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ARTICLE

## APPROACHES TO CHILDREN'S KNAPPING IN LITHIC TECHNOLOGY STUDIES

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### ABSTRACT

This text gives an overview of how lithic technology studies have approached the topic of finding and interpreting the work of children in lithic assemblages. It focuses on examples from Scandinavian and European contexts. A selection of published studies is presented. Methods used in lithic technology studies and results from these studies are discussed. Achievements made and obstacles that still needs to be resolved by future research are discussed.

**Keywords:** Children; Lithic; Assemblages.

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## ABORDAGENS PARA O LASCAMENTO DE CRIANÇAS EM ESTUDOS DE TECNOLOGIA LÍTICA

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### RESUMO

Este texto fornece uma visão geral de como os estudos de tecnologia lítica abordaram o tópico de encontrar e interpretar o trabalho de crianças em conjuntos líticos. Centra-se em exemplos de contextos escandinavos e europeus. Uma seleção de estudos publicados é apresentada. Métodos utilizados em estudos de tecnologia lítica e os resultados desses estudos são discutidos. Conquistas feitas e obstáculos que ainda precisam ser resolvidos por pesquisas futuras são também discutidos.

**Palavras-chave:** Crianças; Lítico; Conjuntos.

## ENFOQUES PARA LA TALLA INFANTIL EN ESTUDIOS DE TECNOLOGÍA LÍTICA

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### RESUMEN

Este texto ofrece una visión general de cómo los estudios de tecnología lítica han abordado el tema de encontrar e interpretar el trabajo de los niños en conjuntos líticos. Se centra en ejemplos de contextos escandinavos y europeos. Se presenta una selección de estudios publicados. Se discuten los métodos utilizados en los estudios de tecnología lítica y los resultados de estos estudios. Se discuten los logros alcanzados y los obstáculos que aún deben ser resueltos por investigaciones futuras..

**Palabras clave:** Niños; Lítico; Conjuntos.

[...] we know that to some extent all societies are structured in certain ways because of the presence of children [...] this argues that analyses are likely to not just be incomplete, but may actually be flawed, if children are missing (KAMP, 2015:167).

## INTRODUCTION

Without children there is no inter-generational continuity of life and culture. As humans live on earth today, it is an empirical (and banal) fact that children must have been born, raised, grown into adults and had their own children throughout the deep time of human evolution and prehistory. Children were present in prehistory. Whether or not archaeologists acknowledge this in their research, children have without exception made up a large share of prehistoric populations. Therefore, things done by children, with children and for children have had impact on the archaeological record (KAMP, 2006). As Lillehammer (1979) and Hammond and Hammond (1981) recognized almost 40 years ago, this fact was largely overlooked by a mass of archaeological work done since archaeology became an interpretative theoretical practice on its own. And it still is (see KAMP, 2001, 2006, 2015 for extensive discussion).

Although earlier studies raised questions of how to identify children in the archaeological record (LILLEHAMMER, 1979) and in lithic tool production (LILLEHAMMER, 1982; KNUTSSON, 1983), Lillehammer's influential article "A child is born" from 1989 (LILLEHAMMER, 1989) is seen by many as the start of childhood research within archaeology (e.g. BAXTER, 2006; SCHWARTZMAN, 2006; KAMP, 2001, 2006, 2015; CUNNAR & HÖGBERG, 2015; LILLEHAMMER, 2015). Anyone who has read Lillehammer's discussion on the importance of including children and childhood as topics for interpretative archaeology, will have difficulties ignoring children as a substantial part of past societies, and, as such, important contributors to the archaeological record we excavate and interpret. This is also something that has been well investigated since Lillehammer's article was published (e.g. MOORE & SCOTT, 1997; SOFAER DEREVENSKI, 2000; KAMP, 2001, 2006; BAXTER, 2005, 2006; DOMMASNES & WRIGGLESWORTH, 2008; LILLEHAMMER, 2010; FAHLANDER, 2011; LANCY, 2017).

