The meanings of standardisation: conical cups in the late Bronze Age Aegean

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Standardisation is not simply an indicator of economic factors, such as mass-production or craft specialization but can have roots which may be technical, social or political. Here the fabric, forming technique and dimensions of conical cups in the Bronze Age Aegean are studied by comparing products from the islands of Kea and Melos. While the fabric and forming technique on both islands are standardised and emulate Cretan models, the degree of standardisation of the pottery shapes varies between the two sites. This is explained by their having different social contexts of production.

Keywords: Bronze Age, Aegean, standardisation, pottery production.

Introduction

Standardisation of material culture is a commonly observed phenomenon. In the past, increasing standardisation has often been linked to increasing production, craft specialisation or economic competition. Recently, however, attempts have been made to also consider socio-political and technological factors. By investigating the production of conical cups at Phylakopi on Melos and Ayia Irini on Kea during the Late Bronze Age (Late Cycladic I-II), this paper attempts to illustrate that the term 'standardisation' can refer to a range of intentional strategies and unintentional factors. It will be argued that the conical cup production at Ayia Irini appears to be intentionally standardised, but at Phylakopi, while the method of manufacture and fabric were as standardised, the range in dimensions was more varied. Cultural forces are suggested as explaining the differences between the two sites.

Motives for standardisation

In our modern day society standardisation is frequently regarded as a positive goal (Schmidt & Werle 1998), as for example the imposition of standard-width train tracks to ease travel between countries in the European Union. On the other hand, some effects of standardisation are perceived as negative, such as the similar range of shops in Great Britain's city centres and (on a much larger scale) globalisation. Thus, while we can provide a definition of standardisation, the interpretation of the process or outcome remains varied, eliciting complex responses along a spectrum from ready acceptance to outright rejection.

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Received:15 October 2001; Revised: 31 January 2003; Accepted: 21 October 2002

The term standardisation is thus applied to a purposeful and intentional process, but we should not assume that standardisation in antiquity was also intentionally striven for or formed part of a longer-term strategy: there may be incidences where standardisation occurs as a coincidental result of other variables. To give an example, a homogenous pot shape may be the result of a strategic decision by the workshop owner, or optimization of the potter's motor skills over many years of practice. Although the outcome of intentional and accidental homogenisation may be identical, the underlying values and decisions attached to each may differ greatly. It is therefore imperative to look beyond the final product, the standardised object, and investigate the underlying technological, economic and socio-political causes.

Ethnoarchaeological studies have demonstrated that one of the factors influencing standardisation may be the demand of customers for a unified, recognisable product with specific dimensions or volume (Longacre 1999; Arnold & Nieves 1992). Narrow functions or aesthetic ideals, for example, may bring about changes in the production (for an example of how tourist demand can effect the production of *bolas* see Arnold & Nieves 1992). Specific functions or aesthetic considerations are only two possibilities out of a much wider spectrum of factors which govern demand. Other explanations invite us to consider the social dimension. Technology is not autonomous or external to a society, on the contrary, it is influenced and shaped by the societal context (Schmidt & Werle 1998: 13; Arnold 2000).

Defining standard products

Standardisation can be characterised as achieving a relative degree of homogeneity in a product or production process (Rice 1991: 268). It is relative because humans cannot produce an exact copy of an artefact without mechanical aid. Due to limitations in our visual perception, memory and motor skills we identify objects as exact replicas even though they may differ by up to 2-3 per cent in dimensions and weight (the so-called Weber's fraction) (Eerkens 2000; Eerkens & Bettinger 2001). In contrast, a random distribution can result in as much as 57.7 per cent variation (Eerkens & Bettinger 2001: 497). This means that humans, without reference to an independent scale (such as a ruler), will perceive objects as 'the same' even though they differ in size or weight by at least three per cent. If relying on memory alone, experiments have shown that the error is even greater. This means that ancient societies are unlikely to achieve a greater degree of standardisation than within c. five per cent even when it is deliberately striven for (Eerkens 2000: 667).

