A new method for identifying sherd refits: A case study from the Neolithic of Northumbria, U.K.

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Here we present a flexible, quantitative methodology for refitting handmade ceramics. Rather than analyzing the physical joins between sherds, we assess the likelihood that non-adjoining sherds of similar appearance are from the same vessel. The customary disregard of non-adjoining sherds in refitting experiments prompts us to address this issue. Using the Neolithic ceramic assemblage from Thirlings (Northumberland, U.K.) as a case study, we test several scoring systems for assessing the probability of two sherds pertaining to the same vessel. The utility of this approach is supported by the comparison of a set of percentage scores statistically verified using Spearman's rank correlation coefficient. We conclude with a discussion of the contribution of the new method to post-excavation ceramic analyses, and its applicability to other assemblages.

Keywords: Bollong's method, ceramic refitting, Neolithic period, Northumberland, scoring systems, Spearman's rank correlation coefficient

Introduction

Refitting archaeological objects is a post-excavation analytical technique that has been practiced for more than a century. The technique was initially designed by European Palaeolithic and American archaeologists to conjoin lithic materials (Cziesla 1990; Schurmans and de Bie 2007), but it has increasingly been applied to other materials, e.g., ceramic vessels (Sullivan 1989; Bollong 1994; Květina and Končelová 2011), clay figurines (Taniguchi 1990; Chapman and Gaydarska 2007: 113–142), animal and human bones (Lyman 2008; Boulestin *et al.* 2009: 972, fig. 2; Beckett 2011), and shell ornaments (Chapman and Gaydarska 2007: 143–171). Recent attempts have also been made to refit tortoise shell and ostrich eggshell debris (Stewart *et al.* 2011) and quern fragments (Poole 1995: 262; Quinnell 2010: 115; Watts 2008). The basic idea is to identify directly refitting fragments or non-adjoining fragments that likely derive from the same object. Despite the wide application and success of this method, there is no standardized protocol nor is there a unified research strategy (Schurmans 2007). This is especially true of pottery conjoining, a subfield that employs refitting to establish chronostratigraphy; refitting sherds from different contexts at a single site has been interpreted as linking the two contexts stratigraphically.

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Only recently, archaeologists have attempted to gain other kinds of insights concerning pre- and postdepositional taphonomic processes and deliberate fragmentation with reuse of broken fragments (Sullivan 1989; Garrow *et al.* 2005; Chapman and Gaydarska 2007: 83–85; Edwards 2009).

In the last decade, ceramic refitting has become increasingly widespread while accumulating a series of unsolved problems. Most of these problems stem from the constraints accompanying the use of the *châine opératoire* approach designed for Palaeolithic stone tools (Cziesla 1990; Schurmans and de Bie 2007). This approach uses an analytical procedure to identify diagnostic débitage through the study of technological subproducts (Chapman and Gaydarska 2007: 85–87). Methods developed for investigating lithic technologies are not the most appropriate for understanding ceramic technologies (Sullivan and Rozen 1985; Bollong 1994: 17). Ceramic fragments are the product of distinctively complex dynamics of manufacture, use, breakage, discard, abandonment, and postabandonment activities. Multiple case studies reveal the possibilities for refitting ceramics to understand these processes (Sullivan 1989; Garrow *et al.* 2005; Garrow 2006; Edwards 2009; Beadsmoore *et al.* 2010). Here, we challenge previous methods of ceramic refitting and their underlying assumptions. One of the less helpful outcomes of the methodological borrowing from Palaeolithic studies has been the emphasis on the physical conjoining of fragments—

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that is, parts associated by mechanical matching (Lyman 2008: 231). It is important to acknowledge that "these 'ex-connections' are generally rare events" (Sullivan 1989: 104); they constitute a small portion of the recognizable relationships between fragments. This observation raises questions about the validity and representativeness of the conclusions derived from such approaches. Researchers commonly employ statistical indices to summarize the complete ceramic assemblage on the basis of an unrepresentative subset of physically refitted potsherds (e.g., Skibo *et al.* 1989: 396; Fontana 1998: 1068–1070). However, any ceramic refitting study should consider both direct refits and sherds that are probably from the same vessel (Bollong 1994: 17; Garrow 2006: 50, 105–106; Garrow *et al.* 2006: 32; Beadsmoore *et al.* 2010: 126).