If we bear in mind that children throughout prehistory (and in more recent times as well) have been "playing" stone knapping by copying adults work and have learnt how to produce stone tools to master technologies – or just have been banging stones together for the fun of it – it is easy to conclude that children are responsible for a large portion of the knapped stone left for archaeologists to examine (SHEA, 2006). A massive number of stones must have been shattered, over time, generating huge amounts of waste. If we consider that a great number of children have been knapping stone since the time of the first evidence of stone tool production 3.3 million years ago (HARMAND *et al.*, 2015; SHEA, 2017), and have done so up till present day, the amount of waste generated by children throughout prehistory is unimaginably large (STAPERT, 2007; HÖGBERG & GÄRDENFORS, 2015). Hence, it is easy to conclude that much of the stones archaeologists touch at excavations and in collections are the results of children's work.

In this text I will give examples of how lithic technology studies have approached the topic of finding and interpreting the work of children in lithic assemblages. I focus on examples from Scandinavian and European contexts (for a similar approach see GRIMM, 2000, and for a similar approach with a slightly different geographical focus, see HILDEBRAND, 2012; GOLDSTEIN 2018, see also NEUBAUER, this volume). Here I use the concepts child(ren) and adult(s). I am aware of the ambiguity of these terms (see FINLAY, 1997; FERGUSON, 2008 for discussion in relation to stone tool production)

but I have here chosen not to discuss them further. Instead I direct interested readers to the works by e.g. Schwartzman (1978), Sofaer Derevenski (2000), Kamp (2001), Baxter (2005), or Lillehammer (2015) for in-depth theoretical considerations.

## SIZE MATTERS

From an abundance of ethnographic or anthropological studies we find examples of tools used by children – as toys or for other purposes – that are of smaller size than tools used by adults (SCHWARTZMAN, 1978; PARK, 1998). Thalbitzer (1914), for example, showed how Inuit children made miniaturized hunting weapons to use for hunting practice. Another example is Ember and Cunnar's (2015) study of miniaturized artifacts used by children as toys. Inspired by ethnography and anthropology, archaeologists have presented several examples of small artifacts interpreted as miniatures used by children for play and exercise (for early Scandinavian examples, see VINSRYGG, 1979; JOHANSEN, 1986. See also KAMP, 2001; CRAWFORD, 2009; LANGLEY, 2017; RIEDE *et al.*, 2018; for discussions).

Size has also been used in lithic technology studies to explore possible traces of work done by children. An early example is a text by Knutsson (1983) in which he discusses the fact that children's activities in one way or another must be present in lithic assemblages from Stone Age sites (KNUTSSON, 1983). With reference to ethnographic studies, he puts forward the hypothesis that children's tools are probably smaller than adults'. In this way children's tools can be recognized in an archaeological assemblage through their size.

In a text from 1986 Knutsson tests his hypothesis from 1983. He does so in a study of bipolar cores from a north Swedish Stone Age site. This is one of the earliest examples of studies exploring child-knapping as an interpretative explanation for material culture analysis. In a discussion of the size of these cores Knutsson puts forward the idea that small cores may have been used by children. The argument is that the cores are so small that they could only have been held in place by small hands during knapping. An adult's hand, according to Knutsson's hypothesis, is simply too big to hold the small bipolar cores against an anvil when knapping (KNUTSSON, 1986), a hypothesis similar to what Shea (2006) presented 30 years later. Based on this premises, Knutsson concluded that there were no traces of children knapping in the assemblage he studied. More recent studies have shown that miniaturization of bipolar cores is a phenomenon related to factors such as raw material availability and style rather than as an indicator of child-knapping (PARGETER & EREN, 2017; PARGETER *et al.*, 2018).

Since Knutsson published his study, others have elaborated on size of lithic artifacts as basis for analysis of children's activities (e.g. SHEA, 2006; STAPERT, 2007; JOHANSEN & STAPERT, 2008). Small tools are interpreted as toys or other forms of children's material culture. As discussed by Finlay (2008) and Shea (2006), the difficulty with this approach is that "there are many other reasons why adult technological strategies might emphasize the production of small tools, including raw material scarcity, transport efficiency, and the use of hafted tools" (SHEA, 2006:214; see also discussion in JOHANSEN & STAPERT, 2008). Consequently, if size is to be used as a variable for finding the result of children's activities in lithic assemblages, methods need to be developed that take into account other possible reasons for making small tools that might exist in a society. As we will see below, other ways of finding traces of children's work in lithic assemblages have been developed.