Different materials allow different degrees of standardisation. For example, pottery is regarded as more easily standardised than lithics (Eerkens & Bettinger 2000: 500). The term will therefore remain relative and will always require a control group for comparative purposes (be it chronological or geographical). Only with the help of such a control group can we establish if a process or a group of objects became *more* or *less* standardised over time or if one assemblage is *more* or *less* standardised than another one. Likewise, what appears to be standardised in the eyes of one group of people may not be so in the eyes of others. Thus, standardisation is socially defined and contextually variable.

Explanations of standardisation

Most commonly standardisation has been used to support evolutionary models – for example as an indicator of emerging social complexity or increasing craft specialisation (Rice 1981; Longacre 1999; Costin 1991; Benco 1988; Longacre, Kvamme & Kobayashi 1988). Arnold (1991b) and London (1991) have challenged this evolutionary approach by demonstrating that a comparable degree of standardisation can be achieved in both domestic and industrial settings. Standardisation has also been viewed as an indicator of increasing economic competition (Davis & Lewis 1985). While this approach has been recognised as a valid one, Arnold argues that too much emphasis has been placed on the producer thereby neglecting the consumer's impact (1991a: 96-98). More recent studies have focused on socio-political dimensions, and have greatly added to our understanding of the variety of factors contributing to standardisation: use of similar tools (Arnold 1991b), improved skills (Longacre 1999), and consumer demand (Longacre 1999; Costin & Hagstrum 1995; Arnold & Nieves 1992) can all contribute to an intentionally and accidentally standardised product.

Case Studies: the production of conical cups in the Cyclades

The research reported here attempts to build on previous investigations into the socio-political factors bearing on standardisation by discussing the pottery production at two Late Bronze Age settlements in Greece, Ayia Irini on Kea and Phylakopi on Melos – two of the best excavated sites in the region (Figure 1). The early part of the Late Bronze Age is regarded as the peak of Minoan influence in the Aegean, and many Minoan objects found their way to the Greek mainland, the Dodecanese and the Cyclades. The most archaeologically visible of these items was pottery, which was both exported and imitated locally. One of several forms of pottery which epitomises Minoan

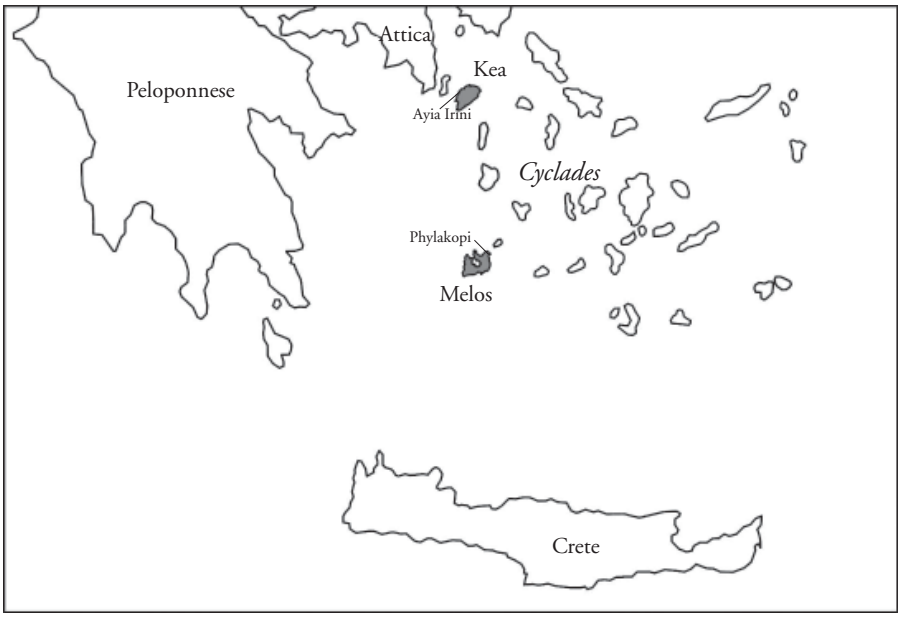

Figure 1 Map of part of the Aegean Sea showing the location of Kea, Melos and the Cyclades.

culture is the conical cup (Figure 2). Due to their abundance, small size and compactness they have become an ideal object for the study of pottery production (Gillis 1990a, 1990b, 1998; Davis & Lewis 1985; Knappett 1999), and hence of standardisation. Conical cups are generally regarded as part of the standard Minoan kitchen/dining kit (Wiener 1990: 135). Having been found in residential and funeral contexts alike they must have fulfilled an important function in the context of drinking and feasting.

