular criteria where met in coding a procedural unit as present or absent, and a citation referring to the figures, or paragraphs, containing the relevant inclusion or exclusion criteria. Without that metadata, it will be more challenging for others to assess the quality of the data.

To help provide more transparency about the coding process, the inclusion and exclusion criteria were tweaked to make clear whether evidence in text, or evidence in figures should be used as evidence either for inclusion or exclusion. This is then mirrored in the procedural unit data sheet where additional columns associated with each procedural unit record what inclusion/exclusion criteria were met, and the page/paragraph and figure/table numbers that meet those criteria.

Other changes include clearer guidance in most entries and removal of some logical inconsistencies.

3 Definitions

Hierarchical cores Cores where platforms are established to strike flakes that shape the main flaking surface of a core, or the main platform itself in preparation for removals across the main flaking surface. In some cases these can be counted as present without figures showing cores if there are unambiguous blanks from formal blade technology, levallois reduction, microblade reduction, presence of adzes, or other hierarchical reduction practices.

Main flaking axis On hierarchical cores, this is the axis parallel to the face along which most target pieces were produced. On a naviform core, for example, the main flaking axis is that along which bidirectional blades are taken. Radial cores have no main flaking axis. Centripetal levallois cores also have no main falking axis, while preferential levallois cores do.

Main flaking surface On hierarchical cores, this is the surface from which targetted blanks were removed.

Core platform Any of the edges percussed or applied with pressure to remove flakes.

Main core platform(s) The platforms used to produce target pieces. Blade platforms on blade cores. Facetted platform on a preferential levallois.

Core back Posterior surface relative to the main flaking surface, roughly parallel to the main flaking surface.

Core bottom Distal surface of a hierarchical core, opposite the main core platform.

4 Procedural unit codes

4.1 Raw material treatment

Short Description: Heat treatment of raw material

Definition: Heating of raw material in order to improve workability. This process alters the fracture mechanics of raw material, and often causes changes in texture, and color.

Inclusion criteria: Described in text.

Exclusion criteria: Not described in text.

Typical exemplars: "Flint was/was likely heat treated". Heat treatment is described as present.

Atypical exemplars: Heating is described, and reference made to glassy/glossy texture of raw material as a result of heating: "flint was glossed/waxy/greasy from heating"

Close but no: "material was fired", "material bears signs of thermal alteration", Images of pieces that appear to have been heat treated, but without accompanying text describing them as heat treated. "Some flints had a glossy/waxy/greasy appearance".

4.2 Faceting of core platform

Short Description: Shaping of a core platform by striking flakes into the platform from the face of the core.

Definition: Removal of two or more flakes struck into the face of a core across the platform, forming a platform with two or more parallel facets.

Inclusion criteria: Requires hierarchical core reduction. Described in text OR shown in illustration.

Exclusion criteria: Absence of hierarchical cores. Not described in text AND not shown in figures.

Typical exemplars: Code if facetting of platforms is described in the text as a method of preparing platforms. Code if illustrations show evidence of faceting and if the faceting flakes were likely struck into the face of the core. Figure 1. Pieces a, c, d, e, f, g, h.

Atypical exemplars: Figure 1. Piece b. Figure 2. Pieces 1, 3-7, Figure 3. Step D and flake illustration in step E.

Close but no:

Phrases like "platforms were carefully prepared" without additional supporting information about the nature of that preparation. Single or very sparse instances of facetted or dihedral platforms: *"Nevertheless it is important to mention that within the excluded material of the 'MSA base-complex' (see above) one flake... shows characteristics of a Levallois preferential flake with centripetal dorsal scars and a facetted striking platform... " (Schmidt, 2011, p. 92).* Determining presence based on figures alone requires figures of the platforms themselves. Do not code based on figures showing only dorsal or ventral views of flakes. All examples in figure 4 would be insufficient to code as present.

4.3 Face shaping through radial removals

Short Description: Shaping of the face of a core through centripetal removals along the perimeter of a core face.

Definition: Flakes taken to modify the distal, lateral, proximal convexities of a core face, to prepare it for preferential removals. The preferential removals could be unidirectional or bidirectional blades, or preferential flakes.

Inclusion criteria: Requires hierarchical core reduction. Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Figure 5. Pieces 1, 2, 4, 7. Consistent evidence in figures of radial scars on blanks along with cores with evidence of centripetal preparation. Core faces should be rounded/oval, not rectilinear. Description of centripetal preparation of cores.

Atypical exemplars: Cases where core faces are described as shaped through lateral removals, and removals from the distal margin, but which fit this definition of centripetal flaking.

Close but no:

Figure 5. Pieces 3, 5, 6. Cores of a rectilinear shape with lateral trimming, and distal trimming.

4.4 Lateral trimming

Short Description: Lateral convexity of core face is shaped with flakes initiated from platforms along lateral margins of core.