## STUDIES OF CHILDREN PLAYING WITH STONES AND LEARNING TO KNAP

Fischer's lithic technology analysis of a flint assemblage from a late Palaeolithic dwelling site in Denmark (FISCHER, 1990) is the first extensive study presented from Scandinavia that discusses the work of a child knapping stone. The study is based on detailed site excavation, refitting, analysis of horizontal distribution of each refitted specimen and an estimation of the technological skill represented in the assemblage. Fischer concludes that blades were produced at the site, using locally available flint nodules as raw material. Two discrete clusters of knapping waste were analyzed. Comparing refitted units from these clusters, Fischer deduced that one of the clusters represents good craftsmanship. The waste products from the expert's work were found close to a boulder, interpreted as a sitting place for knapping. An expert knapper has been working here. About 1.5 meters away from the boulder, other refitted units show less skill in knapping performance. The techniques used here are the same as used by the expert knapper, but the performance of the technique is described as less precise and developed. Trimming of platforms was done less frequently and without precision, and blows applied with a hammer-stone had been delivered with less precision and accuracy in hitting the core. Fischer (1990:44) concludes that "obviously we are here dealing with the traces of an untrained flint knapper – i.e. a child." Fischer (1990), however, does not discuss skill levels in his analysis. Instead he makes a judgment of the waste from what he sees as the expert knapper: "Based on the author's experience as a flint knapper, the craftsman responsible for the refitted unit must be classified as careful, patient and highly skilled" (FISCHER, 1990:41). From the distribution pattern of the cluster, Fischer concludes that "the face of the young flint knapper has been oriented [...] towards the seat of 'the master knapper'" (FISCHER, 1990:45), and consequently he labels the site "a late Palaeolithic school of flint knapping." A later publication (DONAHUE & FISCHER, 2015) confirms these results, and also discusses the presence of a third knapper at the site, described as a "moderately qualified knapper" (DONAHUE & FISCHER, 2015:321).

Broadly contemporary with Fischer's (1990) publication, results from excavations of late Magdalenian sites at the Paris Basin in France were published. Several of these studies present results from extensive refitting analysis, where children's work as knappers is discussed (see STAPERT, 2007; GRIMM, 2000, with references). Two studies that are often referred to, and perhaps also have become trend-setting, are Pigeot's (1990) and Karlin and Julien's (1994). These studies are similar in their styles (see also BODU *et al.*, 1990). Both use a chaîne opératoire approach with technological analysis, raw material analysis, refitting work and site distribution analysis to examine levels of expertise in blade production. Different types of products are interpreted as having been produced by knappers of different skill levels, from experienced to beginners. Both Pigeot (1990) and Karlin and Julien (1994) demonstrate that blades produced by the least knowledgeable and experienced knappers were not secondarily utilized in tool production. Instead, the whole production remained at the knapping area. This was compared with the work of the experienced knappers, parts of whose production were removed from the knapping area for use in tool production (PIGEOT, 1990; KARLIN & JULIEN, 1994). The inexperienced knappers' work were evidently not intended to be used secondarily. Its significance lay rather in the element of practice.

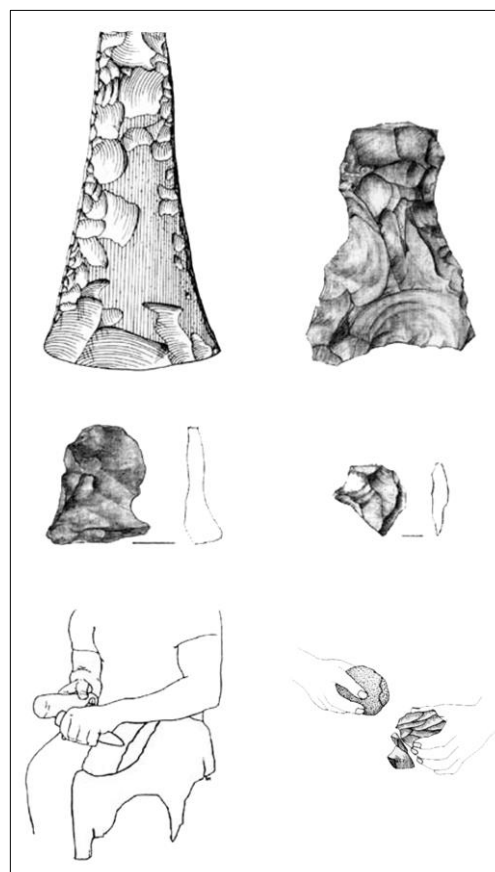
In an approach similar to that of Pigeot (1990) and Karlin and Julien (1994), Grimm presents a study of the French Upper Palaeolithic site of Solvieux (GRIMM, 2000). Applying a chaîne opératoire approach, she analyzes qualities of blade core reduction together with refitting and site distribution analysis to interpret children's work at the site. Grimm also provides an extensive in-depth theoretical discussion of social life and considers aspects of who (age and gender) might have been working at the site and what

