Random accumulation and breaking: The formation of Bronze Age scrap hoards in England and Wales

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ABSTRACT

This article introduces a simple, intuitive model for the random accumulation of objects into groups, and the inverse process of random fragmentation.

The model is used to explore metalwork hoards deposited during the British Bronze Age (2500—800 BC). Between 1997 and 2015, 174 hoards from England and Wales were reported to the Portable Antiquities Scheme. Three-quarters of those large enough to assess are a good match to the model. The model also predicts approximately 85—95% of bronze in circulation must have ended up in hoards. Key consequences are that most large hoards of the Late Bronze Age, and possibly also the Middle Bronze Age, must be the product of random accumulation and breaking, and that their burial must only have been temporary (otherwise the bronze economy in Britain would have collapsed). This runs counter to most contemporary explanations of bronze deposition, which stress selective deposition, votive offerings, status display, and meaningful behaviour.

The same distribution appears in other archaeologically-significant distributions, such as administrative areas and field sizes.

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Deliberately broken objects have been an area of interest for over three decades. Almost all interpretations aim to show that breaking objects and circulating the fragments is somehow meaningful or symbolic. The methods used to demonstrate this have been largely descriptive and comparative. This article presents an alternative approach. It introduces a simple mathematical model which appears to underlie a variety of assemblages formed by fragmenting a fixed resource, then accumulating the resulting fragments. This model is used to interpret Bronze Age hoards found in England and Wales.

1. Bronze Age hoards in Britain

Finds of Bronze Age hoards have been reported in Britain for over three hundred years (Huth, 1997). Because much Bronze Age metalwork is finely-made and well-preserved, it has never disappeared from the attention of antiquarians and archaeologists. Throughout the last century, hoards have provided a leading source of evidence for life during the Bronze Age (e.g. Childe, 1930; Coles, 1959—60; Burgess, 1980). Despite their prominence, however,

analyses of both Bronze Age hoards and objects has been almost entirely descriptive. Quantitative analysis has been limited mostly to radiocarbon dating, metallurgical analysis, and tabulations of object types. This lack of quantitative analysis is puzzling, as weights and dimensions of Bronze Age metal objects are routinely recorded and published (e.g. Schmidt and Burgess, 1981; Burgess and Gerloff, 1981; Burgess and Colquhuon, 1988; Davis, 2015).

Since the publication of the first catalogue of British Bronze Age metalworking (Evans, 1881), British interpretations of hoarding and the treatment of objects within hoards have largely paralleled those elsewhere in northern Europe. These have usually been divided into functional/profane and ritual/sacred. Functional or profane explanations have interpreted hoards as temporary storage—of new-cast items before distribution; of scrap ready for recycling; or of personal items hidden in times of strife. These hoards passed into the archaeological record because the people who buried them failed to retrieve them. Such functional explanations dominated British interpretations from the late-nineteenth century to the 1970s. After then, they were increasingly challenged by social and religious interpretations—under the combined impact of British post-processualism and Northern European interpretations. (The 1989 discovery of over three hundred bronze items deposited into fen from a timber causeway at Flag Fen, Peterborough, also had a

major impact.) Votive offerings and ritual deposition have long been the main interpretations of Bronze Age hoards in northern Europe (e.g. Hänsel, 1997), and these ideas passed into British interpretations from the 1980s (e.g. Bradley, 1982, 1998). In Denmark, Kristensen (1978) noted that periods of hoard deposition appeared to alternate with periods when bronze objects were placed in graves, suggesting that hoards might somehow be surrogates for burials. Bradley (1982) and Barrett (1985), drawing on descriptions of North American potlatch ceremonies, suggested that hoarding was a form of conspicuous consumption. In their account, social elites would gather bronze then, to demonstrate their pre-eminence, 'dispose' of the metal by burying it permanently. In a subsequent modification of this theory, Bradley suggested that the bronze might have been offered to the gods, as an indirect status display (Bradley, 1998). More recently, the field has been influenced by the concept of object biographies (particularly Fontijn, 2002; building on Kopytoff, 1986). This theory suggests that the life-histories of bronze objects influences the sites appropriate for their final deposition (see also Yates and Bradley, 2010a, b). This theory overlaps an older argument (e.g. Needham, 1988) that British hoards were not random accumulations of metal, but rather their contents were the product of 'selective deposition'. The theory of object biographies places meaning and memory at the heart of object deposition. These characteristics are also central to Chapman's theory of object fragmentation, which he developed initially to account for hoards and broken objects in the Balkans (Chapman, 2000; Chapman and Gaydarska, 2007; also Brück, 2006). Chapman argues that many of these objects were deliberately broken, and the resulting fragments then exchanged with others. They went on to have 'lives' and 'biographies' after being broken. Chapman argues that broken objects 'enchained' people. Fragmentation on this view is not simply breaking, but the first stage in establishing relations with others, and the fragments become entwined in the construction of personhood, gender, and social categories.

