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Science and interpretation in microwear studies

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ABSTRACT

Microwear analysis is regarded by some as problematical because of the subjective nature of the functional inferences. Aware of this problem, microwear analysts have proposed various methods of quantification that use several new analytical techniques. Although useful, these methods, employ overly simple experimentation that does no justice to the unlimited variability of human–object relationships. Instead, it is argued that we have to rely more on interpretation, incorporating ethnographic and ethnohistoric information. At the same time we have to improve our daily microwear practice by producing better photographs and studying larger samples. This paper is intended as a general reflection on microwear methodology.

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1. Introduction

Microwear studies have often been seen as rather subjective and therefore of relatively limited interpretive value in the eyes of the larger archaeological community. On the one hand our standard methods involve microscopy, not only the common stereomicroscopes, but also the metallographic, incident light microscope which allows magnifications of up 1000×. When outsiders enter a microwear laboratory, they are usually impressed with the equipment present and ask the characteristic question: "how do you determine tool function?", with emphasis on the word 'determine'. Little do they realize that interpretation is a more applicable term when talking about microwear analysis of objects. In this paper the friction between on the one hand the need for scientific rigor, standardization and quantification and, on the other hand, the need for interpretation and a sensitivity to anomalies which leads to alternative narratives of tool use in the past, will be addressed. On the 'science side' it will be argued that improved sampling strategies will speed up the analytical process. This will enable us to deal with larger samples, allowing us to detect patterns in our empirical observations and to address meaningful archaeological questions. Another area in need of improvement is our methods of photographic documentation. On the 'interpretation side' ethnographic and ethno-historical research broaden our vision of the endless variety of human–object relationships. Clearly, both a 'science' and a 'human' approach are needed for microwear research to contribute to meaningful archaeological questions.

2. Science

In order to move forward and demonstrate the relevance of microwear studies to larger archaeological research questions, it is imperative to improve our methodologies and to incorporate and test the many new techniques becoming available in the natural sciences. The present volume intends to do just that. It is especially crucial because of the subjectivity in our inferences. This has been a major problem haunting microwear studies from the start. Learning the correct descriptive terms is almost like a rite of passage. When do you call a polish 'smooth', when is it 'rough'? What do people mean when they describe polish distribution as resembling a 'melting snow field'? Much of Keeley's (Keeley, 1980) original descriptive terminology of polishes is still in use, but it is actually largely unsatisfactory especially for novices in the field. Yet, at the same time, experienced microwear analysts effectively communicate with these terms and will usually describe the same traces in largely the same way.

Through the years, quite a few researchers have proposed methods of quantification or objectification, ranging from interferometry (Dumont, 1982), tribology (Beyries et al., 1988; Vargiolu et al., 2003), atomic force microscopy to assess the roughness of the polished area (Kimball et al., 1995), and image analysis (González Urquijo and Ibáñez Estévez, 2003; Grace, 1989). Laser scanning confocal microscopy is currently a very promising approach, allowing a detailed visualization and quantification of the roughness of features (Evans and Donahue, 2008; Stevens et al., 2010). All of these studies have shown that experimentally obtained polishes can be distinguished on the basis of various quantifiable attributes. Another approach towards more objective functional inferences is

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formalizing and standardizing the entire inferential process by means of an expert system (Van den Dries, 1998; Van den Dries and Van Gijn, 1997). The main problem with such an expert system is that it still relies on everybody using the same descriptive terminology. Another issue is its fixed nature. New knowledge of the expert does not make its way into the computer system immediately, but requires laborious reprogramming.

A major drawback of all of the above-mentioned attempts is that they depart from experimental tools which were used on one contact material only, and in a very simple, mechanical motion. However, clearly, this is not the way many of the prehistoric tools would have been used. Re-use, re-sharpening, storage, carrying around, destruction and a number of other processes may have left traces that obliterated evidence of initial use. The relationship between people and their material world is highly variable and its complexity far exceeds the simplicity of our experiments. Another, related, problem is that many such experiments are carried out by non-specialists. This has undoubtedly an effect on various attributes of polish, as well as the formation of striations and edge rounding. Developing means of quantification are also hampered by the fact that we still do not know how exactly these microwear traces, notably polish, develop. Almost every beginning microwear specialist makes an attempt at 'solving the puzzle' (a.o. Anderson, 1980; Van Gijn, 1986), addressing the central question: are these polishes due to chemical interaction between the surface of the tool and the contact material or are they simply due to abrasive, mechanical processes? There are supportive arguments for both viewpoints. In favor of a mechanical origin is the fact that there seems to be considerable overlap between the attributes of polishes from various materials, notably wood, bone and antler, the wear traces of which are frequently hard to distinguish (Van den Dries and Van Gijn, 1997). Moreover, researchers have yet to generate consistently diagnostic evidence for adhesive wear, especially in light of the varying responses of different raw materials to the application of force and the chemical interaction between tool and contact material. Recent elemental chemistry has shown that different polishes have different chemical compositions (Evans and Donahue, 2005), in contrast to older research (Van Gijn, 1986). To complicate matters further, the compatibility of different analyses is limited because of the lack of consensus between microwear analysts on how to clean the experimental tools. Some researchers only clean their tool surfaces with water and soap before characterizing and quantifying the microwear polishes, meaning they are often characterizing residue. Others have in fact removed much of the residue by hydrochloric acid and KOH or another alkaline solution. This disturbing lack of consensus on how to clean our experimental tools should indeed be resolved as was previously argued (Evans and Donahue, 2005).