implications this might have for archaeological interpretation of Upper Palaeolithic family life and site function (for a comparable theoretical discussion, see PIGEOT, 1990; FINLAY, 1997).

Johansen and Stapert (2000, 2008) present a refitting study of assemblages from Palaeolithic and Mesolithic sites in northern Netherlands and Denmark. Based on identification of poor standards of knapping in refitted groups of flint pieces, together with a discussion of spatial arrangement at sites, they speculate that some of the knappers identified as responsible for the work were children (see also STAPERT, 2007).

Investigating a south Swedish Neolithic knapping area, Högberg (1999, 2008) focused on play-copying (see RIEDE *et al.*, 2018). In the assemblage, flakes from two different knapping strategies were present. Building on methods similar to those of Fischer (1990), Bodu *et al.* (1990), Pigeot (1990), Karlien and Julien (1994) and Grimm (2000), Högberg (1999, 2008) interprets what happened at the site as an act of a child copying the work of an adult manufacturing a flint axe-head (see also BABEL, 1997). Based on the distribution pattern and technological analysis of flakes, together with other flint implements, he concluded that, alongside a master working on an axe-head, a child playfully knapped an implement resembling an axe-head. The axe-head production (Figure 1, left) is the technology of the master at the knapping area. It is highly specialized and uniform and based on selected raw material. The non-systematic technology (Figure 1, right) is the result of a child's play-copying. It is based on low-quality raw material and has resulted in what looks like a square-sectioned axe-head but could never be used as one.

**Figure 1** - Left: a Neolithic axe-head, a flake from production of such an implement, and a schematic illustration of the technique used for its production. Right: a copy or qualifier axe-head, a flake from its production, and a schematic illustration of the technique used for play-copying (from RIEDE *et al.*, 2018, modified from HÖGBERG, 1999, 2008).



From this example and drawing on results from previous studies (e.g. PIGEOT, 1990; KARLIEN & JULIEN, 1994; GRIMM, 2000), Högberg (2008) concluded that play-copying can be traced by means of variables such as technological systematicity versus ad hoc technology, the use of high-quality (selected) raw material versus low-quality (non-selected) raw material (*sensu* TAKAKURA, 2013), and typological forms (formal tools) versus non-typological forms (informal tools). Inspired by observations made by Mikkel Sørensen (later published in STERNKE & SØRENSEN, 2009), Högberg (2008) concluded that the non-typological forms (informal tools) produced by children can be characterized as having been knapped using a “two-dimensional” approach that copies the outline shape of a tool (like a drawing on a piece of paper) but not the three-dimensional aspects of it (as in a 3D model) (also see SHELLEY, 1990 for discussion). In addition, the distribution of debris resulting from play-copying contrasts with that generated by a master. A master’s debris is recognized as concentrated within an associated work space, whereas debris associated with play-copying was scattered in a less structured manner around the work space, as if the child had moved around while play-copying the work of the adult. Also, the products of a master’s work are typically removed from the knapping site to be used elsewhere. In contrast, products resulting from play-copying are left at the knapping site and not used for other purposes than play (see PIGEOT, 1990; GRIMM, 2000; for discussion). Note that in Högberg (1999, 2008) the term imitation is used to describe the child’s behavior. This is an incorrect term to use. The child’s behavior is correctly described as copying by emulation not by imitation. Emulation is when the learner observes the outcomes of the model’s actions and tries to reach the same outcome (goal oriented), imitation is when the learner observes the sequence of the model’s actions and tries to perform the same actions (process-oriented learning) (see discussion in GÄRDENFORS & HÖGBERG, 2017).