While all these interpretations have undeniably produced interesting results, they have also left whole categories of data untouched. This article examines one distinctive pattern found in the quantifiable attributes of many of hoards—the size, weight, and number of objects—and draws out consequences for the formation and deposition of bronze hoards.

2. Bronze Age hoards: the material

Today, all prehistoric metal hoards found in England and Wales must be reported the local coroner within 14 days of discovery. This has been a legal requirement since 2003, following amendment of the Treasure Act in the previous year, extending the ancient definition of 'treasure' from gold and silver to include collections of two or more pieces of prehistoric base metal. Once the coroner has been notified, a report—a 'Treasure Report'—is prepared by the national museum so the coroner can determine the hoard's legal status. In principle, a Treasure Report includes the provenance and description of each item in the hoard, along with its weight and dimensions. (In practice, undiagnostic items such as ingots, casting waste, and unidentifiable fragments are sometimes not measured or only weighed collectively.) Once the coroner has determined whether a hoard falls within the legal definition of 'treasure', and the finder suitably rewarded, the Treasure Report is made publically accessible through the website of the Portable Antiquities Scheme (PAS), www.finds.org.uk. The PAS itself is a partnership project run by the British Museum and the National Museum Wales which supports a network of local archaeologists (Finds Liaison Officers) across England and Wales, who record archaeological finds made by members of the public.

The PAS has proved an enormously effective scheme for the public to contribute archaeological finds. At the time of writing, over 1.2 million objects had been reported, most of them by metal detectorists. The PAS is now the single largest archaeological dataset in Britain. Over five hundred research projects have been undertaken using the PAS's data. It is not, however, an unbiased source of evidence, and the PAS itself has been careful to examine influences on the dataset (e.g. Robbins, 2013; Brindle, 2014: 15–21). Most of the biases identified concern the spatial representativeness of the data generated by metal detectorists, particularly at a local level, and how well it matches prehistoric distributions. There is much less concern about biases in hoards' contents, which is the focus of this article. At a national level, the use of metal detectors and the mandatory reporting of hoards has seen a large increase in both the number and accuracy of finds over the previous voluntary reporting system (c.f. Murgia et al., 2014). As Pendleton (1999) noted, metal detectorists recover far more metalwork than farm labourers and construction workers—the chief discoverers of BA metalwork before metal detectors became available in Britain in the 1960s. Moreover, the increasing involvement of archaeologists in the excavation of hoards found by amateur metal detectorists has increased the recovery of small, easily-overlooked hoard fragments, greatly improving the accuracy and quality of data on hoards.

By the end of 2015, the PAS had published reports for 174 Bronze Age hoards containing 4374 pieces of bronze (although some hoards were uncovered in several phases and so appear across several PAS records). By contrast, Huth (1997) identified a total of 312 Late Bronze Age (LBA) hoards found in England over the three hundred years to 1990, and Rowlands (1976) catalogued 116 Middle Bronze Age (MBA) hoards from Southern Britain. These hoards amount to just over twice those published by the PAS in the first fifteen years of its operation. While the rate of discovery has accelerated, the national distribution of MBA and LBA hoards is a fairly good match to those recorded by Huth (1997) and Rowlands (1976) (Fig. 1.1 and 1.2). MBA hoards remain clustered along the southern English coast, while LBA hoards are clustered in East Anglia. (The PAS has reported a number in the north of England and Huth did not collate figures for Scotland or Wales). Together, this indicates that the finds reported to the PAS are not markedly biased in their discovery.

3. Modelling items in individual hoards

Fig. 2.1–2.4 show the weights or lengths of items in four medium-sized and large hoards. In each graph, measurements have been ranked from largest to smallest. Fig. 2.5–2.8 show the same data, but with the rank plotted on a logarithmic scale rather than a linear one.

What is immediately apparent is that in each case, when the rank is plotted logarithmically, the size or weight of almost every items falls onto a straight line. This result is unexpected for several reasons. First, the hoards are quite different sizes, ranging from 46 to 213 items and weighing 1.4 to 18.9 kg. Second, they come from different periods and metalworking assemblages: the Bramfield hoard is a Wilburton assemblage (c. 1150–1000 BC), the Stixwould and Woodhall hoard is a Blackmoor hoard (c. 1000–900 BC), the Saunderton and Burnham on Crouch hoards belong to the Ewart Park phase (c. 900–800 BC). Third, although the weights and lengths show a similar pattern in their distribution, the correlation between weights and lengths is loose in these four hoards, as it is in most of the PAS hoards.

The claim of this article is that the characteristics of such hoards can be modelled by a process of random accumulation and fragmentation. The process is illustrated graphically in Fig. 3. Each diagram has 200 points, which have been linking together into chains without loops or branches. In each diagram, every point is given an