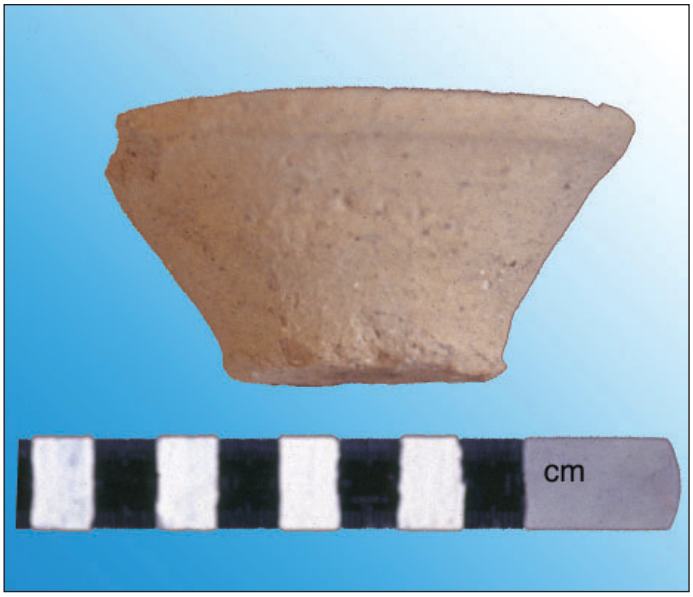

Figure 2 Photograph of a conical cup.

Excavations at Ayia Irini began in the 1960s and uncovered a major fortified Bronze Age town, strongly influenced by Minoan culture (Caskey 1971, 1972; Cummer & Schofield 1984; Davis 1986). Phylakopi was first excavated between 1896 and 1899 (Atkinson *et al* 1904), and more recently by Colin Renfrew in the 1970s (Renfrew, in press; Renfrew & Wagstaff 1982). This town, too, has been regarded as having been under substantial Minoan cultural influence. While selective adoption of Minoan traits and material culture is visible at both sites, they seem to differ in degrees with Ayia Irini having experienced a higher level of acculturation than Phylakopi (Berg 2000).

Method

Conical cups have been found in hundreds at Ayia Irini and at Phylakopi (Cummer & Schofield 1984, 141; Berg 2000). While all pottery was kept from Renfrew's excavations, much of the Keian pottery has unfortunately been discarded. However, Davis and Lewis (1985) undertook a detailed study of conical cups from Ayia Irini and their results can be compared to those derived from my own analysis of the cups from Phylakopi.

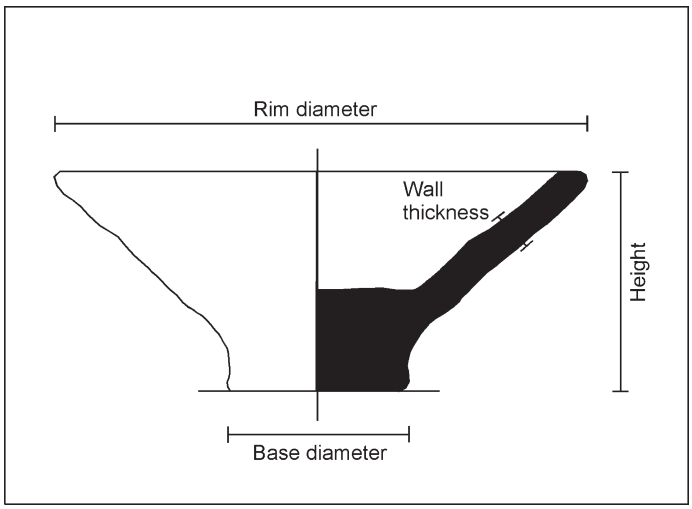

Figure 3 Diagram of a conical cup, showing the attributes studied.