The most comprehensive of the published procedures is Bollong's method (1994: 17–19, table 1; Chapman and Gaydarska 2007: 82, table 5.1), in which he defines criteria for six types of sherd-to-vessel associations, expressed in terms of probability, and ranging from direct refits (Code 1) to more uncertain linkages (e.g., non-adjoining sherds likely from the same vessel [Codes 2–4]), and negative results (e.g., isolated or orphan sherds [Codes 5–6]). Bollong considers actual joins and possible matches, yet the method has three shortcomings. It is a purely qualitative index with no possibility of comparing the effects of different criteria on the result; focused on postdepositional processes, whereas formation dynamics are disregarded; and the results are presented in an impressionistic manner, with little opportunity for replicating the evaluation of the results. While a different analyst can reproduce Bollong's method, the outcomes cannot be assessed independently because they are implicit or intuitive.

By using a qualitative method for refitting ceramics, there has been no progress in scoring the attributes used to assess the probability of a possible match. Instead, refinements have focused solely on the graphical representation of the physical joins, which have evolved from two-dimensional (2D) maps (Sullivan 1983: 315, 319; Fontana 1998: 1070–1071; Sørensen 1996: 63–65) to more complex 3D representations (Bollong 1994: 18–24; Garrow *et al.* 2006: 14), with significant improvements based on the use of GIS (Květina and Končelová 2011: 63; Beckett 2011: 409–411, fig. 7; Stewart *et al.* 2011: 261–269). GIS is used to map refitting items from different features or areas on the same site. Again, most of these representations deal with the rare physically matching fragments. Although we do not discuss graphical representations of our refitting experiment, the new method permits a rich variety of 2D and 3D graphics.

Here we discuss the central problems in conjoining operations as a way of enhancing a widely applicable

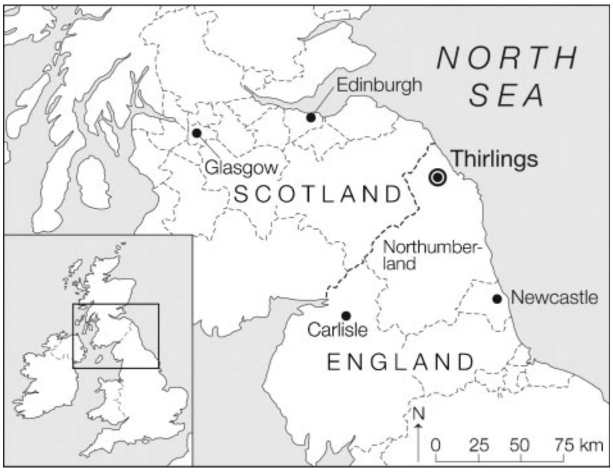

Figure 1 Location of the site of Thirlings in northeastern England.

and flexible method of ceramic refitting. We define and assess stages of refitting using protocols that provide a range of different scoring options (online supplement), allowing for different kinds of probable matches (Sullivan 1983; Sullivan *et al.* 1991; Bollong 1994). It is important to develop a different approach to recording and scoring this wider range of observations about sherd associations, which this work aims at addressing by providing a more comprehensive, explicit, and rigorous method.

The Ceramic Assemblage from Thirlings

As part of the training-through-research program designed to provide one of us (ABG) with hands-on experience with refitting prehistoric ceramics, we studied the Neolithic handmade ceramic assemblage from Thirlings, a pit site located in Northumberland, U.K. (FIG. 1). Roger Miket and Colm O'Brien conducted several seasons of excavation (1973–1981) at this later prehistoric and early Medieval site. The prehistoric occupation consisted of scattered negative features—wells, trenches, post-marked pits, stake holes, etc.—backfilled (i.e., deliberately filled after primary use) with different sandy, loamy, dark, organic and charcoal-rich deposits, and cultural residues (Miket *et al.* 2008; Edwards 2009, 2012). Despite documenting several arrangements of features, the investigators did not identify any clear residential structures. As a result, they describe Thirlings as a place of continuous deposition with subsistence-related activities carried out over several generations (Miket *et al.* 2008: 98–101). They identified two Neolithic phases: Early Neolithic materials associated with the Carinated Bowl style ca. 3800–3650 CAL B.C. and Middle and Late Neolithic Wares (impressed styles) from ca. 3500–2500 CAL B.C. We chose this case study to conduct refitting experiments because of the unusually large amount of ceramic material for northeastern England–over 500 sherds corresponding to ca. 80 vessels (Miket *et al.* 2008: 1, 29, tables 2–3). We also

Figure 2 Part of the Neolithic ceramic assemblage from Thirlings spread over two large tables at the Wolfson Archaeological Laboratory (Newcastle University).