Definition The lateral convexities of the face of a core are trimmed through the removal of flakes from platforms roughly parallel to main flaking axis.

Inclusion criteria: Requires hierarchical core reduction. Described in text OR shown in figures.

Exclusion criteria: Absence of hierarchical core reduction. Not described in text AND not shown in figures.

Typical exemplars: Figure 6, no. 4. Descriptions of shaping of lateral convexities of the face through removals from the lateral margin of the core.

Atypical exemplars:

Figure 5. Piece 3.

Close but no: Descriptions of *débordante* removals, but without further specifics about the orientation of trimming flakes. Do not count if: lateral flakes were struck only during radial/centripetal preparation of a core face, lateral convexities are only trimmed through *débordante* removals meeting this codebook's definition, the lateral margin of a core has flake scars parallel to the main flaking axis, but those flakes originated from a crest used to establish the core face.

4.5 Distal trimming

Short Description: Face shaped with flakes initiated from platform at distal margin of core.

Definition: Distal convexities of the face of a hierarchical core are managed through the removal of flakes from a platform at the distal margin of the core (i.e. the platform is perpendicular to the main flaking axis, and roughly parallel to the main platform).

Inclusion criteria: Requires hierarchical core reduction. Described in text OR shown in figures.

Exclusion criteria: Absence of hierarchical core reduction. Not described in text AND not shown in figures.

Typical exemplars: Figure 5, Levallois cores numbers 5, 6., Figure 6, Levallois core with lateral trimming, number 4. Figure 7. Step 4 in blademaking sequence. Descriptions of shaping of distal convexities of the face through removals from the distal margin of the core.

Atypical exemplars: Figure 8. Step 3 in Chazan's description of La Ferrassie bladelets. Notching a bladelet, to supply end point of microblades taken from lateral margin of that bladelet core. Figure 10, numbers 4 and 7. Any flaking at a distal platform that is argued to control length of flaking surface or to shape the distal end of the blank.

Close but no: Do not count if: the core could be reasonably characterized as centripetally prepared, or if these are flakes initiated from the distal margin that trim the lateral convexities of a core, like what we might find in a Nubian Levallois core (these should be coded as *débordante*).

4.6 Back shaping

Short Description: Back of the core is shaped.

Definition: Back of core is shaped, as is case among naviform cores, and often among microblade cores. All examples so far identified are cases where a nodule was bifacially flaked. One of the flaked crests then is used to remove one or two crested blades to establish a platform and face. Then flakes are removed from that platfom until exhausted. When exhausted there remains evidence of original bifacial flaking at the back of the core.

Inclusion criteria: Shown in figures.

Exclusion criteria: Not shown in figures.

Typical exemplars: Figure 9. Piece 2b. Back of hierarchical core is shaped, typically bifacially.

Atypical exemplars: NA

Close but no:
Crested blades are present, but no illustrations of cores showing evidence for a modified back/non-flaking surface.

4.7 Cresting

Short Description: Cresting to shape core face during initial steps of core preparation.

Definition: A core is bifacially or unifacially flaked along one axis. That crest establishes an artificial ridge along which an elongated flake, with a crested (entirely or partially) dorsal surface is removed.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Figure 10. Flakes whose dorsal surface bears a full bifacially flaked crest. Pieces 1, 2, 4, 5, 6, 7. Cresting of core faces is described as present and/or figures show elements flakes bearing a crest, with at least a partial crest platform present.

Atypical exemplars: The below examples are enough to count cresting as present: *"The rarity of crested blades (0.3%, Table 7) and the presence of blades with centripetal flake dorsal scars on one side only (4.2%, Fig. 9e,h) are most consistent with a reduction strategy that generally prepared the blade exploitation surface with centripetal flake removals"* (Wilkins & Chazan, 2012 p. 10). *"Crested elements (n=26) provide some details of the methods used for initial core preparation. The relatively low number of these pieces compared to the high number of cores used to produce blade/bladelet suggests that, in general, cresting was not necessary, and the natural shape of cobbles/nodules allowed the production of elongated debitage without cresting."* (Smith et al., 2016).

Close but no: Flakes with laterally oriented dorsal scars. Partially crested blades, where no element of the platform of the crest is present. Ski spall flakes removed during reduction of naviform cores which were prepared through cresting. Flakes with unifacial cresting, either complete or partial as in the case of striking platform removals as described in Smith et al. 2016, which were not argued to play a role in initial core shaping. Example 3 in Figure 10.

4.8 *Débordant*

Short Description: Shaping of core face through knapping elongated flakes along lateral margins of core face, across the axis of the main flaking surface.