The use of specific clays and manufacturing techniques used to produce the conical cups was studied and found to be strongly standardised for the production of conical cups at both sites (see below). In order to compare production between the assemblages of the two sites, the cup shape was broken down into a series of dimensional variables. The height, rim diameter and base diameter of the sample group were measured and averaged ($\bar{x}$) for the two period subdivisions of the (early and middle) Late Cycladic I (LC I: c. 1730-1645 B.C.) and Late Cycadic II (including late LC I; c. 1645-1500 B.C.) (Fig 3). Measurements were also taken of body thickness for Phylakopi, while volume was calculated for the Ayia Irini group. The variation from the mean was calculated (here expressed as variance: s^2), where the lower the value, the less variation there is from the mean, and the greater the standardisation. The coefficient of variation (CV) is the variation from the mean expressed as a percentage. The smaller the coefficient, the more standardised the assemblage. An assemblage that displays a CV of less than 1.7 per cent has to be regarded as mechanically produced, while a random production without discernible standardisation CV in excess of 57.7 per cent (Eerkens & Bettinger 2001). The results are displayed in Table 1.

The *change* in variability between the two periods at each site was investigated using an *F*-test, which compares the distributions of two data sets with each other. The *F*-value derived from a *F*-test is the ratio of two variances and indicates if the distributions are similar or significantly different (Table 2). In this case, the *F*-values show that conical cup dimensions and volume measurements at Ayia Irini became more standardardised over time, while those at Phylakopi did not.

Table 1 Variability of four attributes of conical cup in Phylakopi and Ayia Irini for the two periods LC I and LC II

Variable	Period	Phylakopi	Ayia Irini
height	LC I	$\bar{x}$ = 3.8 s^2 = 0.18 CV = 4.74%	$\bar{x}$ = 3.72 s^2 = 0.27 CV = 7.26%
	LC II	$\bar{x}$ = 3.8 s^2 = 0.19 CV = 5.00%	$\bar{x}$ = 3.81 s^2 = 0.18 CV = 4.72%
rim diameter	LC I	$\bar{x}$ = 8.85 s^2 = 0.56 CV = 6.32%	$\bar{x}$ = 8.79 s^2 = 0.90 CV = 10.24%
	LC II	$\bar{x}$ = 8.50 s^2 = 0.48 CV = 5.65%	$\bar{x}$ = 8.08 s^2 = 0.24 CV = 2.97%
base diameter	LC I	$\bar{x}$ = 4.02 s^2 = 0.15 CV = 3.73%	$\bar{x}$ = 3.85 s^2 = 0.27 CV = 7.01%
	LC II	$\bar{x}$ = 3.90 s^2 = 0.14 CV = 3.60%	$\bar{x}$ = 3.51 s^2 = 0.08 CV = 2.28%
body	LC I	$\bar{x}$ = 0.64 s^2 = 0.014	n/a
thickness	LC II	$\bar{x}$ = 0.75 s^2 = 0.014	n/a

Table 2 Measure of change between variance shown in periods LC I and LC II

	height	rim diameter	base diameter	body thickness	volume
Phylakopi	n/s	n/s	n/s	n/s	–
Ayia Irini	**	**	**	–	**

F-test (variance) results comparing LC I and LC II (n/s = not significant; * = significant at the 0.05 level; ** = significant at the 0.01 level)

Standardisation of fabric and manufacturing technique

Melos, together with Thera and Anaphi, is part of the Volcanic Arc (Jones 1986: 259) and as a result, virtually all clay sources contain volcanic inclusions; clays vary in colour from brown to orange. Kea, together with Kithnos, Seriphos, Siphnos, Paros, Naxos and Amorgos, is part of the central Cyclades. The geology of this region is characterised by a mix of limestone and schist. The most commonly used clay for most local shapes as well as Minoan-style cooking wares is very recognisable as it is coarse red to dark red with plenty of inclusions, the most distinct one being mica (Davis & Williams 1981; Morris & Jones 1998).

