Recebido em: 19/05/2018
Aceito em: 23/08/2018

REVISTA DE ARQUEOLOGIA

Volume 31 No. 2 2018 ESPECIAL: ARQUEOLOGIA DA INFÂNCIA

ARTICLE

PLAYING WITH PROJECTILE POINTS: CHILDHOOD FLINTKNAPPING IMITATION AT AN 8,500-YEAR-OLD HUNTER-GATHERER ROCKSHELTER SITE IN SOUTHERN BRAZIL

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ABSTRACT

This paper discusses how archaeologists can potentially identify the presence of children in the archaeological record through the study of finished lithic products. As a case study, I use Adelar Pilger (RS-C-61), a hunter-gatherer rockshelter habitation site in southern Brazil dated to approximately 8500 BP. By linking decisions related to raw material selection with the aesthetic and technological properties of projectile points, I have identified three types of points potentially made by experts, advanced apprentices, and children and/or initial apprentices. I suggest that children at the Adelar Pilger site were producing points as a form of play imitation. Children were able to roughly imitate formal shapes but could not properly reproduce the tools in a three dimensional or technological sense.

Keywords: Childhood play imitation; Flintknapping projectile points at Adelar Pilger (RS-C-61); Hunter-gatherers in southern Brazil.

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DOI: https://doi.org/10.24885/sab.v31i2.586

ARTIGO

BRINCANDO COM PONTAS DE PROJÉTIL: IMITAÇÃO INFANTIL DE LASCAMENTO EM UM SÍTIO DE CAÇADOR-COLETOR EM ABRIGO-SOB-ROCHA DE 8.500 ANOS DE IDADE NO SUL DO BRASIL

RESUMO

Este artigo discute como as arqueólogas e arqueólogos podem potencialmente identificar a presença de crianças no registro arqueológico através do estudo de produtos líticos acabados. Como um estudo de caso, eu uso Adelar Pilger (RS-C-61), um sítio em abrigo-sob-rocha habitado por caçadores-coletores no sul do Brasil e datado de aproximadamente 8500 AP. Ao relacionar as decisões associadas à seleção de matéria-prima com as propriedades estéticas e tecnológicas de pontas do projétil, eu identifiquei três tipos de pontas potencialmente produzidas por especialistas, aprendizes avançados e crianças e/ou aprendizes iniciais. Eu sugiro que as crianças no sítio Adelar Pilger produziram pontas de projétil como uma forma de brincadeira de imitação. Através desta brincadeira, as crianças foram capazes de imitar grosseiramente somente as formas e o contorno geral das pontas do projétil, mas não foram capazes de reproduzir estes instrumentos em um sentido tridimensional ou tecnológico.

Palavras-chave: Imitação de brincadeira de criança; Lascamento de pontas de projétil no Adelar Pilger (RS-C-61); Caçadores-coletores no sul do Brasil.

ARTÍCULO

JUGANDO CON PUNTAS DE PROYECTIL: IMITACIÓN INFANTIL DE LA TALLA EN UN ASENTAMIENTO CAZADOR-COLECTOR EN ABRIGO ROCOSO DE 8.500 AÑOS DE EDAD EN EL SUR DE BRASIL

RESUMEN

Este artículo discute cómo los arqueólogos pueden identificar potencialmente la presencia de niños en el registro arqueológico a través del estudio de productos líticos acabados. Como estudio de caso, uso Adelar Pilger (RS-C-61), un sitio en un abrigo rocoso de cazadores-recolectores en el sur de Brasil con una datación aproximada de 8500 AP. Al vincular las decisiones relacionadas con la selección de materia prima con las propiedades estéticas y tecnológicas de las puntas de proyectil, he identificado tres tipos de puntas potencialmente hechas por expertos, aprendices avanzados, y niños y/o aprendices iniciales. Sugiero que los niños en el sitio Adelar Pilger estaban produciendo puntas como una forma de juego de imitación. Los niños pudieron imitar groseramente sólo las formas y el contorno general de las puntas del proyectil, pero no pudieron reproducir correctamente las herramientas en un sentido tridimensional o tecnológico.

Palabras clave: Juego infantil de imitación; Talla de puntas de proyectil en Adelar Pilger (RS-C-61); Cazadores-recolectores en el sur de Brasil.

INTRODUCTION

As emphasized by John Shea (2006:212), "the reason we know so little about children's knapping behavior in prehistory is not that this behavior was genuinely absent, but rather that we have not looked hard enough or in the right way at the lithic record." Even though archaeologists for a long time have considered children to be invisible in the archaeological record, children are a significant component of most documented social groups. Therefore, it is expected that children played important social, and sometimes economic roles (BAXTER, 2005:10, 2008:162; BIRD-DAVID, 2005:93). The systematic study of the archaeology of childhood began following Grete Lillehammer's (1989) provocative article. Since then, a number of archaeologists have studied the learning processes involved in the production of lithic technology (*e.g.*, BAMFORTH & FINLAY, 2008; FERGUSON, 2008; GRIMM, 2005; KNIGHT, 2017; MILNE, 2005; RODET & DUARTE, 2010; ROUX *et al.*, 1995; STAPERT, 2007).

This paper discusses how archaeologists can potentially identify the presence of children in the archaeological record through the study of their finished lithic products. I focus on a specific child behavior, play, in an attempt to understand what children's lithic play tools look like and how they contrast with advanced apprentice and expert's finished products. According to Anders Högberg (2008), the study of childhood play and imitation could be two of the key methods of identifying and understanding child behavior in prehistory. Regardless of the time and place, children spent part of their time playing. With a focus on the imitative play of children I investigate the archaeological record at Adelar Pilger (RS-C-61), a sandstone rockshelter site in Southern Brazil inhabited by hunter-gatherers (Figures 1 and 2a-b). Umbu occupations at Adelar Pilger date from approximately 8500 to 3000 BP (DIAS & NEUBAUER, 2010:194). The Umbu were located in southern Brazil (Rio Grande do Sul, Santa Catarina, Paraná and São Paulo states), Uruguai, and parts of Argentina (Missiones and Corrientes provinces). The so called "Umbu tradition" was defined in the 1970s through the historical-cultural perspective, as an approach in which classifications of artifact types were used as devices to help trace cultural patterns in time and space. Umbu was defined then as a society that manufactured lithic bifaces, specifically projectile points (DIAS & NEUBAUER, 2010:188).

Archaeologists have conducted morphometric analysis to study Umbu projectile points, which provided important contributions in understanding projectile point variability through time (e.g., ENDRES, 2014; OKUMURA & ARAUJO, 2013, 2014, 2016, 2017). However, as an attempt to offer alternative explanations on the variety of types exhibited in the Umbu projectile points, this paper takes into consideration the differences in skill level by contrasting lithic tools created by children with the products of more skilled flintknappers. We can assume that there were people who were more specialized in the production of more elaborate lithic tools, which demanded greater investments of resources. At the same time, we can also assume that there were individuals who produced more simplistic tools that display mistakes and accidents, due to their creators' lesser skill level, control, dexterity, and understanding of knapping processes (RODET & DUARTE, 2010).

Figure 1 - Map of South America showing the location of the Adelar Pilger site.

At the Adelar Pilger site, I suggest that three possible types of projectile points can be identified according to their maker's raw material selection and skill level. I associate these types with agent groups that I refer to as experts, advanced apprentices, and children and/or initial apprentices. I suggest that hunter-gatherer children there were producing projectile points around the fire as a form of play imitation of the experts' knapping activities. I hypothesize that most children were imitating the production of projectile points at the site as a form of play, not necessarily with the goal of learning how to make finished tools.

