SHAPING CLAY, TRANSMITTING KNOWLEDGE: DIVISION OF LABOUR IN THE 7TH AND 6TH MILLENNIA IN WESTERN ANATOLIA

by

Aysel Arslan

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Koç University

Graduate School of Social Sciences and Humanities

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Aysel Arslan

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that any and all revisions required by the final
examining committee have been made.

Committee Members:

Assoc. Prof. Rana Özbal (Advisor)

Assoc. Prof. Christina Luke

Assoc. Prof. Emma L. Baysal

Lecturer Dr. Fokke A. Gerritsen

Assoc. Prof. Miroslav Králík

Date: July 1, 2022

In loving memory of my grandmother Fatma Arslan

ABSTRACT

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Doctor of Philosophy in Archaeology and History of Art,

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Clay was an essential raw material for daily life in the Neolithic communities in the seventh and sixth millennia in western Anatolia. In addition to using clay as building materials, the Neolithic people made all sorts of objects out of clay, and their relationship became increasingly entangled through time. Despite ample research on clay objects from this period, the social aspects of the technology of making clay objects, such as how labor division was organized and how this technological knowledge was transmitted through the generations, have been neglected in the scholarly work that focuses on Anatolian Prehistory.

To fill this niche, this dissertation explores how labor division in making clay objects was formulated in western Anatolia in the seventh and early sixth millennia (until 5700 BCE) with a specific focus on Barcın Höyük, Ulucak Höyük, and Ekşi Höyük. By using paleodermatoglyphics, the study of ancient fingerprints on archaeological materials, this study analyzes fingerprints left by the producers of these objects in the Neolithic period to estimate their age and sex. The results show that labor division based on age and sex unquestionably existed at all three sites. While very young children were probably not a part of the production, adolescents and adults of both sexes seem to be involved in making different types of objects at each site. Building on these interpretations, this study also proposes how social memory was formed and cultural knowledge was transmitted at these sites.

Keywords:

Neolithic period; labor division; sex; age; craft specialization; paleodermatoglyphics; fingerprints; clay finds; gender archaeology; Barcın Höyük; Ulucak Höyük; Ekşi Höyük

ÖZET

Kile Şekil Vermek, Bilginin Aktarımı:

MÖ 7. ve 6. Binyıllarda Batı Anadolu'da İş Bölümü

Aysel Arslan

Arkeoloji ve Sanat Tarihi Bölümünde Doktora Derecesi

Bahar 2022

Kil, Batı Anadolu'da MÖ yedinci ve altıncı binyıllarda Neolitik topluluklarda gündelik yaşamda kullanılan ana hammaddelerden biriydi. Kili yapı malzemesi olarak kullanmanın yanı sıra, Neolitik dönem insanları kilden çeşitli objeler de yapmış ve insanların kille ilişkisi giderek daha dolaşık hale gelmiştir. Bu dönemden kalma kil objeler üzerine çok sayıda çalışma yapılmış olmasına rağmen Anadolu prehistoryasına odaklanan akademik çalışmalar, kil objelerin üretiminde iş bölümünün nasıl organize edildiği ve bunların yapımına dair teknolojik bilginin nasıl aktarıldığı gibi kil obje üretiminde teknolojinin sosyal yönlerine odaklanmamıştır.

Bu boşluğu doldurabilmek amacıyla bu tez, özellikle Barcın Höyük, Ulucak Höyük ve Ekşi Höyük'e odaklanarak Batı Anadolu'da MÖ yedinci ve erken altıncı binyıllarda (MÖ 5700'e kadar) kil obje üretiminde iş bölümünün nasıl organize edildiğini araştırır. Arkeolojik buluntulardaki antik parmak izlerini inceleyen paleodermatoglifik çalışmalarını kullanan bu çalışma, yaş ve cinsiyet tahmini yapabilmek amacıyla Neolitik dönemde üretilmiş bu objelerde bunları yapan insanlar tarafından bırakılmış parmak izlerini analiz eder. Analiz sonuçları her üç yerleşimde de yaş ve cinsiyete dayalı bir iş bölümünün kesinlikle var olduğunu gösterir. Küçük çocuklar üretim aşamalarına muhtemelen hiç dahil olmamışken her iki cinsiyete mensup ergenlik çağında ve yetişkin bireyler her yerleşimde farklı tiplerdeki objelerin üretimine dahil olmuş görünmektedir. Bu yorumlardan yola çıkarak bu çalışma ayrıca sosyal hafızanın nasıl oluşturulduğu ve kültürel bilginin nasıl aktarıldığına dair de çıkarımlarda bulunur.

Anahtar Kelimeler:

Neolitik dönem; iş bölümü; cinsiyet; yaş; zanaat uzmanlığı; paleodermatoglifik çalışmaları; parmak izleri; kil objeler; toplumsal cinsiyet arkeolojisi; Barcın Höyük; Ulucak Höyük; Ekşi Höyük

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Chapter 1

1 INTRODUCTION

The Neolithic was a transitional time in human history with changes affecting ways of thinking and the modes of living; the way people conceptualized and transmitted ideas must, too, have required a revolution in how people organized themselves, their activities, and lifeways. One's identity, social class, and skillset determined the rhythms of daily life. Clay was an important, inseparable part of daily life in the Neolithic period. It was so crucial that many social groups specifically chose to settle down near clay resources (Doherty 2017; B. de Groot et al. 2017; Ian Hodder 2006, 78). Combined with pyrotechnology, the malleability of clay makes it the perfect raw material to be used in constructing houses, making containers, and many other practical and symbolic objects.

Thanks to clay's undeniable role in the Neolithic communities, researchers have studied it extensively: clay as building material (Tung 2013), various types of artifacts made of clay (Bennison-Chapman 2014; Kuijt and Chesson 2005; Hamilton 1996), and properties of clay (B. de Groot et al. 2017) and the provenance of clay objects (Semiz 2017) have been published throughout many decades. Clay, on the other hand, provides yet another lens into looking at communities that very few paid attention to and even fewer noted down; the most apparent remnants of those who made these objects, their fingerprints on their surface (e.g., Aström and Erikson 1980; Kamp et al. 1999; Králík, Novotný, and Oliva 2002; Branigan, Papadatos, and Wynn 2002; Hruby 2007).

Archaeological research shows that ancient communities shared technological traditions and preserved knowledge through generations while new changes occurred. However, despite the evidence, our knowledge regarding how skills and knowledge were passed on through generations remains limited. New methods for exploring fingerprints provide us opportunities for extending our knowledge on this subject. By analyzing a fingerprint, archaeologists can estimate age and sex. Moreover, given the manuability of ceramics, we often find fingerprints embossed on the surface. This is the method that I explore to better understand gender relationships in the Neolithic and the specifics of identity, gender, age, and the production of the ceramic arts.

Ethnographic studies on labor division suggest that gender, age, and class are primary categories for organizing labor (Costin 1996; Murdock and Provost 1973).

Murdock and Provost's (1973) seminal work shows that ceramics production was a gendered activity, and usually, only one gender was responsible for making pottery for household consumption. A similar case might have been at play for the Neolithic populations in Western and Northwestern Anatolia based on such ethnographic research. The identity of the clay specialists, the potters, and the figurine makers would have been intersectional, involving not only gender but also age and social position. Pottery production might have been a gendered activity in these populations, with an age-based distinction between the types of works individuals were involved in throughout the production sequence. In other words, while some people were in charge of certain types of work, others would be involved with other, maybe more advanced tasks based on their skills and age. Since clay was an essential raw material for these societies, the social position and significance of the specialists might have been determined by their skills and abilities. If so, it would have changed through their life course as they probably started their training as novices and slowly climbed through the levels into becoming master producers.

While much work has been published on technology, the transmission of information through generations, the nature of apprenticeship, and its relationship with gender and age, these studies have focused on areas of the world outside of Anatolian Prehistory (Brumfiel 1991; Levy 2006; McClure 2007; Crown 2007; Bray 2003). Fingerprint analysis provides the perfect means to look at prehistoric communities to understand how labor division was organized in making clay objects as sex and age can be estimated based on the means of epidermal ridges.

In this work, I examine fingerprints on clay objects from three case studies in western and northwestern Anatolia, namely Barcın Höyük, Ulucak Höyük, and Ekşi Höyük. These sites provide extensive enough data to estimate the age and, to some extent, sex of those who might have been involved in the production of clay objects. Ethnographic studies that focus on childhood and labor have demonstrated that in many agricultural societies, the age and sex of children determine the types of tasks children perform (Bradley 1993). As such, the presence of fingerprints from the same age/sex categories on the same types of objects from Barcın, Ulucak, and Ekşi Höyük could point to a gender-based labor division at these sites in the Neolithic period. The built identity of the clay object makers might have been closely entwined with the performance starting from their childhood at these sites. Judith Butler proposes that material culture, space, and gestures are commonly used to reproduce gender and sex categories. To her, gender is created through repeated actions; this way, it is as though gender is natural rather than being illusionary and artificial (Butler 1990; 1993). As the makers of the clay objects possibly belonged to the same gender category, the apprenticeship might have been a part of "becoming" a gendered individual. However, the performance of the specialists does not just make them members of a specific gender category. They might also have moved through the social heterarchy and, through time, eventually became a master with a significant social position that makes up an essential component of their identity.

1.1.Key Concepts and Definitions

Several concepts, some of which have been debated for the last few decades, have been used in this work to convey ideas and interpretations about the nature of labor division in western Anatolia in the Neolithic period. This section focuses on the definition of these concepts in order to avoid any possible misunderstandings.

Sex: Biological, genetic or anatomical features distinguishing males and females. While this concept might seem binary, it encompasses a wide spectrum of sexual categories and male and female are usually seen as two extremes of this spectrum in anthropological, genetic and bioarchaeological analyses.[1] Due to the nature of the paleodermatoglyphic methodology this dissertation uses, the discussion of the results are presented as "male" and "female" categories in relation to the reference sets collected based on biological and anatomical sexual differences of the modern participants.