The fabric of the majority of conical cups at both sites is pale brown in colour and can be scratched with the fingernail Although the differences between the fabrics at Phylakopi are not as pronounced as those at Ayia Irini, it appears that in both cases there was a desire to produce conical cups in a light brown fabric not commonly used for local shapes. The consistent choice of a differently coloured clay for the manufacture of conical cups is a form of standardisation as it leads to a more homogenous product. Reasons for this selective use may be technical: but the clay does not appear to be better suited for small vessels as it is also being used for large Minoan-style vessels. Likewise, the more common reddish clay is used for the full range of vessels, including small tumblers and cups as well as large jugs and jars. Nor does the choice of conical cup fabric appear to be due to changes in supply patterns, such as unequal access to or depletion of specific clay resources as similar clay continues to be used for other Minoan pottery forms.

Given the close similarity in colour to the Cretan fabric (generally pale brown or pink) the choice of the pale clay can more easily find a cultural explanation namely the desire of the consumers to purchase a perfect copy of a desirable Cretan object, which encouraged local potters to imitate it as closely as possible. Such a desire is not limited to the production of conical cups, it is also visible in local imitations of most other Minoan forms where potters would add a pale brown slip to a vessel made of reddish clay in imitation of the pale Cretan fabric, thus creating an impression of standardisation for the consumer (Berg 2000: 167).

A further drive for standardisation is visible in the manufacturing methods used for conical cups. At both Ayia Irini and Phylakopi – just as on Crete – conical cups were thrown off the hump – an extremely efficient way of producing these small cups. However, in the case of Phylakopi at least only the conical cups were exclusively wheel-made, other products generally being hand-thrown (Berg 2000: 154). At Ayia Irini the percentage of wheelmade pottery is higher than that at Phylakopi but here too it is noticeable that conical cups are more regularly thrown on the wheel than other shapes (Berg 2000: 177). It is unlikely that it was technological considerations alone which resulted in such a specific use of the wheel. As wheel-made production was much more limited for all other shapes (including other small open vessels), we must assume important additional social or cultural reasons for its adoption.

While it is difficult to gauge which reasons may have played the determinant role, it is striking that the manufacture of conical cups appears to be identical at all sites with regard to dimensions, fabric colour, and manufacturing technique. It appears that potters outside Crete imitated the whole conical cup 'package' instead of selectively choosing specific features. Such a desire to imitate a Cretan product in all aspects is less prominent in other forms where mixing and matching of local with Minoanising traits is relatively common. I therefore propose that it was not technological (increased output/homogenous production) or economic (competitive edge/craft specialisation) considerations but cultural factors, such as the desire to imitate socially recognised symbols and practices (and hence for customers to demand such a product), which drove the islanders to copy the Minoan product so completely. The desire to be seen as participating in the Minoan cultural sphere and in socially significant activities such as drinking and feasting may have been of greater relevance than economic or technological factors.

Production at Ayia Irini on Kea

Davis and Lewis (1985) were the first to investigate locally made conical cups at Ayia Irini. They argued that economic changes in the settlement, and, in particular, in the production of these cups, were initiated (or possibly intensified) by trade and competition with Minoan Crete. The authors suggested that a desire for improved efficiency – in order to compete with external competitors – stood behind increasing standardisation of conical cup production between LC I and LC II. In order to compete effectively, potters may have attempted to control their rising costs by optimising production techniques and by reducing the amount of clay needed per cup. This development could lead to archaeologically observable increasing standardisation in the dimensions of conical cups, such as a narrowing range in height and rim diameter. A more efficient use of clay and throwing techniques may be indicated by a loss in average cup weight leading to an observable reduction in the amount of clay used per cup. Their findings supported both arguments strongly: Increasing standardisation is visible in the narrowing range of height and rim and base diameter from LCI to LC II; and the measured weight shows a drop from an average of 155g in LC I to an average of 108g in LC II (Tables 1 and 2).