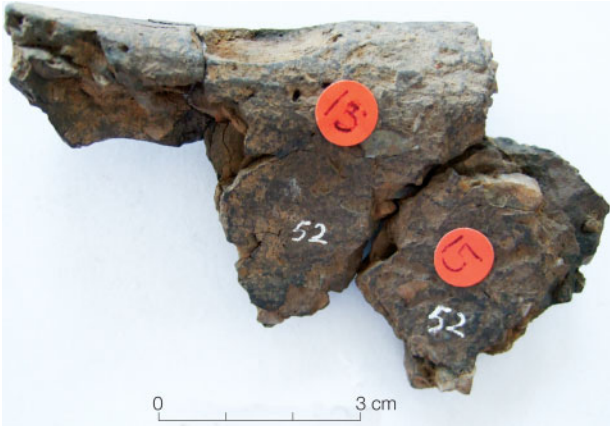

Figure 3 The intra-feature (pit 52) refit no. 15; an example of a highly probable refit (75–85%). Note the imperfect physical matching between the sherds owing to irregularities in the fractured edges.

consider the large surface area exposed during excavations (over 2000 sq m), and the prior analysis of predepositional patterns of fragmentation and abrasion (Edwards 2009: 124–159) that can be tested again using our improved recording and scoring system.

Methods

Our study on focused Neolithic ceramics, therefore, we designed a method that deals with handmade ceramic vessels. The refitting experiment was planned to identify physical matching between sherds as well as possible matches between non-adjoining sherds. Here we use the term "refit" to mean the generalized association between sherds based on their shared attributes. This association can be expressed in terms of the likelihood of these fragments deriving from the same vessel. Therefore two types of positive results are expected: a join is a mechanical or direct match between adjoining sherds, and a possible match (PM) refers to sherds that probably pertain to the same vessel but that cannot be physically matched. The experiment consisted of a close examination of every Neolithic ceramic sherd from the Thirlings excavations currently deposited in the Great North Museum, Newcastle University. Of the 228 negative features documented at Thirlings, we only considered sherds from the later prehistoric features. The sample included a total of 523 fragments recovered from 39 negative features. The material was recorded by feature and sometimes by the level or context within a feature (Miket *et al.* 2008).

The first step in the training exercise consisted of spreading the entire ceramic assemblage across large tables in the Wolfson Archaeology Laboratory, Newcastle University (FIG. 2). The fragments from each context were sorted according to the groups of feature sherds (e.g., sets of rims, bases, carinations, etc.)—and/or different groups of decoration. Sherds smaller than 1 cm in length were excluded. The next step involved a series of systematic comparisons between fragments. First, we determined refits between sherds from the same layer and within the same feature (intra-feature matching). This task enabled the identification of several joins as well as PMs. Next, we tested for PMs between sherds from different dug-out pits (inter-feature refitting). We performed a trial comparison based on sherds with rare attributes. Then we carried out a systematic comparison of three subsets of sherds: large sherds, decorated sherds, and rims. Each subset was placed on trays to permit a simple visual comparison with all other pieces. This produced several PMs. We used colored stickers to label the sherds comprising joins or PMs and numbered each color-coded pair of sherds (FIG. 3). Every refit was entered into an Excel spreadsheet (n=45).

The scoring system

Refits were scored using explicit criteria (described below) in order to calculate the probability of finding a join or a PM. Our method is inspired by Bollong's (1994), but we expanded it to be of greater use for decorated wares and other kinds of sherds. Instead of a rigid scoring system based on mutually exclusive categories (e.g., Code 1, Code 3, etc.) and associated values, we created a system for recording morphological similarities between sherds based on their physical, technological, and taphonomic attributes. Next, we assigned quantitative values to each attribute in order to calculate the resemblance between each set of sherds based on their attributes (Chapman and Gaydarska 2007: 163–166).