Gender: Sociocultural norms and related mental traits that shape an individual's worldview about how they should behave in certain contexts within the society. Gender is related to sex, but it is not equal to it. Gender identity is created by repeated actions and behaviors and should be seen as fluid and contextual (Butler 1990, 33). Gender identities and the expected behaviors from individuals of a specific gender category are always culture-specific. Therefore, it is important to stay away from universal claims about gender-based interpretations. While the interpretations of this work touch upon gendered behaviors in relation to sex, they should not be seen as universal interpretations as they only represent site-based interpretations.

[1] For more discussions on sex and gender in relation to archaeology and anthropology please see (Arslan and Yelözer 2021; Gilchrist 2009; Voss 2008; Sofaer 2006; 2012).

Craft Specialization: An organized, regularized method of producing material objects, where a small group of artisans produce goods and services for a broader group of people (Costin 2015, 1). The concepts of craft specialization and specialized production have been discussed in archaeological literature where different researchers proposed their own definitions (J. E. Clark and Parry 1990; Rosen 1989; Costin 1991; Tosi 1984; Brumfiel and Earle 1987; E. Baysal 2013). Emma Baysal has proposed a list of criteria that focuses on social and technological aspects as well as certain prerequisites including surplus, value and payment for recognizing craft production in the Neolithic period (E. Baysal 2013, 239). These criteria can be applied for understanding craft specialization in clay object production in Barcın, Ulucak and Ekşi Höyük as well.

Fingerprint: Specifically, a fingerprint refers to an imprint of the epidermal ridges from the distal phalanges where the epidermal ridge patterns are visible. However, they are also used in a more generic sense to refer to any imprints of epidermal ridges from hands and feet.

Imprints: Marks left on clay objects by pressing something. While it is possible to find imprints of a variety of things such as plants, animals or hair on clay objects, this term refers to marks left by epidermal ridges from human hands and feet in this work.

Epidermal Ridges: The palms of hands and soles of feet are covered with furrows and friction ridges. These ridges are created by the dermal papillae during gestation and consist of small friction ridge units that contains a sweat gland and a sweat pore.

Minutiae: Small details on the epidermal ridge patterns such as dots, bifurications and short ridges. Carefully examining the minutiae on a fingerprint makes personal identification possible.

Paleodermatoglyphics: the study of ancient fingerprints on archaeological objects.

1.2.Aims and Objectives

This dissertation explores these processes of change through the lens of experimentation and transmission of technological knowledge about making various types of clay objects over multiple generations. The aims and objectives of this dissertation can be divided into five categories:

- To assess the potential of paleodermatoglyphics as a new method for Neolithization research and develop the most robust procedure to ensure the reliability of the interpretations obtained from this methodology,
- To evaluate the clay object assemblages from Barcın Höyük, Ulucak Höyük, and Ekşi Höyük and understand how and when fingerprints are found on different types of objects,
- To examine the fingerprints left on these clay objects to obtain information about the age and sex of the individuals who left these marks,
- To provide a comparison among the sites in terms of clay object production within the temporal and geographical context of the seventh and sixth millennia BCE in western and northwestern Anatolia,
- To assess the data gained from these fingerprints in order to demonstrate how labor division in clay object production was formulated during this transitional period in human history in western and northwestern Anatolia

The first aim is to evaluate the whole clay object assemblage from these sites in order to see how many of them have partial fingerprints. This entails a visual evaluation of each object and a descriptive and visual recording of each partial print on its surface. This set of information and the visual records of fingerprints are provided in the appendices of this dissertation.

The second aim is to use the paleodermatoglyphic data collected from the case studies and compare them with modern reference samples in order to understand if specific groups of people such as children, adolescents, adults, females, or males did certain activities or refrained from participating in them. Artifacts analyzed in this study are categorized by type so that each type can be evaluated for its significant characteristics. The mean epidermal ridge breadth is measured for each fingerprint on each object, and then the data is compared with a reference set obtained from modern European populations through statistical calculations. These comparisons are essential to provide insight into forming age and sex groups in the archaeological dataset.

The third aim is to compare Barcın, Ulucak, and Ekşi Höyük in terms of how clay object production was organized throughout the seventh and sixth millennia BCE in western and northwestern Anatolia. These sites are evaluated through a temporal perspective within themselves and in relation to each other to understand if there is a change or continuity in the production methods.

By combining the second and third aims, the fourth and final objective is to synthesize the evidence gathered from the archaeological and paleodermatoglyphics records. The evidence gained from these fingerprints demonstrates how labor division in clay object production was formulated in Barcın, Ulucak, and Ekşi Höyük throughout their occupation. This analysis will illuminate how social memory and cultural transmission of knowledge, innovations, and ideas might have occurred in the seventh and sixth millennia BCE in western and northwestern Anatolia.

1.3.Challenges and Limitations

Due to the nature of the objects and the methodology employed in this research, this study has several limitations. First of all, anthropogenic and environmental factors play an essential role in the preservation of fingerprints on clay artifacts. If an object, such as a spindle whorl, is heavily used, the surface gets chipped away, removing any fingerprints that might have been present on their surface. Alternatively, those who make these objects might choose to remove any imprints on the finished object before baking them. Moreover, extreme weathering through the millennia can cause clay objects to deteriorate as a result of cracks and breakages on the surface. These cracks would affect how well fingerprints preserve.

Different types of clay shrink at different rates when they dry. Clay shrinkage can also be affected by the type and number of inclusions added to clay during preparation. As the clay shrinks, it automatically shrinks any imprints present on its surface. As a result, fingerprints would appear smaller than they were in reality, underestimating the adults and especially adult males in the data if clay shrinkage is not calculated before they are compared with the reference. In order to prevent skewed results, clay samples have been collected from each site, and experimental analyses are conducted in order to calculate their shrinkage rate.

The comparative reference comes from the modern Czech population, temporally and geographically different from the Neolithic populations in western and northwestern Anatolia. It is not ideal to use such distinct populations as a reference for comparing the means of epidermal ridge breadth. However, this modern population is currently the only available dataset used as a reference in paleodermatoglyphics. Since different populations have been compared to each other in this research, the analyses would not be completely accurate, but they should be seen as guides to understanding the nature of labor division in these communities.

Moreover, the fingerprint dataset in this research is only composed of those that have been well-preserved as the clay object was baked or was not subjected to weathering. This means that there might have been many more fingerprints present on unbaked or poorly preserved objects that have been lost to time. Some of these might have belonged to individuals or groups we do not see in the current data.

Due to the nature of this research, only those whose fingerprints can be successfully analyzed are included in the discussions. There might have been other groups who were active participants in the production process by performing peripheral activities that did not involve dealing with the final forming of clay objects in these three sites. It is not possible to obtain evidence for the presence of these people in the communities of practice with the current methods.

Another limitation of this dissertation is the excavation bias. Due to the excavation methods, the later occupation layers of any site tend to yield a higher volume of artifacts as layers related to these occupation phases can be exposed in a wider area. In comparison, the total number of artifacts from the earlier occupation layers is usually lower, partly because a smaller area would be excavated. This, however, is not the only reason why the number of clay objects is lower in the earliest/basal occupation layers in the seventh millennium in western and northwestern Anatolia. Another reason is that these earliest layers also tend to have a smaller number of artifacts in general.

Finally, a significant portion of this dissertation is prepared between 2020 and 2022, during the COVID-19 pandemic. Due to various restrictions, it was challenging to perform some of the experiments in order to determine the shrinkage rate of clay in lab conditions. After determining that doing some of the experiments at home in a household oven would not skew the results, I completed the experimental analyses at home.

1.4.Chapter Breakdown

This dissertation is composed of ten chapters. This chapter provides an introduction to the research topic, aims and objectives, and the organization of the dissertation.

The second chapter focuses on the theoretical approaches to gender and age-based labor division in archaeology and provides a background for cultural transmission and learning. These two concepts have been approached from different viewpoints in the literature, so this chapter also concentrates on how information about knowledge transfer and learning could be studied in archaeology

Chapter three sets the stage for the dissertation by discussing the neolithization of western and northwestern Anatolia. This chapter explains the different neolithization processes for these two regions, the neolithic package concept and the results from current DNA studies that focus on these regions. Then, it briefly introduces Barcın Höyük, Ulucak Höyük and Ekşi Höyük.

The fourth chapter delves into the methodology of this dissertation. First, the history of fingerprint analyses and the development of fingerprints among humans are discussed. Then, I focus on paleodermatoglyphics, the study of ancient fingerprints, and provide a literature review on the topic. After that, the methodology employed in this work is explained in detail.

Chapter five introduces the materials I use for understanding how labor division was formulated in clay object production in the Neolithic period. The sixth chapter focuses on the experimental analyses performed on clay collected from the case studies. These experiments are necessary to obtain more conclusive results from the statistical comparisons of fingerprint measurements from archaeological finds with the reference. Chapter seven explains the results obtained from the statistical analyses and briefly summarizes the results.

In chapter eight, this dissertation explores the neolithization and clay object production in conjunction with the results from statistical analyses. Moreover, it investigates the Neolithic life in the seventh and sixth millennia and provides a comparison of these two periods.

Chapter nine approaches gender and age based labor division from a social perspective. It takes the statistical results and explores what they mean in terms of the transmission of social memory through generations, and what it means to be a child within the Neolithic communities and gender and communities of clay object producers. Chapter ten provides a conclusion to the dissertation.

