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Integrating anthropological genetics with cultural anthropology and archaeology: new opportunities

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The process of integrating anthropological genetics with cultural anthropology and archaeology has been frustratingly slow. Recently, however, there have been three developments in cultural anthropology and archaeology that have the potential to accelerate the process.

The first is the recognition that analytical techniques from evolutionary biology can be fruitfully applied to cultural data. The techniques that have been used most frequently to date are the neutral model and cladistics. Among the cultural datasets that have been analyzed with the neutral model are decorated pottery from Neolithic Germany (Shennan & Wilkinson, 2001; Bentley & Shennan, 2003) and pre-contact America (Neiman, 1995; Lipo *et al.*, 1997; Kohler *et al.,* 2004; Eerkens & Lipo, 2005), and baby names and dog breeds from 20th century America (Bentley *et al.,* 2004; Herzog *et al.*, 2004). Some cultural applications of cladistics have focused on the evolution of particular types of artifact, such as projectile points (O'Brien *et al.,* 2001) and psalteries (Temkin & Eldredge, 2004). Others have sought to clarify the processes that generate population-level cultural diversity (e.g. Collard & Shennan, 2000; Tehrani & Collard, 2002; Jordan & Shennan, 2003; Collard *et al.,* 2006; Tehrani & Collard, 2009). Still others have used cladistics to investigate colonization processes in prehistory (e.g. Buchanan & Collard, 2007; Coward *et al.,* 2007). The recognition that evolutionary biological techniques like the neutral model and cladistics can be applied to cultural data has at least two potential benefits for the integration of genetic anthropology with cultural anthropology and archaeology. The most obvious is that it opens up the possibility of carrying out analyses in which genetic and cultural data are formally analyzed together as opposed to one dataset being formally analyzed and the results interpreted in the light of previous work on the other dataset, which is the norm at the moment. Less obviously, but no less importantly, the increasing familiarity of cultural anthropologists and archaeologists with the terminology, concepts and epistemology of evolutionary biology should increase the effectiveness of interactions between genetic anthropologists, cultural anthropologists and archaeologists.

The second development that has the potential to accelerate the process of integrating anthropological genetics with cultural anthropology and archaeology is the introduction of a method of estimating changes in prehistoric demography from radiocarbon dates (Erlandson *et al.,* 2001; Gkiasta *et al.,* 2003; Gamble *et al.,* 2005; Shennan & Edinborough, 2007; Buchanan *et al.,* 2008; Collard *et al.,* 2008; Niekus, 2009). The most recent version of the method proceeds by collating a large sample of radiocarbon dates for the location and time range of interest. The dataset is then reduced in such a way that each site-phase in the sample is only represented by a single date. Subsequently, the one-date-per-site-phase dates are calibrated and their summed probability distribution calculated. The major peaks and troughs in the summed probability distribution are taken to reflect fluctuations in population size. The rationale of this approach is that, because the number of occupations in a given time period can be expected to relate monotonically to population size, changes in summed probability distributions of calibrated 14C dates derived from different occupations serve as a proxy for changes in population size. The method has been used to investigate a number of important issues, including the transition to farming in Europe (e.g. Gkiasta *et al.,* 2003; Shennan & Edinborough, 2007) and the claim that the Clovis Palaeoindians of North America were decimated by an extraterrestrial impact at 12,900 calBP (e.g. Buchanan *et al.,* 2008; Collard *et al*., 2008). The introduction of radiocarbon-based demographic modeling has the potential to accelerate the process of integrating genetic anthropology with cultural anthropology and archaeology not only because palaeodemography is one of the main shared interests of genetic anthropologists and archaeologists but also because it can be easily combined with genetic estimates of past population size to generate novel insights about prehistory.

The third development that has the potential to accelerate the process of integrating anthropological genetics with cultural anthropology and archaeology is the growth of interest among cultural anthropologists and archaeologists in a body of theoretical work known as 'gene-culture co-evolutionary theory' or 'dual inheritance theory' (Durham 1979, 1991; Pulliam & Dunford 1980; Cavalli-Sforza & Feldman 1981; Boyd & Richerson 1985). In dual inheritance theory, genes and culture are viewed as two distinct but interacting systems of information transmission. They both involve the transmission of phenotype-influencing information but operate via different mechanisms. The genetic system is based on reproduction, while the cultural one involves social learning. With this difference in mind, dual inheritance theorists hold that genetic evolution and cultural evolution are similar in that they are both based on the process that Darwin referred to as descent with modification, but they also accept that the nature of social learning is such that cultural evolution is influenced by forces that have no obvious equivalents in genetic evolution. Most notably, individuals can choose to copy practices from nonkin, and they are also able to modify or discard practices in the light of experience. The significance of these processes is that cultural evolution cannot be assumed to be always in step with genetic evolution. Sometimes it will be, but frequently it will not. Our ability to learn from nonkin means that cultural patterns will often not coincide with genetic patterns. Likewise, our ability to learn from other individuals and to pass on those behaviors to yet other individuals throughout our lives means that cultural evolution will often be faster than genetic evolution. Dual inheritance theory even allows for the possibility that the transmission of some cultural traits might be maladaptive from a genetic point of view. The reason the growth of interest in dual inheritance theory has the potential to accelerate the process of integrating genetic anthropology with cultural anthropology and archaeology is that dual inheritance theory makes it possible for genes and culture to be analyzed within the same theoretical framework rather than, as has been the case in the past, being dealt with in different and often incompatible paradigms.

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