



Contents lists available at ScienceDirect

Journal of Human Evolution

journal homepage: www.elsevier.com/locate/jhevol

Lithic technology and behavioural modernity: New results from the Still Bay site, Hollow Rock Shelter, Western Cape Province, South Africa

Anders Högberg*, Lars Larsson

Lund University, Institute of Archaeology and Ancient History, Box 117, SE-22100 Lund, Sweden

ARTICLE INFO

Article history:

Received 13 April 2010

Accepted 16 February 2011

Keywords:

Middle Stone Age
 Still Bay points
 Attribute analysis
 Chaîne opératoire
 South Africa

ABSTRACT

The Hollow Rock Shelter site in Western Cape Province, South Africa, was excavated in 1993 and 2008. This study presents new results from a technological analysis of Still Bay points and bifacial flakes from the site. The results show that Still Bay points from the site are standardized tools. The points in the assemblage consist of a complex mixture of whole and fragmented points in all phases of production. The fragmentation degree is high; approximately 80% of the points are broken. A high proportion of bending fractures shows that several of the points were discarded due to production failures, and points with impact damage or hafting traces show that used points were left in the cave. This illustrates that the production of points as well as replacement of used points took place at the site. The result also shows that worked but not finished preforms and points were left at the site, suggestive of future preparation.

The points were produced within the framework of three different chaînes opératoires, all ending up in a typologically uniform tool. This shows that the manufacture of Still Bay points should be regarded as a special bifacial technology, only partly comparable with other bifacial technologies. A raw material analysis shows that locally available quartz and quartzite were used in the production, and that points made of silcrete were brought to the site.

Based on the technological analysis, a discussion of behavioural modernity, focusing on hypotheses about social interaction, experimentation, different strategies for learning to knap, and landscape memories, results in an interpretation that behavioural modernity was established at Hollow Rock Shelter in the Still Bay phase of the southern African Middle Stone Age.

© 2011 Elsevier Ltd. All rights reserved.

Introduction

Several studies have pointed out that the Still Bay lithic industry, along with the later Howiesons Poort industry, provides evidence of social and stylistic elaboration within the southern African Middle Stone Age (MSA) (see for example Henshilwood et al., 2001; Henshilwood, 2005; Rigaud et al., 2006; McCall, 2007; Villa et al., 2010). The Still Bay and Howiesons Poort phases were dynamic periods of change (Henshilwood and Dubreuil, 2009), and hypotheses concerning Still Bay and Howiesons Poort as models for the origins of behavioural modernity have been put forward (see Minichillo, 2005; Lombard, 2007; Henshilwood and Dubreuil, 2009; Chase, 2010; Parkington, 2010).

Previous studies have stressed the importance of documenting the distinctive diachronic and geographic features of the Southern African MSA by studies that go beyond the conventional approaches

based on cultural markers (Porráz et al., 2008). This study is driven by the same approach. First, we present new results from a technological analysis of the Still Bay points from Hollow Rock Shelter. This forms a basis for a discussion of behavioural modernity, focusing on hypotheses about social interaction, experimentation, different strategies for learning to knap and landscape memories. A recently published study states that the Still Bay and the later Howiesons Poort industries represent “important phases in the development of the material culture of early modern humans. How and why these industries occurred when they did, however, remain matters for speculation” (Chase, 2010:1359).

In this article, we intend to clarify the “how” in the quotation above, by taking it from speculation to hypotheses and analyses. The results of our analysis show that behavioural modernity was established at Hollow Rock Shelter in the Still Bay phase of the MSA.

The Hollow Rock Shelter

The northern part of the mountain forming the Cederberg, Western Cape Province, Republic of South Africa, consists of a number of ridges with peaks up to about 1000 m and some fertile

* Corresponding author.

E-mail addresses: anders.hogberg@sydsvenskarkeologi.se (A. Högberg), lars.larsson@ark.lu.se (L. Larsson).

valleys in between. To the west, the Olifants River marks the edge of the mountains. To the east, an area with eroded hills marks the start of the large Karoo Plain. The area in question in the northernmost part of the Cederberg is delimited to the east by a small valley with a river (Figure 1). A bedrock platform some 70 m above the surroundings with a steep ridge towards the valley, is located within the compass of the Sevilla farm. On the edge of the platform rests some large rocks originating from an almost totally eroded peak. One of these rocks has a shape like a small pyramid with a height of 6 m. When still a part of the peak, one side developed a concave shape due to slow erosion. The concave side happened to form the base when a large piece fell off and down on to the bedrock. This caused a hollow area with a size of some 30 m² and a maximum height of 2 m. The edge of the base holds some concave depressions forming openings to the concavity (Figure 2).

Inside, the Hollow Rock Shelter site (HRS) was recognized in 1991 during a survey for rock paintings. An excavation in 1993 revealed an occupation layer, extending for at least two-thirds of the floor (Evans, 1994). A second excavation was carried out in 2008 (Larsson, 2009), led by one of the authors (LL) (Figure 3).

The site has a very special structure compared with other sites in South Africa. It has some similarities to a cave site, as it is protected. In contrast to most caves where excavations cover smaller parts of the settlement, a large proportion of the occupation layer in HRS has been excavated.

A hole in the rock close to the maximum height of the concavity allowed rain to enter but also worked as an excellent exit for the smoke from a fire. Just below this hole, a structure of stone interpreted as a fireplace was documented. Some of the stone artefacts also show clear traces of contact with fire. The only organic components, small pieces of charcoal, were found in the same area as the fireplace. It is evident that the fireplace was a focal point in the settlement from the highest number of tools and refuse in the excavated squares around the fireplace.

The shelter is well located in order to facilitate hunting and gathering, and yet the settlers were well protected. From the shelter, a long stretch of the valley with the small river could be kept under surveillance. A vast area east of the bedrock platform could also be surveyed. A large cliff nearby gave a broad view of the Cederberg (Figure 2).

Except for one backed piece found outside the shelter, no other artefact has been found to prove that the shelter was used during periods later than the Still Bay (Minichillo, 2005), although plenty

of rock art paintings in the vicinity indicate that the area was used during parts of the Later Stone Age (Parkington, 2003).

No stratigraphic divisions could be observed within the thin filling at the 1993 excavation (Evans, 1994). In 2008, the excavated finds were recorded in three dimensions. The predominant parts of the artefacts were found in the upper layers. Even though the habitation layer is thin, the thickness varies within the excavated area but rarely exceeds 20 cm. There seems to be some kind of a settlement sequence as the frequencies of the raw material used on the site vary from one artificial layer to another. The most common material is quartzite (53–75%). Quartz (10–14%), silcrete (4–19%) and hornfels (5–8%) make up the remaining raw materials. Different qualities of quartzite were used; some very fine-grained material and others very rough. Some, especially the latter type, have been more affected by weathering processes than others. Quartz and quartzite are found in proximity to the site. Hornfels is present about 40 km to the west. The origin of silcrete has not been fully investigated (Evans, 1994). Roberts (2003: Figure 4.2a and 4.10) report on one outcrop about 10 km in from the coast at Lamberts Bay, i.e., about 60 km west of HRS. Porraz et al. (2008) report on two sampled silcrete outcrops by the Olifants River about 20 km west of HRS. It is important to stress here that these are 20 km away as the crow flies, and that the Cederberg Mountains are between the HRS and the outcrops. It is also important to stress that this is a list of geological occurrences. We have not studied the “knappability” of raw material from the different outcrops (see Högborg and Olausson, 2007) and therefore do not know anything about the occurrence of raw material suitable for tool manufacture.

Given the size of the site, a relatively large number of Still Bay points were found. The number of other tools is small ($n = 59$ according to Evans, 1994). It includes some side- and end-scrapers. Some flakes but mainly blades are shaped with a denticulated edge, and blades show heavy wear from being used on hard material. Knapping of blades, some with a length of as much as 14 cm, was performed at the site (Evans, 1994).

With reference to Volman's (1984) chronological framework, Evans (1994) places the HRS assemblage at c. 80,000 BP. The excavations in 2008 collected samples for optically stimulated luminescence dating (OSL). At present, the datings require further analysis, but as Table 1 indicates, the preliminary results for the main levels with finds are approximately 72,000 and 80,000 BP (sample number Sevilla 48,3 and Sevilla 48,4 in Table 1). Since the results have not been analysed in detail, no far-reaching

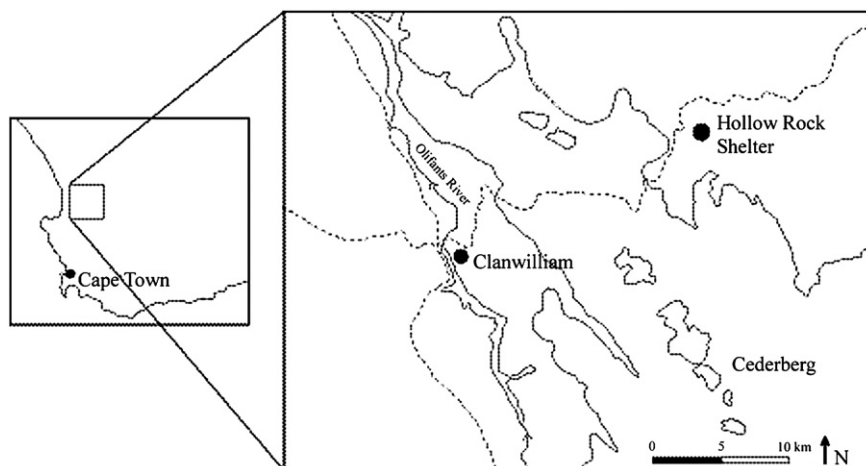


Figure 1. Map showing the location of Hollow Rock Shelter (from Larsson, 2009, reworked from Evans, 1994).



Figure 2. Outside and inside Hollow Rock Shelter, together with a view from Hollow Rock Shelter facing the valley and the small river, green area, beneath the shelter. The photo from inside Hollow Rock Shelter shows the 2008 excavation of square AE13 and AE14, photographed from south west, see Figure 3. Photo: Anders Högberg and Lars Larsson. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

conclusions will be drawn from the OSL dating. What can be observed is that the preliminary dates for HRS are roughly in line with what Evans (1994) suggested, in line with or somewhat older than the ages of the Still Bay phase proposed by Jacobs et al. (2008) and younger than the ages presented from the investigation of Diepkloof Rock Shelter (Tribolo et al., 2009).

Still Bay points from Hollow Rock Shelter

Since the Still Bay was defined in detail by Goodwin and van Riet Lowe in 1929 (Goodwin and van Riet, 1929), the Still Bay points, the

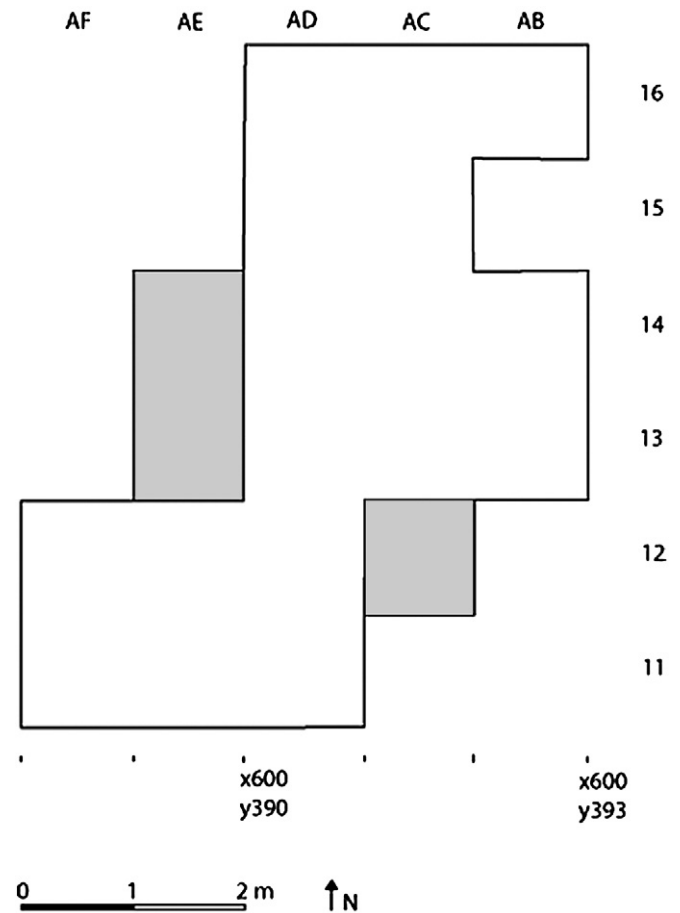


Figure 3. Excavation plan from the excavation at the Hollow Rock Shelter. Area from the 1993 excavation marked in white (Evans, 1994) and area from the 2008 excavation marked in grey.

fossil directeur of the Still Bay industry (Henshilwood et al., 2001; Wadley, 2007; Villa et al., 2009), have been discussed by several researchers (see Minichillo, 2005; Schlanger, 2005 and Wadley, 2007 for an overview). The Still Bay point (SB point) is normally defined as a typically bifacial retouched foliate, a narrowly elliptic to lanceolate-shaped tool, lenticular in cross-section, with either two sharply pointed apices or a sharp point and a wide-angled pointed butt (Evans, 1994; Villa et al., 2009).

Even though finds of SB points have been reported from several sites (see Minichillo, 2005 for an extended overview), there are few sites in the Western Cape Province with excavated Still Bay assemblages in clearly stratified context. HRS is one. Other examples are Diepkloof Rock Shelter (Rigaud et al., 2006; Tribolo et al., 2009) and Blombos Cave (Henshilwood et al., 2001; Villa et al., 2009). From Sibudu Cave (Wadley, 2007) and Umhlatuzana Rock Shelter (Lombard et al., 2010), both in KwaZulu-Natal in eastern South Africa, Still Bay assemblages, also from stratified contexts, have been published.

Materials and methods

The sample from HRS consists of 69 bifacial points from the 1993 and 2008 excavations (Evans, 1994; Larsson, 2009) (Figure 4). The registered items include broken, complete, discarded or used blanks, and preforms and points in different phases of production. The amount differs from previously published numbers ($n = 40$) (Evans, 1994). This is because 15 new points were found during the

Table 1
Preliminary results of OSL datings from Hollow Rock Shelter.

Risø No.	Sample No.	Depth, cm	Age, ka	Dose, Gy	(n)	Dose rate	Gy/ka w.c. %
08 36 06	Sevilla 48,6	1–3	13.7 ± 1.1	26.4 ± 1.7	21	1.93 ± 0.09	4
08 36 07	Sevilla 48,7	2–4	44 ± 3	71 ± 3	33	1.62 ± 0.08	4
08 36 02	Sevilla 48,2	3–5	44 ± 3	83 ± 3	22	1.88 ± 0.09	6
08 36 01	Sevilla 48,1	2–4	45 ± 3	87 ± 4	24	1.92 ± 0.09	6
08 36 03	Sevilla 48,3	5–10	72 ± 4	129 ± 4	21	1.80 ± 0.08	6
08 36 04	Sevilla 48,4	10–15	80 ± 5	134 ± 6	24	1.68 ± 0.08	7
08 36 05	Sevilla 48,5	20	87 ± 6	147 ± 7	21	1.70 ± 0.08	6

The levels with the largest share of finds are those in the intervals 5–10 and 10–15 cm deep. Still Bay points have been found at these levels. There are no points from the deepest level, 20 cm deep. Samples for dating were taken in square unit AE13, see Figure 3. Note that no analyses have yet been performed to investigate how the levels in the different square units in the excavated area correspond. The OSL dating was performed by Risø National Laboratory in Roskilde, Denmark. Carbon was collected during the 2008 excavation and submitted for radiocarbon dating. The result gave infinite radiocarbon dates, i.e., >48,000 BP (number Lus 8979).

excavation in 2008, and bifacial knapped pieces not registered as SB points in Evans's study (1994) have been defined as such in this study.

The sample size from HRS is comparable with the published number of points from Sibudu Cave (Wadley, 2007), and roughly one-fifth of the sample size published from Blombos Cave (Villa et al., 2009). The technological analysis of SB points from Blombos Cave is hitherto the most extensive published study, focusing on the manufacture and intended use of SB points (Villa et al., 2009). To facilitate comparisons, we follow as far as possible the terminology used in the Blombos Cave study.

Attribute analysis and chaîne opératoire

The methods used in the study are attribute-analysis and chaîne opératoire. Tools as well as flakes, i.e., the product and by-product of stone tool production or core reduction, show numerous traces of the knapping that created them. These traces consist of various attributes, all with their special characters. The composition of the attributes is directly related to the technique and method employed in the knapping, and the variation as well as the distinctiveness of the diagnostic attributes increases with the complexity of the knapping (Inizan et al., 1992; Andrefsky, 1998; Holdaway and Stern, 2004; Odell, 2004). Both the attributes and the variations in the morphology of the attributes thus show more or less distinct and diagnosable traces of the technique and method used when knapping (Högberg, 1999, 2008, 2009). By analysing the character of different attributes, separately or together, it is thus possible to reconstruct the technology, i.e., the knapping techniques and methods with which the SB points were manufactured (Shott, 1994; Ballin, 1995; Högberg, 2009).



Figure 4. Two refitted Still Bay points from Hollow Rock Shelter shown here as examples of what Still Bay points looks like, point r102.53 to the left and point r209 to the right. Photo: Anders Högberg.