While acknowledging that the concepts of what constitutes a child and the experience of childhood are cultural constructs and can vary significantly between and within societies, the term "children" in this paper is used to describe biologically sub-adults in general, from the ages of zero to ten. Also, for the purpose of this paper, the term "projectile point" is not employed based on the tools' actual function as projectiles, which would require a use-wear analysis to determine. Here, projectile points are simply the range of tools that archaeologists have traditionally grouped together based on their techno-typological morphology. Contrary to this typological definition however, one of the projectile points at the Adelar Pilger site exhibit heavy macroscopic use-wear polishing upon one edge, indicating its probable use as a cutting implement.

In this paper, I first discuss relevant information related to skill levels and childhood play, and the differences between lithic artifacts produced by experts, advanced apprentices, and children and/or initial apprentices. I then introduce the Adelar Pilger site and summarize the results of our excavations there in 2006 and 2008. The complete results of the excavation and of my techno-typological analysis of all 12,700 lithics

recovered at the site have been presented elsewhere, as well as a contextual discussion of the site's settlement patterns and of hunter-gatherers in the region (DIAS & NEUBAUER, 2010). Therefore, I focus here on the evidence relevant to understanding child knapping behavior. I suggest — based on their distinct technological choices, raw material selections, skill levels, objectives, and behaviors — that most projectile points recovered at the Adelar Pilger site were produced by children. Drawing insights from studies of cognitive development and flintknapping experiments, I suggest that these children were probably of an age younger than about ten years old, due to their lack of an understanding of three-dimensional forms and inability to efficiently thin a flake blank.

SKILL LEVEL AND CHILDHOOD PLAY

The "interaction of children's play activities – 'a repertoire of behaviours in which they are the only or primary actors', as Jane Eva Baxter (2005, 62) puts it – with the archaeological record is not of primary interest and importance in most archaeological reports" (CRAWFORD, 2009:58-59). Notwithstanding, cross-cultural ethnographic studies suggest that children play in all societies and that play and work time form the bulk of children's lives during the day (EMBER & CUNNAR, 2015). Although play and work represent two different types of activities, ethnographic studies of children often report a blurring of what constitutes work and play as they are often more fluid in the daily lives of children (*e.g.*, POLITIS, 1998). Children's play is an expression of their labor to grow up and is fundamental to their adaptive process, and is not necessarily solely a matter of leisure and spare time spent away from a daily routine (LILLEHAMMER, 1989:95).

Play, from a Western point of view, is one of the main characteristic features of modern children (LILLEHAMMER, 1989:94). Interaction with toys represents one of a variety of ways that children play. A problem with identifying toys in the archaeological record however lies in the levels of proof demanded to demonstrate that any artifact was a child-use object, whereas the identification of an adult-use object (e.g., projectile points and pottery fragments) exemplifies the default assumption that artifacts belong to the adult world unless proven otherwise (CRAWFORD, 2009:59). Furthermore, toys can end up being objects that were not necessarily designed to be toys. Children, for example, can play with real knives and real points. When children play with them, they become a kind of toy, however, when adult uses them, they cease to represent a toy. Thus, miniature versions of adult artifacts in Inuit society, for example, were found in three different contexts: as children's toys, as grave offerings of both adults and children, and as a paraphernalia used by shamans (PARK, 2008).

Archaeologically, children's toys represent two different levels of social meaning: instructions from adults, and the redefinition and adaptation by children themselves (DE LUCIA, 2010:609). Therefore, two major types of children's play have been proposed by anthropologists: *adult-structured play*, in which the adult supplies the toys to the children, and *child-structured play*, in which children's play and toys are constructed by the child (BAXTER, 2005; SCHWARTZMAN, 1976).

Furthermore, archaeologists often incorporate and utilize four general topics to explore the presence of children in prehistory through lithic analysis: apprenticeship, learning, play, and imitation (HILDEBRAND, 2012:33). Play is a cultural constraint and a cross-cultural phenomenon that exhibits certain levels of a child's behavioral development, while imitation can in some cases represent a type of play that prepares a child for integration into society's socioeconomic activities (HILDEBRAND, 2012:33). The process of play knapping provides opportunities to practice and develop both

conceptual and motor skills through the process of play within the company of other apprentices in order to fully mastering skills (LILLEHAMMER, 1989). Play is arguably an important time for learning skills and creativity. "Michael Tomasello (1999) distinguishes between learning by emulation, where the learner observes the outcomes of the model's actions and tries to reach the same outcome (goal oriented), and learning by imitation, where the learner observes the sequence of the model's actions and tries to perform the same actions" (GÄRDENFORS & HÖGBERG, 2017:190). However, for the purpose of this paper, the term imitation is used synonymously with emulation since some combination of the two was likely practiced at the Adelar Pilger site.

One of the ways that children play is to imitate the behaviors of adults. Many ethnographic studies have shown that children often mimic adult roles and daily tasks as part of their play (*e.g.,* EMBER & CUNNAR, 2015; KAMEI, 2005; KEITH, 2005; PARK, 1998, 2008; TURNBULL, 1962). The act of imitation requires someone or something to imitate, so one way to observe this type of play in the archaeological record is by inferring the probability that these imitation activities took place in close proximity to locations where adults were working (HÖGBERG, 2008). We can test this hypothesis by identifying the child's imitation activities that took place where experts were producing craft objects. For example, through the imitation of adult flintknapping of finished stone tools such as projectile points, we can search for children's behavior in the archaeological record. It is likely that children would play-imitate the behavior of adults. Their "play" tools would represent a totally different type of artifact then, because of their lack of the more refined art of making finished lithic artifacts (HÖGBERG, 2008). Anders Högberg (2008:128-129) suggests that imitation through play is a different behavior than learning, although the former is tightly connected with the latter. "The role of play in a society may significantly influence the acquisition of knapping skills" (FERGUSON, 2008:56). In addition, knappers with any degree of skill have often learned by observing other knappers (SHEA, 2006:213).

With the understanding that knowledge is not unilaterally transmitted, but that agents shape, interact, and perceive objects in unique ways, I hypothesize that the projectile points at the Adelar Pilger site potentially represent three distinct productions made by: experts, advanced apprentices, and children and/or initial apprentices. For the purpose of this paper, I distinguish the final products manufactured by these three agentive groups as follow:

Experts – For a stone tool to be functional, it is necessary to ensure the complete steps of the *chaîne opératoire*. Each phase of its manufacturing represents goals, specificities, and risks. An expert is able to pass through all phases correctly evaluating all risks, and choosing adequate techniques, gestures, and strengths during all steps of manufacture (RODET & DUARTE, 2010:5). Experts have total domain of their proposed project and successfully follow the necessary steps to produce, with rare exceptions, functional tools (RODET & DUARTE, 2010:5). Their products often follow and reproduce closely a local, canonical, or historical style, while exhibiting flourishes of creativity according to their own tastes and abilities. For Anders Högberg (2008:126), a skilled toolmaker would not use an inadequate technique or method. Having learned the basic principles of the trade, they would no longer approach it as an outsider. Thus, their trials and errors would exhibit flaked materials which are still purposed toward the production of an artifact recognizable as a typological form, and they would not make extreme methodological and technological misinterpretations.

Advanced Apprentices – Advanced apprentices often do not succeed in the most difficult and riskier steps of manufacturing. They also rarely produce the exact object intended due to their lack of training and refined skill (RODET & DUARTE, 2010:5). Their behavior, however, is focused on properly following the methods of an expert, though their skill may be incomplete or lacking definition in its performance.