We considered several ways of assessing the similarity between possible refits. Based on the attributes tested by previous refitting methods (Sullivan 1983: 318, 1989: 104; Bollong 1994: 17; Fontana 1998: 1069) we selected six common variables: decoration, surface, thickness, internal firing section or core, fabric, and refit. Following Bollong (1994: 17–18, table 1), we used codes to evaluate each of these attributes; some of them (core, fabric, and refit) as falling within a range of 1 (likely) to 2 (unlikely)—an estimation of the likelihood of fragments deriving from the same vessel. However, this simple scoring system does not capture the complexity of some of the attributes, which require more precise and nuanced measures. Therefore, we treat decoration, surface, and thickness as more complex attributes owing to the wide range of variability; these attributes are coded in one of three ways. For instance, decoration is designated as: 1=same decoration/form, 2=no documented decoration, and 3=dissimilar decoration or one sherd decorated and the other undecorated.

Surface refers to the finishing treatment at the time of manufacture: e.g., polished, smoothed, or coarse. Some stages in the use life of a vessel prior to its discard may also leave physical marks—e.g., blotches from differential firing, attritional traits, or accretions on the surfaces—which increase the likelihood of two sherds deriving from the same vessel. For example, the two sherds corresponding to refit no. 42 (pits 89 and 98) and those from PM no. 40 were burned prior to breakage, probably during cooking activities (Skibo 1992: 148–152). We also observed sherds with post-breakage thermo-alterations (e.g., Sullivan 1983: fig. 9), such as the two sherds with surface cracking from PM no. 41. Post-breakage disturbance can be recognized when the very fractures are also affected by these alterations, as this is the case. The latter kind of surface alteration provides information about the subsequent trajectories (including reuse) of broken sherds, but is less useful for determining whether two sherds were part of the same vessel. As a result, we defined three codes for the attribute surface: 1=same surface treatment, 2=different surface treatment, and 3=similar pre-breakage mark. Post-breakage changes are not reliable to address correspondence to the same vessel, as only post-breakage alterations affect the very fractures.

Thickness refers to vessel wall thickness (measured in mm), but it must also account for possibly matching fragments with varying wall thickness (e.g., carination, neck curvature, base). Thus, codes for thickness include: 1=same thickness, 2=different thickness, and 3=same shape of the sherd and same thickness.

Core requires the examination of conjoining fracture edges in order to assess their similarity. Fabric has to do with the technological choices of potters and records similarities in the nature, proportion, and size of the temper or inclusions as well as the clay. Fabrics were observed with the naked eye.

Percentage scoring for attributes

The codes for each attribute were scored using a percentage measure, following Chapman and Gaydarska (2007: 164, table 7.5). The relative importance of the six attributes is not equal, inasmuch as join and decoration are more diagnostic for refitting than the other attributes (Sullivan 1983). As a result, it was useful to design different scoring systems based on varying values for the two most important attributes—join and decoration—and similar values for the others. We defined and tested five alternative scoring systems, A, B, C, D, and E, using the ceramic assemblage from Thirlings (TABLE 1) (online supplement).

Each attribute receives a percentage score, the value of which depends on its presence on both sherds, absence, or difference between both sherds. Thus, the values for decoration range from: 1=same decoration (30–10%), 2=no decoration (15–0%), and 3=different decoration (always receives a score of 0%). For surface, the three possibilities are: 1=same treatment (5%), 2=different treatment (0%), and 3=special pre-break marks (10%). Thickness includes the wall thickness and the shape of the sherd: 1=same wall thickness (5%), 2=different wall thickness (0%), and 3=same shape (10%). The technological attributes core and fabric are scored in a similar manner: 1=similar (10%) or 2=dissimilar (0%). Join is the most important attribute for assessing refits; however, it is not scored as 100% since this attribute can also be ambiguous because handmade ceramics usually exhibit eroded or worn fracture edges (FIGS. 3, 4). Consequently, physical matching should be assessed more carefully than by a simple yes/no appraisal. For example, physical matches can be recognized between sherds of different colors acquired in a post-breakage stage (FIG. 4); in such cases, a probability percentage can be expressed,

Table 1 Range of scores given to two attributes—join and decoration—in the five scoring systems (A–E).