The chaîne opératoire is an approach that, with some simplification, aims at reconstructing the production steps that are expressed in an assemblage. With its roots in French anthropology, the method was established in the 1960s as a way of developing ideas about analyses of actions that comprise more than their material consequences (Audouze, 2002). This was done by focusing on cultural and cognitive aspects of the action (the technology) and not just on the result of the technology (the objects) (Leroi-Gourhan, 1993). Since then, the chaîne opératoire has been used for analyses of a wide range of materials and techniques (Lemonnier, 1993; Schlanger, 1994, 2005; Audouze, 2002; Roux, 2003; Sørensen and Desrosiers, 2008). In lithic research on knapping technologies, the chaîne opératoire has been discussed, criticized, developed, and applied in a great many studies and on material from highly diverse periods and places (see for example Karlin and Julien, 1994; Bleed, 2001; Högberg, 2002, 2006, 2008, 2009; Copeland and Moloney, 2003; Hirth, 2003; Shott, 2003; Roche, 2005; Sørensen, 2006), and the chaîne opératoire is well rooted in lithic analyses focusing on technology (Inizan et al., 1992; Eriksen, 2000; Holdaway and Stern, 2004). It includes all of the processes in a lithic technology, from the collection of raw material, through manufacture and use, to the discarding of the tool and the waste: "The chaîne opératoire structures man's use of materials by placing each artefact in a technical context, and offers a methodological framework for each level of interpretation" (Inizan et al., 1992:12).

In the technological analysis, we first present a survey of the SB points from HRS in regard to their size and appearance. We then discuss the degree of fragmentation of the points, production phases, impact damage, hafting traces and production failures. This is followed by chaîne opératoire analyses of the patterns of manufacture of the points and a small-scale study of bifacial flakes. The analyses end with a study of raw material utilization.

Results

A technological analysis of Still Bay points and bifacial flakes from Hollow Rock Shelter

All of the points are presented in figures with what we have interpreted as the base down and the tip up. All of the flakes are presented in the figures with the bulb of percussion up and the distal end down. The attributes and characteristics registered in this study are shown in Table 2. The results are presented below. **Fragmentation and morphology** As seen in Table 3, approximately 80% of the SB points from HRS, i.e., blanks, preforms and points in different phases of production, are broken. This is a fragmentation frequency similar to that noted from Blombos Cave (Villa et al., 2009). From Sibudu Cave, whole SB points are uncommon and bifacial points are represented by either distal tips or proximal ends of broken points (Wadley, 2007).

Table 2

Attributes and characteristics registered in the analysis of the Still Bay points from Hollow Rock Shelter.

Attributes	Definition
Raw material	The raw material that the artefact has been classified as, defined according to Evans (1994)
Length	The longest line on the artefact, measured along the length axis in cm
Width	The widest line on the artefact, measured at right angles to the length axis in cm
Thickness	The thickest part of the artefact, in cm
Fragment type or whole point	The fragmentation of the point, stating which part is left. According to Villa et al. (2009:448, Table 4)
Breakage	Defined according to Villa et al. (2009: 448f)
Hafting traces	Defined according to Villa et al. (2009:449ff) . Traces of patination, curvation and impact damage on the base of the point have been registered
Impact scars	Defined according to Villa et al. (2009:449ff) . The occurrence of burin spalls, hinges or spin-off breakage has been registered
Phase	Defined according to Villa et al. (2009:445, Table 3) with modification in the form of an additional phase in between Villa et al. phase 2a and 2b , here called phase 2ab
Cross-section	Defined as lenticular or D-shaped
Ridge	Defines whether there is or is not a ridge on one broad side of the point formed by the distal meeting of flake scars at a ridge
Blank	This is an attribute with which we have tried to estimate or evaluate whether the point was made from a block-like nodule or a pebble or from a flake
Bifacial or unifacial	A definition which estimates whether the point was knapped bifacially or unifacially

Since not all attributes or characteristics can be observed on every single point, the total number of registered points per attribute varies.

The length, width and thickness registered on each piece are shown in [Table 4](#). It is clear that most of the points are between 2.6 and 7.5 cm long, 1.6 and 3.0 cm wide, and 0.5–1.5 cm thick. Since all but one of the broken SB points from HRS have a break, which reduces the length but does not affect the width or thickness of the point, the result presented in [Table 4](#) and illustrated in [Figure 5](#) shows that the SB points were produced with a regulated width and thickness ratio. [Minichillo \(2005\)](#) also reports on a similarity in size and form.

Table 3

Fragmentation by type and number on the Still Bay points from Hollow Rock Shelter.

Fragment type	Number
Tip	4
Distal	7
Distal-middle	9
Midsection	12
Proximal-middle	4
Base	6
Base missing	1
Lateral fragment	1
Whole point	13
Whole point, but missing tip	5
Other	5
Total	67

The fragment types follow the definitions used in [Villa et al. \(2009:448, Table 4\)](#): tips: small apical fragments between 0.5 and less than 3 cm long; distal fragments: 3 cm long or more; midsections are delimited by a proximal and distal fracture and whole point, but missing tip; points with the outermost part of the tip not present. Two points consist of two pieces, which are glued together, see [Figure 4](#). They are not included in the table. Note that registered items include broken, complete, discarded or used blanks, preforms and points in different phases of production.

Table 4

Length, width and thickness, registered numbers per interval on the 69 Still Bay points from Hollow Rock Shelter.

Cm	Length	Width	Thickness
0.5	–	–	3
0.6–1.0	1	–	45
1.1–1.5	–	5	13
1.6–2.0	3	15	6
2.1–2.5	4	17	2
2.6–3.0	7	17	–
3.1–3.5	10	4	–
3.6–4.0	7	3	–
4.1–4.5	9	4	–
4.6–5.0	4	3	–
5.1–5.5	5	–	–
5.6–6.0	5	–	–
6.1–6.5	2	–	–
6.6–7.0	4	–	–
7.1–7.5	3	–	–
7.6–8.0	1	–	–
8.1–8.5	1	–	–
8.6	3	1	–
Total	69	69	69

Mean width: 2.7 cm, standard deviation width: 1.2 cm. Mean thickness: 1.0 cm, standard deviation thickness: 0.4 cm. Note that registered items include broken, complete, discarded or used blanks, preforms and points in different phases of production.

Most of the points were knapped bifacially, not unifacially ([Figure 6a](#)). About two-thirds of the points were made out of a blank from a block-like nodule or a pebble, and one-third were made out of a flake blank ([Figure 6b](#)). This corresponds to previous studies, which have noted that the SB points were made from blanks of cobbles as well as flakes ([Henshilwood et al., 2001; Rigaud et al., 2006; Wadley, 2007; Villa et al., 2009](#)). Roughly half of the points have a lenticular cross-section, and the other half are D-shaped ([Figure 6c](#)). About one-third of the points have a ridge on one of the broad sides, formed by the distal meeting of flake scars. Accordingly, two-thirds do not have that kind of ridge ([Figure 6d](#)). **Production phases** The manufacturing technology for bifacial flaked tool production is a well-investigated subject worldwide. Research from a wide range of sites and on industries from different periods has given a firm basis for further studies concerning knapping tools, techniques, methods, reduction sequences, production stages, debitage analysis, raw material studies, and chaîne opératoire analysis ([Odell, 2004](#)). As has been noted by [Rigaud et al. \(2006\)](#), SB points were exclusively made by bifacial percussion.

According to [Villa et al. \(2009\)](#), the manufacture of SB points is a progressive process, which goes for all bifacial knapping ([Whittaker, 1994](#)). However, clearly distinct production stages are difficult to define: “The manufacturing sequence appears to be less regular, less standardized than the reduction stages defined for Folsom and other bifacial Paleoindian points” ([Villa et al., 2009:446](#)).

With this in mind, [Villa et al. \(2009\)](#) chose to use the term ‘production phases’ instead of stages, which we follow in this study. [Villa et al. \(2009\)](#) divides the manufacture sequence into four phases (phases 1–4), with a subdivision of phase 2 into phase 2a and 2b. This division follows a generally established description of idealized biface knapping stages (for example [Whittaker, 1994: Figure 8.21](#)).

In the study of SB points from HRS, we have chosen to develop this classification somewhat. Studies of bifacial experimental knapping as well as studies of archaeological assemblages ([Whittaker, 1994; Högborg, 1999; Apel, 2001; Soressi and Dibble, 2003; Callahan, 2006; Nunn, 2006](#)) have shown that even if these four idealized biface phases exist, several phases in between each phase also exist. This was also recognized by [Villa et al. \(2009\)](#), resulting in their division of phase 2 into a 2a and 2b phase. We

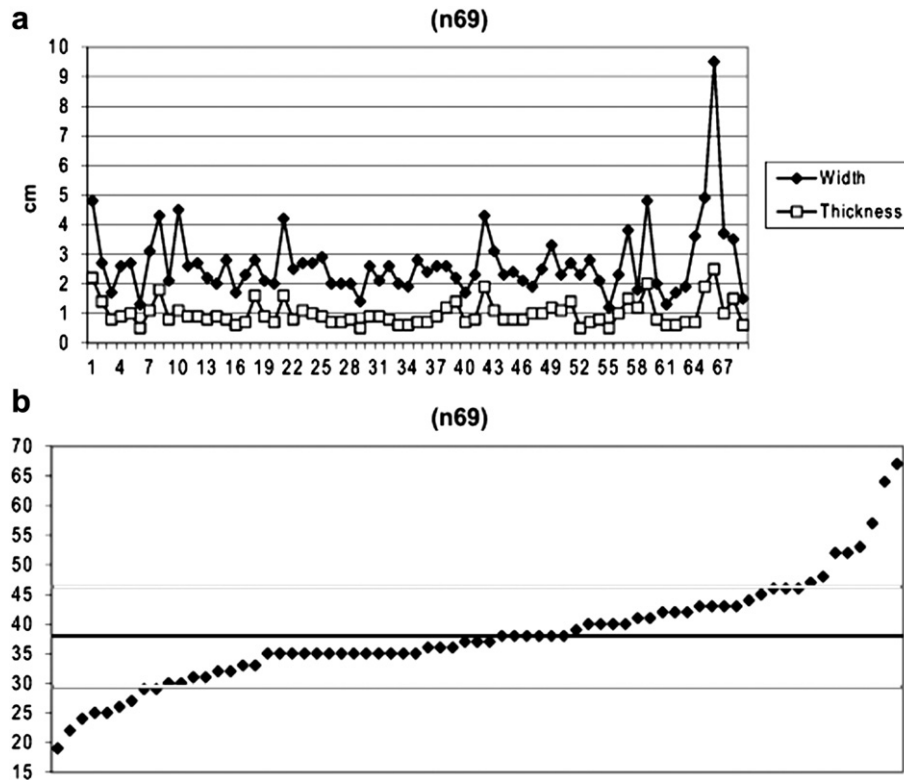


Figure 5. (a) Diagram showing the relationship between width and thickness on each individual Still Bay point from Hollow Rock Shelter. Most of the points have a similar size relation between width and thickness. (b) The Figure illustrates the statistical comparison of the relation between thickness and width for each Still Bay point from Hollow Rock Shelter. For each point, the thickness has been divided by the width. This gives a ratio between thickness and width, and that figure has been multiplied by 100 to give an index figure. The index figure for each point is shown in the diagram. The mean value of all the index figures is 38, marked with a black line in the diagram. The standard deviation of the index figures is 8.8. This indicates that Still Bay points are about one-third as thick as they are wide. This is illustrated with the two lines above and below the black line marking the mean in the diagram. The standard deviation has been calculated by the standard formula as the root of all the index figures for the points totalled and then divided by the number of points minus one. It is clear from the diagram that most of the points have a similar size relation between width and thickness. Note that the registered items include broken, complete, discarded or used blanks, preforms and points in different phases of production.

have chosen here to take the division of phase 2 further, because we believe phase 2a and phase 2b in Villa et al. (2009) do not capture the entire complexity of the extensive manufacture sequence in phase 2. Therefore, we have defined an additional phase between the two phases 2a and 2b, called phase 2ab (Table 5; Figure 7).

From Figures 7 and 8, it is clear that all of the phases of production defined in Table 5 are present in the HRS assemblages. Figure 8 shows the different fragment types divided according to the phases of production defined in Table 5. It is obvious from the figure that the SB points in the assemblage from HRS consist of a complex mixture of whole as well as fragmented points in different phases of production. It is also clear that whole points consist of finished points in phase 3, as well as points in different phases of production.

This observation is clarified in Figure 9, which shows that there are roughly as many finished SB points as points in preparation from HRS.

It is important to emphasize here that there are preforms in different phases of production in the assemblage, which are not 'broken', i.e., they are preforms that could be finished without technological problems to give whole points. They have consequently not been rejected because the makers made technological mistakes, or did not have the skill needed to turn them into finished points (Figure 10). This indicates that the person(s) working in the shelter left behind finished points as well as points in different phases of production at the site.

Previous studies have reported variations in the length of SB points (Evans, 1994; Minichillo, 2005; Villa et al., 2009). As shown

in Table 4, there is variation in length in the HRS assemblages as well. However, if we look at the seven intact points defined as finished in Figure 9, the variation lies between 3.7 and 7.6 cm. The shortest point is made out of quartz. One point made of quartzite is 4.4 cm and the other five, two of silcrete and three of quartzite, are between 5.7 and 7.6 cm long. All of the other whole points in the assemblage that exceed 7.6 cm are not finished points, but SB points in different phases of production. This, together with the discussion above about the relationship between width and thickness, shows that finished SB points to a large extent were standardized tools in regard to form and size. The sole exception in the HRS assemblage is a 3 cm long broken phase 3 point made of silcrete with only the base preserved. The length of the fragment compared with its width, 3.6 cm, shows that this point was probably at least 12 cm long before it broke. Occasional large points from other assemblages have previously been reported (Minichillo, 2005).

Impact damage, hafting traces and production failures The study from Blombos Cave presents a comprehensive analysis of impact damage and hafting traces (Villa et al., 2009). The function of SB points has previously been discussed and Shea (2006) places them in between the metrical range of larger than arrowheads and dart tips, but smaller than thrusting spears. However, the study does not distinguish between ready-made points and points in different phases of production (Villa and Soriano, 2010). Lombard (2006) and Minichillo (2005), have both proposed that some SB points might have had a function as blades in a hafted knife. Villa et al. (2009) discuss previous research on the function of the SB points together with results from Blombos Cave and

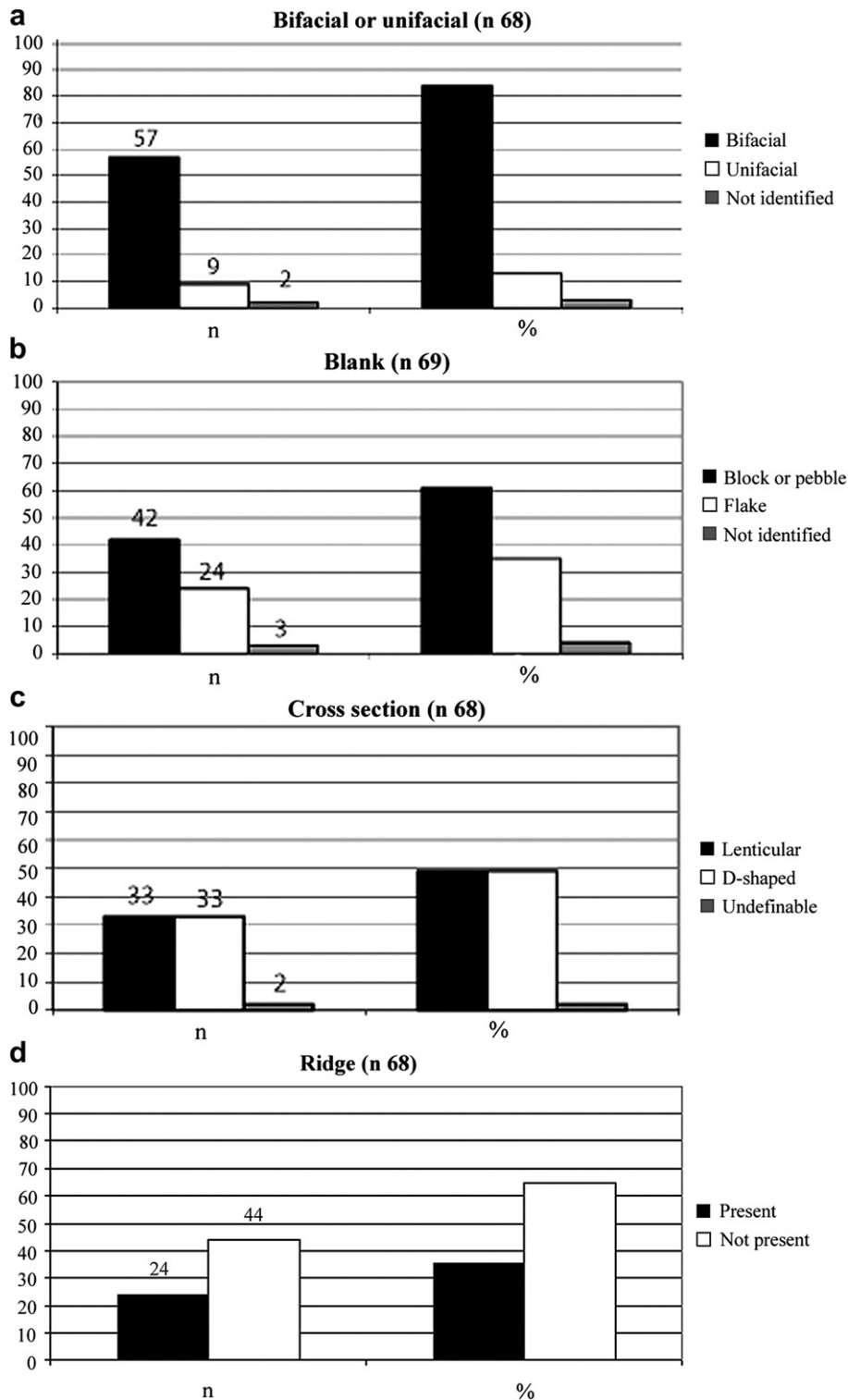


Figure 6. a–d. Diagrams showing results from the registration of attributes and characteristics on the Still Bay points from Hollow Rock Shelter. See Table 2 for definition of attributes. Note that the registered items include broken, complete, discarded or used blanks, performs and points in different phases of production.

concludes that the Blombos points were mainly used as points, even though some of them may have had secondary uses as knives.