Children and/or Initial Apprentices – Children and/or initial apprentices lack control over basic technical principles, and their products often reflect in errors in both conception and execution in the knapping process (GRIMM, 2005:54). The child is distinguished by the game-like and non-utilitarian character of poorly knapped pieces, displaying less skill than the advanced apprentice (HÖGBERG, 2008:116-117). The reduction strategies pursued by novices are often incompletely or inadequately conceptualized in the sense that they are often not capable of evaluating the problems presented by the raw materials, the techniques employed, or the problems that appear during manufacture (GRIMM, 2005:54; RODET & DUARTE, 2010:5). As a result, they often produce pieces with different patterns than defined by the standards in their group's industries and, therefore, their final product greatly differs from the expert's artifacts.

ADELAR PILGER SITE

The Adelar Pilger site is located in the city of Harmonia in the Caí River Valley, in the Brazilian state of Rio Grande do Sul (Figure 1), at a current distance of 150 m from the Caí River and 9 m above mean sea level. The site is situated in a sandstone rockshelter measuring 20 m in length, 4.6 m high, and 8.9 m deep (Figure 2b). The rockshelter is now utilized as a cattle den and storage space by the owner Paulo Pilger (DIAS & NEUBAUER, 2010:192).

The site was first registered by the archaeologist Pedro Mentz Ribeiro in 1971, who in the same year excavated two units 1.5x1.5 m each to a maximum depth of 230 cm below surface. The artifactual assemblage from this excavation included a total of 390 lithics and an abundance of faunal remains (DIAS & NEUBAUER, 2010:192).

Adelar Pilger was later excavated by PACA (*Projeto Arqueológico do Rio Caí*, or Caí River Archaeological Project in English) coordinated by Adriana Schmidt Dias (Federal University of Rio Grande do Sul). I participated in the excavations conducted by PACA, which were executed during three seasons with a total of 70 days of field activities in January and July of 2006, and January of 2008. Six 1x1 m units were excavated in the central portion of the rockshelter. This paper will focus on data collected from the excavation conducted by PACA. As previously stated, I analyzed all the 12,700 lithics recovered from our excavation (DIAS & NEUBAUER, 2010).

All screened sediment was collected for flotation in order to identify micro-debitage. This methodology aided in the recovery of microflakes (direct percussion flakes up to 1 cm long), which encompassed 15% of the lithic assemblage (n. 1,901). The graph of the artifactual assemblage by stratigraphic layer in Figure 3 shows that the percentages of direct percussion and bipolar flakes (for definitions see NEUBAUER, 2016:210-211), as well as formal artifacts, remained fairly constant through time. However, there was a considerable decrease of fire-cracked rocks, as well as an increase in frequency of flake fragments and microflakes in the two deepest layers (Figure 3).

Figure 2 - View of: (a) the Adelar Pilger rockshelter site; (b) a close-up of the rockshelter showing its dimensions; (c) the four 1x1 m units (view facing the south wall profile) that were excavated in July, 2006, showing the original floor and wall of the rockshelter in the right and the heavy concentration of hearth features in light gray (Photos: courtesy of Adriana Schmidt Dias).

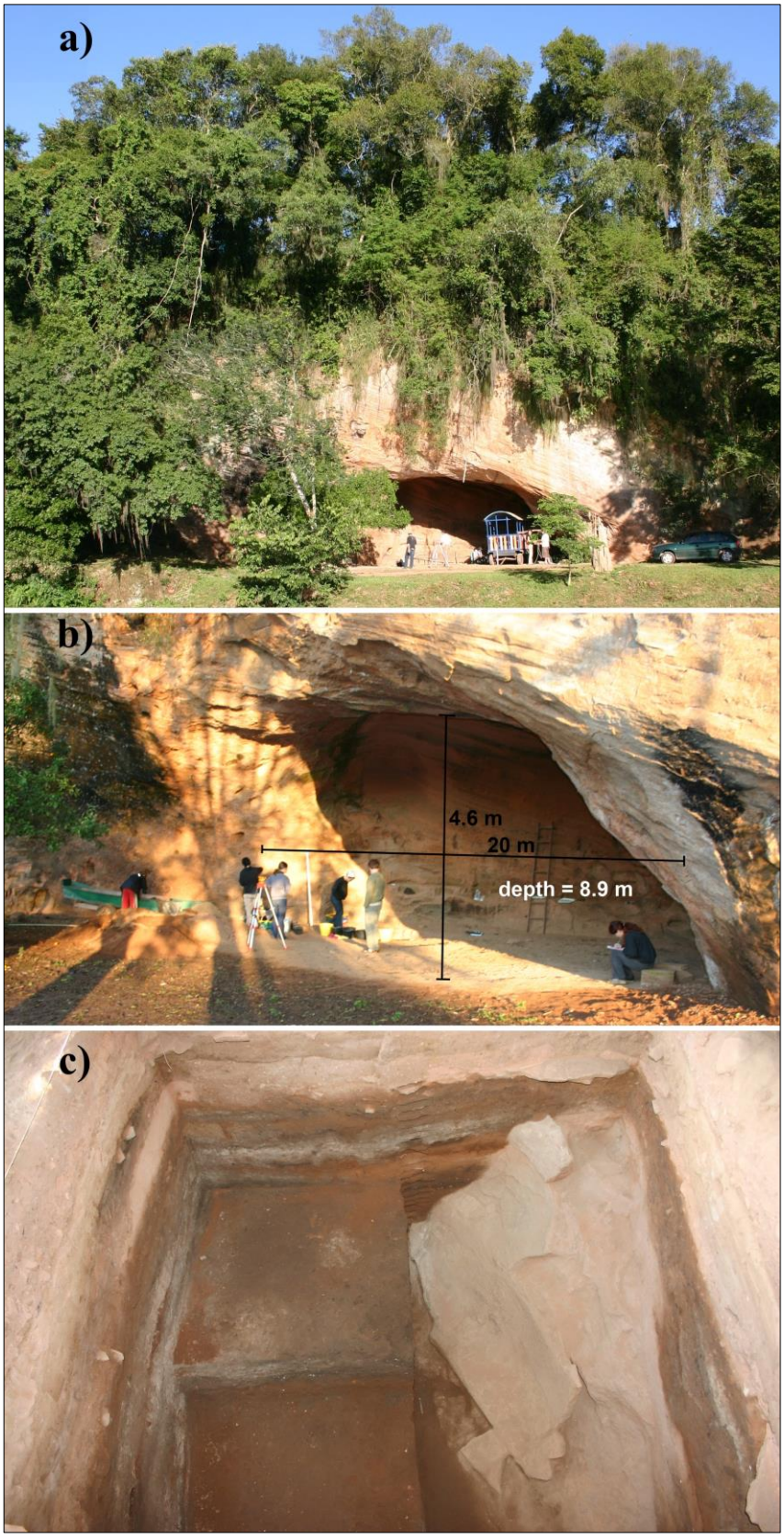
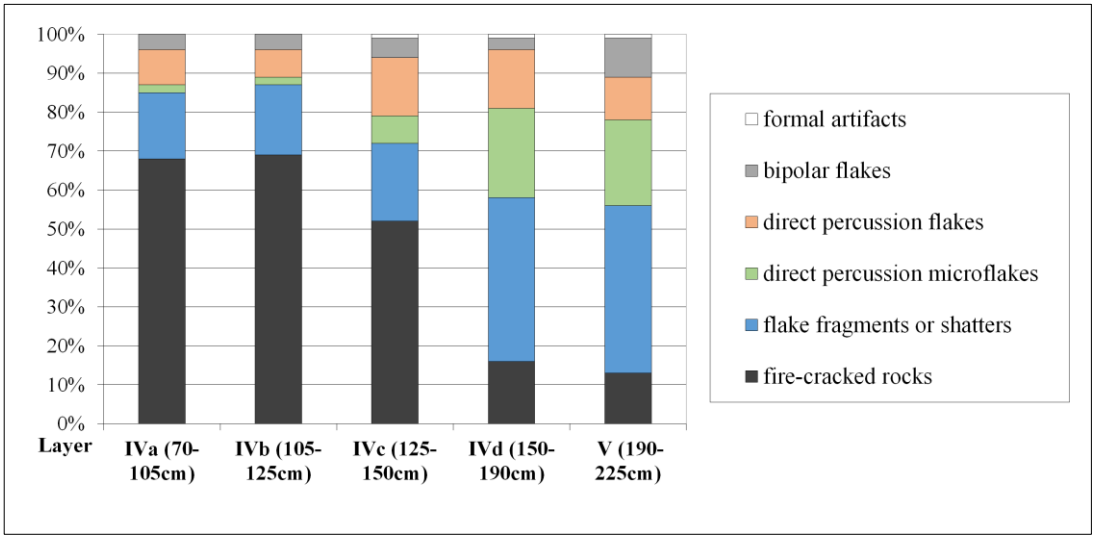