Chapter 2

2 MAKING CLAY: A COMMUNITY OF PRACTICE

Clay seems to have been an indispensable resource ever since the Paleolithic period. Humanity's relationship with clay is complex. Many depended on it through time for their houses, storage facilities, tools, weapons, and daily items. The malleability and plasticity of clay make it possible to create an infinite variety of shapes by pinching, rolling, squashing, molding, incising, piercing, impressing, or adding something else to it. Moreover, potters can easily create similar objects using different techniques or a range of objects by following comparable techniques (Sofaer 2015, 4).

While clay provides total artistic freedom, regional shapes and styles persist among many communities so much that it is archaeologically possible to estimate the region and the approximate date of pottery and many clay objects. In that sense, shaping clay, just like any other craft, is a culture-specific activity, and the techniques and the know-how are passed on through generations. These rapid or gradual changes tend to occur over time and can be traced in the archaeological record.

The questions of who makes clay objects and how as well as how the knowledge is transferred to the next generation are closely related to the sociocultural ideas about knowledge transfer, gender, age, and status. In other words, their communities of practice. Therefore, this section concentrates on gender, age, as well as knowledge transfer, and learning as indissociable components of craft production.

2.1.Division of Labor in Archaeology

2.1.1. Gender

Who made the objects that archaeologists find, the conditions under which they were produced, and how labor was organized in the past can yield invaluable information about past societies. These questions are intimately tied to gender and age. In their seminal 1973 study, George Murdock and Caterina Provost studied 185 preindustrial societies. They explored 50 different activities and concluded that many activities were assigned to males or females, but rarely to both genders simultaneously (Murdock and Provost 1973). Importantly, when all of the cross-cultural data was corroborated, their results indicated that these activities could have been associated with either gender. On the other hand, subsequent research has shown that when reviewed individually, a pattern emerges that illustrates a clear gender-based task differentiation in each society; the data demonstrate that males and females either use different kinds of technologies, use different production methods or target different consumers (Costin 2015, 2). For example, in their study, Murdock and Provost showed that weaving was a craft taken up by both genders among the Hausa (Murdock and Provost 1973, 217). Furthermore, both women and men produced textiles in the Inka Empire, but they probably used different types of looms to produce different types of clothes (Costin 2016; 2015, 2).

While Murdock and Provost's (1973) study suggested that men were somewhat more likely to specialize in craft production, this conclusion likely carried Eurocentric stereotypes and biases, as early ethnographic research tended to overlook the work of one gender or the other in their records (Costin 2015, 2). For example, although textile production has generally been associated with females, and male textile producers have been disregarded in archaeological literature, there are multiple examples of textile production as male activity throughout the world (Costin 2013; Burke 2010; Gleba 2007). Moreover, early ethnographic research overlooked the household and specialized production for domestic activities (Costin 2015).

Early ethnographers often resorted to circular reasoning when it comes to gendered labor divisions, and they often fell victim to stereotyping, such as the presumption of gendered lines of labor. These *approaches*, in turn, fueled a priori assumptions and led to flawed conclusions (Bolger 2013). While ethnographic analogies can be valuable for archaeological research on labor division, it is vital to move away from generic analogies and find societies that show similarities and parallel activities with the one under investigation.

Bolger (2013) criticizes Murdock and Provost's approach precisely because their conclusions are gender-biased. Murdock and Provost (1973) concluded that making pottery was predominantly a female activity. Among the reasons that pottery production tended to be linked to women was that it provided an activity that dovetailed with childcare and repetitive household tasks that allowed for the interruption. Since pottery production does not require much expertise and can be done in such conditions, researchers reasoned that women must have been in charge of this task. Arnold (1985, 106), too, comes to a similar conclusion in his book *Ceramic Theory and Cultural Process*. In fact, men can indeed be potters when society allows for a full-time profession and the production of ceramics for profit. Bolger critiques this outcome because it is an androcentric bias that undermines the value of female labor by categorizing it as a tedious task without much need for expertise or intellectual knowledge (Bolger 2013, 162–63). Despite the high importance of pottery in the Neolithic period, archaeologists have tended to undermine the importance of ceramic production as a low-status activity, possibly due to a general tendency to under-value female labor in ethnographic and archaeological reports, and thus a fundamental failure to understand the technological requirements and innovations required to produce high-quality pottery (Bolger 2013, 165).

Costin's (2015) scholarship is a welcomed contribution. Her work underlines that ethnographic analyses yield no universal gender divisions in craft production. Gender-based task specialization is usually differentiated from culture to culture, indicating very few universally accepted gendered crafts. However, she points out that some tasks, especially wood carving and metal working, might have been entirely male-gendered in traditional societies (Costin 2015, 2). Nonetheless, there are no such exclusively female-gendered crafts; case studies reveal that men can perform both weaving and pottery production. Costin looks to social and political contexts to unpack gender relationships. She suggests that when a craft is socially, economically, ritually, and politically more significant, it is a male-centered craft. For example, while both males and females produce pottery, female potters produce ceramics for domestic use, but male potters produce vessels for ritual or ceremonial use.

Interpretations of the ethnographic data further elucidate these entanglements (Costin 2015, 3). First of all, if the raw material is intrinsically more valuable, such as used in ritual practice, the craft specialists are usually males. Moreover, when females are the craft producers, their production is more privatized, such as in production for domestic purposes within a household context. In light of this evidence, Costin (2015) suggests that this private sphere reinforces the notion that women were confined to the domestic/private sphere and men were a part of the public/social sphere, a sphere more valued by those conducting the research. Ethnographic research among the Ban Non Wat community in Northeastern Thailand, on the other hand, shows that both women and men participated in various parts of the pottery manufacturing process (Halliwell, Yankowski, and Chang 2016, 130). The production process is a communal activity where either gender can undertake any aspect of it. Nevertheless, in this community, especially recently, women usually process the raw materials by making and decorating the vessels;

in contrast, men often procure the raw materials and fire the vessels (Halliwell, Yankowski, and Chang 2016, 130). Such task allocations might go unnoticed in the archaeological record as they would leave little material evidence.

Despite many scholars' rightful critiques of gender bias in ethnographic research, some sort of gender-based division of labor might be a universal phenomenon among anatomically modern humans (Costin 1996, 113). Gender and age seem to be the primary factors in deciding who does what kind of work in kin-based societies (e.g., Ember and Cunnar 2015). In complex societies, on the other hand, apart from gender and age, class and rank play crucial roles as the structuring principle of labor organization (Brumfiel and Earle 1987). Costin argues that artisanship is an essential determinant of social roles and positions in non-capitalist societies, as they are the sole creators of goods necessary for the societies they live in (Costin 1996, 114). Through the production of necessary or luxury goods, they might strengthen their social positions and sociopolitical power. Gender attribution, craft production, and specific economic activities are often inextricably linked. Therefore, it is crucial to investigate how the relationship between gender and crafts changes through time. If there is a gender-based differentiation in craft production in a society, this might lead to gender differentiation in social participation, wealth, and social positions.

Such specializations in craft production might have some comparative advantages such as more time devoted to a specific task, which enables producers to become more competent. In turn, the skilled producers generate more goods in a shorter time period (Kelly and Ardren 2016, 6). While there is usually no physical reason for only a specific gender to do a specific task, the cultural and societal norms might dictate which tasks are gendered even if both genders participate in the production process (Kelly and Ardren 2016, 8). In a society where pottery production is gendered as female, for example, men can engage in pottery production, but they would not gain the same recognition or credit from their society as a woman who engages in the same task, as men's actions fall outside the idealized gendered expectations (Kelly and Ardren 2016, 9). In a way, craft producers play a performative role in the reproduction of gendered ideals within the society (Butler 1993).

On the other hand, the association of gender and specific crafts might change due to shifting economic, political, or social conditions within a community. According to

Costin, the Inka state increased textile production, traditionally a household based feminine craft, by recruiting male weavers together with females whose domestic responsibilities such as cooking and child rearing were limited (Costin 1996, 131). While the newly recruited women were denied the reproductive aspects of their gender identity, they were hyper-femininized as weavers. As a response to the problems that emerged from the recruitment of male weavers, the state created a distinction between male and female weavers via linguistic, technological and logistical means (Costin 1996, 131). Similarly, Ardren and her colleagues propose that there might have been a shift in household production in Xuenkal, Yucatan, Mexico during the Terminal Classic period due to warfare: the male artisans might have been removed from the workforce and their positions might have been filled by females and young people, which changed the gender association with these crafts (Ardren, Olvera, and Manahan 2016, 108).

Various ethnographic research points to a complex organization of labor division that goes beyond mere gender. Even when there is a gender-based labor division, some sort of variation in task allocation between women would exist based on their position within the household as well as their age group (Harry and Huntington 2010, 84). For example, in many communities, potters are older women who do not have younger children or other farming responsibilities (Kelly and Heidke 2016, 214; Stark 1995, 187–88; Fontana et al. 1962, 20 in Kelly & Heidke, 2016, p. 214; Harry and Huntington 2010, 87). Female bonding might also play a significant role in the intensification of production as women would rely on each other for taking care of children and performing other responsibilities (Harry and Huntington 2010, 89) as they take part in various stages of the production process.

2.1.2. Age

Archaeologists have rarely considered children as active agents that produce material culture with an impact on society. Despite the underrepresentation of children in archaeological interpretations (even today), literature on children and childhood in archaeology has grown, as a part of gender archaeology for more than 30 years. While the pioneer articles mainly documented the existence of children in the archaeological record (Hammond and Hammond 1981; Lillehammer 1989), since the late 1990s, new approaches and perspectives about childhood have developed (Crawford 1999; Gilchrist 2000; Baxter 2005b; Ardren and Hutson 2006; Kamp et al. 1999; Kamp 2001b; Sofaer

Derevenski 1994; 1997b; 2000). Güner Coşkunsu nicely summarizes the probable reasons for the lack of research on children and childhood in the past:

> "Archaeologists have been neglecting the role of children in antiquity for several probable reasons: (1) the supposed intangible nature of childhood in the archaeological record and the a priori assumption that children lack easily recognizable archaeological correlates (yet few archaeologists have made the attempt!); (2) conceptualizations that see children as socioeconomically unimportant; (3) acceptance of a universal/stereotypical view of childhood; (4) gender biases; (5) cultural biases; and (6) the lack of substantial interdisciplinary collaborations on the subject." (Coşkunsu 2015, 4)

The traditional approach to children and childhood in archaeology has been extensively criticized because of its tendency to ignore the presence and impact of children in the past despite the fact that children must have been undeniably present and comprised a significant part of the population in most communities (Baxter 2005b, 1; Coşkunsu 2015, 2).