Scoring system	Join	Same decoration	No decoration	Significance of scoring in system
A	30%	30%	15%	Strong emphasis on shared decoration; least emphasis on physical refit
B	35%	25%	10%	
C	40%	20%	10%	
D	45%	15%	5%	
E	50%	10%	5%	Strong emphasis on physical refit; least emphasis on shared decoration

Figure 4 The inter-feature (pits 366 and 369) refit no. 14; an example of a contentious join with already stuck sherds featuring strong post-breakage changes in color. Note the uneven physical matching, especially evident on the interior surface (upper right view).

Table 2 Probability percentage for each refit according to the five scoring systems (A–E).

Refit	A (%)	B (%)	C (%)	D (%)	E (%)
1	50	45	40	35	30
2	50	45	45	40	40
3	40	40	40	35	35
4	45	40	40	35	35
5	45	40	40	35	35
6	35	30	30	35	25
7	45	40	40	35	35
8	80	80	85	85	90
9	80	80	85	85	90
10	75	75	80	85	85
11	70	70	75	75	80
12	65	65	70	65	75
13	35	30	30	20	25
14	60	60	60	65	70
15	75	75	80	80	85
16	65	60	55	50	45
17	45	40	40	35	35
18	65	65	70	70	75
19	60	55	50	45	40
20	35	30	30	25	25
21	65	60	55	50	45
22	45	35	40	35	35
23	35	30	30	25	25
24	45	40	40	35	35
25	45	40	40	35	35
26	75	75	80	80	85
27	30	25	25	20	20
28	55	50	45	40	40
29	50	45	40	35	35
30	60	55	50	45	45
31	60	55	50	45	45
32	45	35	40	35	35
33	80	75	80	80	85
34	50	45	40	35	30
35	45	40	40	35	35
36	45	40	40	35	35
37	45	40	40	35	35
38	75	75	80	80	85
39	45	40	40	35	35
40	50	45	45	40	40
41	45	40	40	35	35
42	50	45	45	40	40
43	35	30	30	25	25
44	50	45	45	40	40
45	40	35	35	30	30

especially in eroded assemblages due to both pre- or postabandonment attritional processes. We tested a range of values for join, ranging from 30% in scoring system A to 50% in scoring system E (TABLE 1).

Statistical testing

The five scoring templates (A–E) employed here provided measurements for a total of 45 refits (TABLES 2, 3). They offer a sliding scale of emphases on the attributes join and shared decoration providing a mathematical expression of judgments about the importance of these attributes. In general, the values for each refit are similar across the different scoring systems, with an average difference of 10–15 percentage points. The clearest cases of sherd-to-vessel associations are those characterized by physical matching or joins, which produce values of 75–90% (FIG. 3). The more unlikely PMs—e.g., those lacking several diagnostic attributes and with no physical join—produced values of 20–30% (FIG. 5). The refits with major discrepancies across scoring systems (up to 20%) lack physical matching and present other peculiarities in terms of association/dissociation, such as same shape of the sherd and same thickness or differences in the fabrics and cores; these include PM nos. 1, 13, 16, and 21 (TABLE 2).

In order to compare these diverse scoring systems and draw reliable conclusions we employed a statistical ranking method to assess the agreement among the five values. We used Spearman's rank correlation coefficient (Spearman's ρ) (Moroney 1951: 334–340; Drennan 1996: 228–234), a non-parametric bivariate test that is appropriate for ordinal non-normally distributed variables and does not presume a linear relationship between them. To perform this calculation, it was necessary to translate the raw percentage values (TABLE 2) into ordinal ranks of scores using the arithmetic mean whenever multiple values shared the same relative position. For example, in system A three cases (refits 8, 9, and 33) score the maximum (80%), and therefore they must share the highest relative position. Thus, their ordinal rank in the template was obtained using the arithmetic mean of their first, second, and third positions ($\bar{x}=2$) (TABLE 3).

The statistical test yielded values for Spearman's ρ that are close to $+1$, which indicates a significant positive correlation between the five ordinal ranks for each refit (FIG. 6). Using a two-sided P value, the significance level at which the null hypothesis can be rejected is 1%. In other words, the five scoring systems are in good agreement, with statistically insignificant variation among measurements. As a result, we conclude that this scoring system provides a good measure of the likelihood that two or more sherds are from the same vessel.