Figure 3 - Flake, formal artifact, and fire-cracked rock distribution by stratigraphic layer (modified from DIAS & NEUBAUER, 2010:Figure 5, and reprinted with permission).



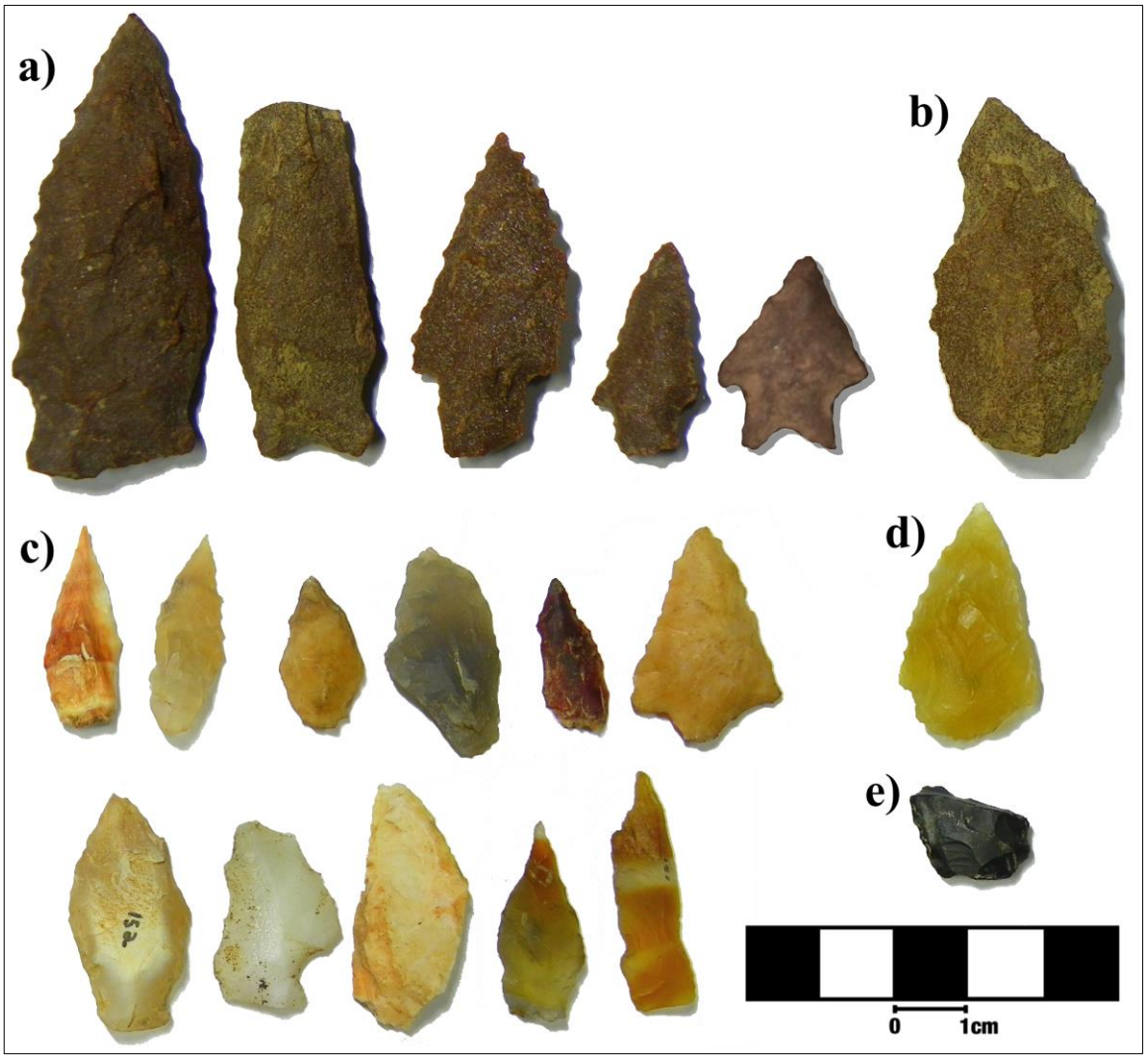
STRATIGRAPHIC CONTEXT

The Adelar Pilger site exhibited a high degree of preservation because of the protection from water and erosion offered by the rockshelter environment. The only recent natural disturbance observed was an armadillo burrow affecting a small portion of two units to a depth of 150 cm. A complex stratigraphy was identified in the site with eight distinct layers, which showed a continuous hunter-gatherer occupation from approximately 8500 (layer V) to 3000 (layer IVa) BP. Four units were excavated to a depth of 225 cm below surface, when the excavation reached the original floor and wall of the shelter (Figure 2c), while two units were only excavated to a depth of 125 cm, because they were open during the last episode of excavation in January, 2008 (DIAS & NEUBAUER, 2010:193-194).

Eighteen complete and broken projectile points (Figure 4) were recovered at the Adelar Pilger site, all of which were manufactured from silicified sandstone (n. 5) or chalcedony (n. 13). Only two points were not recovered in the deepest stratigraphic layers IVd and V. The first point was made of chalcedony and recovered in layer II at 40-45 cm below surface. This layer was created in the beginning of the twentieth century during the removal of earth to level the rockshelter. The second point was made with a high quality chalcedony that was recovered in layer IVa at 95-100 cm below surface. However, this point was broken and only its fragmented base was found (Figure 4e), which provided very limited information on its original morphology and technological production.

Therefore, layers IVd and V are the most important for this paper because the projectile points were found almost exclusively surrounding the hearth features in these stratigraphic layers. Layer IVd (150-190 cm) was radiocarbon-dated to 6150 ±50 BP (Beta 227856; cal 2-sigma BP 7240-6940). The hearth concentrations diminish in this layer and knapping activities increased in frequency compared to the faunal remains that dominated the previous layers (DIAS & NEUBAUER, 2010:194). A total of 5,131 lithic pieces were recovered in layer IVd, including four projectile points made of silicified sandstone and four of chalcedony (Table 1). In addition, this layer is associated with the only preform of a projectile point (Figures 4b and 5e) recovered at the site, manufactured of silicified sandstone.

Figure 4 - Projectile points recovered at the Adelar Pilger site: (a) five silicified sandstone points manufactured by experts; (b) the silicified sandstone projectile point preform made by a skilled knapper; (c) the eleven chalcedony points made by children; (d) the chalcedony projectile point produced by the advanced apprentice; (e) the high quality chalcedony base recovered in layer IVa (Photo: Fernanda Neubauer).