Drawing on results from his study of a south Swedish Neolithic knapping area, Högberg interpreted bifacially knapped implements from a South African Middle Stone Age site, occupied about 80,000–72,000 years ago, as evidence for children learning to knap bifacial spear heads at the site (HÖGBERG & LARSSON, 2011). Inspired by this study, Cunnar (2015) took a similar approach in his analysis of bifacial implements from Nevada, USA.

Building on results from Fischer (1990) and Karlien and Julien (1994), among others, Sternke and Sørensen (2009) conducted lithic experimentation with children and adults to discuss variation in skill-related attributes observed on tools and waste from their work. The approach of Sternke and Sørensen (2009) is clear in how it systematizes technological and morphological attributes of beginners’ products and therefore adds significantly to previous similar studies (SHELLEY, 1990). Sternke and Sørensen conclude that beginners’ (children’s) products are characterized by two-dimensional knapping, a lack of core maintenance, evidence of frequent mistakes, and absence of standardized product (STERNKE & SØRENSEN, 2009:724), results in line with previous studies (SHELLEY, 1990; PIGEOT, 1990; HÖGBERG, 1999; GRIMM, 2000). Based on their experimental outcomes, Sternke and Sørensen (2009) analyzed a Late Mesolithic assemblage from Denmark. They conclude that reused cores and discarded preforms for axes are products of beginners and novices and hence evidence of children’s work. An approach similar to that presented by Sternke and Sørensen (2009) was used by Dugstad (2010) analyzing an Early Mesolithic site from Norway.

#### SUMMING UP SO FAR AND STARTING A DISCUSSION

From the presentation of studies above, some observations can be made. Several studies draw on each other’s results, use similar approaches and come to similar

conclusions based on different excavated sites from various places and periods. The influential work of Pigeot (1990) and Karlin and Julien (1994) has become a standard reference for most studies presented. Also, the work of Grimm (2000) and Högberg (2008), both building on, among others, Pigeot (1990) and Karlin and Julien (1994) is referred to by many (e.g. ASSAF *et al.*, 2015; CUNNAR, 2015; GOLDSTEIN, 2018; NEUBAUER, this volume). Other studies (e.g. STAPERT, 2007) refer little to former studies but come to similar conclusions as they do. If we look at the earliest work presented here, it is interesting to see that some researchers appear to have opened up similar areas of research without referring to each other. For example, Knutsson (1983) does not refer to Lillehammer (1979). Fischer (1990) does not refer to Knutsson (1983, 1986) or Lillehammer (1979, 1982, 1989). Also, early work is not always referred to in later work (but see FINLAY, 1997). For example, in an early experimental study Shelley (1990) present technological attributes important for understanding how to trace learners' (children's) work in lithic assemblages. These are attributes that have subsequently been discussed by others (e.g. FINLAY, 1997; JOHANSEN & STAPERT, 2008). Shelley's attributes are almost similar to attributes used by Högberg (1999, 2008) and Sternke and Sørensen (2009) in their studies. However, none of these studies refer to Shelley (1990).

Artifact size has been used for finding children's work in lithic assemblages. Small implements are interpreted as toys or tools used by children. However, few lithic technology studies have elaborated on this approach and few studies actually present results based on this line of thought. Instead, other methods for finding traces of children's work in lithic assemblages have been developed. Methods such as in-depth knowledge of lithic technology based on chaîne opératoire approaches, experimental work, refitting studies, raw material quality analysis and site distribution analysis for interpretation are used. Using these methods, several studies build significantly on the argument that a child (beginner/learner) learning to make a stone tool will make mistakes at a higher rate than persons (adults) with more experience of stone tool production (see FINLAY 1997, 2015; EREN *et al.*, 2011; GOLDSTEIN, 2018 for discussion). Hence, children's work is characterized by a lack of control over basic technological principles. This is marked in an assemblage by a higher frequency of mistakes such as hinge or step fractures or irregular bulb of percussion. Lack of core maintenance is common and reduction strategies practiced by novices are often unfinished and poorly conceptualized. Low-quality raw material is often used (but see discussion in TAKAKURA, 2013; FINLAY, 2015). The work of children or learners is also typically defined as non-productive, meaning that novices do not produce tools intended for later use: "the debitage clusters of novice knappers are recovered virtually complete, a result of the debitage products having been abandoned at the knapping post (unlike the widely disseminated products of experienced knappers)" (GRIMM, 2000:55). Several studies also point out that spatial arrangement at the archaeological site show that children's work typically is scattered or performed on the periphery of what is regarded as central parts of a site, for example a hearth or a sitting place for knapping.