Grete Lillehammer's seminal work *A Child is Born. The Child's World in an Archaeological Perspective* (Lillehammer 1989) has made a significant impact on the archaeological work on children and childhood in the past. In her article, Lillehammer underlines that despite the rich evidence, there is a lack of research that focuses on children in archaeological discussions and interpretations. She demands that children should not be seen as passive members of society and the archaeological research on children should incorporate a child's relationship with the environment, with adults and with other children. Following her article, research on children and childhood gained pace with a focus on agency (Lopiparo 2006), landscape (Rockman 2013; Romero 2017), ethnoarchaeology and ethnography (Bugarin 2005; Thomas 2005), play, toys, and miniatures (Fassoulas, Rossie, and Procopiou 2020; Menon and Varma 2010; Kamp 2001a; Park 1998; 2005), learning and transmission of knowledge (Keith 2005; Smith 2005; Grimm 2000; Greenfield 2000; Gagné 2019), space (Baxter 2005a), health and demography (Perry 2005), and work (Roy and Polet 2019; Squires 2020; Blaževičius 2019).

As archaeologists have long been aware, cultural traditions and lived experiences of past societies were fundamentally different from their own. They usually seek ethnographic, historical and ethnoarchaeological records in order to compare and provide analogies to understand the cultures they work on. Unfortunately, this has rarely been the case for children and the concept of childhood in archaeology. Instead, archaeologists tend to make assumptions about the lives of children in the past by universalizing their experiences in accordance with the western notions of childhood (Kamp 2001b; Baxter 2008; for critiques of this issue, see 2005b; Sofaer Derevenski 2000; 1997a; 1994).

"Childhood" as a term is very problematic as it is entangled with the sociocultural and economic web of society. Although the biological changes that occur throughout the ontological development cannot be ignored, the concept of childhood and being a child is also dependent on culture and intersects with other social constructs such as class, gender, and ethnicity (Baxter 2008, 163; Hutson 2015; Kamp 2001b). Modern constructions of being a child and childhood are formed in relation to adulthood and maturity as well as oncogenic developments of human beings (Sofaer Derevenski 1997a, 193; Halcrow and Tayles 2008), and they are closely associated with the historical emergence of the contemporary Western ideas of family, privacy, and individuality (Stephens 1995, 4–6) as well as the biological changes that occur in the human body (Kamp 2001b, 3; Halcrow and Tayles 2008, 192–97; Sofaer 2006, 121). Children are seen as incomplete adults, in a liminal stage of their lives between birth and adulthood, who need protection, guidance and to be kept happy. They are typically educated in an institution or within the family (Kamp 2001b, 3).

Despite these hurdles, cross-cultural ethnographic and anthropological research has shown that there is significant variability in definitions of childhood not only among different cultures but also within cultures where economic, political and social changes occur (Kamp 2001b, 3–4; Ariès 1962; Baxter 2008, 161; Joyce 2000; Baxter 2015). Even the age of reaching adulthood varies and has changed over time. For example, according to legal documents from 7th century Anglo-Saxon Britain, ten-year-olds were considered adults, but the cutoff age for reaching adulthood was increased to twelve by the 10th century (Crawford 1991 in Kamp 2001b, 4). Just like gender, age categories, too, are culturally constructed. Therefore, researchers that focus on past societies must be aware of the fact that age categories (Kamp 2001b, 4; Perry 2005; Halcrow and Tayles 2008, 202–3) may intersect with gender and other social attributes such as class (Kamp 2001b, 25; Sofaer Derevenski 1997a; Joyce 2000).

Kathryn Kamp (2015, 44) carefully underlines six perspectives researchers should be aware of while studying childhood in the past: 1. Societies have their own ideas that are created by adults and possibly adopted by children about childhood and the development of children; 2. Adults attempt to influence children in every society with structured or casual systems; 3. Children have their own agency and they actively create their own traditions; 4. "Model" children may exist but multiple childhoods probably exist even within single cultures; 5. Life histories of children probably vary; 6. Children's perspective are different from adults and should be acknowledged.

Both Roberta Gilchrist (2000) and Scott Hutson (2015) underline the importance of a relational approach to understanding children and childhood in the past. The "add children and stir" (Hutson 2015, 54) approach does not really work as we need to take a step back and understand the relations between individuals from all age groups to understand children. The experience of children only makes sense in relation to non-children (adults); therefore, if we want to understand children in past societies, we need to compare them with adults. To Hutson, the study of children is a study of relational identity as people create their sense of identity through their entangled relationship with activities, objects, and social relations (Hutson 2015, 54). Such relational perspectives establish a network between people and objects, places, and other people (Ian Hodder 2012). Giddens underlines that the socialization of children is not done by the children themselves but rather by their parents and those with whom the children interact. While others influence the socialization of children, children equally influence the socialization of their parents (Giddens 1979, 130). In a way, both parties are active participants in the network of the socialization process.

In every society, children need to be taught the cultural norms and the necessary information to continue the existence of their sense of community. Children's play has a significant social function for children to learn and mimic the societal norms and the everyday lives of adults, which helps to maintain a cultural identity. Play acts as a mediator between the children's world and the adult world, where children imitate and learn the biological and social roles of adults within the community (Lillehammer 1989, 95). Fassoulas et al.'s (2020) ethnoarchaeological work in Tiznit, Morocco, shows all aspects of this process. The authors carefully examine the *chaîne opératoire* of production of miniature clay utensils from collecting the soil to baking them in a miniature oven by children, primarily girls, in accordance with the design of widely used everyday objects within the households. The play of preparing miniature household objects and argan oil acts as an informal apprenticeship, and if the girl preparing them is good enough with the proper gestures and the necessary know-how, she might start helping with the actual housework (Fassoulas, Rossie, and Procopiou 2020, 40). Older girls play a critical role in the transmission of technical knowledge and the non-verbal skills of these tasks. Younger children learn to perform specific tasks and production processes by carefully observing adults and older children, but adults do not actively participate in the apprenticeship process (Fassoulas, Rossie, and Procopiou 2020, 51). Through this repeated informal apprenticeship in the form of play, children learn the necessary technical skills as well as the gender-related behaviors and values desired within the society as the transmission of know-how is not limited to technical knowledge but encompasses the transmission of cultural values and meanings (Fassoulas, Rossie, and Procopiou 2020, 52).

Such connections between figurines, miniature objects and children can also be made for archaeological objects to some extent. The fingerprints of children of an average of 11-13 years of age have been found on the animal figurines from Pueblo Sinagua, Arizona (11^{th}-13^{th} cent CE) (Kamp et al. 1999), suggesting their involvement in the figurine production process. Even when there is no direct evidence for the involvement of children, it might be possible to link children with the production of figurines and other miniature objects based on the surface treatments and the poorer quality of these objects since the cognitive development of children is closely related to the way they shape objects (E. V. Brown 1975; Crown 2001; Minar and Crown 2001; Kamp et al. 1999). However, such evidence should be accepted with caution as crudely made objects might not always be the work of children or pupils (Cooney 2013) because poorly made objects might not even make it to the archaeological record as the material (in this case unbaked clay) would be reused (Hasaki 2013).

Despite the ample evidence of the involvement of children in many aspects of everyday lives in the archaeological record, there is still much to be done in the study of children and childhood in the archaeological record. While skeletal evidence of children yields information about the health, life course, and the relationship between children and adults in the past, much research on agency remains. Especially, the study of playtime among children can provide invaluable information about how cultural transmission happens through generations.

2.2. Theoretical Approaches to Cultural Transmission and Learning

The question of how knowledge, ideas and beliefs were transmitted among groups and throughout generations is among the main research areas in archaeology. Through this lens, we better understand cultural continuity and change. Archaeological research offers a material assemblage for scholars to theorize about how cultural continuity, deviations from traditions and changes occur. Many scholars within and outside the discipline of archaeology concentrated on different aspects of knowledge transfer and learning. This section briefly discusses situated learning, psychological and developmental stages of learning acquisition, and anthropological perspectives on knowledge transfer and craft production in order to provide the necessary background to the concepts discussed in the following chapters.

Many culture historians questioned various aspects of social organization and technology, such as cultural groups and their boundaries based on technological knowledge. Such themes became popular among later works that fall within the theories of New and Postprocessual Archaeology (Stark, Bowser, and Horne 2008, 2–3). Bourdieu's (1977) practice theory, especially the concept of *habitus*, framed these discussions (e.g., Dietler and Herbich 1998). Many studies that make use of the practice theory and agency discuss how daily practices and social reproduction create and reinforce social identities (e.g., Ian Hodder and Cessford 2004; Dobres and Hoffman 1994).

Although transmission of knowledge through generations lies at the heart of archaeological interpretations, anthropological and archaeological research on learning and cultural transmission has only gained importance over the last few decades. Most notably, research on situated learning that suggests learning is done through participation in social daily life (Lave and Wenger 1991), childhood and play (Fassoulas, Rossie, and Procopiou 2020; Hughes 2010; Kamp 2001a; Sofaer Derevenski 1997a), and crafting (Greenfield 2000; Grimm 2000) have contributed significantly to archaeological interpretations.

