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Using obsidian transfer distances to explore social network maintenance in late Pleistocene hunter–gatherers

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ABSTRACT

Social behaviour is notoriously difficult to study archaeologically and it is unclear how large the networks of prehistoric humans were, or how they remained connected. Maintaining social cohesion was crucial for early humans because social networks facilitate cooperation and are imperative for survival and reproduction. Recent hunter–gatherer social organisation typically comprises a number of nested layers, ranging from the nuclear family through to the ~1500-strong ethnolinguistic tribe. Here we compare maximum obsidian transfer distances from the late Pleistocene with ethnographic data on the size of the geographic areas associated with each of these social grouping layers in recent hunter–gatherers. The closest match between the two is taken to indicate the maximum social layer within which contact could be sustained by Pleistocene hominins. Within both the (sub)tropical African and Subarctic biomes, the maximum obsidian transfer distances for Pleistocene modern humans (~200 km and ~400 km respectively) correspond to the geographic ranges of the outermost tribal layer in recent hunter–gatherers. This suggests that modern humans could potentially sustain the cohesion of their entire tribe at all latitudes, even though networks are more dispersed nearer the poles. Neanderthal maximum obsidian transfer distances (300 km) indicate that although Neanderthal home ranges are larger than those of low latitude hominins, Neanderthals travelled shorter distances than modern humans living at the same high latitudes. We argue that, like modern humans, Neanderthals could have maintained tribal cohesion, but that their tribes were substantially smaller than those of contemporary modern humans living in similar environments. The greater time taken to traverse the larger modern human tribal ranges may have limited the frequency of their face-to-face interactions and thus necessitated additional mechanisms to ensure network connectivity, such as the exchange of symbolic artefacts including ornaments and figurines. Such cultural supports may not have been required to the same extent by the Neanderthals due to their smaller tribes and home ranges.

1. Introduction

Social networks are imperative for human survival and reproduction: they allow the sharing of information, knowledge and resources, as well as aiding cooperation, for example in hunting and for collective childcare (e.g. Adams et al., 2002; Cashdan, 1985; Colson, 1979; Low, 1990; Whallon, 2006; Wiessner, 1982). An individual with a larger social network should be better able to cope with local resource failure than someone with a smaller network, due to the more numerous independent sources of help available to them (Nettle, 1996, 1998; Whallon, 2006). Furthermore, a larger network will provide more opportunities for mating and shared childrearing. Similarly, larger networks might be better able to conserve cultural knowledge because the reservoir of 'experts' would be larger and this might facilitate the diversification of technology and the cumulative development of complex storage procedures that reduce the risk of shortfalls (Henrich, 2004; Powell et al., 2009; Testart et al., 1982). These advantages mean that maintaining the relationships that comprise social networks is critical, and doing so would seem straightforward given frequent face-to-face interaction. However, rather than being aggregated in a single location, the members of a hunter–gatherer's social network are distributed between a number of different residential groups, which disperse and re-aggregate over time across an ecologically-determined home range area (Binford, 2001; Grove, 2009; Grove et al., 2012; Layton and O'Hara, 2010). Sustaining social bonds beyond the residential band is a challenge that hunter–gatherers need to solve in order to

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survive. A key question, then, is to what extent different hominins managed to do this.

The overarching question tackled in this paper is how large a social network late Pleistocene hominins could maintain, in terms of both membership and the geographic area over which members of the network were spread. The number of individuals that could be successfully incorporated into a single network might have limited the advantages listed above. We explore possible variation in network size at different latitudes and between different hominin taxa, namely modern humans and Neanderthals. Note that although technically 'groups' are aggregations of individuals whereas 'networks' denote the actual relationships between those individuals, due to the paucity of network data for recent hunter–gatherers, we treat groups and networks synonymously here.

Social interaction does not survive in the archaeological or fossil record, so in order to gain insight into potential constraints acting on hominin social network maintenance during the late Pleistocene, we combine archaeological and ethnographic proxies. Raw material transfer distances between archaeological sites and their geological source that exceed typical hunter–gatherer foraging radii have been taken to represent interaction between social groups (Féblot-Augustins, 2009; Gamble, 1998; Marwick, 2003; Mellars, 1996; Moutsiou, 2011). However, if tools are curated they may be carried over distances that exceed the foraging radius of any particular site during the seasonal round or as part of logistic expeditions. We argue that the most conservative interpretation of the distance over which raw materials are moved is that it reflects the distance over which there exists the *potential* for maintaining social cohesion *if* social encounters and interactions occur. Whether transfer distances represent *actual* social interaction depends on which behaviours underlie the movement of raw materials: whether artefacts are exchanged/traded or curated.