2.1. Sampling

It is well-known that microwear analysis is a very time consuming enterprise. Especially the so-called high power approach, which makes use of metallographic (incident light) microscopes using high magnifications of up to 1000×, requires a lot of time. Examining the entire surface of an object with a metallographic microscope is extremely time consuming as the surface of the tool has to be positioned exactly at a 90° angle to the source of light in order for the traces to be visible. It is thus easy to miss even the most obvious traces, especially when the tool surface is irregular and the tool has to be readjusted to the light source repeatedly. In practicality we therefore always sample the surface of the tools by focusing on those areas where we expect traces of use, whereas the remaining parts of the tool are examined in a less rigorous manner (Van Gijn, 1990; Van Gijn, 2010, pp. 30–34).

Unfortunately, to a large extent our own preconceived ideas of tool use influence the way we study each object: which areas we scrutinize more carefully and which areas we gloss over more superficially. A classic example of how our ideas regarding the way tools were used can interfere with an objective examination of an implement comes from the multi-analyst blind test of Tübingen (Unrath et al., 1986). The two people who experimentally used the tools both had a background in Arctic archaeology, whereas the analysts involved were all focused on Northwest European prehistory, especially the late Paleolithic. One of the experimental tools was a burin spall, the proximal end of which was used by the two experimenters. None of the analysts found the traces, though in hindsight they were blatantly obvious. The reason for missing these traces is that the four analysts expected the traces to be on the other end of the burin spall so they did not scrutinize the remainder of the tool sufficiently. Examining the objects under low magnification by stereomicroscope can help us to detect areas with possible traces of wear that require more detailed study, without being influenced by our preconceived ideas of tool use.

Sampling does not only occur on the level of the individual artifacts, as described above, but obviously also at the level of assemblages. Especially in commercial archaeology time and money restrictions will determine how many implements can be studied. However, in order to be able to address meaningful archaeological questions and to detect patterns, we need to study larger samples. Obviously, the old debate about the relative merits of the low- and high power approach is long behind us and ever since the meeting on *The Interpretive Possibilities of Microwear Studies* in Uppsala in 1989 researchers have agreed that both methods are complementary (a.o. Grace 1990; Odell 1990 and other articles in Gräslund et al., 1990). Nevertheless, microwear specialists, especially European practitioners, rarely use the stereomicroscope as a purposive sampling tool. Using a stereomicroscope to study large numbers of objects rapidly gives us critical knowledge about patterns of wear traces in our assemblage that can direct our sampling strategy for further, in-depth study with higher magnifications.

Obviously there are drawbacks to the use of a stereomicroscope in taking samples: we may miss briefly used tools and implements used on soft materials like meat or green plants, but these also tend to be under-represented when performing high power analysis (Van den Dries and Van Gijn, 1997). In general, however, we are less likely to overlook used zones on edges that we do not expect – on the basis of our own experience and knowledge – to have been used. Last, using a stereomicroscope allows us to detect most of the residue left on the tools. A stereomicroscopic analysis prior to any further analysis is thus crucial in avoiding excessive washing and the use of alcohol both of which can potentially alter or even remove residue. By using a stereomicroscope we are forced to carefully look at the objects in their entirety. This way, our chances of finding 'strange traces' or anomalies are more substantial and we are less likely to continue to find only what we expect.

2.2. Visualization

One major drawback of the microwear approach is the lack of convincing visual evidence. The pictures generally shown at meetings are fuzzy and lack depth of field. Usually only a small part of the photograph is sharp, namely the spot of polish we want to address. Although insiders may usually see and recognize what is being discussed, it is little wonder that the general audience has no idea what it has to look at and remains rather skeptical. There is much to gain from improving the visualization of the microwear traces. In recent years some researchers, especially Hugues Plisson

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