Proceeding from the results of the Blombos Cave study, step-terminating fractures, burin-like fractures originating from the tip or from a break and spin-off fractures on the distal end of a point are defined here, as diagnostic of use of the SB points as part of

a compositae stone-tipped projectile weapon (Shea, 2006; Villa et al., 2009; Villa and Soriano, 2010).

It may be noted that 10 of the SB points, nine phase 3 and one phase 4 point, from HRS have some sort of impact damage, six of them at the tip, three at the base, and one is a midsection with distal and proximal snaps with a burin spall on both (Figure 11).

Table 5
Manufacturing sequences, from Villa et al. (2009:445), with an additional phase here called 2ab.

Phase 1	Phase 2a	Phase 2ab	Phase 2b	Phase 3	Phase 4
Phase 1 is a blank. It consists of a raw or slightly worked block, pebble or large flake.	Phase 2a is a worked piece with a distinct shape, clearly showing the intentions of the knapper in making a point. The worked piece has several negative removal scars on the surface. The scars show that the flakes have been knapped away from edge. The worked piece is clearly bifacially knapped with two flat faces, which meet in two edges orientated in the direction of the length.	Phase 2ab is a preform shaped as a point. The preform has invasive surface-covering negative flake removal scars, showing that away-from-edge as well as on-edge knapping were used. Several of the flake removals reach over the length axis of the point. The edges are regular. The preform is large, compared with the finished points, but the proportions between length, thickness and width show that the preform can be reduced to a point.	Phase 2b is a point with a clearly shaped form and well-balanced proportions. The tip and the base are defined. The edges are pronounced and stable. Several invasive surface-covering negative flake removals, knapped with on-edge knapping, reach over more than half of the two faces of the point. The point looks like a finished point, but lacks the final retouch on the edges and the tip.	Phase 3 is a finished point.	Phase 4 is a point, which in some way or another has been intentionally reworked with a technology not typical of the production of a Still Bay point, and with the purpose of producing something other than a point.

Previous typological and morphological analyses as well as residue analyses have clearly shown that SB points were hafted and that, even though a portion of them are double-pointed, they were not designed to be reversible (Wadley, 2007). Two of the SB points from HRS with impact damage also have hafting traces. One has a burin spall on the base and one has crushing as well as a small burin spall on the base (Figure 11). Previous studies have stated that SB points were resharpened and curated in their haft (Minichillo, 2005; Villa et al., 2009). We have found no such evidence in the assemblages from HRS. The point r225 from HRS (see Figure 7) has previously been interpreted as a point that has been resharpened in its haft (Minichillo, 2005). Our analysis does not support this interpretation (see below).

Breakages other than impact damage are registered for 42 of the 69 SB points from HRS (phase 4 points not included). Of these, 37 are bending (snap) fractures (see Whittaker, 1994), making this type of break the most common (Figure 12).

Bending fractures are also the most common break from Blombos Cave, and in line with the results from that study, we interpret bending fractures on the SB points at HRS as production failures (Villa et al., 2009). Two breakages are lateral breaks and one point has a bending fracture together with a lateral break. As in the Blombos Cave study (Villa et al., 2009), we exclude trampling as a reason for breakage because no other features diagnostic for trampling (other than bending fractures), for example dorsal and ventral random edge scarring (Tringham et al., 1974), is present on the SB points.

The result of the analysis of different breakages shows that used points, together with points in different phases of production but broken during production, were deposited in the cave.

The manufacture of Still Bay points at Hollow Rock Shelter, a chaîne opératoire analysis

A chaîne opératoire analysis of the SB points from HRS reveals that the points were produced within the framework of three different strategies: a bifacial block chaîne opératoire in two versions and an unifacial flake chaîne opératoire. The results of the analysis of the different chaînes opératoires are described below.

Bifacial block chaîne opératoire This chaîne opératoire starts with a block, a pebble or a 'block-like' flake (Wadley, 2007) and results in an SB point showing invasive retouch with flake removals that travelled beyond the centre of the face (Holdaway and Stern, 2004).

The bifacial block chaîne opératoire comes in two versions. One version, here called block chaîne opératoire version 1 (block co v.1), follows what can be called typical bifacial reduction phases, as has been described for example by Whittaker (1994) for the production

of North American Paleoindian points or by Apel (2001), Stafford (1998), and Callahan (2006) for the production of Late Neolithic Danish daggers. This is also the description of the production of SB points that has previously been suggested (Villa et al., 2009). The other version, here called bifacial block chaîne opératoire version 2 (block co v.2), follows in many respects the reduction sequences of the block co v.1, but differs radically in the way that the reduction is set up between two of the production phases.

Below, the block co v.1 is first presented as a general characterization of the bifacial block chaîne opératoire (Figure 13). We then discuss how the other version, block co v.2, differs from this general description.

Block chaîne opératoire version 1 (block co v.1) Phase 1 is a blank. The knapping starts with a raw or slightly worked block, pebble or 'block-like' flake. It seems as if elongated pieces were preferred. From phase 1 to phase 2a, the piece is worked into a distinct shape, clearly showing the intentions of the knapper in making a point. Several negative removal scars on the surface are detached, using away from edge knapping (non-marginal percussion). The worked piece is clearly bifacially knapped, with two flat faces that meet in two edges in the direction of the length.

From phase 2a to phase 2ab, the piece is worked into a preform shaped as a point. This is achieved by detaching invasive surface-covering negative flake removals, and using away-from-edge (non-marginal percussion) as well as on-edge (marginal percussion) knapping. Several of the flake removals reach over the length axis of the point. The edges are kept regular. The preform is large, compared with the finished points, but the proportions between length, thickness and width show the intention of the knapper to reduce the preform to a point.

From phase 2ab to phase 2b, a point with a clearly shaped form with well-balanced proportions is formed by marginal percussion. The tip and the base are defined and the edges are made pronounced and stable. Several invasive surface-covering flakes are knapped, reaching over more than half of the two faces of the point. The point looks like a finished point, but lacks the final retouch on the edges and the tip.

From phase 2b, the final retouch on the edges and the tip gives a phase 3 finished point.

Block chaîne opératoire version 2 (block co v.2) The significant difference between block co v.1 and block co v.2 lies in how the reduction is set up, going from phase 2ab to phase 2b. In block co v.2, the symmetry of the bifacial point is totally altered and the edge lines of the biface changed. This is clearly illustrated on one of the points, r225 in Figure 7n–q, from HRS. This preform is a symmetric point, worked by on-edge (marginal percussion) knapping with invasive surface-covering negative flake removal scars reaching over the

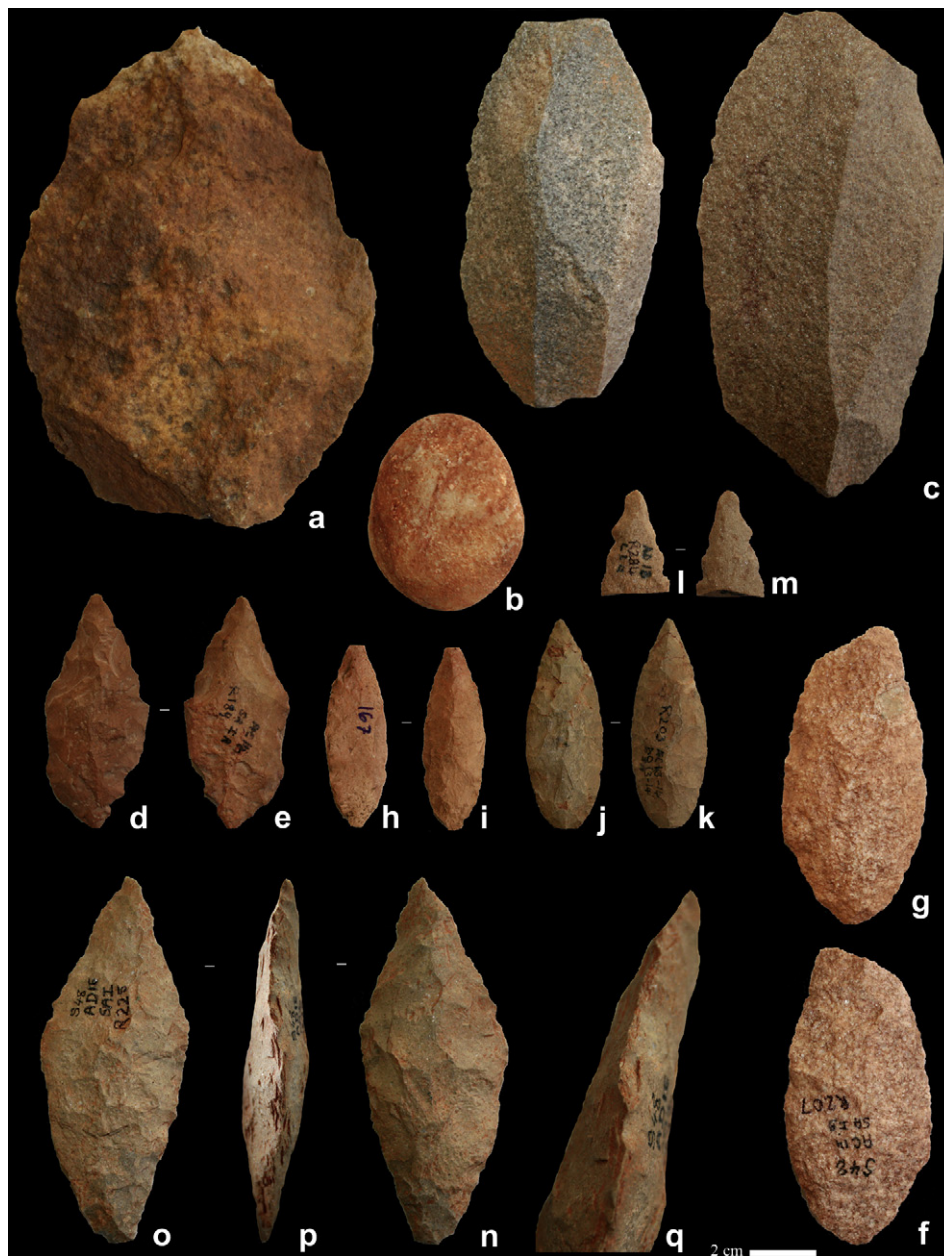


Figure 7. Still Bay points from Hollow Rock Shelter in different phases of production. A large, slightly worked quartzite blank, a quartz pebble and two quartzite flake blanks, all in phase 1, a–c. Point r189 is in phase 2a. It is cracked by heat. There is nothing on the piece to show why it was not knapped into a phase 2ab preform. The worked piece shows no knapping mistakes, d–e. Point r207 is in phase 2ab. The tip of this preform was broken off during knapping. It could still, however, have been knapped into a phase 2b point, f–g. Point L167 is a phase 2b point. It just needs a final retouch on parts of the edge and the tip, h–i. Point r203 is a finished phase 3 point, j–k. Point r284 is the distal part of a reworked phase 4 point, l–m. Point r225, n–q, is in the same phase as r207, but has, as can be seen in p–q, a few negative removals made by the tip that created the form the tip has in Villa et al.'s definition of phase 2b (Villa et al., 2009, Table 3). This is an example of a point which makes it reasonable to establish a phase between Villa et al.'s phase 2a and phase 2b. We have called this phase 2ab. Note that q is a close up and not to scale. Photo: Anders Högberg.

length axis of the point. The preform has the phase 2ab proportion, showing that it can be worked into a phase 2b point. Knapping by the tip has been started to shape the preform into a phase 2b point. However, it has been done in a way that differs radically from the block co v.1 chaîne opératoire. The knapping has not been done with on-edge knapping (marginal percussion) using all four available platform sides. Instead, the preform has been knapped slightly away from the edge (non-marginal percussion) using only two sides as platform (Figure 14). This strategy has given the preform totally a new look. As seen on preform number r225, it appears twisted, but when completed the preform will have been knapped into a balanced phase 2b point.

This reduction strategy has to our knowledge never been described before for SB points. It has some similarities with, but is not identical to, the way Scandinavian Late Mesolithic bifacial flint core axes were produced, where a thick bifacial tool is formed with knapping away from the edge (non-marginal percussion), which first alters the edge line of the bifacial tool and then is stabilized with small flake removals, creating a straight edge line between the two faces of the tool. The point r225 has been interpreted in a previous study (Minichillo, 2005) as evidence that SB points were resharpened in their haft. As mentioned earlier, our study does not support this interpretation. The chaîne opératoire analysis performed here shows that the form of the point r225, as seen in

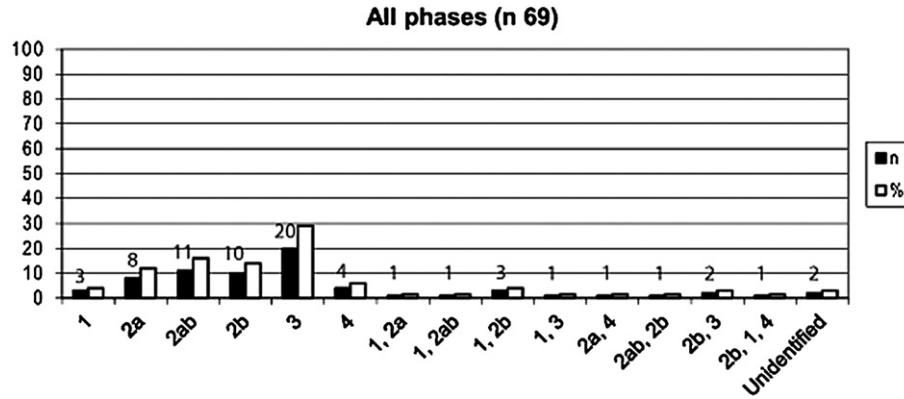


Figure 8. All of the Still Bay points from Hollow Rock Shelter defined according to different phases of production from Table 5, in number and percentage. The bar with two or more phases defined are Still Bay points that show different phases of production on the two faces of the point or on different areas on the point.

Figure 7n–q, can be interpreted as a consequence of the reduction strategy used in the production of SB points.

The unifacial flake chaîne opératoire The unifacial flake chaîne opératoire is a quite different approach from the two versions of the block chaîne opératoire, but results in an SB point morphologically similar to those knapped within the block chaîne opératoire. The unifacial flake chaîne opératoire starts off from a flake blank. This flake blank is generally knapped with the ventral side as a platform, with flakes running up over the dorsal side. The ventral side of the flake blank is left unworked far into the reduction process. This has the result that some of the preforms show knapping on the dorsal side that can be described as having progressed to phase 2b, while the ventral side shows knapping that can be described as only having reached phase 1 or 2a (see Figure 15). Three finished SB points from HRS (r147, r246 and r333) actually have not been knapped at all on the ventral side (Figure 15c). This technological approach is the reason that we call this strategy of producing SB points unifacial, even though the term unifacial is somewhat ambiguous. We use the term only to describe a reduction strategy, not as a typological classification.

The flake blank needs to have a long coherent dorsal ridge running from the platform to the distal part. The flake blank must also have an even curvature. The platform of the flake blank will be the base of the finished SB point (Figures 15d and f; Figure 16), which has also been noted on SB points from Sibudu Cave (Wadley, 2007).

The flake blanks were produced from a large core with faceted platform and a straight front that had several previous negative removals. In a study of the lithic assemblages from Blombos Cave, Henshilwood et al. (2001) noted that the flakes used for blanks for

the SB points were struck from cores with little preparation. The production technology for these flake blanks, however, should not be mistaken for simple or random. Since the form and shape of the dorsal ridge as well as the thickness and curvature of the flake blank are important technological prerequisites for producing an SB point, the core for producing these blanks must have been specialized for this purpose (see Högberg, 2009). This means that a specialized technology existed for producing flake blanks to be used for the production of SB points.

Flake blanks may have been introduced to the site ready-made, since there are no cores present from the production of flake blanks. However, studies of specialized flake blank production during the Scandinavian Late Bronze Age have shown that the presence or absence of cores can be inappropriate indicators of production, since they have been used for further knapping and therefore are difficult to recognize (Högberg, 2009). Since a chaîne opératoire analysis of the flake blank production is not included in this study, it is difficult to say anything with certainty about whether flake blanks were introduced to the site or not.

There are a few preforms that indicate the presence of an additional reduction strategy. This is a knapping strategy that is similar to the unifacial flake chaîne opératoire, but with the difference that it starts from a block or pebble, not a flake blank.