Definition: Elongated flakes modify the lateral convexities of a core face, knapped along the axis of the main flaking surface. Débordante flakes/blades only include materials that maintain lateral and distal and sometimes proximal convexities of a core face. These can be removed either from the proximal/main core platform (more common), or distal area of the core (see atypical exemplars below). These tend to have a wedge shaped cross section. In near eastern traditions these are sometimes refered to as naturally backed blades or knives (Shimelmitz et al., 2011; Smith et al., 2016) though these sometimes might refer to elements that are not from hierarchical preferential cores, that happen to have a wedge shaped cross section.

Inclusion criteria: Requires hierarchical core reduction. Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: The term debordante is used and likely is not referring to what we would otherwise code as lateral trimming.

From Wilkins and Chazan** "*Débordante* flakes/blades with unidirectional or bidirectional dorsal scars and a preserved lateral platform surface are also present in the assemblage (n ¼ 13, 1.3%, Fig. 9a) and may have sometimes been used to rejuvenate core edges"(Wilkins & Chazan, 2012). Figure 5. Pieces 5, 6, and 9 in figure below.

Atypical exemplars: If backed flake/knife is used, only count as present if there is further discussion about the role they play in managing convexities of core face, OR if core faces show clear evidence of *débordante* removals in illustrations. For example *"Only one elongated flake could be attributed to the Taramsa reduction method. The presence of many backed pieces (N=10) confirms this trend, since these flakes are removed to maintain the strong lateral convexity of the core"(Spinapolice & Garcea, 2013).* If "debordante" is not used, but there are phrases like "elongated flakes were used to align the core face/modify lateral and distal convexities/modify core edges" count as present. Figure 5. Piece 8.

Close but no: Descriptions of *débordante* removals, but without further specifics about the orientation of trimming flakes either in text or in figures. Discussion of face shaping with flake removals or discussion of naturally backed blades/knives/flakes without mention of the role they served in maintaining face shape/convexity.

4.9 Overshot flakes

Short Description: Elongated flake removals that clip or remove the distal margin of the core.

Definition: Medial and distal convexities of a core face on a preferential hierarchical core are modified with an invasive flake that removes the distal end of the core, which may bear a platform (often opposed to its own) on the distal margin.

Inclusion criteria: Requires hierarchical core reduction. Described in text OR shown in figures.

Exclusion criteria: Absence of hierarchical core reduction. Not described in text AND not shown in figures. No argument for presence. No Hierarchical preferential cores. No overshot blades/flakes in illustrations. No discussion of overshot blade/flake role in modifying distal convexity/rejuvenating distal platform.

Typical exemplars: Shimelmitz et al. 2011 *"The frequent removal of laminar items with an overpassing end termination along the reduction in order to control core convexities."*

Atypical exemplars: From Wilkins and Chazan. *"Blades preserving a distal striking platform (Fig. 7d) further attest to the bidirectional production of blades."*. This phrase has enough information for us to code this as an overshot blade used to manage distal convexities, but there is also supporting information in the figure showing overshot blades.

Close but no: Morphological overshot pieces are present, but there is no discussed role in modifying distal convexity/rejuvenating a distal platform. This will most often be the case where there are overshot flakes taken from cores that do not have another platfrom at the distal end of the core face, or where the overshot flake on a single platform core does not remove stacking towards the distal end of the core face. Flakes that have a distal end of core, but the distal end is cortex.

4.10 Kombewa

Short Description: Removal of flake from ventral surface of a flake

Definition: Ventral surface of a flake is treated as a core face, where the original flake platform is treated as the core platform.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Kombewa technique described as present, "Janus flakes" and the processes to make them are described. "Cleavers were made on sometimes completely unmodified Kombewa flakes"

Atypical exemplars: NA

Close but no: Core on flake described as present without discussion of where the flaking surface is on that flake. Flakes from retouching large flakes, which are initiated at dorsal margin, and capture some of the ventral surface, but were not initiated from the original platform, and did not remove much of the ventral surface. Scars not propagated across ventral surface. Burin spalls, or *tranchet* spalls taken from flakes. Kombewa flakes should not have two ventral surfaces.

4.11 Core tablet removals

Short Description: Flake removals that rejuvinate or prepare a core platform, by removing some or all of the core platform.

Definition: Striking a flake into the face of a core, where the dorsal surface of that flake is the main platform of a core. These are intended to rejuvinate the core platform by establishing a fresh flaking surface.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Figure 11. Cores a and d. Descriptions of core tablets, or illustrations of core tablets themselves and text describing the function they served in rejuvenating core platforms, or illustrations of cores with strong evidence for core tablet removals. Phrases like,'the assemblage has several core tablets', or "core platforms were rejuvenated through striking core tablets".

Atypical exemplars: Figure 11. Cores b and e show evidence of flakes taken across the top of the core (the negative bulb of the flake is present) and this flake erased the negative bulbs of several of the blade scars (the flake did not just establish a platform, but was taken after several blades had been struck). These lines of evidence on a single platform hierarchical core are sufficient to infer that these cores were rejuvenated with tablets. Figure 12. Pieces 1-4 show insufficient evidence to call them core tablets, but the presence of additional text describing their role in rejuvenating platforms gives us enough infromation to call them core tablets.