If artefacts are exchanged or traded then the distance over which they are transferred directly reflects social interaction and the distance over which social ties are maintained and network cohesion can be assured. Although transfer distances do not necessarily reflect direct exchanges between two social partners, under this scenario raw material displacement distance may represent the summed distance of transfer through a chain of individuals in overlapping exchange networks.

In contrast, if artefacts are curated, their transfer reflects the movement of individuals or social units. However agents move around the landscape we can assume that social interactions do take place, if only for mating purposes, between these individuals or social units and others that they encounter. That is to say, transfers of raw materials under this second scenario do not represent direct face-to-face interactions themselves, but do reflect the *potential* for interactions to occur at a particular spatial scale. Even if transfers represent a palimpsest of the mobility of individuals over their lifetimes, or even of a specific residential group over its history, rather than inter-personal exchange, the distances involved still give some indication of the area within which inter-individual and inter-group interactions could, and almost certainly did, take place. To a certain extent, therefore, the transfer of curated artefacts can still tell us something about the scale of social interaction.

Interpretation of raw material transfers also depends to some extent on the mobility strategy used, ranging on a continuum from a residential group moving as an integrated unit on a seasonal round to periodic fissioning into logistic subgroups that make forays out from a more sedentary base camp (Binford, 1980). Which strategy dominates will vary both between habitats (which could be exploited by the same group) and seasonally, which might be reflected in the distribution of transfer distance frequencies for different sites in terms of occupation duration and journey length. If transfers are the result of exchange then they may reflect either the social network maintained by the members of a mobile band or the network maintained by individuals in logistic subgroups. Network maintenance via the interaction of logistic subgroups would imply a relatively high degree of variation in network size and structure between individuals in the mobile subgroups (in effect 'social representatives') and those in the residential camps left behind. If mobility consists of seasonal rotation of a cohesive residential unit, fluid band membership could equally lead to transfer patterns reflecting the behaviour of independent family units, although there would be less variation between these than in the case of logistic mobility.

On the other hand, if transfers are created through the movement of curated artefacts, then they reflect either the seasonal mobility of residential units (bands) or the movement of fissioned logistic task forces making trips from residential base camps. In terms of implications for social network maintenance, logistical movement might increase the chance that mobility within a certain area leads to social interactions actually taking place: fissioning into logistic subgroups would likely increase the encounter rate with other social groups (similarly to hunting encounters: Grove, 2010a) and thus create more opportunities for maintaining ties.

Although different movement patterns have interesting implications for network maintenance, the ethnographic data we use (Binford, 2001, see below) does not record mobility behaviour in sufficient detail to distinguish between these strategies. Consequently, here we take transfer distances to reflect the geographic area over which groups (whether residential bands or logistic subgroups) move and within which individuals have the potential to maintain social unity through encountering and interacting with other groups.

A greater barrier to interpreting raw material transfers in terms of social behaviour is the possibility that artefacts may have been discarded and re-used by socially disconnected individuals, perhaps in episodes thousands of years apart. However, given the functional and aesthetic value of the raw material we focus on, obsidian (Moutsiou, 2011, 2012), here we assume that artefacts made from this material would either be curated until no longer usable (i.e. until retouching reached diminishing returns) or retained in exchange circulation. In either case this reduces the likelihood of discard and the opportunity for recycling by completely unrelated individuals. Rather than being the result of recycling, we propose that transfer distances represent the geographic extent of either (i) the combined social network of individuals in a social unit of a particular size reflected through direct evidence of exchange or (ii) the area over which social interactions could have taken place given the potential for mobile groups to meet each other. Transfer distances may thus provide information on the total area covered by actual or potential overlapping individual personal networks and we take the more conservative interpretation of *potential* interaction here. Since individuals cannot interact with the members of groups moving in areas that they themselves do not exploit, this scenario will still provide insight into any upper threshold on social cohesion in terms of social network size.

In this paper, the longest archaeological obsidian transfer distances for a particular time period and environment (Moutsiou, 2011, 2014) are taken to index the maximum area over which component subgroups had the potential to maintain contact. It is worth noting that these data are distances to the nearest obsidian source and do not use chemical identification, meaning that they provide conservative maxima. Previous literature has compared lithic transfer distances to ethnographic hunter–gatherer mobility data, for instance regarding foraging radii and distances associated with visiting relatives and finding a spouse (Cavalli-Sforza and Hewlett, 1982; Gamble, 1998, 1999; Gamble and Steele, 1999; Hewlett et al., 1982; Layton and O'Hara, 2010; Layton et al.,