Learning is socially and historically situated. Novices become included in the communities of practice by legitimate peripheral participation as they master the knowledge and skills by participating in the production process, starting with the more straightforward tasks from the periphery and slowly learning the whole process to become competent craftspeople (Lave and Wenger 1991; Wendrich 2013a, 9). The concept of communities of practice can be described as a group of people engaged in joint practice who share the same interests in improving skills and knowledge and learning from each other (Lave and Wenger 1991, 98–100; Wenger 1998). Individuals in a community of practice usually learn in an informal environment and share their knowledge and experience among themselves. While this form of learning can be compared to a formal learning environment, it is not the opposite but rather a complementary form of learning (Wenger 1998, 63–71; Wendrich 2013a, 5).

Educational and developmental psychologists also have studied how learning and acquisition of different skills happen through the developmental stages of children. They suggest that universal stages of child development exist, especially in terms of motor skills and cognition (Piaget 1972). For example, Brown's (1975) work on the developmental characteristics of clay figures made by children suggests that children working and playing with clay follow a particular trend in terms of increased symmetry and complexity through age. However, the universal model of developmental stages has been criticized by many, as the socialization process of working alone appears to differ from that of working in groups or under adult supervision in terms of cognitive development (Minar and Crown 2001; Crown 2014b; Vygotsky 1978, 86–87).

Barbara Rogoff (2008) sees development as participation in sociocultural activities in three stages: apprenticeship, guided participation, and participatory appropriation. She argues that these three stages should be seen not as a unidirectional continuum but as occurring together when people, groups and communities come together and transform through sociocultural activities (Rogoff 2008, 59). Along the same lines, Jean Lave and colleagues question how learning is different from other activities and how inventions and reinventions of knowledge happen (Lave 1988; Chaiklin and Lave 1996). She also questions whether failure to learn is a part of active social identity or a result of some inability (Lave 2009, 206).

Schiffer and Skibo (1987, 597) divide technological knowledge into three components: recipes for action, teaching frameworks, and techno-science. The techno-science component of technological knowledge involves the scientific knowledge behind the transformations in a specific technology (such as the chemical transformation that occurs when a clay object is fired). While techno-science is primarily implicit in non-industrial societies, it is helpful for archaeologists and anthropologists working on a specific technology to understand the fundamental principles and the technological variability and change (Schiffer and Skibo 1987, 598). Recipes for action include the 'hardware' of technical knowledge (Wright 1996, 84) such as which tools to use, where to collect the raw materials, the necessary steps to follow in the creation process, or how to solve specific problems. However, such recipes alone would not be enough to learn a technology, which is why different teaching frameworks are employed to ensure intergenerational transmission of knowledge: self-teaching, observation and imitation, verbal instruction and explanation, and hands-on demonstration (Schiffer and Skibo 1987, 597).

Anthropological studies show that learning is highly dependent on the nature of the division of labor. If for domestic consumption, labor division is mainly based on gender and age, and children learn at home, either under adult supervision or with the help of older children. However, if production exceeds household consumption, learning and apprenticeship become more formal, and it is usually done outside the household unit (Crown 2014b). A combination of formal and informal learning systems, perhaps based on age or gender, may also exist within the same community (e.g., Holdaway and Allen 2013).

Neurophysiological theories, on the other hand, distinguish between learning in different parts of the brain as motor learning and other types of learning (Minar and Crown 2001; Minar 2001). Along this line of thinking, craft production processes are learned step by step and require conscious effort until the individual becomes competent. While novices are slow and prone to error, once they become competent through repeated practice, steps that are necessary for making a craft are chunked together and become automatic, requiring much less conscious effort (Schneider and Fisk 1983; Minar and Crown 2001; Crown 2014b). Conditioned motor learning is beneficial for repetitive, monotonous tasks that require high levels of production. If, however, any section of this process is altered, production slows down and it again becomes a conscious effort until it turns into a rote motor activity (Schneider and Fisk 1983, 122). Nonetheless, once learning is completed and production becomes habitual, changing even a minor step comes with difficulty.

The social context of learning also affects the individual works of craftspeople in terms of their motor performance (Creese 2013). If the craft is learned through imitation or participation in the community level, the microvariables would be small and microstyles would be similar as group members might do the same things in a particular way (Creese 2013, 56), such as always coiling pottery or baskets in a given direction. Then, these activities will be maintained within the community through time (Minar and Crown 2001, 374). For example, Minar's (2001) work on hammock making shows us how conditioned learned craft production can be conservative until significant changes occurred in social organization that changed the learning networks. Ethnographic research also demonstrates that at least at one population spinning direction reflects important structural divisions along gender (Minar 2001, 392). Among the Kogi, women spin to the right; men twist to the left. While children are learning how to spin, they follow the spinning direction of their gender identification (Minar 2001, 392). Both Lemonnier (1992) and Jean-Pierre Warnier (1999; 2007) discuss the effects of the embodiment of technological practice and the role of the body in communication and social practice. While these concepts are very important and can yield crucial information about technology, it is only possible when studying living cultures where anthropologists can examine the voluntary and involuntary bodily movements (Wendrich 2013c, 258).

Materiality has also provided important insights into craft production and consumption (Miller 2005; Skibo and Schiffer 2008; S. R. Clark 2009). An object or a craft is created by the individual in accordance with the social context and historical traditions. The object / craft itself is the manifestation of the knowledge, ideals, and the mindset of the producer that also reflect the society. At the same time, since it becomes a part of social engagements through consumption or use, it acts as an agent that aids cultural transmission of ideals and concepts to the future generations. When apprentices learn how to make certain crafts or produce certain types of objects, they are heavily influenced by the ideals the objects convey, and recreate them (Dant 2005, chap. 1).

2.3. Learning, Apprenticeship, and a Community of Practice in Archaeology

So far, this chapter has explored the concepts of gender, age, learning and knowledge transfer in relation to craft specialization. In this section, I elaborate on apprenticeship and community of practice in archaeology in order to tie these concepts together.

In 2001, the *Journal of Anthropological Research* published a special issue on Learning and Craft production. This issue explores how certain crafts are maintained and transmitted within specific communities. Scholars approach learning from quite different, sometimes conflicting, theoretical perspectives ranging from developmental psychology to neurophysical theories. Among these, the most notable is Kathryn Kamp's work on clay objects in relation to children and learning. Kamp (2001a) examines fingerprints on figurines and ceramics from Lizard Man Village in Northern Sinagua (1100-1250 CE) as a case study. She suggests that the crudely made and smaller vessels and figurines might have been made by children while they were learning the craftsmanship. The identification of child fingerprints on these objects provides the critical evidence to support her theory.

Much research has been done on learning and flint knapping in archaeology. Of specific interest is the special issue of the *Journal of Archaeological Method and Theory* on learning and lithic production. The issue, entitled Skillful Stones: Approaches to Knowledge and Practice in Lithic Technology (eg. Bamforth and Finlay 2008; Bamforth and Hicks 2008; Apel 2008; Bleed 2008; Ferguson 2008) offers critical perspectives on theories of learning and apprenticeship common in any craft. For example, Bamforth and Finlay (2008) define what skill is: an intersection of knowledge and know-how. A person should have the cognitive capacity and the knowledge as well as the motor abilities to have a skill. Since novice knappers tend to repeat the same mistakes while learning how to knap, it is possible to find material evidence in the archaeological record (Milne 2013, 119). Brooke Milne (2005, 335) underlines that novice flintknapping can especially be seen at sites close to resources as there would be plenty of material to use and mistakes would be more acceptable.

The question of how poorly made an object should be in order to be considered the work of an apprentice is important to researchers. A badly made artifact might not automatically point to a novice's or an apprentice's presence because in a structured apprenticeship, the student would not be allowed to produce an object unless they were ready for that particular learning process (Cooney 2013). Moreover, as Eleni Hasaki (2013, 175) also points out, a failed work of the apprentice would probably not make its way to the archaeological record because the raw material would be reused with the exception of those that go through transformations such as stone tools.

Archaeology has greatly benefited from the ethnographic and ethnoarchaeological work on craft production. While cross-cultural patterns provide us with some ideas about how humans learn technical behaviors, intra-cultural work on apprenticeship help scholars to understand how learning and apprenticeship is shaped by cultural contexts (Wallaert-Pêtre 2001, 472). Various ethnoarchaeological studies have focused on the apprenticeship patterns throughout the world. For example, Helene Wallaert compares two case-studies where pottery making is a gendered activity (Wallaert 2013). Among the Dowoyo in Cameroon, girls learn to make pottery from their own mothers starting from age 6. By the time they are old enough to marry, they become expert potters. However, they receive a second apprenticeship when they get married from their mother-in-law for another three years where they not only re-learn the craft but also the expected social behaviors suitable for the new wife such as submission to the authority of the new household (Wallaert 2013, 31). This double apprenticeship not only enables the continuity of specific microstyles typical of the village, but it also strengthens the social ties within the potter community. A similar, double apprenticeship was also present among the San Idelfonso Pueblo people in New Mexico. Although the tradition is currently in decline, the mother-in-laws acted as the guardian of knowledge and tradition in which pottery tradition was passed on through the generations in the family (Wallaert 2013, 37). Moreover, learning certain microstyles first from their mothers and then from their mother-in-laws provides a mechanism of change because it can create novel connections between separate communities of practices. Such connections and merging microstyles can potentially be studied through archaeology as well.

An apprenticeship may take multiple forms. It is possible to receive a direct transmission from a teacher /master to the student /pupil, as in the case of Cameroon and New Mexico examples discussed above. Ancient Mesopotamian texts provide evidence for such transmission of knowledge from the master scribe to the apprentice scribe in a formal environment (Kelly- Buccellati 2013, 204). Knowledge can also be transferred through emulation and experimentation, such as by copying and imitating a long-lost method where there are no experts or masters to teach and correct the mistakes of the students. In such scenario, the student needs to understand the *chaîne opératoire* in order to recreate the model (Kelly- Buccellati 2013, 211). Although usually overlooked, peer-to-peer learning is another method to obtain knowledge about craft production as has been suggested for the Northern Iroquoian potter communities in the Late Woodland (Dorland and Ionico 2021).