Discussion

The use of a formalized scoring system to analyze ceramic refitting permits a more reflexive assessment of the method. The Thirlings case study demonstrates that this method provides a richer and more accurate interpretation of the ceramic assemblage. The initial refitting analysis carried out by the excavators of the site provided evidence for sherds derived from the same vessels in both the Early and the Middle–Late Neolithic assemblages (Miket *et al.* 2008; Edwards 2009, 2012). Despite the fact that many refitted sherds were already glued together, only a small portion of them were discussed and interpreted as such (Miket *et al.* 2008: 44, 49, 67) or prompted statements about the improbability of their belonging to the same vessels (Miket *et al.* 2008: 68). These initial observations remained largely implicit and were barely acknowledged because of the absence of a more systematic approach.

Table 3 Ordinal ranks of scores for each refit according to the five scoring templates (A–E).

Refit	A	B	C	D	E
1	21.0	22.0	30.0	30.5	38.0
2	21.0	22.0	19.0	19.0	18.5
3	39.5	31.5	30.0	30.5	29.0
4	31.5	31.5	30.0	30.5	29.0
5	31.5	31.5	30.0	30.5	29.0
6	42.0	42.0	42.0	30.5	42.0
7	31.5	31.5	30.0	30.5	29.0
8	2.0	1.5	1.5	2.0	1.5
9	2.0	1.5	1.5	2.0	1.5
10	5.5	5.0	5.0	2.0	5.0
11	8.0	8.0	8.0	8.0	8.0
12	10.5	9.5	9.5	10.5	9.5
13	42.0	42.0	42.0	44.5	42.0
14	14.5	12.0	11.0	10.5	11.0
15	5.5	5.0	5.0	5.5	5.0
16	10.5	12.0	12.5	12.5	13.5
17	31.5	31.5	30.0	30.5	29.0
18	10.5	9.5	9.5	9.0	9.5
19	14.5	15.0	15.0	15.0	18.5
20	42.0	42.0	42.0	42.0	42.0
21	10.5	12.0	12.5	12.5	13.5
22	31.5	38.0	30.0	30.5	29.0
23	42.0	42.0	42.0	42.0	42.0
24	31.5	31.5	30.0	30.5	29.0
25	31.5	31.5	30.0	30.5	29.0
26	5.5	5.0	5.0	5.5	5.0
27	45.0	45.0	45.0	44.5	45.0
28	17.0	18.0	19.0	19.0	18.5
29	21.0	22.0	30.0	30.5	29.0
30	14.5	15.0	15.0	15.0	13.5
31	14.5	15.0	15.0	15.0	13.5
32	31.5	38.0	30.0	30.5	29.0
33	2.0	5.0	5.0	5.5	5.0
34	21.0	22.0	30.0	30.5	38.0
35	31.5	31.5	30.0	30.5	29.0
36	31.5	31.5	30.0	30.5	18.0
37	31.5	31.5	30.0	30.5	29.0
38	5.5	5.0	5.0	5.5	5.0
39	31.5	31.5	30.0	30.5	29.0
40	21.0	22.0	19.0	19.0	18.5
41	31.5	31.5	30.0	30.5	29.0
42	21.0	22.0	19.0	19.0	18.5
43	42.0	42.0	42.0	42.0	42.0
44	21.0	22.0	19.0	19.0	18.5
45	39.5	38.0	39.0	40.0	38.0

Figure 5 The intra-feature (pit 57.9) PM no. 27, with a low probability of deriving from the same vessel (20–30%).

Some examples from our analysis of the Thirlings material highlight the disagreements between the excavator's refitting operation and our own results about possible sherd refits. The excavators identified a single inter-feature join, reported here as refit no. 14 (FIG. 4). It consists of one rim sherd from pit 366 and one body fragment from pit 369 in Cluster A (Miket *et al.* 2008: 44–45, fig. 21, no. 31.2; Edwards 2009: 159, 172). Despite the postulated physical matching of the sherds, they present differences in several attributes producing a score in the range of a PM (60–70%) rather than a secure join. Considering that the sherds seem to match fairly imperfectly, this score represents a low absolute value and illustrates the complexities of handmade sherd matching, especially when fragments are worn out and the fractures have lost matter, as this is the case.