Close but no: Coding as present should not be based only on illustrations of pieces that look like tablets. It should also not normally be based on illustrations of cores that have a single scar as the platform without supporting evidence that that scar was made to rejuvenate the platfrom. Flakes with large facetted proximal margins are illustrated without any other information in the text about rejuvenation of platforms. Figure 12. Pieces 1-4. Without additional information about the geometry of the core from which these were taken, we should not call these core tablets (though the paper from which the figure is borrowed provides enough context to call these tablets).

4.12 Abrasion/grinding

Short Description: Abrasion or grinding performed at any point in reduction sequence.

Definition: Core was abraded/ground to strengthen platform, or tools were abraded or ground as part of production sequence.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Any discussion of the abrasion of the core platform in relation to platform preparation in the text, or the presence of grinding/abrasion to finish a tool. For example: 'platforms were prepared by abrasion.'. Figures showing evidence of abrasion, or polishing of platforms or of edges. Presence of polished adzes, and groundstone tools that are not formed only through pecking.

Atypical exemplars: "These bifaces have several common attributes. All were primarily shaped by abrasion by rubbing with a coarse material, leaving parallel striae on their surface" (Rosenthal, 1996).

Close but no: Platform preparation described, but the kind of preparation not explicitly described. Tools show suggestive, though ambigious evidence of being ground/abraded but no discussion of the technique in text. Presence of use polish (e.g. sickle polish). Figure 13. shows a hammer dressed/pecked tool, which may have been abraded too, but without additional info in text or in other figures do not call it present.

4.13 Overhang removal/microchipping of area below platform

Short Description: Removal of chips to modify area below platform.

Definition: Removal of chips initiated from platform to modify proximal margin of core face/proximal convexities, and modify the platform angle.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Illustrations show small flakes removed at proximal margin of flakes, or on areas below core platforms. Descriptions of overhang removal, or microchipping of platform in text.

Atypical exemplars: NA

Close but no: Similar practices described in text, but this refers to what we would otherwise code as faceting.

4.14 Percussion by striking with hard hammer

Short Description: Use of a hard hammer

Definition: Use of a hard hammer to strike onto some substrate, whether it is a core, held in the hand, mounted on an anvil, or whether the core itself was struck on a hard substrate (as in case of passive hammer technique). Flakes need not to have been produced.

Inclusion criteria: Flakes produced OR hard hammers present.

Exclusion criteria: (No flakes produced AND no hard hammers present) OR described as absent.

Typical exemplars: If flakes are produced in assemblage,but there is no discussion about the kind of hammer/percussion technique used, count as present.

Atypical exemplars: Examples of technologies where there is only percussion, with no production of flakes (e.g. nutcracking). Explicit description of hard hammer percussion as method of flaking. Hammer dressing/pecking as a method of shaping tools.

Close but no: Flakes produced, but only percussion techniques described do not include use of hard hammer. For example: later blade production techniques which likely involved hard hammer percussion in early stages of core preparation, but where only the later stages of blank production are represented and these are described as involving soft hammer/indirect percussion/pressure flaking.

4.15 Core supported by hand

Short Description: Any stage of tool manufacture includes holding the core in hand while striking it (i.e. use of anvil is absent).

Definition: NA

Inclusion criteria: Flakes produced OR any hard hammer,soft hammer,or indirect percussion present.

Exclusion criteria: Bipolar percussion is main mode of flaking OR passive hammer is main mode of flaking OR cores described as primarily mechanically mounted.

Typical exemplars: "Nodules were reduced through freehand percussion".

Atypical exemplars: "Early stage reduction likely included soft hammer percussion and hard hammer percussion to shape core prior to it being reduced through bipolar percussion", "Nodules were bifacially flaked to produce a crest, prior to being mounted in a substrate where flaking was then performed through application of pressure".

Close but no: Passive hammer percussion resulting in flakes.

4.16 Use of anvil

Short Description: Any incorporation of an anvil, or hard substrate, in the reduction process.

Definition: Use of an anvil or hard substrate at any point in the tool reduction sequence.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Any discussion of anvil use, including bipolar percussion.

Atypical exemplars: Descriptions or illustrations of anvil resting: *"... many of our early replications were performed with the aid of an anvil (Figure 5), and this was found to be a successful technique for creating the initial steep sides on large flakes and cobbles. Anvil resting was more successful than true bipolar flaking in generating steep-angled edges and moving flaking on to new edges"* (Clarkson et al., 2015 p.74)

Presence of *pièces esquillées* or other kinds of scaled pieces described as resulting from smashing a flake against a hard substrate.

Close but no: Cases where bipolar is mentioned briefly, but where there is a possiblity that it refers to bidirectional flaking. In such cases, there must also be some visual evidence for bipolar percussion with an anvil (in the form of scaled pieces, for example).