Gentle retouch, using pressure From the description of the knapping phases within the three chaînes opératoires, it is clear that the production of the SB point from HRS included some sort of fine retouch in the final phase. This fine retouch was conducted using a small tool with a fine tip, which was pressed, not hit, on to the edge. It is not an advanced parallel pressure-flaking technique as described for example by Kelterborn (1984). It can better be

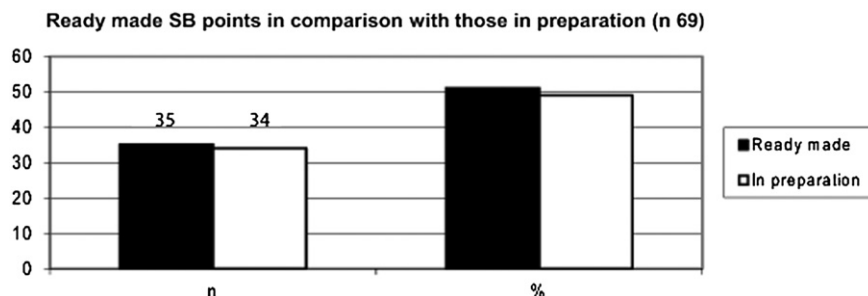


Figure 9. All points of phase 3, i.e., finished (except r246, which is a point that needs the final trimming of the tip, all points of phase 4, except point PID 419, which is a preform that has been badly knapped afterwards, one phase 1,3 and one phase 2b, 1,4) in comparison with all points of other phases, i.e., in preparation.

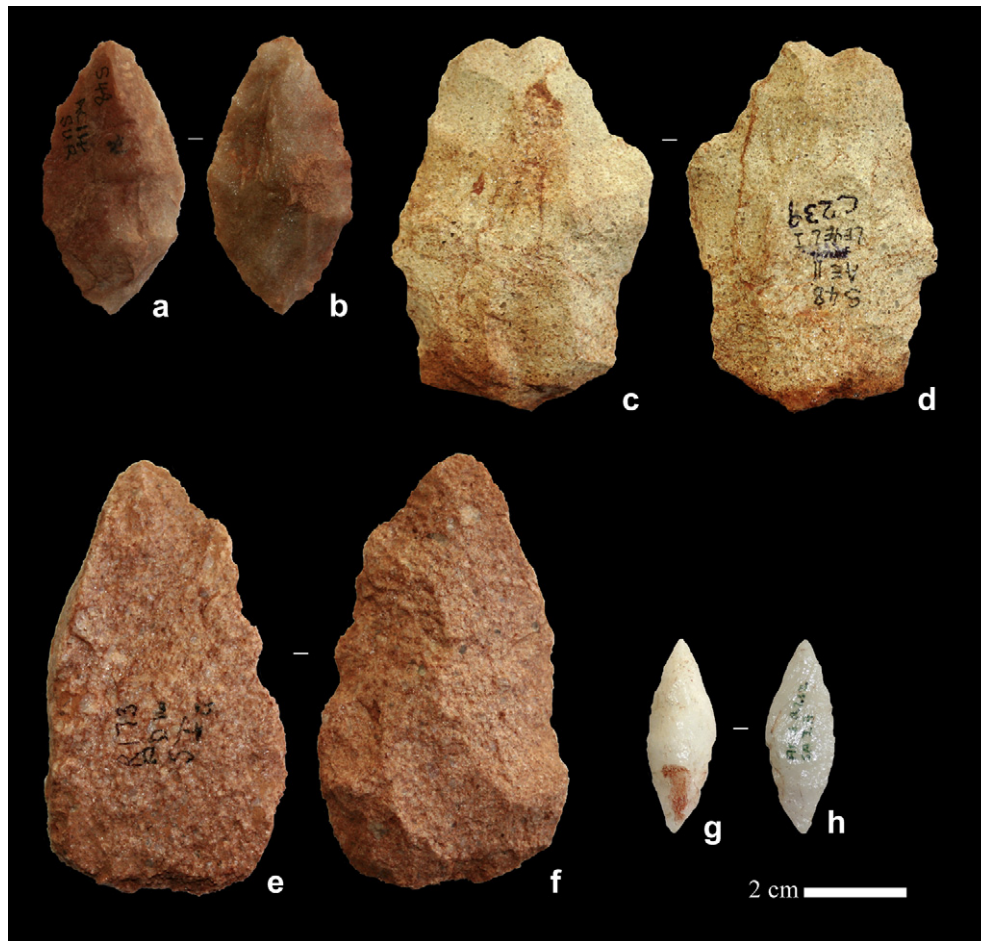


Figure 10. Whole points in different phases of production that have been left at the site. Whole points in phases 2a, 2b, 3 and other combinations of phases together with the presence of blanks – blocks, pebbles and flakes – show that points in different phases of production were left behind at the shelter together with blanks of various shapes. All of these points are or can be made into finished points, i.e., phase 3 points. Point r1 is a preform knapped into phase 2a on one side, a–b. Point C239 is a phase 2a preform, c–d. Point r173 is a phase 1 point on one side and a phase 2a on the other, e–f. Point r262 is knapped into a phase 3 point on one side and with only a few removals on the other side, g–h. See also Figure 7 for other examples of whole points left at the site. Photo: Anders Högberg.

described as a gentle retouch, using more pressure than hitting. Pressure flaking on points from Blombos Cave has also been reported (Mourre et al., 2010).

Which chaîne opératoire was the most common? It is clear from the above analyses that it is not possible to calculate how many of the SB points from HRS were made in each chaîne opératoire. The reason for this is that, even if the different chaînes opératoires differ in reduction strategies, they result in SB points that may look the same. Yet the analyses also show that there are attributes, which if the manufacture did not make the points look completely similar, can give indications of the chaîne opératoire that was used. These attributes are cross-section, ridge, blank, and bifacial or unifacial, (see Table 2). These attributes are presented above in Figure 6a–d, which shows that 57 points were knapped bifacially and nine unifacially, 42 points have been evaluated as made out of a block or pebble and 24 as made out of a flake blank, and as many points have lenticular as D-shaped cross-section, and 24 of the points have a ridge on one of the broad sides. None of these attributes alone is characteristic of any of the three chaînes opératoires, and the comparisons of the attributes in Figure 6 provide no answers as to how many points were made within each chaîne opératoire. At present, we see no way to investigate this. It may be observed, however, that the comparisons in Figure 6 at least provide indications that the three chaînes opératoires were used to such

an extent that they have made an imprint on the attributes of the points.

The manufacture of Still Bay points at Hollow Rock Shelter: summary The manufacture of SB points at HRS was conducted in different ways. Several strategies and chaîne opératoire approaches were used, all ending up in a typologically uniform implement. The results indicate that the manufacture of SB points should be regarded as a very special bifacial technology, only partly comparable with other well-investigated bifacial technologies, for example the manufacture of North American Paleoindian points (Whittaker, 1994) or Scandinavian Late Neolithic daggers (Apel, 2001). The results also show that bifacially knapped tools do not always automatically follow what has been established in lithic research as a general and idealized description of a bifacial knapping and reduction strategy (Andrefsky, 1998; Hayden and Villeneuve, 2010).

Flake attribute analysis

Studies based on experimental knapping as well as thorough studies of prehistoric lithic assemblages have shown that flakes coming from bifacial knapping have several characteristic attributes unique to that mode of knapping. Similarities as well as variations between and within different assemblages are well known (Whittaker, 1994; Högberg, 1999; Apel, 2001). However, since few

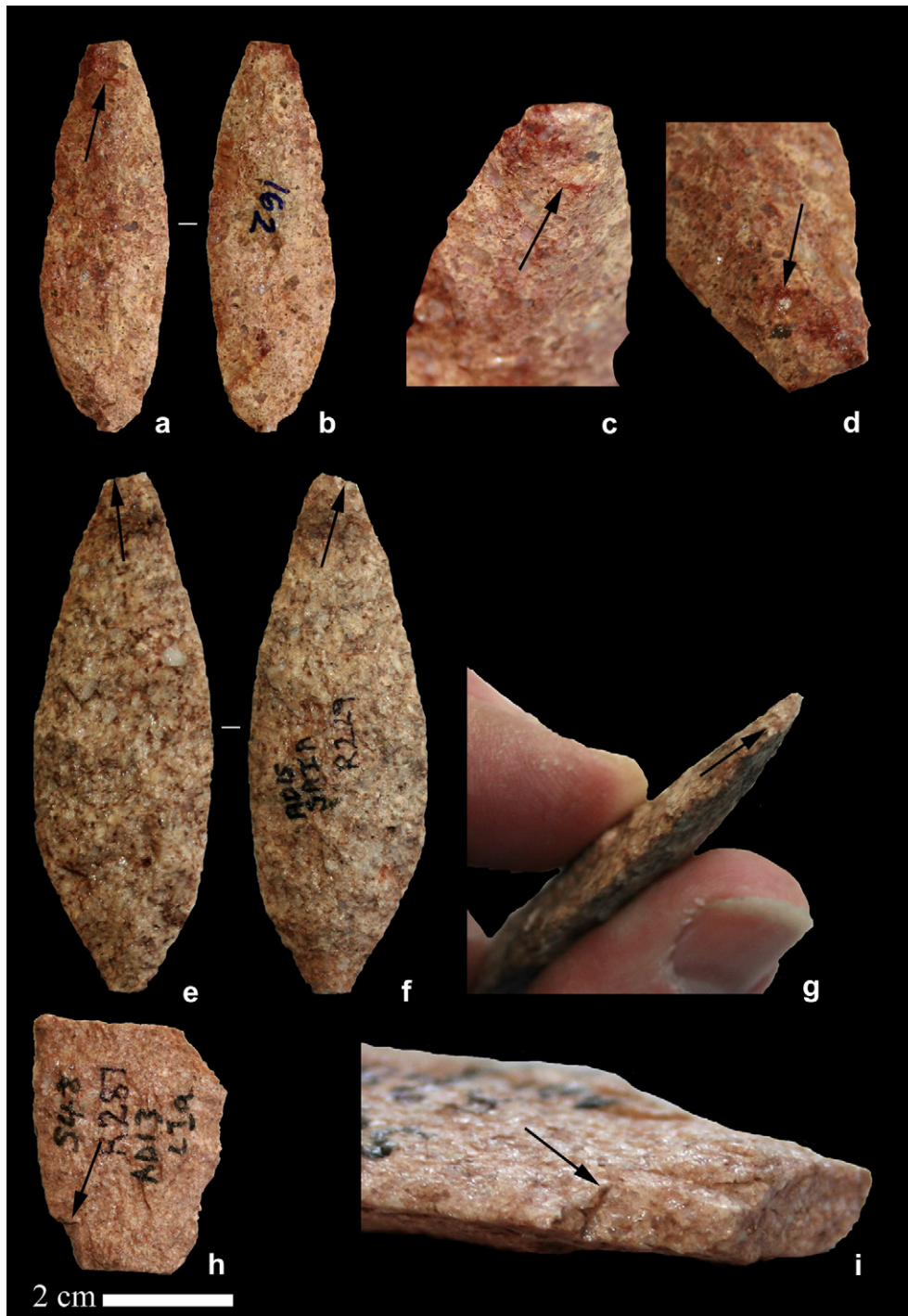


Figure 11. Still Bay points from Hollow Rock Shelter with impact damage or hafting traces. L162, a–d, and r229, e–g, are phase 3 points, both with the tip missing. Both points have a characteristic hinge by the tip, shown in the close-ups, interpreted as impact damage. Point r287 is a phase 3 base fragment with a burin spall interpreted as hafting traces, h–i. Note that c, d, g and i, i.e., the close-ups, are not to scale. Photo by Anders Högberg.

technological or experimental studies on the production of SB points have been published (see Soriano et al., 2009; Villa et al., 2009), and no experimental analysis is included in our study, the variations in the characteristics of the bifacial flakes resulting from the production of SB points are not well known. Therefore, we have chosen to register only what we see as very typical bifacial flakes (see Whittaker, 1994) from the HRS assemblages. These are on-edge bifacial thinning flakes with a small platform as well as away-from-

edge thinning flakes with a somewhat larger platform. Both types of flakes have a platform angle (angle de chasse) of $55 (\pm 10)$ degrees, a diffuse bulb of percussion and a curved shape and two or more negative removals on the dorsal side (Whittaker, 1994; Högberg, 1999; Apel, 2001; Soriano et al., 2009), all attributes diagnostic for bifacial thinning flakes. The flakes can be broken, but the proximal and middle part of the flake must be present to be registered. This means that several distal parts of flakes present

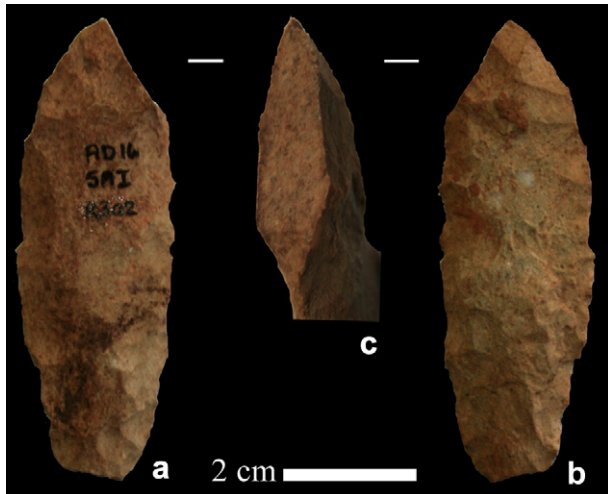


Figure 12. Point r302, Figure 13a–b, is a phase 2b point with a characteristic break from a bending (snap) fracture, close-up in Figure 13c, interpreted as a production failure. Note that close-up c is not to scale. Photo: Anders Högberg.

in the HRS assemblage, which probably come from bifacial knapping, are not included in the study. Flakes that show these attributes and are defined as coming from bifacial knapping have been registered according to the attributes defined in Table 6.

A total of 249 flakes from HRS are characterized here as flakes derived from bifacial knapping (see also Minichillo, 2005). Almost 90% (222) of the bifacial flakes are larger than 2 cm. Debris is present in all squares and layers if it was collected during the excavation. Virtually all of the bifacial flakes, on edge as well as in from the edge and hard hammer as well as soft hammer, have a lip on the transition between the platform and the ventral side. All of the flakes that show a trimmed platform were knapped on edge (marginal percussion) (Figure 17).

The result of the flake analysis shows that part of the flake assemblages from HRS is waste material from bifacial knapping, i.e., from manufacture of SB points. Debitage from SB point manufacture

has previously been reported from Blombos Cave and detailed analysis of these flakes is planned (Villa et al., 2009), but not published. There is no published debitage analysis from Sibudu Cave (Wadley, 2007). It is important to point out that the purpose of this study on flakes from HRS is merely to establish whether bifacial knapping took place at the site, not to quantify or estimate the intensity of the bifacial knapping performed at HRS.

Raw material

The definition of different raw materials used here follows the classification of Evans (1994), divided into quartzite, silcrete and quartz. Of the 69 SB points from HRS, 32 are made of quartzite, 27 of silcrete and 10 of quartz. As previously mentioned, quartz and quartzite are available on site, while silcrete is not (Evans, 1994; Roberts, 2003; Porraz et al., 2008). Of the 249 analysed bifacial flakes from HRS, 204 are of quartzite, 36 of silcrete, seven of quartz and two of a raw material not definable. In the HRS lithic assemblage, blades made of hornfels occur (Evans, 1994). This raw material was not used for the SB points from HRS.

The result of the raw material analysis shows that points made of quartzite and silcrete are about equally common in the assemblage, and that the majority of the bifacial flakes analysed (81.9%) are of quartzite. The difference in the choice of raw material the points are made of, and the raw material that is shown by the bifacial flakes to have been knapped on the HRS site, indicates that SB points made out of silcrete to some extent were brought to the site, while quartzite and quartz SB points were manufactured on site, most likely out of the locally available raw material on site.

Compared with other sites, we can see that the raw materials used for the production of SB points vary. At Blombos Cave, silcrete is the most common material used (71.7% of the points), followed by quartzite and quartz (Villa et al., 2009). At Sibudu Cave, dolerite dominates. This material is available near the site. Other materials used there are quartz, quartzite and hornfels (Wadley, 2007).

It is obvious that there is variation in raw material usage for SB points and that locally available raw material was important for manufacturing SB points. It is also likely that SB points to some extent were transported and brought to sites.