The overview presented here thus shows that a basic premise for studies attempting to identify traces of play, learning, or skill development in lithic assemblage is that the children or 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 (for a critical discussion of this perspective, based on experimental archaeology see EREN *et al.*, 2011). Another basic premise is that this "unskillful knapping behavior" is traceable in an assemblage by comparison with adults' work. Artifacts interpreted as deriving from the activities of children or learners 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). Typically, children's work is defined by its less skillful performance in relation to a more skillful (expert/adult) performance evident in the lithic assemblage.

Hence, the work by children is not defined on its own terms (see FINLAY, 1997 for discussion). Instead, dichotomies are a vital part of defining children's work (see GRIMM, 2000; GOLDSTEIN, 2018; NEUBAUER, this volume, for discussion). This is evident, for example, in Högberg's (2008) study where dichotomies such as technological systematicity versus ad hoc technology, the use of high-quality raw material versus low-quality raw material, and typological forms versus non-typological forms are formulated as a basis for interpretation. Here, technological systematicity, the use of high-quality raw material and typological forms are the definitions of an adult's work that is used to define the presence of a child working at the site. Consequently, identification of children's work in lithic assemblages heavily relies on identifying artifacts and production patterns that deviate from what the analyst defines as the expert norm (GOLDSTEIN, 2018).

#### EMBEDDED LEARNING

Ferguson (2003) presents an alternative pattern for learning strategies. In an experimental study, pressure-flaking arrowheads together with beginners, he showed that beginners working together with a skilled knapper in an embedded learning situation produce flakes and artifacts that are difficult to distinguish from that of the experienced. Ferguson designed his experiments in such a way that, as soon as the beginner was confronted with a problem in her/his knapping, Ferguson, who is an experienced knapper, took over the work and while handling the problem simultaneously showed the beginner how to approach the problem to solve it. After the problem was solved, the beginner continued knapping on the point. In this way problems encountered that made it difficult for the beginner to knap a blank into a finished arrowhead were practically solved by the experienced knapper while solutions to knapping problems were taught simultaneously. The result was assemblages of flakes and arrowheads with no or only modest traces of less skillful knapping (FERGUSON, 2003). That different knappers can work on one and the same core is known from anthropological studies (BINFORD, 1986). And what Ferguson's (2003) experiment does is to move away from the identification of the individual per se in a learning situation (see FINLAY, 1997 for discussion). Consequently, if an assemblage like the one produced by Ferguson and his students was found on an archaeological site, it would be difficult to use the approaches presented above to identify the work done by learners (children). As mentioned, these studies have identified children's and learners' work as less skillful in relation to more skillful work represented in the assemblage. But in Ferguson's (2003) study the non-skillful knapping is not clearly visible. Instead, every time a problem is encountered in the knapping it is merged with the skillful knapping (also see discussion in FERGUSON, 2008).

The result of Ferguson's (2003) study has, to my knowledge, not been tested further in archaeological lithic assemblage analysis. This is clearly an area that needs further innovative studies to develop (but see EREN *et al.*, 2011 for a discussion based on experimentation).