Production at Phylakopi on Melos

A comparative study was undertaken with 305 LC I–II conical cups from Phylakopi, focussing on Caskey Type M to ensure comparability with the assemblage from Ayia Irini. The correlation is based on equal measurements for the modal height in both groups (3.9 cm in LC I). As the Melian LC I period had been subdivided into several sub-phases, LC I was defined as encompassing all early and middle LC I conical cups while LC II was characterised as including all late LC I/LC II conical cups. It should be noted that sample sizes vary slightly for each variable as some cups are only partially complete and were unsuited for some of the measurements.

Height, rim diameter and base diameter do not show an increase of standardisation from LC I to LC II (Table 1 and 2; Fig 4 gives the example of cup heights). The thickness of the

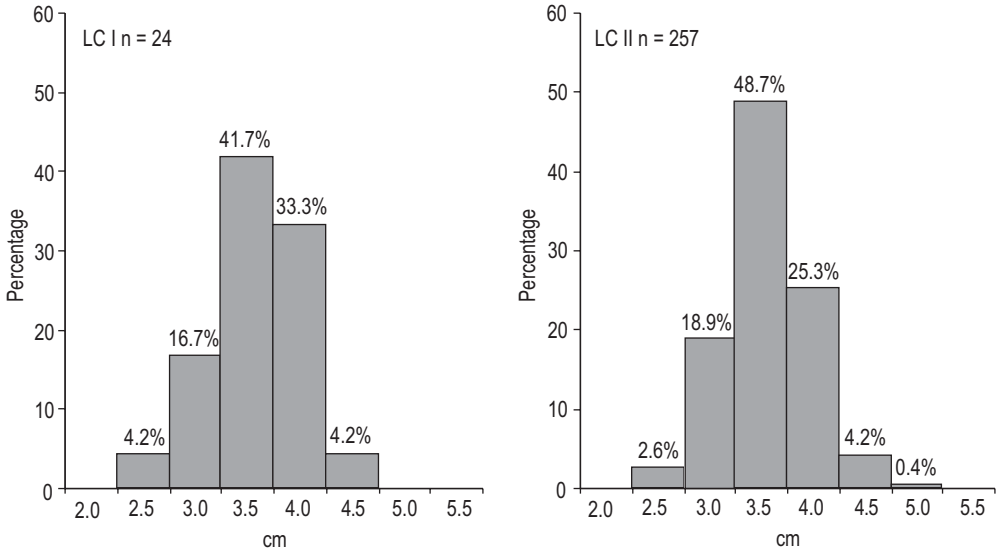

Figure 4 The range of heights in conical cups at Phylakopi: LC I and LC II

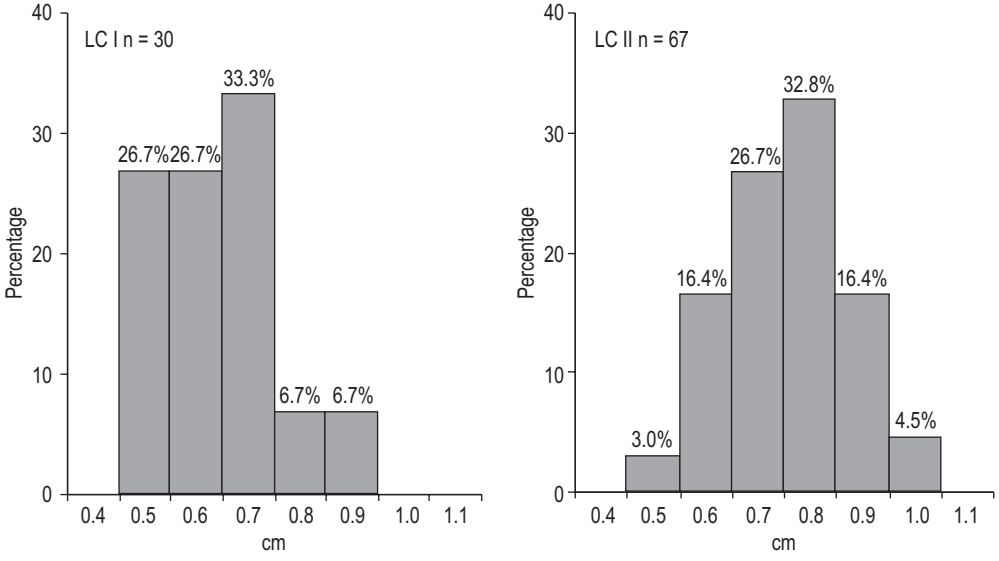

Figure 5 The range of wall thickness in conical cups at Phylakopi: LC I and LC II

wall used in the cups, however, does change – unexpectedly, walls got thicker over time (Fig 5). Standardisation in volume should lead to a reduction in weight of the average cup: the assumption is that potters, in order to achieve a reduction in weight, will use less clay to build the vessel, so a reduction in wall thickness might indicate such a process. But here potters were using more clay in LC II to produce conical cups than they did before. The implication is that there was no standardisation of volume.

Comparing Keian and Melian production

Our most important indication of increasing standardisation is the *F*-test (Table 2) which assesses to what extent two distributions of measurements are different. If we can observe that LC II cups are clustering together more tightly than their LC I counterparts, this could indeed indicate the potters' attempts to standardise; the resulting products would be more similar to each other than they had been before. On this basis, the trend at Ayia Irini was clearly towards greater standardisation in the production of conical cups. However, no such trend could be observed among the Melian conical cups. The *F*-tests indicate without exception that there was no significant change through time for any of the variables considered. Contrasting with the situation at Ayia Irini where less clay was used per cup over time, at Phylakopi the mean body thickness increased in LC II, indicating that potters must have used *more* clay for each individual conical cup. We are therefore to conclude that there was no trend towards reducing costs by rationing clay, nor to achieve a product with more standardised dimensions. Thus while Keian cups decreased in their variance over time, which has been interpreted as a sign of increased standardisation (Davis & Lewis 1985), Melian ones did not change between the LC I and LC II period.