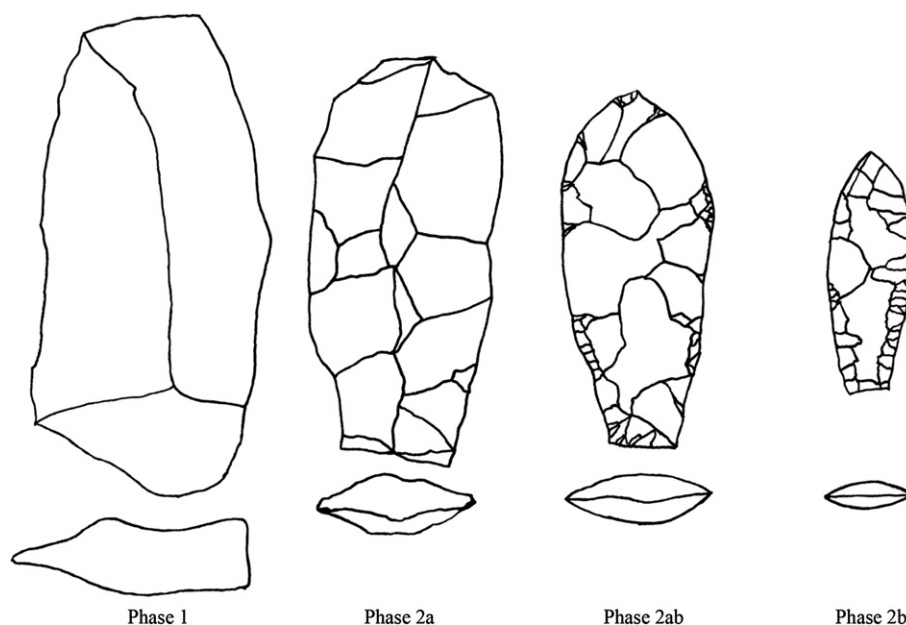


Figure 13. Schematic illustration of the block co v.1 chaîne opératoire, from phase 1 to phase 2b. Phase 3, i.e., the finished point, is not included in the illustration.

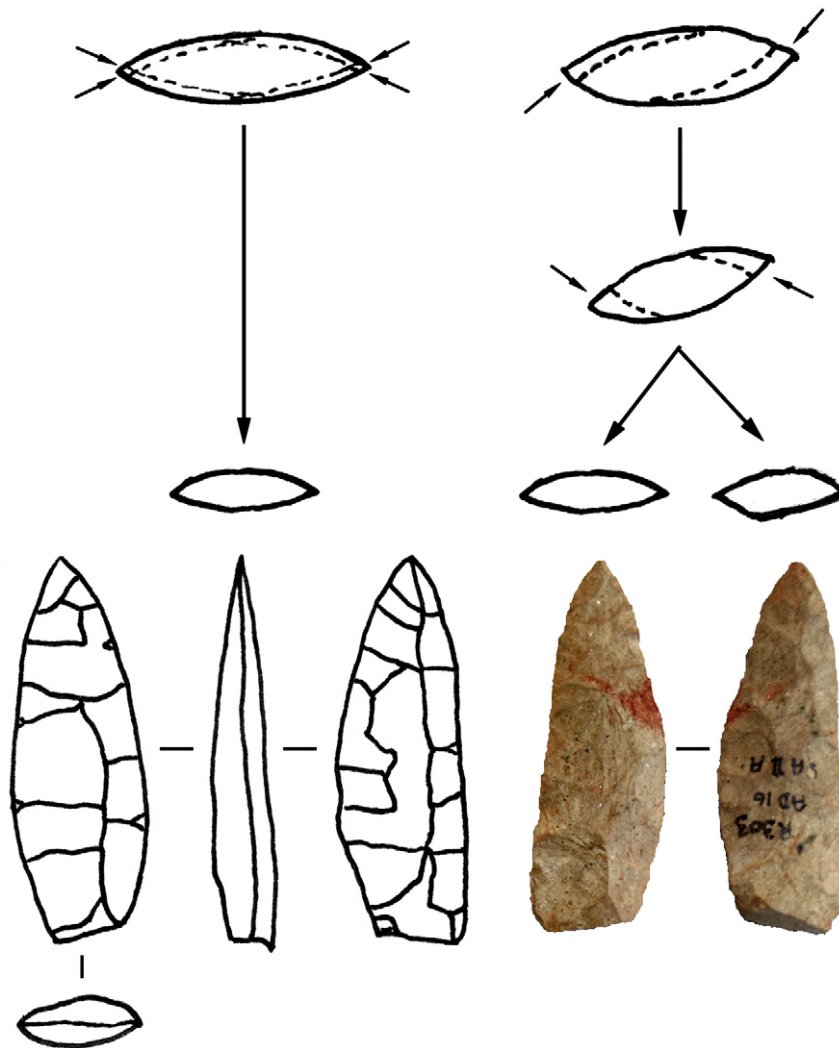


Figure 14. Schematic illustration of how the reduction from phase 2ab to 2b is handled in the two different versions of the bifacial block chaîne opératoire, i.e., block co v.1 and block co v.2, illustrated with cross-sections. To knap a phase 2ab preform into a phase 2b point according to block co v.1, you need to reduce the piece with on-edge (marginal percussion) knapping from four platforms, to the upper left in the figure. In this way you will reduce the thickness and width in a manner that controls the cross-section, the shape of the piece and the line of the edges. If you knap a phase 2ab preform into a phase 2b point according to block co v.2, you use away-from-edge (non-marginal percussion) knapping from two platforms, to the upper right in the figure. Doing so, the symmetry of the piece is changed and two new edges are created. The lenticular cross-section will change into a rhombic biconvex cross-section. To stabilize the edges and to re-create the lenticular cross-section, the edges are slightly retouched. If the lenticular cross-section is fully re-created in a phase 3 point, it is impossible to tell from that phase 3 point whether it has been knapped with a block co v.1 or a block co v.2 reduction strategy. However, if the cross-section still keeps some of its rhombic biconvex cross-section when the piece is knapped into a phase 3 point, then the block co v.2 can be distinguished from the block co v.1. This means that since block co v.2 can result in the same kind of phase 3 point as block co v.1, the block co v.2 can be difficult to discover. Either the assemblage needs to contain phase 2ab preforms or 2b points, or points like number r303, which is shown in the bottom line of the figure with a sketch and photographs. On this point one can see clearly how the use of the block co v.2 has given a rhombic biconvex cross-section. It is also evident how the use of only two platforms has caused a shift towards the edge of the ridge formed by the meeting of flake scars on either broad side.

Heat treatment to improve the flaking qualities of raw materials has been discussed for the manufacture of SB points (see Villa et al., 2009; Mourre et al., 2010 for an overview). We have not seen any evidence of heat treatment on points or in the flake assemblage from HRS.

Technological analysis of Still Bay points and bifacial flakes: summary

A total of 69 registered SB points from the 1993 and 2008 excavations were analysed, including broken, complete, discarded or used blanks, preforms and points in different phases of production, giving new results about the manufacture and management of SB points.

The results show that SB points from HRS are standardized tools in size and form, produced with a regulated width and thickness ratio. The fragmentation degree is high. Approximately 80% of the SB points are broken. The SB points in the assemblage from HRS consist of a complex mixture of whole and fragmented points in all phases of production. The presence of bending fractures shows that several of the points were discarded due to production failures. Ten points show some kind of impact damage or hafting traces, indicating that used points were left in the cave. This illustrates that the production of points as well as replacement of used points took place at the site. Several of the preforms and points in different phases of production left at the site could have been made into finished points. They were thus not rejected for reasons of manufacturing technology. This indicates that preforms and points

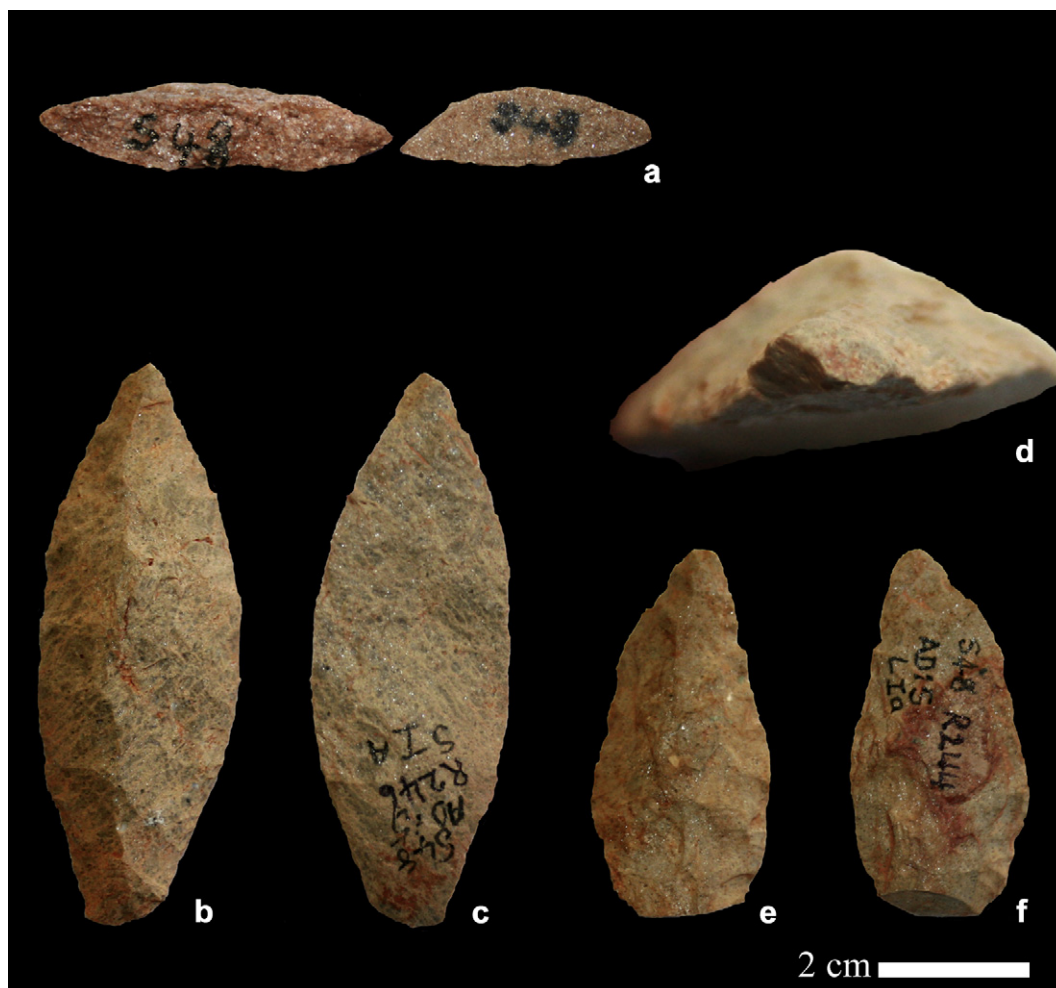


Figure 15. The reduction strategy for the unifacial flake chaîne opératoire gives a lying D-shaped cross-section, to the right in a, compared to the block chaîne opératoire, which as been described above, gives a lenticular or rhombic lenticular cross-section, to the left in a. The production within the unifacial flake chaîne opératoire starts with knapping using the ventral side of the flake blank as platform. The flakes run over the dorsal side of the flake blank, ending up against the dorsal ridge of the flake blank. This has the effect that the finished SB points knapped with the unifacial flake chaîne opératoire often have a ridge on one face, Figure 15b, placed in the area on the broad side of the point which originally held the dorsal ridge on the flake blank. A bit into the reduction process the preform is turned over and surface-covering flakes are knapped, extending over the originally ventral side of the flake blank. The edges are then stabilized and the point is finished. Some points are made in a set-up which seems to alternate more than once between knapping on dorsal and ventral side. Some finished SB points actually have not been knapped on the ventral side at all, c. Even though this is a technological approach which radically differs from a general bifacial knapping technology, the end result is an SB point which, regarding size and form, does not differ typologically from points manufactured within the block chaîne opératoire. Point r246, b–c, has not been knapped at all on the original ventral side of the flake blank. A clear ridge is present on the knapped surface, b. A close-up of the base of the point shows clearly that this is the original platform on the flake blank which the point was made of, d. Point r244, e–f, is worked on both sides. This point also has a clear ridge on the side that originally was a ridge on the dorsal side of the flake blank. On the photo of the other side, f, the former platform on the original flake blank is clearly visible at the base of the point. a and d are close-ups and not to scale. Photo: Anders Högberg.

in different phases of production were left at the site, most likely for future preparation.

The points were produced within the framework of three different chaînes opératoires; two versions of a bifacial block chaîne opératoire and an unifacial flake chaîne opératoire, all ending up in a typologically uniform tool. This results show that the manufacture of SB points should be regarded as a special bifacial technology, only partly comparable with other bifacial technologies. A specialized technology existed for producing flake blanks to be used for the production of points within the unifacial block chaîne opératoire. Our study is influenced by the Blombos Cave study, which in turn is influenced by previous studies of North American Paleoindian bifacial points. “We do not imply that Paleoindian points are in any way formally homologous to the Blombos points, only that certain aspects of their manufacturing and impact breaks allow us to make reasonable inferences about the Blombos points, using relational analogies” (Villa et al., 2009: 444). The results of our

study show that the caution expressed by Villa et al. (2009) in the quotation above is important to bear in mind in future technological studies of SB points (see also Smallwood, 2010 for a discussion on variation among Paleoindian points). The variation in the manufacture of the points that our analysis has revealed shows that the Still Bay bifacial knapping technology should be assessed and analysed on its own terms, rather than in relation to a generally accepted picture of what bifacial technology looks like (see Soressi and Dibble, 2003 for similar discussions).

In summary, the results of the technological study give a complex picture of the way SB points were handled at the HRS site. Production, use, deposition, raw material utilization, different manufacturing strategies, points in different phases of production left behind at the site, and curation of the weapon in which the SB points were hafted – these were all elements of what happened there. The fact that several chaînes opératoires were used for the manufacture reveals that there was experimentation with different

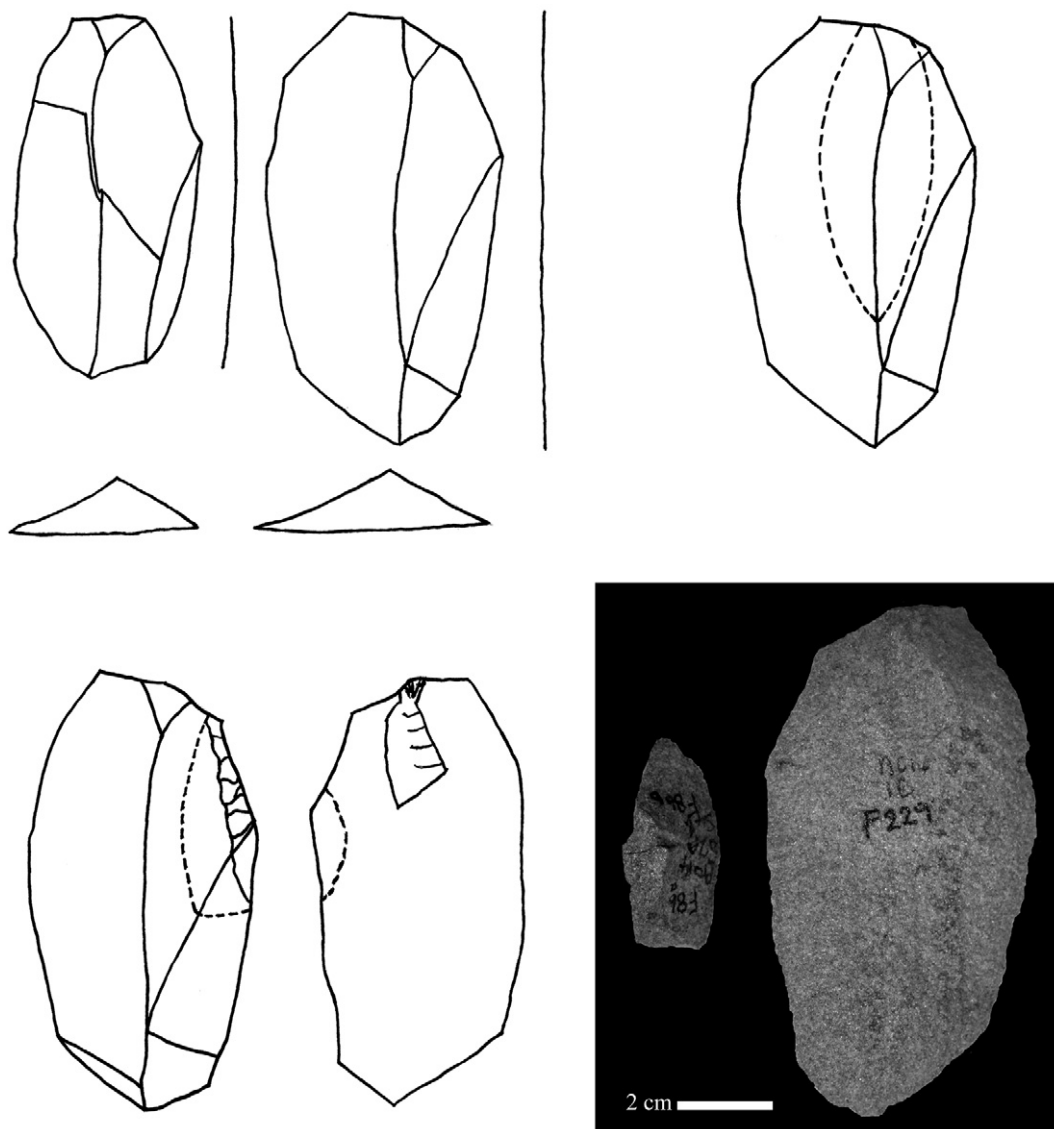


Figure 16. Two flake blanks from Hollow Rock Shelter for the production of Still Bay points (SEV 48 3/2/93 AC14 Sand IIA and SEV 48 3/2/93 AC14), to the upper left, showing the shape and outline of a typical flake blank used in the unifacial flake chaîne opératoire, and, to the upper right a flake blank (SEV 48 3/2/93 AC14 Sand IB) with a Still Bay point, r203, sketched into the blank. Note that the base of the point is the platform of the flake blank and that the dorsal ridge on the flake blank running from the platform to the distal end is present on the final Still Bay point as a ridge created by the meeting of the distal part of several flake negative removals. A flake blank with a flake from the knapping of the ventral side sketched in shows the position of a flake from the initial knapping of a flake blank, bottom left, and a photo of a flake blank together with a flake from the initial knapping, bottom right. See also Figure 7 for a photo of point r203 and photos of flake blanks. Photo: Anders Högberg.

reduction strategies. Even though these strategies differed, they resulted in points with a similar morphological appearance. We will bear these results in mind in a concluding discussion of behavioural modernity at the HRS site.