4.17 Core rotation

Definition: Core rotated at any point in reduction sequence

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Figures showing cores with flake removals across two different axes. Bifacial flaking of any kind.

Atypical exemplars: NA

Close but no: Single platform cores are present without evidence of removals across the top of the core.

4.18 Soft Hammer

Short Description: Use of a soft hammer

Definition: Use of a soft hammer (whether the material be wood, bone, soft stone, etc).

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Authors explicitly state that soft hammer percussion was likely performed, soft hammers present in the archaeological assemblage and flakes present consistent with use of soft hammers. For example, if delicate, thin, wide flakes are present and soft-hammers were recovered from related contexts.

Atypical exemplars: Examples where indirect percussion, soft hammer, and pressure flaking are all reported as possibilities, but soft hammer percussion is reported as most likely.

Close but no: Soft hammer use not specified, thinned bifaces appear consistent with soft-hammer percussion but no description in text. Flakes with lipped platforms present, but no discussion about soft-hammer percussion. Statements like "soft hammer percussion is one method that could produce the forms here", without noting that it is the most likely method.

4.19 Indirect percussion

Short Description: Use of a punch to remove flakes

Definition: Use of a punch of any given material placed on a platform, and struck with a hammer to punch flakes from the core.

Inclusion criteria: Described in text

Exclusion criteria: Not described in text.

Typical exemplars: 'The blades in this assemblages would have likely required indirect percussion', 'experimental reconstructions of the stitching pattern on these Danish daggers indicate that indirect percussion/use of a punch would have been required'. Examples where indirect percussion, soft hammer, and pressure flaking are all reported as possibilities, but indirect percussion is reported as most likely.

Atypical exemplars: NA

Close but no: 'Indirect percussion could have been employed', figures showing evidence of stitching patterns, or flaking patterns that exploit pronounced negative bulbs of percussion as platforms that appear difficult to achieve without indirect percussion, but could potentially have been produced through pressure flaking. Statements like "indirect percussion is one method that could produce the forms here", without noting that it is the most likely method.

4.20 Flaking with application of pressure

Short Description: Removal of flakes through application of pressure on core platform.

Definition: Use of typically soft indentor, bone, metal, or hard wood,to press off flakes, or burin spalls.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Descriptions of the use of pressure to produce blanks, typically microblades or repeated initiation of burin spalls from a flake to serve as microblades.

Atypical exemplars: 'Microblades were struck through application of pressure', 'burin spalls were likely removed through pressure flaking". Examples where indirect percussion, soft hammer, and pressure flaking are all reported as possibilities, but pressure flaking is reported as most likely.

Close but no: Descriptions of delicate blade manufacture, but no clear statement indicating that pressure flaking was the likely method of core reduction. Statements like "pressure flaking is one method that could produce the forms here", without noting that it is the most likely method. Cases of pressure flaking retouch.

Pressure flaked single burins, or otherwise later stage pressure flaked burins where there is no argument that they served as microblade cores.

4.21 Pecking/hammer dressing

Short Description: Modification of core or tool through pecking

Definition: NA

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Figure 13. Hammer dressing, or pecking described in text as method employed at any point in tool manufacture. Hammer dressing is unambiguously present in illustrations.

Atypical exemplars: NA

Close but no: Artifacts appear pecked in figures but this could be consistent with either use, or post-depositional processes and there is no clarification in text.

4.22 Invasive flaking

Short Description: Removal of non-cortical flakes that extend beyond the midpoint of the core face.

Definition: Removal of non-cortical flakes that extend beyond the midpoint of the core face, The midpoint can either be in relation to the long axis (if striking things like burin spalls or blades), or along the short axis (in cases of tranchet resharpening, and biface thinning).

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Examples of blade production.

Atypical exemplars: Invasive flaking during early stages of biface reduction.

Close but no: Invasive flaking described only in text, but without further information about how invasive the flake are. No description of flakes invasive to the degree that they extend beyond midline. Candidate invasive flakes are cortical. Biface thinning flakes and tranchet spalls which are better characterized as invasive retouch.

4.23 Ochre use

Short Description: Use of ochre in any stage of tool making

Definition: Use of ochre as a pigment or as a binding agent.

Inclusion criteria: Described in text.

Exclusion criteria: Not described in text.

Typical exemplars: 'Ochre was applied to points', 'the adhesive residues include ochre'

Atypical exemplars: NA

Close but no: NA

4.24 Asphalt use

Short Description: Use of aslphalt at any stage of the tool making process.

Definition: Use of asphalt as a binding agent

Inclusion criteria: Described in text.

Exclusion criteria: Not described in text.

Typical exemplars: 'asphalt was applied to points', 'the adhesive residues include asphalt'. Asphalt adhered to tool, typically at its base/tang.

Atypical exemplars: NA

Close but no: Asphalt in association with tools likely through post-depositional processes.