What might have caused this difference in production history observed in the two locations? Davis and Lewis interpreted the increasing standardisation of the Keian production as a "*reflection of changing* regional *economic conditions at the level of the individual potter*" (1985: 87, emphasis mine). They argued that potters from Crete and Ayia Irini were competing for the Keian market, and the observed standardisation was perceived as a direct result of competition between these two potting groups. This scenario is unlikely as virtually no Minoan conical cups were imported into Kea and no locally produced Keian conical cups have been found on Crete (Berg 2000). We therefore have to conclude that conical cups were produced for local consumption only and were not traded over great distances (Gillis 1990b: 99). Standardisation in conical cups on Kea is therefore unlikely to be a response to *external* competition but may be explained in terms of *internal* developments, such as increasing competition between different potting groups at Ayia Irini, possibly encouraged by exposure to a more technologically efficient society. As no Keian control group was examined for its degree of standardisation, this hypothesis cannot be further explored.

Why did the conical cup production at Phylakopi not experience increased standardisation? Was there no optimisation in dimensions because there were many different potters at work throughout? Did Melian potters strive to achieve standardisation but failed or did they consciously decide not to follow that path? Was pottery manufacture organised differently thus preventing trends of standardisation? A preliminary pointer to an answer to these questions can be gathered from the study of three unusual deposits at Phylakopi, ΠA 67, KKd 35 and KKd 38, which had a larger than average proportion of conical cups. The positioning and location of these levels within the stratigraphy suggests that all of the conical cups found in them are contemporary and possibly produced by the same potter. A statistical analysis demonstrates that the degree of standardisation of dimensions in this group of pots was much the same as in the overall assemblage from the site. We do not see here an increase of variability in vessel dimensions – that 'cumulative blurring"– which was characterised by Blackman *et al.*(1993: 74) as being due to multiple production events in several different

workshops. We have to acknowledge that pottery production at Phylakopi never became as standardised as that of Ayia Irini.