Discussion

Behavioural modernity at Hollow Rock Shelter

Behavioural modernity is a key question concerning the behavioural development of anatomically modern humans. The definition of how and when behavioural modernity appeared, and the relationship between behavioural modernity and anatomical modernity is controversial (Nitecki and Nitecki, 1994; Klein, 1995, 2000; Mithen, 1996; McBrearty and Brooks, 2000; Gärdenfors, 2003; Henshilwood and Marean, 2003; Soressi, 2005; Mellars

et al., 2007; Henshilwood, 2007; Zilhão, 2007; Wurz, 2008; Botha and Knight, 2009; Henshilwood et al., 2009; Marean, 2010). Differences among studies are usually due to different assumptions about the definition of behavioural modernity and how it can be detected in archaeological material culture. Some scholars think that the existence of behavioural modernity in present-day South Africa should be sought as far back in time as 250,000 years ago, while others believe that it arose about 80,000 BP or as late as in the 40,000 to 50,000 range (for a discussion see Klein, 1995; McBrearty and Brooks, 2000; Henshilwood and Marean, 2003; d'Errico and Backwell, 2005; Mellars et al., 2007; Lombard et al., 2008). Recent research stresses that the development of behavioural modernity should be understood as a complex interaction of a great many variables. Geological, climatic and environmental changes, in combination with changes in people's biological, social and cultural circumstances, have been highlighted as important factors to study

Table 6

Attributes used in the analysis of the bifacial flakes from the Hollow Rock Shelter assemblage.

Attribute	Definition, specific for this analysis
On edge (marginal percussion)	Flakes with a platform that is 2 mm or less in thickness
Away from edge (internal percussion)	Flakes with a platform that is more than 2 mm in thickness
Flat platform	A platform without ridges or traces of a negative bulb of percussion
Facetted platform	A platform with ridges or traces of a negative bulb of percussion
Hard hammer	Flakes with a broken line between the platform and ventral side of the flake
Soft hammer	Flakes with a smooth line between the platform and the ventral side of the flake
Trimmed platform	Marks from abrasion on the edge between the platform and the dorsal side of the flake
Big flakes	Flakes larger than 2 cm
Small flakes	Flakes between 2 and 1 cm
Debris	Flakes smaller than 1 cm

Since not all attributes are present on every single flake, the total number of registered flakes per attribute differs from attribute to attribute. A hard hammer would be made of hard stone or hard wood. No antler is present in the fauna, so a soft hammer would be made of wood, bone or a soft stone. Soriano et al. (2009) have in a study of flakes from Sibudu Rock Shelter suggested that ochre nodules were used as both abraders and hammers in the production of Still Bay Points (Soriano et al., 2009).

(Henshilwood, 2007; Lombard et al., 2008; Parkington, 2010). Several studies published in recent years have also stressed the importance of viewing the development of behavioural modernity as something that may have taken place gradually in a variety of ways at different places over a long time (Mellars et al., 2007). Our

goal is to apply a sociotechnical perspective to discuss behavioural modernity at one such site, HRS, over a limited period.

There is no common agreement on how behavioural modernity is recognized in the material culture (Henshilwood, 2007; Wynn and Coolidge, 2007; Henshilwood and Dubreuil, 2009). We make no claim here to date or define the introduction of behavioural modernity. Instead we discuss aspects of social and technological behaviours expressed at HRS, which we find relevant for a broader discussion on behavioural modernity. This is done on the basis of the data on lithic technology strategies at HRS that we have presented. Our ambition is to discuss aspects of social interaction, knowledge and know-how, learning strategies and landscape memories. Based on this discussion, we present a few hypotheses as to how these issues can be a springboard for future research on behavioural modernity. We are aware that there are other lines of evidence for behavioural modernity in the material culture than SB points during the Still Bay phase, for example worked ochre (Henshilwood and Dubreuil, 2009; Henshilwood et al., 2009) also present at the HRS (Evans, 1994). However, in this study we have chosen to focus only on sociotechnical aspects of SB points and behavioural modernity.

Social interaction The ability to translate intelligence, imagination and social interaction into technology has had an essential impact on human development (Donald, 1991, 2001; Brain, 2005). The production of knapped stone artefacts in all of their varieties has exerted a major formative influence in human evolution (Roux and Bril, 2005; Stout, 2005; Csibra and Gergely, 2011), and several studies have discussed the rise of behavioural modernity as intimately linked to knapped stone and the Still Bay industry (Lombard et al., 2008).

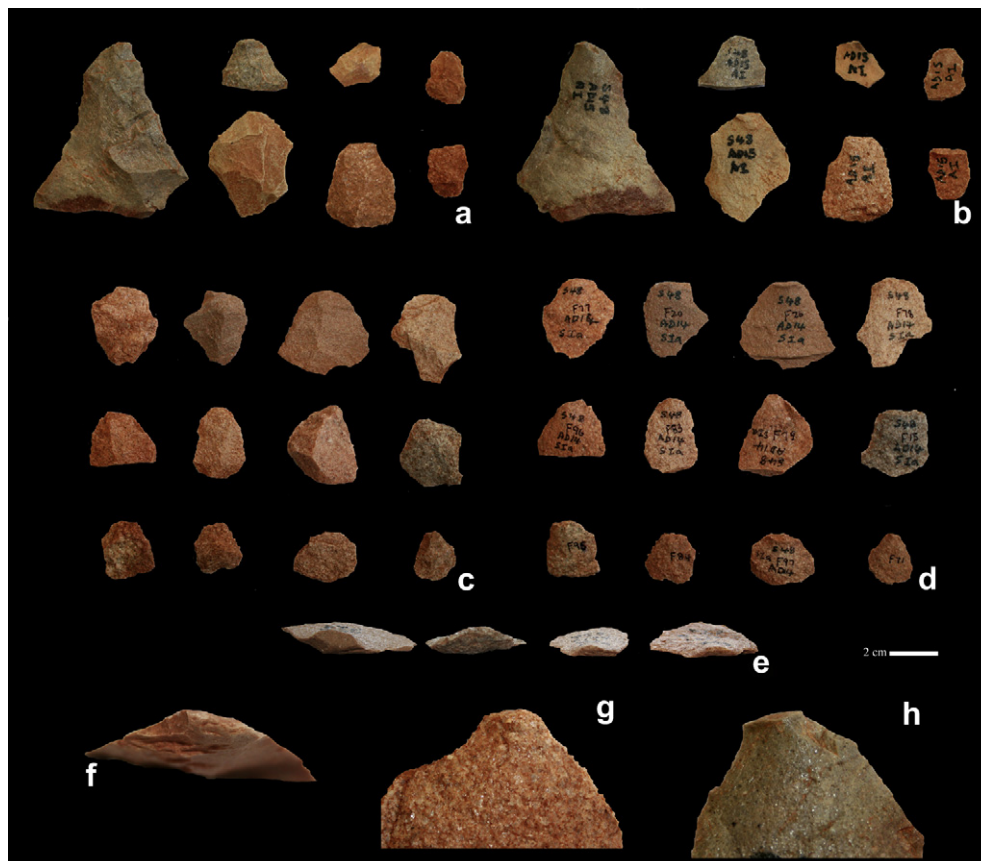


Figure 17. Bifacial flakes from the Hollow Rock Shelter assemblage, dorsal and ventral sides, a–d, and four flakes seen from the platform side, e. Close-ups of a typical trimmed and abraded platform, f, a platform with a lip on a flake of coarse quartzite, g, and one of silcrete, h. f–h are close-ups not to scale. Photo: Anders Högberg.

Recent research in neuropsychology has clearly shown that genetic influences on human behaviour are not something fixed and predetermined from birth: “Genetic and environmental influences on behaviour are *absolutely inextricable*, and genetic influences are therefore anything but immutable” (Solms and Turnbull, 2002:218, original italics). This means that nature and nurture (note that by nurture here we are chiefly referring to social environment or culture) work in dynamic interaction in regard to the way that the behavioural parts of the brain evolve. The human mind, i.e., the mind itself not merely particular experiences, cannot come into existence on its own. It is wedded to a collective process, and filtered through culture and the social environment (Donald, 2001; Singer, 2006). The intimacy of the link between genetic and environmental influences varies for particular periods in the developmental process, and the years up to the age of 13 are particularly crucial for how the behavioural parts of the brain develop (Solms and Turnbull, 2002).

This means that behavioural modernity can be discussed as something that emerges gradually in anatomically modern humans, not in a linear and irreversible evolutionary development by leaps, but as a behavioural development shaped in social interaction between nature and nurture (Donald, 2001; Zilhão, 2007; Mithen and Parsons, 2008). This interaction is based on the brain’s genetic ability to be shaped behaviourally by the environment and its increased complexity in relation to social interactions. As long as the complexity is maintained, the brain’s behavioural function develops, and as long as the brain is stimulated in this respect, there is also a potential for the complexity of the behaviour in the surrounding environment to be maintained and extended: “The maturational sequence of the expression of genes in brain cells is associated with spurts in the production of synapses at different sites in the nervous system at different times. During these periods [i.e., up to the age of 13] of rapid growth, many more connections are formed than will ultimately be used. The environment that the brain finds itself in at these critical times will determine which connections are used (are activated) and therefore which will or will not survive. Those that are not activated sufficiently are “pruned” from the maturing structure. During these critical periods, therefore, maturing brain structures are particularly sensitive to environmental influences” (Solms and Turnbull, 2002: 222). The consequence of this reasoning is that if the interaction between the brain’s behavioural functions and the environment changes, the complexity of human behaviour can also change (Mithen and Parsons, 2008), which may perhaps explain the fact that behavioural modernity, as reflected in material culture, seems to disappear in the southern African late MSA record, not to reappear until the LSA (Henshilwood, 2007; d’Errico and Vanhaeren, 2009; Parkington, 2010). This means that, even if the development of behavioural modernity can be interpreted in a long-term perspective as linear, from premodern to modern people, the process should not necessarily be regarded as cumulative or linear.

By changing the social environment, each generation changes the brains of the next (Mithen and Parsons, 2008). Since humans up to the age of 13 are especially sensitive to environmental influences, it is consequently important to focus on children and young people in a discussion of behavioural modernity at HRS (for discussions of the complex concepts of children and childhood see Kamp (2001) and, in a lithic technology perspective, Högberg, 2008).

One of the strongest environmental influences that shape a child’s behaviour is social interaction through learning processes. If we assume that behavioural modernity goes hand in hand with some form of change in the production of synapses and maturing brain structures (Solms and Turnbull, 2002), then children’s learning processes, in the light of the discussions about nature and nurture, are essential to study (Mithen and Parsons, 2008).

Social interaction is a powerful catalyst for learning (Vygotsky, 1962; Meltzoff et al., 2009). At the same time, learning is an important part of social interaction (Schwartzman, 1978; Lillehammer, 1989; Sofaer Derevenski, 2000; Kamp, 2001). Consequently, what children know and do is a product of their own understanding, as well as an interaction in the social life with more experienced and versed members of the community of which the child is a member (Wood, 1998; Sofaer Derevenski, 2000; Kamp, 2001). In the identification of the interplay between children and adult activities, conditions exist for the study of fundamental manifestations of how a society develops its sense of community through world views, cultural patterns and basic cultural themes (Högberg, 2008).

Below we discuss learning strategies and social interaction based on the technology of manufacturing SB points at HRS. To be able to do this, we must discuss what the traces of learning can look like. This is done first on the basis of the terms knowledge and know-how, after which we discuss two different learning strategies. Knowledge and know-how Two concepts are important in discussions of lithic technology and learning: ‘knowledge’ and ‘know-how’ (Pelegrin, 1990), also sometimes referred to as ‘knowing how’ and ‘knowing that’ (see for example Portisch, 2009). Knowledge is defined as what can be learned by seeing, listening, and thinking, and what can be taught by showing, telling, and sharing experience. Knowledge is thus communicative, something that can be transferred from one person to another through conversation or actions. Know-how is muscular embodied memory, that is, something that can only be learned by doing it yourself. It is a tacit knowledge that is acquired through practical experience, not something that can be taught (Apel, 2001).

What makes knowledge and know-how such important concepts in the discussion here on learning and behavioural modernity is the link to social interaction (Wurz, 2008). Simple tool production, for example making flakes from a core to use for cutting, requires little knowledge and know-how. It is something that one can learn almost completely by watching someone making flakes, thus acquiring basic knowledge, and then copying the technical knapping gesture (Pelegrin, 1990). It requires almost no planning or problem solving (Stout and Chaminade, 2007). Advanced bifacial tool production, such as the manufacture of SB points, requires a high degree of both knowledge and know-how (see Olausson, 1998; Apel, 2008). This manufacture can only be learned by gaining access to knowledge by seeing others manufacturing and hearing them tell about the knacks and methods for handling difficulties in knapping, along with years of practice and gradual refinement of the embodied know-how (Apel, 2001; Högberg, 2009). It is thus a technology that requires a high degree of social interaction in order to be passed on and maintained in the community. In this sense, knowledge and know-how, even though they are used here as two concepts, are not separate but complementary expressions of cognitive and embodied dispositions for learning (Portisch, 2009).

Learning strategies: learning by doing or embedded learning? Practice, learning and skills training are well-researched behavioural topics in lithic technology analysis (Bamforth and Finley, 2008). The basic premise for studies attempting to identify traces of learning in lithic assemblage is that the learners are beginners and therefore have not yet attained the skill and ability in their craft that they are expected to reach later on in life (Fischer, 1990; Pigeot, 1990; Babel, 1997; Högberg, 1999; Grimm, 2000; Apel, 2001, 2008; Bamforth and Finley, 2008). Two learning strategies are important to discuss here: learning by doing and embedded learning.

Karlin and Julien (1994), in a study of a number of French Upper Palaeolithic settlements, identified technological and methodological features in lithic assemblages, which they have interpreted as

work carried out partly by experienced flint knappers and partly by beginners. Through analyses of manufacturing techniques and methods on a refitted assemblage, different levels of proficiency and experience in stone-working were analysed. Karlin and Julien (1994) were able to demonstrate that the flake assemblage that was produced by the least knowledgeable and experienced flint knapper was not secondarily utilized in tool production. Instead, the whole production remained at the knapping area in the form of unmodified flakes and blade-like flakes. This was compared with the experienced flint knapper's work, parts of whose production were removed from the knapping area for use in tool production (Karlin and Julien, 1994). The inexperienced flint knapper's work was evidently not intended to be used secondarily. Its significance lay rather in the element of practice. Other knapping sites have been investigated with similar approaches (Fischer, 1990; Pigeot, 1990; Grimm, 2000; Johansen and Stapert, 2000; Högberg, 2008; Sternke and Sørensen, 2009). What these sites have in common is that they have all been interpreted as representing the work of adults performing systematic work together with children or adolescents learning by doing. Artefacts interpreted as deriving from the activities of children or apprentices are perceived as less technologically and methodologically developed than those produced by non-children (for critical comments on this point of view, see Finlay, 1997). According to these studies, the work of children and learners can consequently be identified as more simple and unstructured, compared with the more elaborate (adult) work.

Ferguson (2003) analysed an alternative pattern for learning strategies. In an experimental study, pressure-flaking arrowheads together with beginners, he showed that if a beginner works together with a skilled knapper in an embedded learning strategy, the work of the learners is difficult to distinguish from that of the experienced. Ferguson designed his experiments in such a way that, as soon as beginners encountered problems in their knapping, Ferguson, an experienced knapper, took over the work and demonstrated to the beginner what had to be done to get around the problem. In this way, problems that made it difficult to knap a blank into a finished arrowhead seldom arose. The consequence of this was that the debitage as well as the arrowheads from the knapping sessions showed no or only modest traces of learning (Ferguson, 2003).

Learning strategies at Hollow Rock Shelter The examples above show two different strategies for teaching and learning to knap. The first one involved an apprentice learning by doing beside a master, both working on one piece each. This is a learning activity that will leave recognizable traces in the lithic assemblage. The second one concerns the apprentice and the master working together on the same piece, the apprentice still learning by doing but with continuous correction by the master during the knapping process. This is a learning activity that embeds the learning process in the production and hence will leave very few recognizable traces in the lithic assemblage. The question is, what implications could this have for studies of learning and behavioural modernity?

In the Blombos Cave assemblages, probable evidence of learning processes and differences in manufacturing skills is reported (Henshilwood et al., 2001). Within the HRS, however, there is a little variation in the assemblages of SB points that can be attributed to learning processes, and no considerable differences in skill among the knappers making the points. Making an SB point, as we have seen, requires great skill and a high degree of knowledge and know-how, and the mistakes that were made when SB points were being manufactured at HRS tend more to reveal the difficulties involved in making small, thin bifacials from coarse raw material that is hard to work, rather than mistakes associated with someone learning how to knap.