As in the previous layer, knapping activities in layer V (190-225 cm) were the dominant activity, but hearth features are still present. This layer was radiocarbon-dated to 8430 ± 50 BP (Beta 260455; cal 2-sigma BP 9530-9400/9350-9320), 8150 ± 50 BP (Beta 260456; cal 2-sigma BP 9260-9000), and 8010 ± 50 BP (Beta 229583; cal 2-sigma BP 9020-8730) (DIAS & NEUBAUER, 2010:194). A total of 2,493 lithic pieces were recovered in layer V, including seven projectile points made of chalcedony and one of silicified sandstone.

Figure 5 - Illustrations of: (a-d) four experts' projectile points; (e) a projectile point preform manufactured by a skilled artisan; (f) the apprentice's projectile point (modified from DIAS & NEUBAUER, 2010:Figure 4, and reprinted with permission).

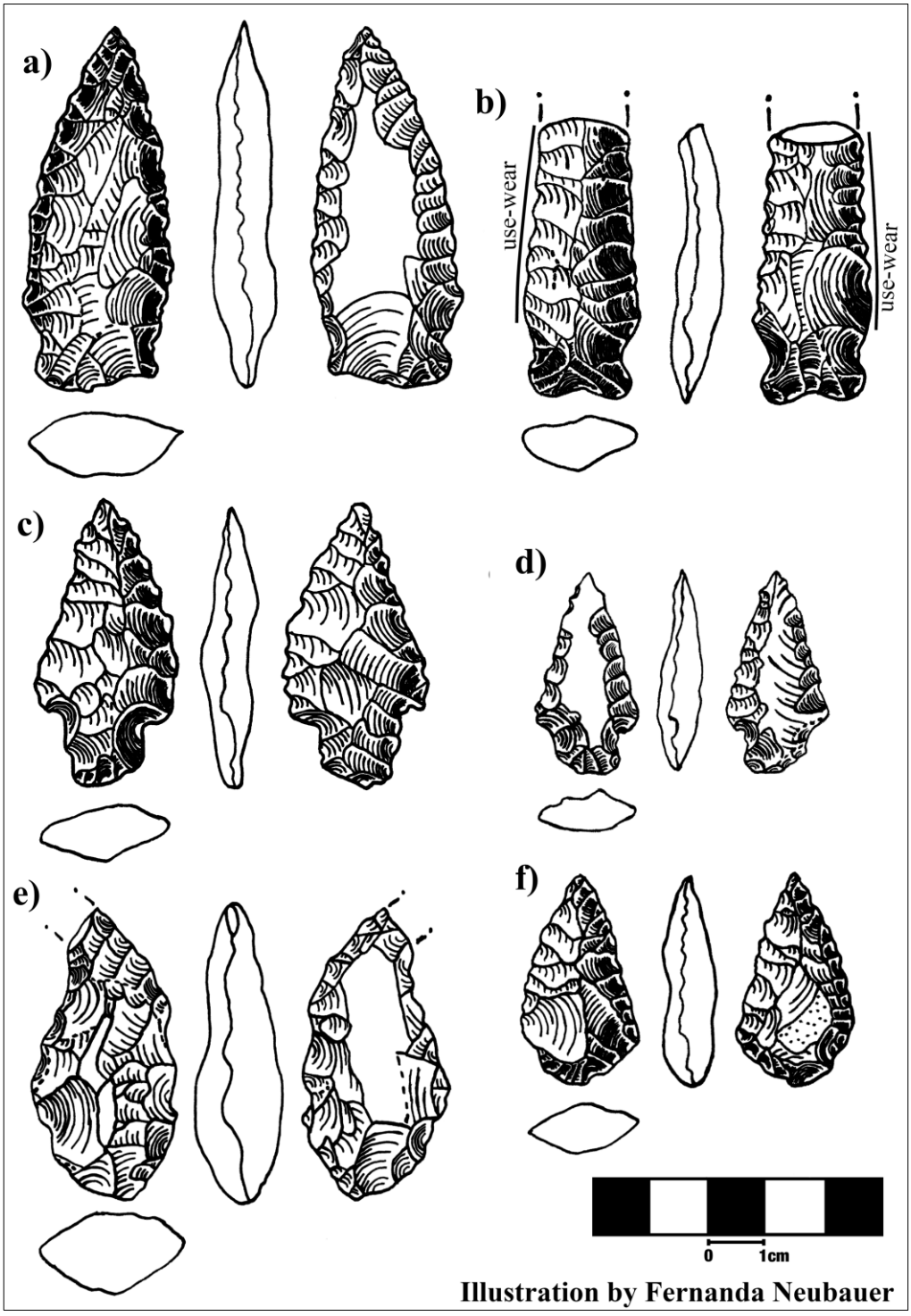


Table 1 - Flintknapped silicified sandstone and chalcedony techno-typologies recovered in stratigraphic layers IVd and V.

	Layer IVd		Layer V		
	Silicified Sandstone	Chalcedony	Silicified Sandstone	Chalcedony	Total
Direct percussion microflakes (smaller than 1 cm long)	1013	56	363	120	1552
Direct percussion flakes larger than 1cm long	637	21	177	33	868
Bipolar flakes		158		191	349
Direct percussion cores		1		1	2
Bipolar cores		8		3	11
Unifaces	2				2
Bifaces	1			1	2
Flake fragments and shatter	1495	401	519	386	2801
Stemmed "micro-scraper"				1	1
Projectile point preforms	1				1
Projectile points	4	4	1	7	16
Total	**3153**	**649**	**1060**	**743**	**5605**