## NOT ALL POORLY KNAPPED PIECES ARE FROM CHILDREN'S WORK

From the studies presented above it can be concluded that there is a consensus in the way children's knapping is characterized – reduction strategies practiced by novices are often poorly conceptualized, evident in an assemblage by higher frequency of mistakes, such as hinge or step fractures or irregular bulb of percussion, with no practice of core maintenance (e.g. SHELLEY, 1990; HÖGBERG, 1999; GRIMM, 2000; STERNKE & SØRENSEN, 2009). But these characteristics are also typical attributes for expedient knapping strategies in societies where informal chipped tools dominate (see HOLDAWAY *et al.*, 2015; GOLDSTEIN, 2018 for discussion). For example, south Scandinavian Late Bronze Age and Early Iron Age flint assemblages from household contexts are characterized by informal flake tools knapped in an ad hoc manner. Flakes are fragmented. They have an irregular bulb of percussion and a crushed platform. Core maintenance is not performed. Core platforms are not prepared and show impact marks from repeated unsuccessful attempts to detach flakes using a hammer stone. Core faces show hinge and step fractures (HÖGBERG, 2001, 2009, 2010). Another example is Downey's (2010) study of expedient lithic technologies from excavated sites in Peru. Downey show the importance of the use of expedient knapping strategies producing informal tools for activities associated with a ceremonial center (DOWNEY, 2010). Yet another example is lithic assemblages from a distant evolutionary past, with huge variation in how informal tools were knapped a million years ago (SHEA, 2006, 2017).

Consequently, attributes and characteristics used to identify children's work in lithic assemblages are also attributes and characteristics typical of various assemblages predominated by informal tools produced with expedient knapping strategies. Consequently, poorly knapped pieces of stone cannot routinely be labeled as the work of a child. And as Finlay (2008) has shown in an experimental study on the reproduction of Scottish Late Mesolithic Blades, a skillful knapper occasionally has a bad day and individual variation in knapping performance over time can influence what the assemblage produced looks like. Now, this is all basic knowledge to researchers working with identifying the work of children in lithic assemblages. The point I want to make here is that the established way of identifying children's work – shown above to have been used in many studies – is an approach that does not work if one wants to identify children's work in assemblages dominated by informal tools produced using expedient knapping strategies. To find ways to work with such assemblages to identify children's work is a challenge. As for example Högberg (1999, 2008) and Grimm (2000) show, to include social context and site analysis in the work to identify children's knapping is one way forward. To discuss this in detail is however beyond the scope of this text and needs to be dealt with in future research.

## EACH GENERATION CHANGES THE BRAIN OF THE NEXT

As Reynolds (1993:410) notes, “the concept of the stone tool as the product of an artisan working alone is an artifact of archaeology itself.” Drawing on this conclusion, Finlay (2008) observes that lithic technology studies typically present stone tool production as a relationship between individuals, tools, and raw material. But learning to produce stone tools is not an activity done in isolation. The actions of tool makers are closely constrained by the knowledge-transfer systems in which they are situated (REYNOLDS, 1993; RIEDE, 2006). Technologies and their attributes are thus embedded in culture (LEMONNIER, 1993), and prehistoric knowledge-transfer was performed in context. Multivariate combinations of intra- and intergenerational transfer of knowledge by social learning, teaching, and play-copying took place. It can be done on a

one-on-one basis but is largely embedded in cultural settings (STERELNY, 2012) and should be understood in a context of a many-to-many relationship, as well as horizontally distributed within a generation and/or vertically between generations (see discussion in D'ERRICO & BANKS, 2015; HÖGBERG *et al.*, 2015; GÄRDENFORS & HÖGBERG, 2017; LOMBARD & HÖGBERG, 2018; RIEDE *et al.*, 2018).

As we seen from the discussion above, children are identified in lithic assemblages as individuals based on their knapping skill and raw material choice and the way they moved around at a site. But this is not the full story. Several studies also position the skill represented by the child in relation to adult skills, and like the study by Högberg (2008), for example, present the child's work as a shared experience between a child and an adult. Or as Grimm (2000) does, presenting an interpretation of the child in a social setting in a discussion of prehistoric families. Yet these studies still emphasize results from individuals' working efforts. Such an approach may hamper interpretation in serious ways, as becoming human is not an individual thing. As discussed by Högberg and Gärdenfors (2015), genetic influences on children's cognitive development are not something fixed and predetermined from birth. They are entangled (SOLMS & TURNBULL, 2002) and work in dynamic interaction with regard to the way that the mind evolves. Consequently, the human mind cannot come into existence on its own. It is wedded to a collective process and filtered through culture and the social (DONALD, 1991, 2012). How intimate the link between genetic and environmental influences is varies. The years up to about twenty are particularly crucial (WASSERMAN & ZAMBO, 2013). This means that cognitive development must be seen as something that emerges gradually from early infancy onwards and shaped in social interaction between nature and nurture. Sterelny (2012) has described this as a "positive feedback loop" between social complexity and individual cognitive capacity. It is an interaction based on the brain's ability to be shaped by the environment (body, culture, nature) and its increased complexity in relation to social interactions. Consequently, by changing the social environment, each generation changes the brains of the next (MITHEN & PARSONS, 2008). One way this is institutionalized is by intra- and intergenerational knowledge transfer systems (HÖGBERG & LOMBARD, 2016). The processes of social learning and teaching through verbal instructions, gestures and imitations, matching the actions of others and facilitating learning in others, together with pro-social acts of feedback, are unique characteristics of human social exercise. Consequently, studying children is important (NOWELL, 2010, 2015; SHEA, 2006). They are and have for a long time during prehistory been the ones that learn and are taught. In this sense it is not just what children have done during prehistory, but childhood itself that has been fundamental to development of societies (KAMP, 2001; BAXTER, 2006; SCHWARTZMAN, 2006).