Both ethnographic and archaeological research shows that both multiple craftsmanships might complement each other or exist within the same household, either practiced by the same or closely related artisans or by different specialists working in the same area (Stahl 2016, 160; Costin 2001, 312). For example, pottery making and metallurgy are crafts pursued by husbands and wives in many African regions (Stahl 2016, 161). Blacksmith men and potter women marry each other in endogamous lineages in some regions of West and Central Africa. The complex technological knowledge of metallurgy and pottery making are passed on within endogamous families and across generations. The fact that these two crafts complement each other in various ways, such as both are activities performed in the dry season when farmers have more free time and it is possible to collect dry fuels for the fire, might play a role in this arrangement alongside the perceived nature of these crafts; both are considered to be transformative practices that might be linked with birth, adolescence and death (Stahl 2016, 161–64). Household archaeology, especially sediment geochemistry and microarchaeology, have proven to be very useful for determining overlapping or distinct activity areas within households (e.g. Ardren, Olvera, and Manahan 2016; Middleton and Price 1996; Kalkan, Özbaşaran, and Özbal 2020).

Since communities change through time, changes in the apprenticeship models and innovations might also occur within the same community. For example, a shift in the apprenticeship model of textile production was observed via a long-term study by Greenfield (2000) among the Zinacantec Maya community in Chiapas, Mexico. While the earlier model from the 1970s was based on an apprentice and a teacher working closely together where the teacher was correcting the mistakes of the student, the later model from the 1990s involved apprentices working on their own or getting help from their peers to correct their mistakes (Greenfield 2000, 76–77). This change in the apprenticeship model was due to economic changes from an agricultural economy to an entrepreneurial cash economy. The introduction of new technologies such as paper patterns as well as the greater freedom in the apprenticeship model in the 1990s enabled innovations and creativity in terms of new styles and designs in the weaving patterns (Greenfield 2000).

Perhaps Kelly and Heidke's (2016) work on gendered labor division in pottery production among the Hohokam communities in the Phoenix Basin in the American Southwest in the 11th century CE provides an excellent example of the communal nature of pottery production. The authors explore various lines of evidence especially concentrating on the intensity of production by calculating the volume of pottery, the production time, the number of specialists, and the time available to complete the production in order to understand the nature of labor division among the Hohokam people. The authors propose that some households might have engaged in pottery production as a community, men and children assisting in various low-skilled stages of the manufacturing process while women devoted more of their time to the high-skilled portions of ceramic production such as shaping and decorating the vessels (Kelly and Heidke 2016, 220). Task segmentation in craft production is present in ethnographic literature, especially when it comes to pottery production as potters tend to work together with less skilled people (members of the opposite sex and children) who provide help during the production (Harry and Huntington 2010; Margaret W. Conkey and Gero 1991; Wright 1991; Kramer 1985; Callaghan 2016). Therefore, pottery production becomes a communal activity with several individuals sharing the workload in the production process despite the fact that the low-skilled people would not be credited as potters within the community or receive benefits of the title (Callaghan 2016, 271; Kelly and Heidke 2016, 221).

2.4. Conclusion

This chapter provides a background to the nature of labor division in craft specialization and attempts to factor age and gender into the discussion. Archaeological research on craft production heavily depends on ethnographic, historic and anthropological accounts. These show the intersectional nature of craft specialization as task differentiations and the transmission of knowledge through generations are closely related to gender, age, class, and other social factors in many societies.

Clay, an essential resource for the lives of the Neolithic communities, was integral to their everyday life. Making clay objects might have been regulated by various social factors including gender and age in western and northwestern Anatolia. Given the nature of the production of clay objects such as figurines and sling missiles, they should be considered products of a community of practice where the necessary know-how is transferred through generations via formal or informal apprenticeship processes in the Neolithic period as well. Considering clay objects as products of a community of practice creates a new research potential as they become an entry into the formation and inter-generational maintenance of social groups in this period. The following chapter will provide the necessary background on the Neolithization of western and northwestern Anatolia.

Chapter 3

3 SETTING THE STAGE: NEOLITHIZATION OF WESTERN ANATOLIA

Western and Northwestern Anatolia witnessed the emergence of a series of new settlements during the early seventh millennium BCE. While these sites shared some similar characteristics in their material culture, they developed their own traditions through time as well. The origins of these earliest settlers continue to be at the center of discussions; were they the hunter gatherers already living in this region beforehand, or were they new settlers coming from somewhere else to claim these new-found lands? Or perhaps, was it a mixture of both? Among the elements these sites shared are their close relationship with clay, making stylistically similar things from clay such as animal and human representations, sling missiles, conical tokens, and pottery. As this research focuses on the transformation of the relationship between people and clay in these regions, it is important to set the stage and briefly discuss the current debates about the Neolithization of Western and Northwestern Anatolia before I delve into site-specific details. This chapter provides a temporal and geographical background to the Neolithic spread towards the west of Anatolia from that point of view.

3.1.The Development of the Neolithic Concept

Until recently, the term Neolithic was used to refer to subsistence based on domesticated animals and plants and the appearance of sedentism (M. Özdoğan 2005). Many scholars have questioned this way of approaching the Neolithic because these assumptions undermined the process as well as how the socio-cultural elements changed in this period. Therefore, it is now acknowledged that the Neolithic implies more than technological developments by encompassing social, ideological, and economic developments, and even a form of shared lifestyle (M. Özdoğan 2005; 2014).

The general trend in the archaeological approach to Neolithization is to look at human development in (pre)history from an evolutionary perspective. The discussions about the emergence of the Neolithic lifestyle revolve around whether transformations in socio-economic practices led to sedentism or if sedentism led to changes in subsistence. However, these theories see the process as a linear development in human history from hunter-gatherers to agriculturalists, from egalitarian societies to complex societies. This perspective sees the major developments in (pre)history as logical, clear steppingstones, and therefore, the trajectory of research tended to evaluate settlements in terms of whether they were successful in reaching that milestone or failed to do so.

Similar processual perspectives on historical developments have been common throughout the world since the 1960s (Binford 1965; 1980; Binford and Sabloff 1982). Processual archaeology tended to approach history scientifically to explain social developments on a global scale. It saw material culture as the adaptation of people to the environment from a functionalist perspective. Communities were compared to biological organisms with perfectly functioning systems, so the central driving force of change was changing physical conditions, such as the environment or war. However, since then, it has become clear that such generalizations about human populations are problematic and insufficient in explaining changes in culture. Seeing human development only from an evolutionary perspective is problematic because it diminishes the importance of human impact, personal choices, and various adaptive strategies people choose to cope with different stress factors (Asouti and Fuller 2013). Hence, archaeological interpretations have become more nuanced as the value of specific histories that focus on the development of communities became clear. In order to move from such positivist perspectives, a bottom-up approach is also necessary to understand the Neolithization of western and northwestern Anatolia.

3.2.The Spread of the Neolithic towards the West

One of the long-lasting debates among prehistorians is the issue of how and why the Neolithic spread. This issue has been explained by three different theories, namely migration, diffusion and local invention, and debates over the spread of the Neolithic continue after several decades with new evidence being uncovered at archaeological excavations and ancient DNA studies. For a long time, many archaeologists proposed that large groups of people migrated from the core regions of the Neolithic, the Fertile Crescent and Central Anatolia towards the west and colonized these regions (M. Özdoğan 2011a; Perlès 2005; Horejs et al. 2015; Perlès 2004; M. Brami and Heyd 2011). The colonization arguments are mainly based on the similarities of the newly founded settlements with the ones in the core regions. However, different origins have been proposed for the migratory groups by different researchers.

Mehmet Özdoğan proposes that there were at least three waves of migrations: the first one was towards the Northwestern Anatolian plateaus (possibly herders), and the second wave was towards the Aegean (possibly farmers) while the third wave was probably a mass migration because hundreds of new sites appeared in the Balkans and Western Anatolia in this period, between 6200 and 6000 BC[2] (M. Özdoğan 2005; 2008; 2019). Özdoğan (2014) looks at the westward expansion of the Neolithic in terms of various zones based on the stylistic similarities and suggests that demographic movement towards the west might have happened quickly because Western Anatolia, Northwestern Anatolia, and the Balkans and Thrace share many similarities in terms of style. Similarly, Maxime Brami and Volker Heyd (2011) propose a three-phased Neolithization of Western Anatolia based on the radiocarbon dates and pottery assemblages from the Neolithic occupations in Western Anatolia, Greece and Southeast Europe.[3] Both Central Anatolia (Schoop 2005) and the Fertile Crescent (M. Özdoğan 2014) have been proposed to be the origin of these migratory groups as different researchers saw different aspects of the Neolithic lifestyle in Western and Northwestern Anatolia relevant for their comparison. At this point, it is important to focus on regional developments in Western and Northwestern Anatolia, as they do not show a uniform cultural development. Therefore, the following sections discuss the various theories about the neolithization of these two regions.

3.2.1. Western Anatolia

The earliest sites in the İzmir region, especially Çukuriçi and Ulucak, are at the center of the current migration debate. Çukuriçi and Ulucak, relatively newly discovered occupations, are two Neolithic settlements that were founded around the same time, in the first half of the seventh millennium BCE. Apart from using the inland routes, the first settlers might have also made use of the sea routes that were already established as early as the Mesolithic period to come to Western Anatolia (Horejs et al. 2015). Despite the large time gap between the PPN groups and the initial settlement phase of Çukuriçi in the 7th millennium BCE, Horejs et al. (2015) suggest that Çukuriçi was probably founded by migrant groups coming from the sea from Upper Mesopotamia or the Levant based on some shared cultural elements with the PPN cultures of these regions and Çukuriçi.