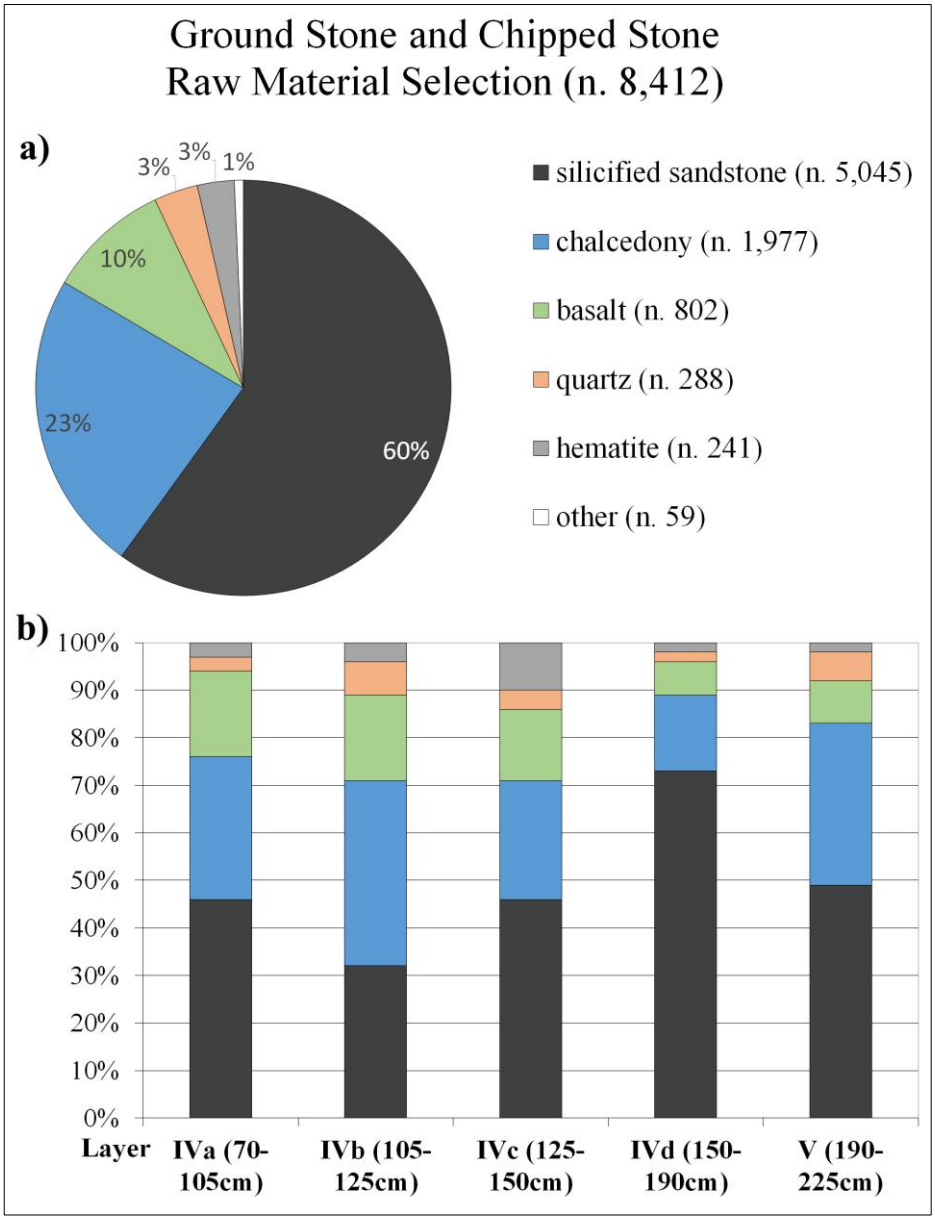
RAW MATERIAL SELECTION

The geology of the Caí River Valley region is characterized by the Botucatu Formation, which consists of eolian sandstones. Below this formation are the basalts from the Serra Geral Formation. The holes present in the basalts were filled totally or partially by quartz, chalcedony, calcite, and zeolite. Silicified sandstone was formed through the contact of the basalt lava and sandstone. Because of the intense erosive action on the slopes of the Serra Geral Formation, these raw materials can be found spread throughout the landscape due to the actions of the water and wind, after they have become separated from the outcrop (LEINZ & AMARAL, 1989 *apud* DIAS, 2007:38).

Among the lithic raw material selection (Figure 6a), silicified sandstone was the most utilized for flintkapping at the Adelar Pilger site, representing a total of 59% of the assemblage. Chalcedony was the second most popular raw material with 24%, followed by basalt, with 10%, and by quartz and hematite, with 3% each. Other types of raw material encompassed only 1% of the assemblage. This indicates that, with the exception of hematite, all raw materials recovered at the Adelar Pilger site can be found in the Caí River Valley and its surrounding regions. Therefore, the raw material selection at the site was the result of a strategy that privileged the most local abundant resources.

The distribution of raw material through the stratigraphic layers display similar patterns, with the exception of the increase in frequency of hematite in layer IVc and of silicified sandstone in layer IVd, and the decrease of chalcedony also in layer IVd (Figure 6b).

Figure 6 - Raw material selection at the Adelar Pilger site: (a) total percentage of chipped stone and ground stone; and (b) their distribution by stratigraphic layer (modified from DIAS & NEUBAUER, 2010:Figure 3, and reprinted with permission).



Projectile points

I suggest that there is only one projectile point that can be related to the work of an advanced apprentice, which was made of chalcedony and identified in layer V (Figures 4d and 5f). The other eleven complete or almost complete chalcedony projectile points were most likely the products of children and/or initial apprentices' manufacture (Figures 4c and 7).

In contrast to the raw material selection of chalcedony by children and apprentices, I suggest that all five silicified sandstone projectile points (Figures 4a and 5a-d) at the Adelar Pilger site have been manufactured by experts. Two were made by very skilled knappers, including the point that has a broken tip and exhibit a pronounced rounding use-wear edge that was visible macrospocically (Figure 5b). Furthermore, the silicified sandstone preform of a projectile point (Figures 4b and 5e) seems to represent a step in

the work of a skilled craftsperson's production, although it was abandoned without being finished.

Therefore, I suggest that children and the advanced apprentice at the site were flintknapping chalcedony projectile points while silicified sandstone was restricted to expert's work. Debitage recovered at the site represents all steps of the manufacturing process of projectile points from both silificied sandstone and chalcedony. Therefore, I suggest that all, or nearly all, of the recovered projectile points were manufactured *in situ*. Because of their functionality, expert's projectile points often disappear from the archaeological record (RODET & DUARTE, 2010:5). I calculated the ratio of the amount of direct percussion flakes for each point recovered in the stratigraphic layers IVd and V (Table 2). In layer IVd, 1,650 silicified sandstone flakes were recovered along with 5 projectile points/preforms manufactured, indicating a ratio of 330 flakes for each projectile point/preform. In the same layer, there were 77 direct percussion flakes of chalcedony recovered along with 4 chalcedony projectile points, indicating a ratio of 19 flakes for each point (Table 2).

Table 2 - Direct percussion flakes and projectile point/preform ratios in the stratigraphic layers IVd and V.

Layer IVd		Layer V		Layers IVd and V	
Silicified Sandstone	Chalcedony	Silicified Sandstone	Chalcedony	Silicified Sandstone	Chalcedony
1650	77	540	153	2190	230
5	4	1	7	6	11
330:1	19:1	540:1	22:1	365:1	21:1

Layer V displays similar results (Table 2), with a ratio of 540 silicified sandstone flakes for each projectile point (540 flakes and 1 projectile point), and a ratio of 22 flakes for each chalcedony projectile point (153 flakes and 7 projectile points). These results indicate that the majority of the projectile points manufactured from silicified sandstone were intended to be used somewhere else, while the chalcedony projectile points were being discarded at the site after manufacturing, probably without being used. I suggest that the chalcedony projectile points, unlike the silicified sandstone points, were not being manufactured for the purpose of functioning in a utilitarian sense.

As mentioned previously, both silicified sandstone and chalcedony raw materials can be found in abundance in the region, so why were the children and apprentices at the Adelar Pilger site only knapping chalcedony while the experts chose to use silicified sandstone instead? The probable answer to this question is related to the workability and ease of flaking the two materials. For the advanced apprentice, silicified sandstone would not be the desirable material to start learning the technique, because to work this type of raw material great skill, control, and strength is needed. Chalcedony on the other hand is more glass-like, but does not shatter as easily as quartz that is also available in the region, which would make of this raw material the best to play and learn with because it is easier to flake and shape. For experts though, who were manufacturing points for use, silicified sandstone, although harder to work, is much stronger than chalcedony and would be more resistant to breakage during use.