Now, if the thoughts discussed here are set against what has been discussed earlier about how lithic analyses concentrating on children are set up, it is easy to agree with Finlay (2008) in her critique of studies focusing on individual achievement. As discussed, identifying children's work in lithic assemblages is typically done using methods that isolate the products of individual knappers. Hence, analyses build on individuals and how they relate to others. But stone tool production is social and embedded in culture. Learning or teaching to produce stone tools facilitates intra- and inter-generational knowledge transfer (LOMBARD & HÖGBERG, 2018). As such it is fundamental for culture. This means that studying children using lithic assemblage analysis is not solely about children, but also about society (GOLDSTEIN, 2018). This is theoretically discussed by, for example, Pigeot (1990), Finlay (1997), and Grimm (2000). However, these theoretical perspectives have not yet come to full realization in interpretations based on lithic technology studies (see GOLDSTEIN 2018 for discussion).

## ENDING

As Cunnar and Högberg (2015) noted a few years ago, Lillehammer's child from her 1989 article has grown into a full-fledged adult on her own. Writing these words, her 30th birthday in 2019 is approaching, and it is easy to conclude that aspects of children and childhood have developed into archaeological research topics on their own (see KAMP, 2015 for discussion). Archaeologists have developed empirical, theoretical and methodological work on the topic, and important research has been published concerning the identification of artifacts produced by children in the archaeological record and the theoretical implications for interpretation.

At the same time, children and childhood still have not become part of mainstream archaeology. Prehistoric children and childhood are discussed only by a limited number of archaeologists, whose results have not made it to the mainstream of archaeological interpretation. As Finlay (1997) argued more than 20 years ago, the recognition of children and their impact on material culture is not yet part of an integrated methodology and theory of interpretation that can provide a more complete picture of ancient societies. And, almost twenty years after Finlay (1997), Kamp (2015:161f) reached a similar conclusion:

Lillehammer (1989) made a case for the need for archaeologists to study children and what has been referred to as 'the archaeological child' was born [...] like a real child, the archaeological child has matured [...] the archaeological child has grown – working, playing and learning from both peers and elders. The child has also been creative, modifying existing tools and perspectives as well as developing new ones. Despite its accomplishments, however, the archaeological child is still lingering on the fringes, trying to prove its relevance and waiting to be fully-integrated in the 'adult world' of archaeological theory and practice.

This can also be seen in the field of lithic technology studies. The words from Finlay's (1997) influential text are still valid: "Add children and stir is not the solution, rather we need to transform how we discuss people and lithics" (FINLAY, 1997:210). Shea (2006) urges archaeologists to pay more attention to children in lithic analysis and to develop methods to identify products of their work in lithic assemblages. As the presentation above shows, a number of studies have been published over the years which interpret in different ways lithic assemblages using the idea that they may represent flint knappers of different age (infancy, early childhood, middle childhood, adolescence), or learners in different stages of skill development (novices, beginners, apprentices, experts). These studies have presented clear results that demonstrate methodological and theoretical achievements. Yet there are few studies based on lithic technology analysis that have succeeded in analyzing children as the complex individuals they are "occupying the realm of childhood, yet also embedded within the world of adults" (KAMP 2015:166) and as such part of society. From this perspective, we have yet to see future innovative lithic technology analysis studies presented.

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