4.25 Tanging

Short Description: Retouching base of piece to form a tang

Definition: Retouching a piece, typically through backing and notching to aid with hafting.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Stemmed points, side notched points (Figure 14, all points shown). Description of retouch as forming a tang for the purpose of hafting.

Atypical exemplars: No mention of tanging, but pieces with basal modifications consistent with a tang are described as frequent or have many illustrations. Tangs associated with pieces like Aterian points.

Close but no: Pieces likely hafted, but where the only basal modification is a truncation/backing, such as atypical salabiya points discussed in Smith et al. 2016. Pieces with “tangs” that are interpreted as drills and perforators.

4.26 Retouch

Short Description: Retouch of flake

Definition: Retouch of any kind present. Small flakes are removed from either a retouched flake/blank or core tool to shape it or resharpen it.

Inclusion criteria: Retouch described as present. Illustrations of pieces show unambiguous evidence of retouch.

Exclusion criteria: Bifacial retouch is present. No unambiguous illustrations of unifacially retouched pieces, and no mention of retouch.

Typical exemplars: NA

Atypical exemplars: NA

Close but no: NA

4.27 Abrupt retouch.

Short Description: Retouch forms an abrupt, scraper-like margin

Definition: Retouch that increases the angle of the margin to ~70-90 degrees.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Presence of artifacts with retouch that forms an angle greater than 70 degrees. Description of scrapers in assemblage.

Atypical exemplars: Tanged pieces where tangs are formed by lengths of abrupt retouch.

Close but no: Abrupt retouch on flat thin flakes. Cases that are best described as notches or denticulates. Retouch is abundant, but but lack of evidence for artifacts with retouch forming greater than 70 degree angle.

4.28 Notching

Short Description: Retouch forms round concavity.

Definition: Retouch, either unifacial or bifacial, forms a round concavity, or series of concavities.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Figure 14. Piece 1. Figure 15. Pieces E, F. Description of notches, or denticulates. Illustration of pieces with notches formed.

Atypical exemplars: Step 3 in Figure 8. Lateral notches on artifact 1 in Figure 14. The complete "ear" on artifact 2 in Figure 14.

Close but no: Basal concavities on points. Basal concavity on artifact 1 in Figure 14.

4.29 Burination

Short Description: Flaking of burin spalls.

Definition: Removal of flakes along the margin of another flake. Flakes from this process should have two ventral surfaces, the parent flake's, and its own.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Figure 16. from Smith et al. 2016. all examples. Illustrations of flakes with evidence of spalls taking across their lateral, proximal, or distal margins. Burins, or burin spalls described as present.

Atypical exemplars: Steps 2,4, and 5 in Figure 8. Systematic production of Krukowski microburins and the regular microburin technique are both examples of burination, as the resulting flakes have two ventral surfaces. However, isolated instances should not be coded as these can be produced by accident (de Wilde and de Bie 2011). The only spalls meeting the definition produced through bipolar percussion should be pieces like microburins or Krukowski microburins.

Close but no: Mention of 'impact burination', 'spalling', 'core-on-flake'. Burin spall-like removals on bifaces, cores, or core tools, which are better characterized as tranchet spalls, or crested blades. Spalls from scaled pieces, scaled pieces themselves or *pièces esquillées*. Isolated examples of Krukowski microburins and regular microburins.

4.30 Tranchet removal.

Short Description: Retouch of a core-tool by removing a flake across the face at the distal margin or bit.

Definition: Retouch of a core-tool by removing a flake across the face at the distal margin or bit. The spall removed in this process is typically curved, and may be trihedral in a way similar to a burin spall. One lateral margin of the spall will be the distal margin/bit of the core-tool. The opposite face of the core tool will have a remnant on one face of the spall, adjacent to the ventral surface of the spall.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Description of tranchet resharpening in text, or *coup de tranchet*. Illustration of core-tools with negative from tranchet spall visible: for example in Figure 17. Pieces 1-3. Illustration of tranchet spalls themselves with further description that role they played in shaping core tools.

Atypical exemplars: Illustrations of multiple core-tools with examples of tranchet resharpening, but no description of this method of resharpening in text. Tranchet axes on flakes with predominately unifacial retouch, whose tranchet spalls could be reasonably interpreted as burins (code them as tranchet spalls).

Close but no: Illustrations of what appear to be tranchet spalls in context of a site with core-tools that could reasonably have been resharpened with such spalls, but no description in the text that these spalls served that purpose. Examples of micro "tranchet" adzes in the Solomon Islands illustrated in Harrison (1931) which have the same kind of bevelled bit as a tranchet axe, but which were likely produced through careful preparation of a core, rather than through a *coup de tranchet*.

4.31 Pressure retouch

Short Description: Pressure flaking retouch

Definition: Retouching a piece (core-tool or flake) with application of pressure.

Inclusion criteria: Described in text OR shown in figures.