EXPERIMENTAL FLINTKNAPPING STUDIES

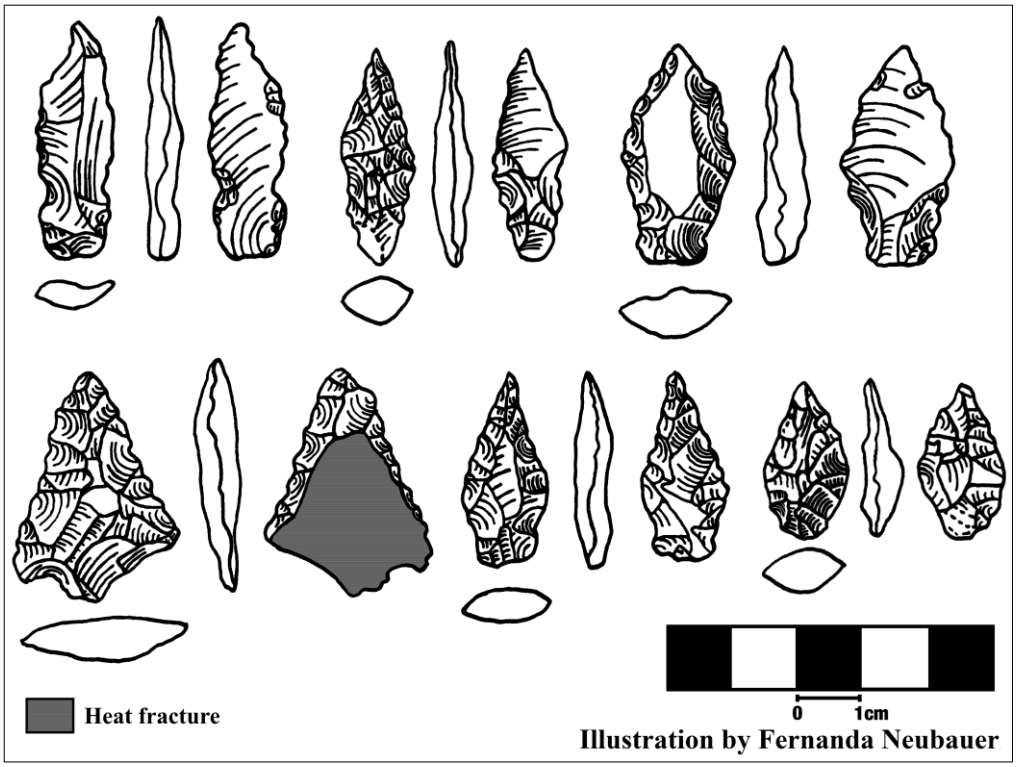
Jeffrey Ferguson's (2008:62) knapping experiments reveal some useful insights:

> I have performed numerous demonstrations for elementary school age children in formal classroom settings as well as informal summer camps. When I first began doing these demonstrations I allowed a few of the teachers to convince me to let the children try basic pressure flaking. After hours of instruction, almost all children younger than about 10 years old were incapable of producing flakes long enough to actually thin a flake blank. In contrast, a 50-year-old retired custom bike builder with no previous knapping experience was able to produce long pressure flakes on his very first attempt with less than a minute of verbal instruction and the demonstration of only one flake removal.

At the Adelar Pilger site, both experts and the advanced apprentice started the production of their projectile point with thick flakes that could be thinned and shaped. They were also able to take flakes across the middle section of the piece, an important and difficult step to successfully thin and shape the point, but the advanced apprentice made a number of technological mistakes. The advanced apprentice was able to shape her/his point symmetrically, but struggled to thickened the bottom of the piece and to manufacture its base, and was unable to completely remove the natural surface (cortex) and to finally shape the tool for its intended function (Figures 4d and 5f). Unlike the experts and the advanced apprentice though, children and/or initial apprentices were for the most part, unable to produce flakes that extend across the center of the piece, and they often consistently used the ventral surface as striking platform (Figures 4c and 7). Children and/or initial apprentices also produced asymmetrical points to varying degrees, depending on their skill level, which would make them, according to Gustavo Politis (1998:15), aerodynamically inefficient and, therefore, unsuitable for the point of a throwing weapon like an arrow or spear point. Politis (1998:15) identified projectile points from prehistoric hunter-gatherer sites in Argentina that were also smaller in size, asymmetrical, and recovered in association with their counterparts within the same context. He interpreted these points as the products of children.

Moreover, the children's projectile points at the Adelar Pilger site showed a different behavior than the expert and apprentice's, and appear to resemble the artifacts produced by a six year old boy in the experiment conducted by Mikkel Sørensen at the National Museum in Copenhagen, Denmark (STERNKE & SØRENSEN, 2009). During a week, Sørensen asked the six year old son of the museum staff to sit beside him while he was knapping. Sørensen did not give any instruction to the boy on how to flake. The boy imitated Sørensen's work, asked questions, observed, and tried to knap as Sørensen did. The boy also looked at the artifacts displayed in the museum exhibit and tried to copy them while knapping. The results of his flintknapping and imitation pieces were shaped to look like prehistoric artifacts, but lack all significant technological attributes. His pieces were knapped from one side with a direct percussion technology, consistently using the ventral surface as striking platform. While his artifacts resembled prehistoric tools, the technology was incorrect. The boy was able to imitate the form and shape only, but not the technology (for examples of the boy's tools see Figures 1 and 2 in HÖGBERG, 2008:118-119).

Figure 7 - Illustrated examples of projectile points made by children and/or initial apprentices.



Based on the results of this and other experiments involving child flintknapping behavior conducted by Farina Sternke & Mikkel Sørensen (2009), the authors concluded that children tend to: produce two-dimensional designs in the sense that their tools are flatter in profile view, vary greatly from the experts' standardization, and pay more attention to the morphology of the formal tools they are trying to manufacture (*i.e.*, they try to utilize flake blanks that are morphologically similar to the formal tools they are trying to replicate rather than attempting to shape a flake).

That is likely the same behavior of the children at the Adelar Pilger site who imitated the form and shape of the projectile points but could not reproduce its technology, or did not hold this as their primary goal. The children at the site appear to be more interested in playing or performing flintknapping as a game than actually learning the technology. Playing to build something is often directed toward the goal of creating an object that children have in their mind, which in the Adelar Pilger site case, was the projectile point shape. But the primary objective of such play is the act of creating the object, not the desire to have the actual object. This suggests that the process of manufacture, not the final product is what motivates the play (GRAY, 2009:481). This fact is also evident in their choice of flakes to start their projectile point game. The majority are very small and thin with shapes that already resemble a projectile point, and as I stated earlier, they consistently used the ventral face as a striking platform, like the 6 year old boy in Sørensen's knapping experiment (Figure 7).

Thus, John Shea (2006:214) suggests that "stone tools made or used by children are likely to be relatively small, to fit the small hands of their makers or users". Furthermore, Gustavo Politis (1998) observed, during his etnoarchaeological studies among the *Nukak* hunter-gatherers of the Colombian Amazon, that the size of the objects made for or by children is often proportional to the size of the child who will play with or use them. Similarly, Martin Gusinde (1983) describes that parents among the *Yámanas* of the Southern Cone of South America teach their children to make artifacts, including

projectile points, from the age of three and that their hunting tools and weapons increase in size proportionally to a child's size. The children and/or initial apprentices's points at Adelar Pilger site were much smaller than the experts, with a mean length of 2.9 cm, in contrast to 4.4 cm of the experts' points and 3.4 cm of the advanced apprentice (Table 3).

Table 3 - Average dimensions of the projectile points made by experts, advanced apprentice, and children and/or initial apprentices.

Average Dimensions (cm)	Length	Width	Thickness
Children and/or initial apprentices	2,9	1,4	0,5
Advanced apprentice	3,4	1,9	0,8
Experts	4,4	2,1	0,8

Also, from eleven of the children's projectile points, four were collected from the hearth, because they showed heat fractures (*e.g.*, Figure 7, bottom left) from before knapping had commenced (for a discussion of the various use-alteration patterns of fire-cracked rocks see NEUBAUER, 2018). Flintknapping fire-cracked rocks was an exclusive behavior of children at the Adelar Pilger site, a choice not identified in the experts and the advanced apprentice's points. A skilled person would not use an inadequate technique or method, such as the use of fire-cracked rocks to manufacture projectile points for example, and their points would not exhibit extreme methodological and technological errors, such as those observed in the children's points, who chose thin flakes that could not be worked and thinned to further shape them into a more three-dimensional projectile point design.