2 Stable Isotope Analysis on skeletons at the Danube Gorges yielded evidence possibly supporting this migration hypothesis (Boric and Price 2013). According to this study, the region received migrations after 6200 cal BCE and most of the immigrants are females.

3 Brami and Heyd (2011) propose that the northwestward spread of the Dark-faced Burnished Ware (DFBW) represents the first phase towards Northwestern Anatolia and Thrace. This is followed by the westward spread of the Red-slipped Burnished Ware (RSBW) towards the Aegean. And finally, they suggest a tentative third phase of Neolithization in which the first two phases merge and consolidate, represented by the impressed pottery traditions.

Çukuriçi people made use of marine resources as well as domesticated and wild animals and plants (Horejs et al. 2015; Horejs 2016). Therefore, it is possible to say that the earliest settlers were farmers, herders, and expert fishermen.

Settlement to Ulucak, on the other hand, might have happened through an inland route. Considering the existence of red plastered floors, plant cultivation, animal domestication and rectangular houses in the earliest Neolithic layer VI, it is suggested that the occupants at Ulucak were not hunter-gatherers adapting the settled lifestyle through frontier mobility model[4] (Ç. Çilingiroğlu and Çakırlar 2013). Instead, the leap-frog colonization model[5] fits better to Ulucak because in this model, small groups of people search for optimum locations to settle down leaving some lands in between unsettled (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012; Ç. Çilingiroğlu and Çakırlar 2013). The Ulucak community might have originated from Inner-West Anatolia (Lake District) and moved through the Gediz basin looking for a suitable environment and brought their technologies and practices with them.

Zooarchaeological research on the westward spread of domesticated animals in Anatolia supports Horejs' aforementioned arguments about maritime migrations at the beginning of the Neolithic in Western Anatolia (Arbuckle et al. 2014; Horejs et al. 2015). Arbuckle et al.'s study on animal remains from 17 different sites and 42 chronological phases shows that all types of domesticated animals did not show up in Neolithic sites together. While some regions had all four types of domestic animals, Northwestern Anatolia, for example, did not have any domesticated pigs until 5800 BCE. The authors suggest a coastal route for the spread of domestic animals and propose that Central Anatolia probably did not play a major role on the earliest spread of domestic animals to the Lake District or to Western and Northwestern Turkey as domestic cattle and pigs were absent in Central Anatolia while these were being consumed in the Lakes Region and Western Anatolia (Arbuckle et al. 2014). Based on the absence of domesticated cattle and pigs in Central Anatolia, it would be plausible to rule out Schoop's hypothesis that the earliest migrants in Western Anatolia came from Central Anatolia. The map presented in Arbuckle et al. (2014) (**Figure 3.1**), on the other hand, suggests both inland and maritime

[4] According to Marek Zvelebil (2001, 2), the frontier mobility model suggests a small number of people forming relationships between the contact zones through exchange networks, alliances, and social bonds.
[5] As explained by Marek Zvelebil (2001, 2) in the leap-frog colonization model small groups of people explore ideal locations for their settlements, presumably by leaving some uninhabited areas between their original settlement and the new settlement.

routes might have been possible for the emergence of domesticated sheep, goat, cattle and pig, supporting both Horejs' arguments for Çukuriçi and Çilingiroğlu and Çakırlar's hypothesis for Ulucak (Arbuckle et al. 2014, Fig. 1; Horejs et al. 2015; Ç. Çilingiroğlu and Çakırlar 2013).

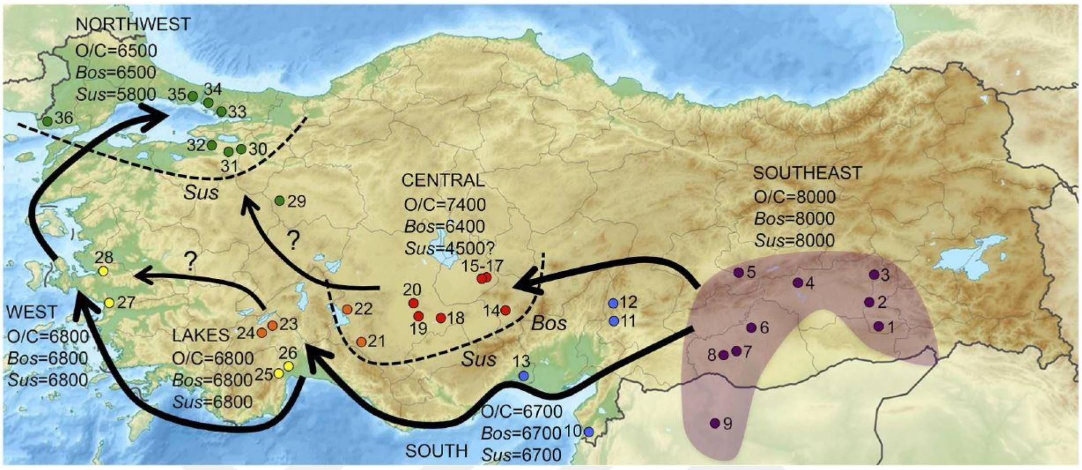


Figure 3.1 Map of Turkey, arrows indicating the potential migration routes of domesticated animals (Arbuckle et al. 2014, Fig.1)

These arguments received criticism because they disregard the existence of local hunter-gatherer populations already living in these newly-settled lands. Both Horejs et al. and Çilingiroğlu and Çakırlar base their claims partly on the assumption that there were no local hunter-gatherer populations in or around İzmir. This assumption has recently been challenged by two groups of evidence.

First of all, recent excavations at the Girmeler Cave, near Tlos in Fethiye, yielded archaeological evidence for a sedentary community living at the site in the 9th and 8th millennia BCE (Takaoğlu et al. 2014; Erdoğu et al. 2021). The inhabitants of this settlement were hunters and gatherers whose subsistence was very diversified and based on wild animals, fish and birds as well as gathered wild plants (Erdoğu et al. 2021).The site has evidence for structures with lime plastered floors, and associated features such as basins, hearths, fire cracked stones starting from the earliest occupation layer (Takaoğlu et al. 2014). While the terrazzo floors suggest relationships with the settlements from the Near East, the chipped stone assemblage is distinctly similar to the Aegean Mesolithic. Girmeler Cave shows us that there are still a lot of previously unknown and unimagined settlements in western Anatolia.

The second group of evidence for the presence of hunter gatherers in Western Anatolia comes from Çiler Çilingiroğlu's survey in Karaburun, İzmir. This ongoing survey yielded evidence for the presence of both Middle Paleolithic and Mesolithic hunter gatherers in the region. The survey team report that the group of chipped stones found during the survey show similarities with Aegean Mesolithic lithic assemblages that were found at Franchthi in phase VII, as well as several sites on the Aegean islands (Ç. Çilingiroğlu et al. 2016). Since this group of finds is the only known Mesolithic assemblage on the western coast of Turkey, this is possibly even more significant than the Girmeler occupation for the discussion about migration to Ulucak and Çukuriçi.

3.2.2. Northwestern Anatolia

The Neolithization of Northwestern Anatolia has been approached differently from Western Anatolia. Intensive surveys of the Marmara region yielded evidence for the presence of Mesolithic hunter-gatherers in this region (Gatsov and Özdogan 1994). This group of sites (Ağaçlı, Gümüşdere, Domalı, İbo'nun Rampası) are mainly found on the shore of the Black Sea in İstanbul[6] and are named after their type-site Ağaçlı. Based on the location of all of these sites, it is plausible that marine resources made up a significant portion of their subsistence (Düring 2010, 40). However, none of these sites have been excavated so far, making it impossible to understand whether they were permanently occupied throughout the year or only seasonally. Moreover, it should be noted that the sea levels at both Marmara and the Black Sea were much lower than today as they were still cut off from the Aegean at that time. This makes it more challenging to estimate the subsistence strategies of the Ağaçlı hunter gatherers without excavation.

The chipped stone assemblage of the Ağaçlı group is distinct from those in the Antalya region. Circular and semi-circular stone tools are commonly found at Ağaçlı sites, but geometric microliths are absent. Gatsov and Özdoğan concluded that the chipped stone tools from Ağaçlı sites show similarities with tool assemblages in Bulgaria, Romania, and Ukraine (Gatsov and Özdogan 1994), suggesting that there was interaction among the Mesolithic communities via the Black Sea.

An important question is the possible relationship between the earliest Neolithic settlements in the Marmara region and the Mesolithic Ağaçlı group. The Neolithic

[6] It should be noted that İbo'nun Rampası is located by the Sea of Marmara in Yalova. Apart from those by the Black Sea, some of them are also located in the close vicinity of lakes in the Marmara Region.

settlements around Marmara are named after their type-site, Fikirtepe. Since many sites of the Fikirtepe culture are also located by the sea or lakes and their chipped stone assemblages are almost identical to the Ağaçlı group, it has been suggested that the Neolithic Fikirtepe culture could have been the continuation of the Ağaçlı culture.

Possible evidence for the earliest Neolithic presence in the Marmara region comes from surveys at Musluçeşme and Çalça (M. Özdoğan and Gatsov 1998). These two very small, flat sites yielded chipped stones that seem to be distinct from the Ağaçlı stone tool assemblages and have been dated to the end of the pre-pottery Neolithic period (2011b, 662). Moreover, Keçiçayırı and Asarkaya have been dated to the Pre-Pottery Neolithic period based on the lithic assemblages as well (Efe 2005; Efe, Gatsov, and Nedelcheva 2013). Nonetheless, it should be noted that the lack of excavations at any of these sites except for Keçiçayırı hinders our understanding of the presence of Mesolithic or PPN communities in Northwestern Anatolia.