Conclusion

While there are a number of similarities between the sites on Kea and on Melos there are also great differences. The distinct selection of the raw materials and the exclusive use of the wheel have in both cases been interpreted as stemming from the producers' or customers' desire to make or purchase pottery which imitates the Cretan product as perfectly as possible. This pattern is also visible in other Minoanising shapes but is most complete among the conical cups discussed here. Conical cups were an essential ingredient of a Minoan lifestyle; they played a vital role in secular and sacred contexts and are associated with drinking or feasting (Gillis 1990a). Buying into this lifestyle and participating in meaningful rituals may have fostered islanders' desire to create or possess a perfect copy of an item so closely associated with Minoan culture.

Potters at Ayia Irini and Phylakopi appear to differ, however, in their approach to dimensional standardisation. Conical cup dimensions at Ayia Irini became less variable over time. If internal competition is accepted as a potential explanation, we need to postulate as yet unrecognised changes in the pottery organisation or in customer demand. At Phylakopi, on the other hand, conical cups remained variable in their dimensions throughout. If this is due to lack of competition, lack of change in the production organisation, a greater variety of functions, lack of customer demand or cultural resistance against such standardisation is as yet uncertain.

It is undoubtedly possible that competition may stimulate production to become more cost- and time-effective, but there is a range of accidental processes which may lead to identical results. The reduction of several workshops to a single one, a change from part-time to full-time production, or product specialisation can all lead to increased standardisation. Longacre, for example, argues for a moderate but discernible correlation between decreasing metrical variation and increasing skill resulting from greater experience (Longacre 1999; London 1991; Eerkens 2000).

We are no closer to discriminating between intentional and accidental optimisation. Only when we can exclude that the observed optimisation is not a result of accidental technological changes will it be possible to pinpoint underlying economic or socio-political reasons. Unfortunately, with most of the excavated pottery being disposed of and only a selective collection remaining, we are unable to assess the accidental changes in the technology of the Keian pottery production with any accuracy. The competition hypothesis therefore remains a possible but unproven scenario.

A future research project is designed to address some of these points. For the moment, suffice it to say that Phylakopi did not participate to the same degree as Ayia Irini in the Minoanisation of its wares. Melian potters used the wheel less frequently than their Keian counterparts, and there was more mixing between local and Minoan decoration and shapes than at Ayia Irini (Berg 2000). In the case of Ayia Irini, cultural demands were battling with possible economic forces, ultimately resulting in an overall more homogenous product. At Phylakopi, cultural forces are at play again but this time pulling in different directions

ultimately leading to a product which is homogenous in its material and production method but quite variable in its shape. This difference in standardisation is symptomatic of the settlements' general attitude towards Minoan Crete. Ayia Irini embraced Minoan culture and incorporated Minoan shapes, decorations and technologies into its own pottery repertoire. This development went hand in hand with the creation of workshop-like facilities in an attempt to promote itself as a meeting point for traders between the Greek mainland and Crete. In contrast, Phylakopi remained settled in its local ceramic tradition, employing the wheel almost only for Minoan-style shapes and thereby signalling its desire to be peripheral to Minoan trade and contact (Berg 2000).

We can thus conclude that standardisation of a product or process is neither a necessary indicator of craft specialisation or social complexity nor is it a purely technological or economic event, but it is greatly influenced by socio-political factors. Without considering the social context our interpretations will be incomplete.

Acknowledgements

I would like to thank Carol Gillis for her comments on an earlier draft of this paper. Chris Fowler liberally gave his time to discuss issues arising from the paper and proof-read the final version. Colin Renfrew kindly granted permission to study the pottery assemblage of Phylakopi. A study of a selection of the kept pottery from Ayia Irini was made possible thanks to Elizabeth Schofield and Jack Davis.

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