COGNITIVE DEVELOPMENTAL STUDIES

Jennie Hawcroft & Robin Dennell (2000) conducted cognitive skill tests on 300 children, ranging in age from 5 to 11 years old, in a primary school setting. Two of their tests were undertaken to determine the strength of a child to detach a flake and their ability to produce three-dimensional shapes. The strength test referred to whether or not the child would be physically capable of hitting a target that represented a lithic nodule hard enough to detach a flake. Their results showed that only a few of the very youngest children lacked the ability to detach flakes. They concluded that this was probably because of the children's lack of focus rather than the lack of strength to detach a flake.

Jennie Hawcroft & Robin Dennell's (2000:97) shape test results indicate that:

> two-dimensional drawing was well within the capabilities of the youngest children (the youngest being aged 5) and that this skill was already fairly accomplished, improving only gradually as age increased. Three-dimensional modelling skills, however, were not well grasped at the level of 5 and 6 year olds, but showed a significant improvement amongst the 7 and 8 years olds, with the skill fully grasped by the 10 and 11 year old group.

This research has implications for the study of some lithic tools, such as projectile points, because their creation is a process that involves three-dimensional skills. Very young children would not be able to fully comprehend how to make projectile points because of their lack of such skills, although they would be able to create two-dimensional designs (HAWCROFT & DENNELL, 2000:98). The children's projectile points at the Adelar Pilger site were flatter in profile view and displayed a lack of three-dimensional modeling skills, while all the points manufactured by the experts and the advanced apprentice exhibited a more clearly three-dimensional depth.

Of course we have to acknowledge that the main problem with comparing prehistoric children to knapping experiments with modern children is that stone working is not encountered in the daily lives of modern children. Ancient children would have perceived lithic manufacture and use as a common task that was culturally embedded in their everyday lives. Even so, I argue that prehistoric children would exhibit some of the same patterns and a similar cognitive trajectory as any other human child, especially in terms of their physical limitations (e.g., size, strength, hand-eye coordination).

DISCUSSION

I suggest that the objectives of experts, advanced apprentice, and children for manufacturing projectile points differ technologically and morphologically at the Adelar Pilger site, according to the differential goals and abilities of the artisans. The experts were likely manufacturing the projectile points with the primary goal of making tools that could be utilized (Figures 4a and 5a-d). The only projectile point that exhibits discernible macroscopic signs of use, visible through heavy polishing on one of the piece's edges from wear, is made of silicified sandstone (Figure 5b).

In contrast, the advanced apprentice's primary goal was probably to learn the technology of projectile point manufacturing, but her/his final product led to mistakes during the production process (Figures 4d and 5f).

Children on the other hand, were probably not trying to learn the technology nor manufacturing it for the primary purpose of making usable tools. Most of the children's projectile points (Figures 4c and 7) appear to have been produced for the purpose of imitating the shape of the expert's projectile points, not their technology, as a way of playing or for entertainment in the form of a game.

In contrast to the children's points, the experts' points are larger in size (Table 3), exhibit more flake scars in both ventral and dorsal sides, are symmetrically shaped and thicker than the children's, and they all have stemmed bases. Furthermore, the children's points at the Adelar Pilger site have a flat profile, while all the points made by experts and the advanced apprentice were executed with a more three-dimensional depth. Based on this apparent aesthetic gap and their inability to produce flakes that extended across the center of the piece, I suggest that the children at Adelar Pilger who were producing projectile points as play were probably younger than ten years old and that the advanced apprentice and experts were of an age older than ten.

Although I acknowledge that the sample size of this analysis was limited to the number of projectile points found at the small rockshelter site by our excavations (DIAS & NEUBAUER, 2010),

I suggest some general patterns of behaviors and products of children at the Adelar Pilger site. Children at Adelar Pilger often:

1. were incapable of evaluating and recovering from problems that appeared during manufacture;
2. had difficulty thinning tools (they could not produce flakes that crossed the mid section of pieces);
3. chose to knap raw materials that were more glass-like and easier to work (which differed from the experts' choices);
4. chose to knap flakes that already resembled the tools they were trying to imitate (triangular flakes resembling point shapes);
5. were only able to replicate the general form or profile of tools, not the correct technology;

6. consistently used the ventral surface as striking platform;

7. worked where adults and/or experts were working (around the fire by way of imitation);

8. discarded their tools in their place of manufacture, without signs of use;

9. produced tools that were asymmetrical and deviated the standard style of their group;

10. produced smaller-sized points in comparison to the counterparts produced by the advanced apprentice and experts; and finally,

11. produced tool shapes that lacked three-dimensional modeling skills and were flatter in profile view.

CONCLUSION

Children represent a major component of social groups, both in number and influence. Therefore, it should be expected that they played a relevant role in the creation of the archaeological record, even though we as archaeologists struggle to identify and interpret their impacts upon the material record. In seeking to understand the many roles that children have played, this paper contrasted lithic tools created by children and/or initial apprentices with the products of experts and more skilled flintknappers.

An important theme throughout this paper is an appreciation of child agents in archaeology. Evidence of children in the archaeological record can be potentially enhanced with studies of lithic technology and by experimental and cognitive developmental approaches. Using the study of eighteen projectile points and one projectile point preform from the Adelar Pilger site as a case, this paper highlighted one possible way that children can be made visible in the archaeological record through the study of lithics. By linking decisions related to raw material selection with the aesthetic and technological properties of projectile points, I have identified three types of points potentially made by expert knappers, advanced apprentices, and children and/or initial apprentices.

The raw material selection at the Adelar Pilger site indicates that experts there were utilizing silicified sandstone while the apprentices and children chose to knap chalcedony. Thus, the experts were manufacturing functional projectile points and the majority of their points were taken somewhere else to be utilized, and were not discarded at the site.

In contrast, the purpose of the advanced apprentice was to support her/his acquisition of the understanding of the technology of manufacture, not necessarily to make a usable tool. The final product made by the advanced apprentice shows that the technology was successful until the final and most difficult steps of removing the natural surface completely and thinning the projectile point base for shaping.

I suggested that most children, on the other hand, were producing projectile points around the fire as a form of play imitation of adults' and/or experts' knapping activities. Through their play, children were able to roughly imitate formal projectile point shapes but could not properly and skillfully reproduce the tools in a three dimensional or technological sense. As such, their tools were often made from fire-cracked rock that was available around the fire, and discarded there at the place of manufacture after their play had concluded, without having been used beyond that.

I hope that, by isolating the formal artifacts produced by experts, future studies can investigate the technological sequence of projectile point production, as well as regional and temporal variations, which could serve as models for comparative studies with hunter-gatherer settlement sites in South America. Such comparisons will be crucial to

understanding early hunter-gatherer technology and migrational movements throughout the landscape.

ACKNOWLEDGMENTS

This research was made possible by the financial support of the *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (grant n. BEX 5646-10-3), and the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (research scholarship PIBIC/CNPq UFRGS). I thank Sarah Clayton, James M. Skibo, and the lab and field team for their comments and/or contributions during the elaboration of this paper. I also thank Michael J. Schaefer for contributing to, editing, and commenting on all drafts. I am very grateful to the reviewers Jane Eva Baxter and Anders Högberg for providing comments that greatly improved this manuscript. Finally, I would like to thank Adriana Schmidt Dias for the courtesy of using Figure 2, and Diana Leonis Mazzanti and Mónica Berón, editors of the journal *Cazadores Recolectores del Cono Sur: Revista de Arqueología*, for granting permission to reprint adaptations of Figures 3, 5, and 6b.

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