However, from the 1993 excavation, four small bifacial pieces were recovered and two similar pieces were found outside the shelter during survey work in 2008 (Figure 18). These pieces all display similar surface-covering bifacially knapped negative flake removals, showing that they were knapped with on-edge marginal percussion. However, the length-width-thickness ratio shows that none of these pieces could have been knapped into an SB point. The six pieces shows several hinge fractures, step fracture plateaus and crushed platforms, indicating that they were knapped with a not fully developed knapping strategy.

The six pieces are the kind of bifacial artefact that have been identified in experimental as well as archaeological studies as typical of novice bifacial knapping according to the learning-by-doing strategy (Shelley, 1990; Brooke Milne, 2005). They are worked with the proper technical approach, i.e., on-edge (marginal percussion) knapping with the aim of removing thin flakes extending over more than half of the face of the piece, but with the wrong mental template, i.e., even though the appropriate technique was applied, the knapping could never result in an SB point because the knapper did not seem to have had the right skills to apply this technique within the right chaîne opératoire concept. This is a clear example of a knapper who acquired a large portion of knowledge, but was still practising to get the right know-how (Högberg, 2008). From the analysis of these six bifacial pieces, our interpretation is that learning by doing took place at the HRS site.

Landscape and materiality at Hollow Rock Shelter Oral traditions as social interactions and as tools for communication are important to human beings and are regarded as a vital part of behavioural modernity (Henshilwood and Marean, 2003). There are endless archaeological examples of the communicative and constitutional possibilities of narratives (Högberg, 2006). Existential conditions and the fundamental meanings of human life are investigated by way of narratives (Donald, 1991). Narratives of origins, being and the future, and their association with people, events, objects and places are a fundamental part of myths and rituals (Lévi-Strauss, 1962; Bourdieu, 1977; Edmonds, 1995, 1999; Andersson et al., 1997; Cooney, 1998; Grøn and Kutznetsov, 2003; Zvelebil, 2003). Henshilwood and Marean have stated that "Modern human behaviour is defined as behaviour that is mediated by socially constructed patterns of symbolic thinking, actions, and communication that allow for material and information exchange and cultural continuity between and across generations and contemporaneous communities" (Henshilwood and Marean, 2003: 635). As discussed above, the analysis of the lithic assemblage from HRS showed that SB points in different phases of production were left behind in the shelter. Several anthropological examples have been described where tools and raw materials have been stored for future use (Binford, 1983). The tools and raw materials have not always been stored with the intention of being used by those who stored them. Binford describes this with the term "insurance gear," and explains the term by using the words of a Nunamiut spokesman: "Every time men go out for something they have space in the pack or on the sled on the way out. Good men always say what can I carry that may help someone in the future. Maybe they decide that where they are going there is no firewood, so maybe they take out some extra. Maybe there is no good stone for using with Strike-a-Light, so maybe they take out some extra to leave out there in case somebody needs it later. In the old days [...] fellows always carried out shiny stones for making tools and left them all over the place so if you needed them they would be around" (Binford, 1983: 271). If this tradition of solidarity is transferred to the discussion of the SB points in different phases of production at HRS, it would, hypothetically, mean that an organized habit and



Figure 18. Four bifacial knapped pieces (C32, C43, C57 and C60) found in square unit AD14 during the 1993 excavation, and two small bifacial knapped pieces (PID 359) found outside the shelter during survey work in 2008, the two to the left on the bottom row. The four pieces from AD14 are prefixed by “C” in the numbering since previous researchers have classified them as cores. The six pieces are made out of quartzite, available on site. The pieces are here interpreted as evidence for the presence of a learning-by-doing strategy at Hollow Rock Shelter. Photo: Anders Högberg.

tradition may have stated that supplementary blanks, preforms and almost finished SB points “always” were, or needed to be, available at the site. In a sense this implies the building of a landscape memory, i.e., the shared narratives among the community member about how specific places in the landscape hold special values (Högberg, 2006). To use Parkington’s words, “The surroundings, from immediate to regional, have now become landscapes marked with material items linking times, places and people” (Parkington, 2010: 194).

The three-stage model of cognitive evolution (Donald, 1991, 2001) is described as going from episodic to mimetic culture, from mimetic to mythic culture and from mythic culture to external symbolic storage and theoretic culture (Donald, 1991). The third stage is usually linked to behavioural modernity (Wurz, 2008). Whereas in the previous stage cultures relied on individual biological memory, in the third stage cultures relied more on external memory devices, thus making the important shift from internal to external memory storage devices (Donald, 1991), i.e., memories linked to materiality (Högberg, 2009). Wurz (2008) also discussed external memory storage as a behavioural modernity, which has served to materialize common experiences and underline common values. When viewed in this light, the building of a landscape memory as manifested in finds of blanks, preforms and almost completed SB points at the HRS can be regarded as the building of external memory devices. Future studies investigating the HRS lithic assemblages in more detail, together with assemblages from other sites, might provide the results to test this hypothesis. This is however beyond the scope of the study presented here.

Conclusions

Lithic technology and behavioural modernity at Hollow Rock Shelter

Social intelligence, symbolically organized behaviour and syntactical language use are regarded by most researchers as integral parts of behavioural modernity (Henshilwood and Marean, 2003). A well-developed working memory, understood as reflecting the capacity for attention control, has been put forward as essential for the definition of modern thinking, and by extension behavioural modernity (Wynn and Coolidge, 2007: 79): “Working memory is much more than recall. It is, in a real sense, what one can “hold in mind” and process at the same time” (original italics).

No single technology can cover all of the multifaceted aspects embraced by working memory. However, the sociotechnical aspects discussed here concerning SB points display some features that suggest a developed working memory, as discussed by Wynn and Coolidge (2007) in relation to behavioural modernity. This is expressed in a technology that requires advanced planning and step-by-step thinking if it is to be performed and maintained, and intergenerational transmission of knowledge and know-how, which goes far beyond the act of imitation or repetition. SB points are manufactured with a technology that calls for an ability to remember and execute a technological proficiency resulting from an extended prior learning, and at the same time the knapper has to be able to deal with complications that arise and plan ahead with the goal of making an SB point of a size and form according to a standard on which the community agrees.

The different strategies for producing SB points revealed by the chaîne opératoire analyses are examples of experimentation with different technological approaches in order to achieve one and the same result – SB points. This reveals an open and creative learning process in which the technological frames (cf. Bijker, 1995) were under negotiation within the framework of a social craft setting where knowledge and know-how were developed. This experimentation, together with learning activities that developed learner's knowledge and know-how in relation to an advanced knapping technology, is a sign of well-developed forms of social interaction. According to Solms and Turnbull (2002), this type of social interaction has a fundamental effect on human behaviour. As we mentioned above, if we regard behavioural modernity as shaped by interaction between nature and nurture, that is to say, between the ability of the brain to be influenced by the environment and the social complexity of the surroundings (Donald, 2001), then the experimentation and learning that took place at HRS can be interpreted as a part of the complex development of behavioural modernity during the MSA (Wurz, 2008).

We have interpreted behavioural modernity at HRS based on artefacts representing innovative behaviour. In this sense, the study is in line with previously presented results (see Henshilwood, 2007; Wurz, 2008; Parkington, 2010). The new results of this study lie in the hypothesis that social processes of interaction in learning and experimenting with an elaborate technology may have led to a development of working memory over time in the form of intergenerational transformed knowledge and know-how.

Another aspect of behavioural modernity discussed is the hypothesis that SB points in different stages of production that were left at the site represent the materiality of landscape memories, i.e., what Donald (1991) calls external symbolic storage. This might indicate that socially constructed patterns of symbolic thinking and narratives may have built a "Still Bay landscape" of memories.

From a neuropsychological perspective, we have demonstrated the value of a focus on children and young people in the study of the development of behavioural modernity. By highlighting neuropsychological results in the discussion, we have put forward the hypothesis that the rise of behavioural modernity can be seen more as a wave movement than as a linear process. Wadley (2007: 208, cited from Henshilwood and Marean, 2003: 636) has pointed out that technological innovation cannot be simplistically linked with behavioural modernity: "It is not the invention per se of lithic spearheads or bone points and awls that proclaims symbolism and modern human behaviour but rather the subsequent use of these artefacts for purposes such as the definition or negotiation of individuals or group identity" We have not discussed the SB points as an innovation, even though we see them as such. Instead we have analysed the process of producing them as an inventive technological experimentation. With our sociotechnical analyses of SB points from HRS, we have considered a number of hypotheses as to how this technological experimentation may have involved social interaction manifested in narratives of knowledge, know-how, landscape memories and bodily embedded learning processes, as well as development of the working memory. Additional future studies might explore these hypotheses in greater depth.

If we accept the preliminary results of the OSL ages of find-bearing levels with SB points from the 2008 excavation, the results of our analysis show that behavioural modernity, as discussed by Henshilwood and Marean (2003), was established at HRS approximately 72,000 to 80,000 years before the present.

Acknowledgements

Thanks to our colleagues at the Department of Archaeology UCT Cape Town. Two anonymous reviewers provided useful comments

on an earlier draft of this text. The research was financed by the Crafoord Foundation.

Translated by Alan Crozier

References

- Andersson, R., Boman, K., Borbás, I., 1997. Lyckad nedfrysning av herr Moro. Ordfront, Stockholm.
- Andrefsky Jr., W., 1998. Lithics. Macroscopic Approaches to Analysis. Cambridge Manuals in Archaeology. Cambridge University Press, Cambridge.
- Apel, J., 2001. Dagers, Knowledge and Power. The Social Aspects of Flint-dagger Technology in Scandinavia 2350–1500 cal BC. Kust till kust-böcker 3, Uppsala.
- Apel, J., 2008. Knowledge, know-how and raw material. J. Archaeol. Meth. Theor. 15, 91–111.
- Audouze, F., 2002. Leroi-Gourhan, a philosopher of technique and evolution. J. Archaeol. Res. 10, 277–306.
- Babel, J., 1997. Teaching flint knapping skills in Neolithic mining societies. In: Schild, R., Sulgostowska, Z. (Eds.), Man and Flint. Proceedings of the VIIth International Flint Symposium Warszawa – Ostrowiec Swietokrzyski September 1995. Institute of Archaeology and Ethnology, Polish Academy of Sciences, Warsaw, pp. 167–169.
- Ballin, T.B., 1995. Teknologiske profiler – datering af stenaldersboplader ved attribut analyse. Universitetets Oldsaksamling Årbok 1993/1994. 25–46.
- Bamforth, D.B., Finley, N., 2008. Introduction: archaeological approaches to lithic production skill and craft learning. J. Archaeol. Meth. Theor. 15, 1–27.
- Bijker, W.E., 1995. Of Bicycles, Bakelites, and Bulbs. Toward a Theory of Sociotechnical Change. The MIT Press, Cambridge.
- Binford, L.R., 1983. Working at Archaeology. Studies in Archaeology. Academic Press, New York.
- Bleed, P., 2001. Trees or chains, links or branches: conceptual alternatives for consideration of stone tool production and other sequential activities. J. Archaeol. Meth. Theor. 8, 101–127.
- Botha, R., Knight, C. (Eds.), 2009. The Cradle of Language. Studies in the Evolution of Language. Oxford University Press, Oxford.
- Bourdieu, P., 1977. Outline of a Theory of Practice. Harvard University Press, Cambridge.
- Brain, C.K., 2005. Essential attributes of any technologically competent animal. In: d'Errico, F., Backwell, L. (Eds.), From Tools to Symbols. From Early Hominids to Modern Humans. Witwatersrand University Press, Johannesburg, pp. 38–51.
- Brooke Milne, S., 2005. Palaeo-eskimo novice flint knapping in the eastern Canadian Arctic. J. Field Archaeol. 30, 329–345.
- Callahan, E., 2006. Neolithic Danish daggers: an experimental peek. In: Apel, J., Knutsson, K. (Eds.), Skilled Production and Social Reproduction. Aspects of Traditional Stone-Tool Technologies. Proceedings of a Symposium in Uppsala, August 20–24, 2003. SAU Stone Studies, vol. 2, pp. 115–129. Uppsala.
- Chase, B.M., 2010. South African palaeoenvironments during marine oxygen isotope stage 4: a context for the Howiesons Poort and Still Bay industries. J. Archaeol. Sci. 37, 1359–1366.
- Cooney, G., 1998. Breaking stones, making places: the social landscape of axe production sites. In: Gibson, A., Simpson, D. (Eds.), Prehistoric Ritual and Religion: Essays in Honour of Aubrey Burl (Sutton. Thrupp, Gloucestershire).
- Copeland, L., Moloney, N., 2003. The Mousterian lithic assemblages from Ras El-Kelb cave, Lebanon. In: Moloney, N., Shott, M.J. (Eds.), Lithic Analysis at the Millennium. Institute of Archaeology, University College, London, pp. 17–28.
- Csibra, G., Gergely, G., 2011. Natural pedagogy as evolutionary adaptation. Phil. Trans. R. Soc. B 366, 1149–1157.
- Donald, M., 1991. Origins of the Modern Mind. Three Stages in the Evolution of Culture and Cognition. Harvard University Press, Cambridge.
- Donald, M., 2001. A Mind So Rare. The Evolution of Human Consciousness. W.W. Norton, Company, London.
- d'Errico, F., Backwell, L. (Eds.), 2005. From Tools to Symbols. From Early Hominids to Modern Humans. Witwatersrand University Press, Johannesburg.
- d'Errico, F., Vanhaeren, M., 2009. Earliest personal ornaments and their significance for the origin of language debate. In: Botha, R., Knight, C. (Eds.), The Cradle of Language. Studies in the Evolution of Language. Oxford University Press, Oxford, pp. 16–40.
- Edmonds, M., 1995. Stone Tools and Society. Working Stone in Neolithic and Bronze Age Britain. Batsford, London.
- Edmonds, M., 1999. Ancestral Geographies of the Neolithic Landscape, Monuments and Memory. Routledge, London.
- Eriksen, B.V., 2000. Chaîne opératoire – den operative proces og kunsten at tænke som en flinthugger. In: Eriksen, B.V. (Ed.), Flintstudier. En håndbog i systematiske analyser af flintinventarer. Aarhus University Press, Århus, pp. 75–100.
- Evans, U., 1994. Hollow rock shelter, a middle stone age site in the Cederberg. S. Afr. Field Archaeol. 3, 63–73.
- Ferguson, J.R., 2003. An experimental test of the conservation of raw material in flint knapping skill acquisition. Lithic Technol. 28, 113–131.
- Finlay, N., 1997. Kid knapping: the missing children in lithic analysis. In: Moore, J., Scott, E. (Eds.), Invisible People and Processes. Writing Gender and Childhood into European Archaeology. Leicester University Press, London, pp. 203–212.
- Fischer, A., 1990. A late palaeolithic "School" of flint-knapping at Trollesgave, Denmark. Results from refitting. Acta Archaeol. 60, 33–49.
- Goodwin, A.J.H., van Riet, C., 1929. The stone age cultures of South Africa. Ann. S. Afr. Mus. 27.