We also offer some general conclusions about the refitting experiment through a consideration of the percentage values recorded in different templates (FIG. 6). Of the total refits (n=45) recorded in the experiment, only 11 could be considered as secure joins, all of which scored over 60% in all five scoring systems (A–E). Each pair of sherds shares common attributes, allowing a multidimensional appreciation

		Systems				
Systems*	Spearman's rho	A	B	C	D	E
A	Correlation coefficient	1	0.987†	0.974†	0.962†	0.927†
	Significance (2-tailed)		0	0	0	0
B	Correlation coefficient	0.987†	1	0.973†	0.961†	0.928†
	Significance (2-tailed)	0		0	0	0
C	Correlation coefficient	0.987†	0.973†		0.989†	0.975†
	Significance (2-tailed)	0	0		0	0
D	Correlation coefficient	0.962†	0.961†	0.989†	1	0.964†
	Significance (2-tailed)	0	0	0	0	0
E	Correlation coefficient	0.927†	0.928†	0.975†	0.964†	1
	Significance (2-tailed)	0	0	0	0	

*Each system has an N of 45.
†Correlation is significant at the 0.01 level (2-tailed).

Figure 6 Results of the Spearman's rho (ρ) testing the link between the ranks of scores according to the five assessment systems (A–E) presented in Table 3.

of the refitting evidence. Thus, it is worth mentioning that none of these sherds exhibit decoration, only four of these associations involve rims or bases, whereas three cases include fragments sharing both thickness and shape of the sherds.

Even though we agree with the overall interpretation proposed for Thirlings (Miket *et al.* 2008; Edwards 2009, 2012), our refitting analysis permits a more nuanced reading with implications for the depositional patterns responsible for the formation of this sample. Miket and colleagues (2008: 36, 100) characterized the assemblage as containing few refittings and nearly one third of the sherds as having a medium to high level of abrasion. Consequently, site activities were thought to include a phase of provisional discard during which broken materials were accumulated in transitory contexts for prospective reuse. In our opinion, this account does not satisfactorily address the considerable amount of potentially refitting sherds within the features and is based on an overestimation of the amount of abrasion (Miket *et al.* 2008: 31–36, 100–101; Edwards 2009: 147–159). Our analysis revealed that there is much more intra-feature refitting than previously acknowledged, evidence of further shattering of large sherds within the pits due to natural degradative processes, mostly because of their crude fabrics and incomplete firing. However, ceramics do not reveal clear differences among pits. The majority of the sherds we examined exhibit no abrasion or very little, with few weathered (i.e., ceramics exposed to the effects of rain or wind), or eroded (i.e., attrition due to their reuse) sherds. This suggests that sherds were discarded almost immediately after breaking, or they were provisionally discarded in a protected context (contra Edwards 2009: 193). Overall, we agree that there is strong evidence for selective depositional patterns; "Thirlings shows evidence of the careful assignment of particular pots to certain pits" (Edwards 2009: 194). For example, there seems to have been deliberate depositions of the most fragmented sherds in post-marked pits (Edwards 2012: 89). Moreover, the high frequency of orphan sherds—especially large, decorated rim sherds—suggests that they may be tokens that stand in for complete vessels (synecdoche, or part for whole symbolism) (Chapman and Gaydarska 2007). This constitutes a disregarded pattern worth considering in future works on Neolithic Northumbria.

Conclusions

The primary goal here is to provide a method for performing the first stages of any refitting analysis. Here we have proposed a method for systematic recording and quantitative scoring of ceramic refits. This procedure is designed to be flexible; any refitting analysis can be replicated and assessed according to different scoring systems. Using the Middle–Late Neolithic assemblage from Thirlings as a case study, we gained a hands-on impression of particular patterns of breakage and deposition. The variability recorded in this sample constitutes new evidence that suggests a slightly different account of this site. Its excavators interpreted a prolonged stage between the breakage of pottery and its eventual incorporation to the pits (Miket *et al.* 2008). By contrast, our reappraisal let us envisage a rather short timespan between the fracture of vessels and their entering the pits. It also illustrates the possibilities of employing the scoring systems for other assemblages. Despite the fact that our ceramic sample is small (n=523) compared with other European assemblages, the scoring system is applicable to larger ensembles, especially if the refitting analyses can benefit from the use of databases, statistic packages, and GIS for scoring, recording, and displaying the results (Květina and Končelová 2011). The scoring system can be adjusted and automated by means of databases to cope with larger samples. The method is designed for prehistoric handmade ceramics, i.e., highly heterogeneous and irregular sherds; however, it can be applied to ceramics produced with more standardized techniques by resorting to the use of archaeometric characterization (Blanco-González *et al.* in press) to test the likelihood of sherds deriving from the same vessel.

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