Exclusion criteria: Not described in text AND not shown in figures.

Typical exemplars: Invasive flake scars on retouched pieces that are extremely narrow (~.5mm), thin (<.1mm, and relatively invasive (~5mm) OR description of pieces as pressure flaked. 'There were x pressure flaked bifaces in the assemblage'

Atypical exemplars: ‘Burin spalls removed through pressure flaking’, or ‘microblades removed from an end nosed scraper through pressure flaking.’

Close but no: ‘biface was thinned through invasive and delicate removals’, ‘delicate burin spalls removed’, ’blank production was performed through pressure flaking. Delicate retouched tools without strong evidence of pressure flaking retouch.

4.32 Invasive retouch

Short Description: retouch that initiates flakes which extends to beyond the midline of the flake or core-tool.

Definition: NA

Inclusion criteria: described in text OR shown in figures

Exclusion criteria: No illustrations of retouched pieces.

Typical exemplars: Flakes that extend beyond the midpoint of a flake or core-tool during retouch. Descriptions of pieces as having invasive retouch. Illustrations of retouched pieces showing retouch extending beyond midline of tool.

Atypical exemplars: Burin spalls that extend beyond midline of the artifact. Tranchet spalls.

Close but no: Retouch described as invasive, but retouch scars in illustrations extend to or short of the midline of the artifact. Invasive flake scars on early stage bifaces and unretouched core-tools.

5 Figures

Figure 1. Figure 23 illustrating levallois point variation from Kibish formation (Shea, 2008).

Figure 2. From figure 5 illustrating levallois flake and centripetal flake diversity (Picin & Vaquero, 2016).

Figure 3. Figure 2 illustrating schematic drawings of blade manufacture methods in Queensland (Moore, 2003).

Figure 4. Figure 4 on technological blade classifications at Rose Cottage Cave (Soriano et al., 2007).

Figure 5. Figure 1 in in description of Levallois technology (Bordes, 1980).

Figure 6. Figure 2 in description of Levallois technology (Bordes, 1980).

Figure 7. Figure 5 description of bladelet core preparation at 'Ein Qashish with distal preparation at step 4.(Malinsky-Buller et al., 2014)

Figure 8. Figure 2. Schematic illustrating busqued burin production methods at La Ferrassie (Chazan, 2001).

Figure 9. Figure 2. Microblade core variability at Amakomanak.(Coutouly, 2017)

Figure 10. Initial blade subtypes from Kfar HaHoresh (Barzilai & Goring-Morris, 2010).

Figure 11. Figure 4 in description of blade cores from Fumane cave (Falcucci & Peresani, 2018).

Figure 12. Figure 14 illustrating platform spalls from bidirectional blade cores recovered from Kfar HaHoresh (Barzilai & Goring-Morris, 2010)

Figure 13. Figure 2 illustrating hammer dressing on stemmed obsidian tool from Biak Island, West Papua (Robin Torrence et al., 2009).

Figure 14. Figure 13 illustrating projectile points recovered from Motza (Khalaily et al., 2007).

Figure 15. Figure 8 illustrating some retouched tool tyles from Ayn Abu Nukhayla (Henry & Mraz, 2020).

Figure 16. Figure 5 illustrating burin variation at the PPNA site El Hemmeh (Smith et al., 2016).

Figure 17. Figure 14 illustrating tranchet axe variability at Motza (Khalaily et al., 2007).

6 Bibliography

Barzilai, O., & Goring-Morris, A. N. (2010). Bidirectional Blade Production at the PPNB Site of Kfar HaHoresh: The Techno-Typological Analysis of a Workshop Dump. Paléorient, 36(2), 5–34. https://doi.org/10.3406/paleo.2010.5386

Bordes, F. (1980). Le débitage Levallois et ses variantes. Bulletin de la Société préhistorique française, 77(2), 45–49. https://doi.org/10.3406/bspf.1980.5242

Chazan, M. (2001). Bladelet Production in the Aurignacian of La Ferrassie (Dordogne, France). Lithic Technology, 26(1), 16–28. https://doi.org/10.1080/01977261.2001.11720973

Clarkson, C., Shipton, C., & Weisler, M. (2015). Front, back and sides: Experimental replication and archaeological analysis of Hawaiian adzes and associated debitage: A study of Hawaiian adze manufacture. Archaeology in Oceania, 50(2), 71–84. https://doi.org/10.1002/arco.5056

Coutouly, Y. A. G. (2017). Amakomanak: An Early Holocene Microblade Site in Northwestern Alaska. Arctic Anthropology, 54(2), 111–135. https://doi.org/10.3368/aa.54.2.111

De Wilde, D., & De Bie, M. (2011). On the origin and significance of microburins: an experimental approach. Antiquity, 85(329), 729-741.