- Grimm, L., 2000. Apprentice flint knapping: relating material culture and social practice in the upper palaeolithic. In: Sofaer Derevenski, J. (Ed.), *Children and Material Culture*. Routledge, London, pp. 53–71.
- Grøn, O., Kutznetsov, O., 2003. Ethno-archaeology among Envenkian foresthunters. Preliminary results and a different approach to reality. In: Larsson, L., Kindgren, H., Knutsson, K., Loeffler, D., Åkerlund, A. (Eds.), *Mesolithic on the Move: Papers Presented at the Sixth International Conference on the Mesolithic in Europe*, Stockholm 2000. Oxbow Books, Oxford, pp. 216–221.
- Gärdenfors, P., 2003. How Homo Became Sapiens: On the Evolution of Thinking. Oxford University Press, Oxford.
- Hayden, B., Villeneuve, S., 2010. Sex, symmetry and silliness in the bifacial world. *Antiquity* 83, 1163–1175.
- Henshilwood, C.S., 2005. Stratigraphic integrity of the middle stone age levels at Blombos cave. In: d'Errico, F., Backwell, L. (Eds.), *From Tools to Symbols. From Early Hominids to Modern Humans*. Witwatersrand University Press, Johannesburg, pp. 441–458.
- Henshilwood, C.S., 2007. Fully symbolic Sapiens behaviour: innovation in the middle stone age at Blombos cave, South Africa. In: Mellars, P., Boyle, K., Bar-Yosef, O., Stringer, C. (Eds.), *Rethinking the Human Revolution. New Behavioural and Biological Perspectives on the Origin and Dispersal of Modern Humans*. McDonald Institute Monographs, Cambridge, pp. 123–132.
- Henshilwood, C.S., Dubreuil, B., 2009. Reading the artefacts: gleaned language skills from the middle stone age in southern Africa. In: Botha, R., Knight, C. (Eds.), *The Cradle of Language. Studies in the Evolution of Language*. Oxford University Press, Oxford, pp. 41–61.
- Henshilwood, C.S., d'Errico, F., Watts, I., 2009. Engraved ochres from the middle stone age levels at Blombos cave, south Africa. *J. Hum. Evol.* 57, 27–47.
- Henshilwood, C.S., Marean, C.W., 2003. The origin of modern human behaviour. *Curr. Anthropol.* 44, 627–651.
- Henshilwood, C.S., Sealy, J.C., Yates, R., Cruz-Uribe, K., Goldberg, P., Grine, F.E., Klein, R.G., Poggenpoel, C., van Niekerk, K., Watts, I., 2001. Blombos Cave, Southern Cape, South Africa: preliminary report on the 1992–1999 excavations of the Middle Stone Age levels. *J. Archaeol. Sci.* 28, 421–448.
- Hirth, K.G. (Ed.), 2003. *Mesoamerican Lithic Technology. Experimentation and Interpretation*. The University of Utah Press, Salt Lake City.
- Högborg, A., 1999. Child and adult at a knapping area. A technological flake analysis of the manufacture of a Neolithic square sectioned axe and a child's flint knapping activities on an assemblage excavated as part of the Öresund fixed link project. *Acta Archaeol.* 70, 79–106.
- Högborg, A., 2002. Production sites on the beach ridge of Järvallen. Aspects of tool preforms, action, technology, ritual and the continuity of place. *Curr. Swed. Archaeol* 10, 137–162.
- Högborg, A., 2006. Continuity of place: actions and narratives. In: Apel, J., Knutsson, K. (Eds.), *Skilled Production and Social Reproduction. Aspects of Traditional Stone-Tool Technologies. Proceedings of a Symposium in Uppsala*, August 20–24, 2003. SAU Stone Studies 2, Uppsala, pp. 187–206.
- Högborg, A., 2008. Playing with flint: tracing a child's imitation of adult work in a lithic assemblage. *J. Archaeol. Meth. Theor.* 15, 112–131.
- Högborg, A., 2009. Lithics in the Scandinavian Late Bronze Age. *Sociotechnical Change and Persistence*. BAR International, Oxford.
- Högborg, A., Olausson, D., 2007. *Scandinavian Flint. An Archaeological Perspective*. Aarhus University Press, Århus.
- Holdaway, S., Stern, N., 2004. *A Record in Stone. The Study of Australia's Flaked Stone Artefacts*. Victoria Museum. Aboriginal Studies Press, Melbourne, Canberra.
- Inizan, M.-L., Roche, H., Tixier, J., 1992. *Technology of Knapped Stone. Préhistoire de la Pierre Taillée*. Crep, Meudon.
- Jacobs, Z., Roberts, R.G., Galbraith, R.F., Deacon, H.J., Grün, R., Mackay, A., Mitchell, P., Vogelsang, R., Wadley, L., 2008. Ages for the middle stone age of southern Africa: implications for human behaviour and dispersal. *Science* 322, 733–735.
- Johansen, L., Stapert, D., 2000. Two "Epi-Ahrensburgian" sites in the northern Netherlands: Oudehaske (Friesland) and Gramsbergen (Overijssel). *Palaeohistoria* 39/40, 1–87.
- Kamp, K.A., 2001. Where have all the children gone?: the archaeology of childhood. *J. Archaeol. Meth. Theor.* 8, 1–34.
- Karlin, C., Julien, M., 1994. Prehistoric technology: a cognitive science? In: Renfrew, C., Zubrow, E.B. (Eds.), *The Ancient Mind. Elements of Cognitive Archaeology*. New Directions in Archaeology. Cambridge University Press, Cambridge, pp. 152–164.
- Kelterborn, P., 1984. Towards replicating Egyptian predynastic flint knives. *J. Archaeol. Sci.* 11, 433–453.
- Klein, R.G., 1995. Anatomy, behaviour, and modern origins. *J. World Prehist.* 9, 167–198.
- Klein, R.G., 2000. Archaeology and the evolution of human behaviour. *Evol. Anthropol.* 9, 17–36.
- Larsson, L., 2009. What can be found in a hollow rock? A site from the middle stone age in western Cape, south Africa. In: Burdukiewicz, J.M., Cyrek, K., Dyczek, P., Szymezak, K. (Eds.), *Understanding the Past. Papers Offered to Staefan K. Koztowski*. Center for Research on the Antiquity of Southeastern Europe. University of Warsaw, Warsaw, pp. 199–206.
- Lemonnier, P. (Ed.), 1993. *Technological Choices. Transformation in Material Culture Since the Neolithic*. Routledge, London.
- Leroi-Gourhan, A., 1993. *Gesture and Speech*. Mass. MIT Press, Cambridge.
- Lévi-Strauss, C., 1962. *The Savage Mind*. University of Chicago Press, Chicago.
- Lillehammer, G., 1989. A child is born. The child's world in an archaeological perspective. *Nor. Archaeol. Rev.* 22, 89–105.
- Lombard, M., 2006. First impressions of the functions and hafting technology of Still Bay pointed artefacts from Sibudu Cave. *South Afr. Hum.* 18, 27–41.
- Lombard, M., 2007. The gripping nature of ochre: the association of ochre with Howiesons Poort adhesives and Later Stone Age mastics from South Africa. *J. Hum. Evol.* 53, 406–419.
- Lombard, M., Sievers, C., Ward, V. (Eds.), 2008. *Current Theme in Middle Stone Age Research*. South African Archaeological Society. Goodwin Ser. 10.
- Lombard, M., Wadley, L., Jacobs, Z., Mohapi, M., Roberts, R.G., 2010. Still Bay and serrated points from Umhlatuzana rock shelter, Kwazulu-Natal, south Africa. *J. Archaeol. Sci.* 37, 1773–1784.
- Marean, C.W., 2010. Pinnacle point cave 13B (western cape province, south Africa) in context: the cape floral kingdom, shellfish and modern human origins. *J. Hum. Evol.* 59, 425–443.
- McBrearty, S., Brooks, A.S., 2000. The revolution that wasn't: a new interpretation of the origin of modern human behaviour. *J. Hum. Evol.* 39, 453–563.
- McCall, G.S., 2007. Behavioral ecological models of lithic technological change during the later middle stone age of south Africa. *J. Archaeol. Sci.* 34, 1738–1751.
- Mellars, P., Boyle, K., Bar-Yosef, O., Stringer, C. (Eds.), 2007. *Rethinking the Human Revolution. New Behavioural and Biological Perspectives on the Origin and Dispersal of Modern Humans*. McDonald Institute Monographs, Cambridge.
- Meltzoff, A.N., Kuhl, P.K., Movellan, J., Sejnowski, T.J., 2009. Foundations for a new science of learning. *Science* 325, 284–288.
- Minichillo, T. J., 2005. *Middle Stone Age Lithic Study, South Africa: An Examination of Modern Human Origins*. Ph.D. Dissertation, University of Washington.
- Mithen, S., 1996. *The Prehistory of the Mind. A Search for the Origins of Art, Religion and Science* (Phoenix, London).
- Mithen, S., Parsons, L., 2008. The brain as a cultural artefact. *Cambridge Archaeol. J.* 18, 415–422.
- Mourre, V., Villa, P., Henshilwood, C.S., 2010. Early use of pressure flaking on lithic artifacts at Blombos Cave, South Africa. *Science* 330, 659–662.
- Nitecki, M.H., Nitecki, D.V. (Eds.), 1994. *Origins of Anatomically Modern Humans*. Plenum Press, New York.
- Nunn, G., 2006. Using the Jutland type IC Neolithic Danish dagger as a model to replicate parallel, edge-to-edge pressure flaking. In: Apel, J., Knutsson, K. (Eds.), *Skilled Production and Social Reproduction. Aspects of Traditional Stone-Tool Technologies. Proceedings of a Symposium in Uppsala*, August 20–24, 2003. SAU Stone Studies, vol. 2, pp. 81–114. Uppsala.
- Odell, G.H., 2004. *Lithic Analysis*. Kluwer Academic/Plenum Publishers, New York.
- Olausson, D., 1998. Different strokes for different folks. Possible reasons for variation in quality of knapping. *Lithic Technol.* 23, 90–115.
- Parkington, J., 2003. *Cederberg Rock Paintings*. Creda Communications (Cape Town).
- Parkington, J., 2010. Coastal diet, encephalisation and innovative behaviours in the late middle stone age of Southern Africa. In: Cunnane, S.C., Stewart, K.M. (Eds.), *Human Brain Evolution: The Influence of Freshwater and Marine Food Resources*. Wiley-Blackwell, NY, pp. 189–202.
- Pelegrin, J., 1990. Prehistoric lithic technology: some aspects of research. In: Sinclair, A., Schlangier, N. (Eds.), *Technology in the Humanities. Archaeological Review from Cambridge*, vol. 9, pp. 116–125.
- Pigeot, N., 1990. Technical and social actors. Flint knapping specialists and apprentices at Magdalenian Etioles. *Archaeol. Rev. Cambridge* 9, 126–141.
- Porraz, G., Texier, J.-P., Rigaud, J.-P., Parkington, J., Poggenpoel, C., Roberts, D.L., 2008. Preliminary characterization of a middle stone age lithic assemblage preceding the "Classic" Howieson's Poort complex at Diepkloof rock shelter, western Cape province, South Africa. In: Lombard, M., Sievers, C., Ward, V. (Eds.), *Current Themes in Middle Stone Age Research*. Goodwin Ser. 10, 105–121.
- Portisch, A.O., 2009. Techniques as a window onto learning: Kazakh women's domestic textile production in western Mongolia. *J. Mat. Cult.* 14, 471–493.
- Rigaud, J.-P., Texier, P.-J., Parkington, J., Poggenpoel, C., 2006. Le mobilier Stillbay et Howiesons Poort de l'abri Diepkloof. La chronologie du Middle Stone Age Sud-Africain et ses implications. *Hum. Palaeontol. Prehistory: C. R. Palevol.* 5, 839–849.
- Roberts, D.L., 2003. *Age, Genesis and Significance of South African Coastal Belt Silcretes*. Memoir 95. Council for Geoscience South Africa, Pretoria.
- Roche, H., 2005. From simple flaking to shaping: stone-knapping evolution among early Hominins. In: Roux, V., Bril, B. (Eds.), *Stone Knapping, the Necessary Conditions for a Uniquely Hominin Behaviour*. MacDonald Institute for Archaeological Research, Cambridge, pp. 35–48.
- Roux, V., 2003. A dynamic systems framework for studying technological change: application to the emergence of the Potter's wheel in the southern Levant. *J. Archaeol. Meth. Theor.* 10, 1–30.
- Roux, V., Bril, B. (Eds.), 2005. *Stone Knapping. The Necessary Conditions for a Uniquely Hominin Behaviour*. MacDonald Institute for Archaeological Research, Cambridge.
- Schlangier, N., 1994. Mindful technology: unleashing the chaîne opératoire for an archaeology of mind. In: Renfrew, C., Zubrow, E.B. (Eds.), *The Ancient Mind. Elements of Cognitive Archaeology*. New Directions in Archaeology. Cambridge University Press, Cambridge, pp. 143–151.
- Schlangier, N., 2005. *The History of a Special Relationship: Prehistoric Terminology and Lithic Technology Between the French and South African Research Traditions. From Tools to Symbols. From Early Hominids to Modern Humans*. Witwatersrand University Press, Johannesburg, 9–37.

- Schwartzman, H.B., 1978. *Transformations. The Anthropology of Children's Play*. Plenum, London.
- Shea, J.J., 2006. The origins of lithic projectile point technology: evidence from Africa, the Levant, and Europe. *J. Archaeol. Sci.* 33, 823–846.
- Shelley, P.H., 1990. Variation in lithic assemblages: an experiment. *J. Field Archaeol.* 17, 187–193.
- Shott, M.J., 1994. Size and form in the analysis of flake Debris: review and recent approaches. *J. Archaeol. Meth. Theor.* 1, 69–110.
- Shott, M.J., 2003. Chaîne opératoire and reduction sequence. *Lithic Technol.* 28, 95–105.
- Singer, W., 2006. *Vom Gehirn Zum Bewusstsein*. Suhrkamp Verlag, Frankfurt am Main.
- Smallwood, A.M., 2010. Clovis biface technology at the Topper site, South Carolina: evidence for variation and technological flexibility. *J. Archaeol. Sci.* 37, 2413–2425.
- Sofaer Derevenski, J. (Ed.), 2000. *Children and Material Culture*. Routledge, London.
- Solms, M., Turnbull, O., 2002. *The Brain and the Inner World. An Introduction to the Neuroscience of Subjective Experience*. Karnac, London.
- Sørensen, M., 2006. Teknologiske traditioner i Maglemosekulturen. En diakron analyse af Maglemosekulturens flækkeindustri. In: Eriksen, B.V. (Ed.), *Sten- alderstudier. Tidligt mesolitiske jægere og samlere i Sydskandinavien*. Jysk Arkæologisk Selskabs Skrifter, vol. 55, pp. 19–75. Højbjerg.
- Technology in archaeology. In: Sørensen, M., Desrosiers, P. (Eds.), *Proceedings From the SILA Workshop: The Study of Technology as a Method for Gaining Insight into Social and Cultural Aspects of Prehistory*. Publications from the National Museum Studies in Archaeology, History, vol. 14 (Copenhagen).
- Soressi, M., 2005. Late Mousterian lithic technology: its implications for the pace of the emergence of behavioural modernity and the relationship between behavioural modernity and biological modernity. In: d'Errico, F., Backwell, L. (Eds.), *From Tools to Symbols. From Early Hominids to Modern Humans*. Witwatersrand University Press, Johannesburg, pp. 389–417.
- Soressi, M., Dibble, H. (Eds.), 2003. *Multiple Approaches to the Study of Bifacial Technologies*. University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.
- Soriano, S., Villa, P., Wadley, L., 2009. Ochre for the toolmaker: shaping the Still Bay points at Sibudu (KwaZulu-Natal, South Africa). *J. Afr. Archaeol.* 7, 41–54.
- Stafford, M., 1998. Search of Hindsgavl: experiments in the production of Neolithic Danish flint daggers. *Antiquity* 72, 338–349.
- Sternke, F., Sørensen, M., 2009. The identification of children's Flintknapping products in Mesolithic Scandinavia. In: McCartan, S., Schulting, R., Warren, G., Woodman, P.C. (Eds.), *Mesolithic Horizons. Papers Presented at the Seventh International Conference on the Mesolithic in Europe, Belfast 2005*. Oxbow, Oxford.
- Stout, D., 2005. Neural foundations of perception and action in stone knapping. In: Roux, V., Bril, B. (Eds.), *Stone Knapping. The Necessary Conditions for a Uniquely Hominin Behaviour*. McDonald Institute for Archaeological Research, Cambridge, pp. 273–286.
- Stout, D., Chaminade, T., 2007. The evolutionary neuroscience of tool making. *Neuropsychologica* 45, 1091–1100.
- Tribolo, C., Mercier, N., Valladas, H., Joron, J.L., Guibert, P., Lefrais, Y., Selo, M., Texier, P.-J., Rigaud, J.-Ph., Porraz, G., Poggenpoel, C., Parkington, J., Texier, J.-P., Lenoble, A., 2009. Thermoluminescence dating of a Still Bay–Howiesons Poort sequence at Diepkloof rock shelter (Western Cape, South Africa). *J. Archaeol. Sci.* 36, 730–739.
- Tringham, R., Cooper, G., Odell, O., Voytek, B., Whitman, A., 1974. Experimentation in the formation of edge damage: a new approach to lithic analysis. *J. Field Archaeol.* 1, 171–196.
- Villa, P., Soressi, M., Henshilwood, C.S., Mourre, V., 2009. The Still Bay points of Blombos cave (South Africa). *J. Archaeol. Sci.* 36, 441–460.
- Villa, P., Soriano, S., 2010. Hunting weapons of Neanderthals and early modern humans in South Africa. Similarities and differences. *J. Anthropol. Res.* 66, 5–38.
- Villa, P., Soriano, S., Teyssandier, N., Wurz, S., 2010. The Howiesons Poort and MSA III at Klasies River main site, cave 1A. *J. Archaeol. Sci.* 37, 630–655.
- Volman, T.P., 1984. Early prehistory of southern Africa. In: Klein, R.G. (Ed.), *Southern African Prehistory and Paleoenvironments*. A.A. Balkema, Rotterdam, pp. 169–220.
- Vygotsky, L.S., 1962. *Thought and Language*. The Massachusetts Institute of Technology, Cambridge MA.
- Wadley, L., 2007. Announcing a Still Bay industry at Sibudu Cave, South Africa. *J. Hum. Evol.* 52, 681–689.
- Whittaker, J.C., 1994. *Flint Knapping. Making and Understanding Stone Tools*. University of Texas Press, Austin.
- Wood, D., 1998. *How Children Think and Learn. The Social Context of Cognitive Development*. Blackwell, Oxford.
- Wurz, S., 2008. Modern behaviour at Klasies river. In: Lombard, M., Sievers, C., Ward, V. (Eds.), *Current Themes in Middle Stone Age Research*. Goodwin Ser. 10, 150–156.
- Wynn, T., Coolidge, F.L., 2007. Did a small but significant enhancement in working memory capacity power the evolution of modern thinking? In: Mellars, P., Boyle, K., Bar-Yosef, O., Stringer, C. (Eds.), *Rethinking the Human Revolution. New Behavioural and Biological Perspectives on the Origin and Dispersal of Modern Humans*. McDonald Institute Monographs, Cambridge, pp. 79–90.
- Zilhão, J., 2007. The emergence of ornaments and art: an archaeological perspective on the origins of "Behavioral modernity." *J. Archaeol. Res.* 15, 1–54.
- Zvelebil, M., 2003. Enculturation of mesolithic. In: Larsson, L., Kindgren, H., Knutsson, K., Loeffler, D., Åkerlund, A. (Eds.), *Mesolithic on the Move: Papers Presented at the Sixth International Conference on the Mesolithic in Europe, Stockholm 2000*. Oxbow Books, Oxford, pp. 65–73.