Falcucci, A., & Peresani, M. (2018). Protoaurignacian Core Reduction Procedures: Blade and Bladelet Technologies at Fumane Cave. Lithic Technology, 43(2), 125–140. https://doi.org/10.1080/01977261.2018.1439681

Harrison, H. S. (1931). Flint Tranchets in the Solomon Islands and Elsewhere. The Journal of the Royal Anthropological Institute of Great Britain and Ireland, 61, 425–434. JSTOR. https://doi.org/10.2307/2843929

Henry, D. O., & Mraz, V. (2020). Lithic economy and prehistoric human behavioral ecology viewed from southern Jordan. Journal of Archaeological Science: Reports, 29, 102089. https://doi.org/10.1016/j.jasrep.2019.102089

Hruschka, D. J., Schwartz, D., St.John, D. C., Picone-Decaro, E., Jenkins, R. A., & Carey, J. W. (2004). Reliability in Coding Open-Ended Data: Lessons Learned from HIV Behavioral Research. Field Methods, 16(3), 307–331. https://doi.org/10.1177/1525822X04266540

Khalaily, H., Bar-Yosef, O., Boaretto, E., Bocquentin, F., Le Dosseur, G., Erikh-Rose, A., Goring-Morris, A. N., Greenhut, Z., Marder, O., Sapir-Hen, L., & Yizhaq, M. (2007). Excavations at Motza in the Judean Hills and the Early Pre-Pottery Neolithic B in the Southern Levant.pdf. Paleorient, 33(2), 5–37.

MacQueen, K. M., McLellan, E., Kay, K., & Milstein, B. (1998). Codebook Development for Team-Based Qualitative Analysis. CAM Journal, 10(2), 31–36. https://doi.org/10.1177/1525822X980100020301

Malinsky-Buller, A., Ekshtain, R., & Hovers, E. (2014). Organization of lithic technology at 'Ein Qashish, a late Middle Paleolithic open-air site in Israel. Quaternary International, 331, 234–247. https://doi.org/10.1016/j.quaint.2013.05.004

Moore, M. W. (2003). Australian Aboriginal Blade Production Methods on the Georgina River, Camooweal, Queensland. Lithic Technology, 28(1), 35–63. https://doi.org/10.1080/01977261.2003.11721001

Perreault, C., Brantingham, J., Kuhn, S. L., Wurz, S., & Gao, X. (2013). Measuring the Complexity of Lithic Technology. Current Anthropology, 54(8).

Picin, A., & Vaquero, M. (2016). Flake productivity in the Levallois recurrent centripetal and discoid technologies: New insights from experimental and archaeological lithic series. Journal of Archaeological Science: Reports, 8, 70–81. https://doi.org/10.1016/j.jasrep.2016.05.062

Rosenthal, E. J. (1996). San Nicolas Island Bifaces: A Distinctive Stone Tool Manufacturing Technique. Journal of California and Great Basin Archaeology, 18(2).

Schmidt, I. (2011). A Middle Stone Age Assemblage with Discoid Lithic Technology from Etemba 14, Erongo Mountains, Northern Namibia. Journal of African Archaeology, 9(1), 85–100.

Shea, J. J. (2008). The Middle Stone Age archaeology of the Lower Omo Valley Kibish Formation: Excavations, lithic assemblages, and inferred patterns of early Homo sapiens behavior. Journal of Human Evolution, 55(3), 448–485. https://doi.org/10.1016/j.jhevol.2008.05.014

Shimelmitz, R., Barkai, R., & Gopher, A. (2011). Systematic blade production at late Lower Paleolithic (400–200 kyr) Qesem Cave, Israel. Journal of Human Evolution, 61(4), 458–479. https://doi.org/10.1016/j.jhevol.2011.06.003

Smith, S., Paige, J., & Makarewicz, C. A. (2016). Further diversity in the Early Neolithic of the Southern Levant: A first look at the PPNA chipped stone tool assemblage from el-Hemmeh, Southern Jordan. Paléorient, 42(1), 7–25. https://doi.org/10.3406/paleo.2016.5691

Soriano, S., Villa, P., & Wadley, L. (2007). Blade technology and tool forms in the Middle Stone Age of South Africa: The Howiesons Poort and post-Howiesons Poort at Rose Cottage Cave. Journal of Archaeological Science, 34(5), 681–703. https://doi.org/10.1016/j.jas.2006.06.017

Spinapolice, E. E., & Garcea, E. A. A. (2013). The Aterian from the Jebel Gharbi (Libya): New Technological Perspectives from North Africa. African Archaeological Review, 30(2), 169–194. https://doi.org/10.1007/s10437-013-9135-2

Tversky, A., & Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. Science, 185(4157), 1124–1131. https://doi.org/10.1126/science.185.4157.1124

Wilkins, J., & Chazan, M. (2012). Blade production ~500 thousand years ago at Kathu Pan 1, South Africa support for a multiple origins hypothesis. Journal of Archaeological Science, 1–18.