The Neolithic occupations in Northwestern Anatolia can be divided into coastal and inland settlements. The Fikirtepe group sites (Fikirtepe, Pendik, Yenikapı and Yarımburgaz) are all coastal settlements located around Istanbul. Excavations at these settlement sites yielded sunken rounded huts built in wattle and daub, an unprecedented architectural style for Anatolia in this time period (after 6400 BCE) (M. Özdoğan 2013, 193–95; Karul and Avcı 2011; Düring 2010, 179–82). Apart from farming, these coastal settlements consumed marine resources such as shellfish and fish. The presence of round huts, the location of the settlements, and the continuation of Ağaçlı lithic traditions at the coastal Fikirtepe settlements led to the interpretation that these sites were the continuation of Ağaçlı Mesolithic groups in the region. However, the lack of archaeobotanical analyses and radiocarbon dates from Ağaçlı and Fikirtepe sites and the lack of excavations at the Mesolithic sites in the region makes these interpretations more controversial (Çakırlar 2013). Moreover, conclusions about the diet of the Mesolithic groups come from interpretations based on their location and cannot be supported by any evidence so far. It is impossible to confidently link the round sunken huts of the coastal Fikirtepe sites to a Mesolithic continuation due to the lack of knowledge about the architectural style of the Mesolithic sites in the Marmara region.

The inland settlements such as Barcın Höyük, Bahçelievler, Ilıpınar, Menteşe, and Aktopraklık share similar lithic assemblages with the coastal ones, but their architecture and subsistence strategies are different. Among these (and the coastal sites), Bahçelievler yields evidence for the earliest occupation in the Marmara region, dating to as early as 7000-6700 BCE (Fidan 2020, Fig. 10; Kolankaya-Bostancı and Fidan 2021, 97). As opposed to the coastal settlements, the inland sites are characterized by rectangular architecture without sunken floors and complete dependence on agriculture and animal domestication (Gerritsen and Özbal 2016; Roodenberg 1999). The inland farmers of this region seem to have come from somewhere in Anatolia with the knowledge of animal and plant domestication. Still, inland and coastal settlements seem to be culturally connected as they share many elements in their material culture, such as bone tools, chipped stone assemblages, and pottery (Gerritsen and Özbal 2016). Moreover, the recent excavations at Pendik, where round structures are well documented, yielded rectilinear architectural remains (Kızıltan 2013), and both circular and rectilinear architecture has been found at Yenikapı (Kızıltan and Polat 2013), suggesting the inland-coastal distinction might not be so clear-cut.

3.3. The Neolithic Package

While reviewing the Neolithization of Western and Northwestern Anatolia, it is crucial to discuss the concept of "Neolithic Package(s)" in detail. Neolithic package as a term has been used to refer to a group of Neolithic assemblages that occur together repeatedly in a wide geographical area. Ever since its first introduction by British archaeologists in the 1960s (S. Cole 1965), the concept has been used and criticized extensively by many scholars (Reingruber 2011; Kotsakis 2001; M. Özdoğan 2008; 2014; Ç. Çilingiroğlu 2005; Arbuckle et al. 2014; Düring 2013; M. Brami and Heyd 2011; Robb 2013).

The contents of the Neolithic Package also went through an evolution in this period. Different scholars identified the contents of this package differently, but it commonly contains domesticated animals and plants, sedentary village life, pottery, groundstone artifacts, and celts[7] (M. Özdoğan 2014). The reason why these shared cultural elements have been found across Anatolia, Southwest Asia, and Southeast Europe might be because these regions have similar climatic and environmental conditions (Ç. Çilingiroğlu 2005). Yet, the Neolithic package was probably a reflection of the Neolithic

[7] These elements have been listed by Mehmet Özdoğan as primary components of the Neolithic Package.

mentality rather than an actual package or the Neolithic itself (Ç. Çilingiroğlu 2005). The package concept has been criticized because it explains the Neolithic spread by migrations without considering the local groups (Reingruber 2011). Reingruber argues that to understand the spread of the Neolithic, archaeologists need to look at the earliest Neolithic levels (Reingruber 2011). The components of the Neolithic Package are sometimes absent in the earliest levels and become apparent in the later Neolithic levels. These initial stages can teach us more about how the Neolithic spread.

Neolithization cannot be described in terms of economic processes alone as it is a more complex process (Kotsakis 2001). It should not be conceptualized as immigrants coming to Western and Northwestern Anatolia with their domesticates and packages or as a one-way evolutionary path from the hunter gatherer lifestyle to sedentism. As Kotsakis recommends for the Greek Neolithic, focusing on short-term occupation sites might be a way to obtain further knowledge about this process because these might be where people experimented with the Neolithic way of life with selective manipulation of resources and by creating new categories and identities (Kotsakis 2001). Neolithization did not follow a linear process as envisaged by diffusionist theorists. It was a much more complex process with extensive interactions. The Mesolithic-Neolithic transition must have been entwined with social and daily practices regarding the decisions of hunter gatherers.

While the earlier research mainly looked for evidence of settled lifestyle, domesticated plants, and animals and defined whether a settlement was Neolithic or not, more recent research showed that this (subsistence strategies) was not how the Neolithic communities identified themselves (M. Özdoğan 2014). Despite the wide variety of subsistence practices, the Neolithic communities shared a particular socio-cultural identity that separated them from the other groups. Moreover, it now became clear that there were many Neolithic Packages that had been appropriated to the space and time (M. Özdoğan 2014; Ç. Çilingiroğlu 2005).

Where does Western and Northwestern Anatolia stand in the Neolithization debate? The earliest occupation levels of Barcın, Ulucak and Çukuriçi are limited in terms of material assemblages (Ç. Çilingiroğlu and Çakırlar 2013; Horejs et al. 2015; Gerritsen and Özbal 2019). However, this seems to change shortly after the earliest level, and the material assemblages become more numerous with more variety. Çilingiroğlu and

Çakırlar (2013) underline that the earliest level at Ulucak, level VI, dating to the first half of the seventh millennium BCE, lacks the typical components of the Neolithic material culture such as figurines, sling missiles, polished stone axes or bone spoons.[8] Pottery was almost nonexistent at this level. We can come to a similar conclusion for Barcın Höyük as well. Level VIe at Barcın dates to the end of the first half of the seventh millennium, approximately 6600-6500 BCE (Gerritsen, Özbal, and Thissen 2013b). There were very few clay objects at this level, and sling missiles were virtually nonexistent. While pottery was present, it was very limited in numbers. Çukuriçi, where very few small sherds have been recovered from the earliest occupation phase XIII, seems to follow a similar trend (Horejs et al. 2015). The fact that there has been an increase in the number and variety of assemblages in such a short time is also an indicator about social changes in these communities. What has not been studied so far, however, is how the Neolithic communities in Western Anatolia passed on knowledge through the generations in pioneer situations, potentially with bottlenecks. We can approach this question by looking at the communities of practice who actively contributed to their production.

Another common feature among several earlier Neolithic sites in Anatolia is the existence of red painted plastered floors (e.g., Fethiye-Girmeler (Takaoğlu et al. 2014), Ekşi Höyük (Dedeoğlu et al. 2018), Bademağacı and Hacılar (Duru 2010, 16), Barcın Höyük (Gerritsen and Özbal 2019), Aşağı Pınar (Özdoğan 2019, 316)). Buildings with such special floors have been identified as public buildings in Central (Aşıklı Höyük (Özbaşaran 2012)) and Southeastern (Çayönü (Erim-Özdoğan 2011, 207)) Anatolia, and those in Western Turkey have been suggested to be imitations of the original terrazzo floors of these public buildings with inferior quality due to lack of organized labor and specialized craftspeople (Özdoğan 2019, 316).

Özbal and Gerritsen (2019b) propose a six-phased process for the Neolithization of the Marmara Region, which ties all theoretical discussions neatly together. According to their model, the Marmara Region is occupied by the Mesolithic and Epipaleolithic forager groups in the first phase, which can be evidenced by the Ağaçlı group. The second phase is the appearance of aceramic Neolithic groups/settlements in the region. Recent excavations at Keçiçayırı in Eskişehir (Efe et al. 2013), and perhaps the surveys at Çalça

[8] Çilingiroğlu and Çakırlar also underline that pottery was absent from Ulucak in this level but based on personal communication with the excavation director Özlem Çevik, I know that recent excavations yielded evidence for pottery, although very few in number.

in Çanakkale, Musluçeşme in Bandırma, and Küçükçekmece in İstanbul (R. Özbal and Gerritsen 2019b, 185) yield evidence for aceramic settlements in the region. The third stage is the arrival of pioneering Pre-Fikirtepe farming communities in Eastern Marmara in the first half of the seventh millennium BCE, among whom Barcın Höyük, Keçiçayırı, Cıbırada and Demircihöyük can be mentioned (Sari and Akyol 2019; Gerritsen and Özbal 2019; Efe, Gatsov, and Nedelcheva 2013). Based on the subsistence data, it is possible to say that the farmer and forager communities did not interact very much. In the 4th stage, Neolithic settlements expanded in the region, inland and coastal sites such as Aktopraklık C, Fikirtepe, and Pendik were settled, and a traditional "Fikirtepe Culture" was established. At this stage, based on settlement organizations, subsistence strategies, and burial customs, it is possible, to some extent, to talk about an interaction between the farmer and forager groups in the region. Stage 5 represents the beginning of the sixth millennium in the Early Chalcolithic Period when most of the Neolithic sites were either abandoned or relocated, and an early version of the "Anatolian Settlement Plan" appeared in Aktopraklık B, Aşağı Pınar 6 and Ilıpınar. In Stage 6, semi-subterranean round structures appear at several sites as the main architectural layout after 5500 BCE in the Middle Chalcolithic period.

The Neolithic Package concept does not seem to work very successfully for pioneer settlements in Western and Northwestern Anatolia. However, after 6500 BCE, their material cultures seem to be enriched by the components of these "packages." Multiple migration episodes toward the west could explain this change (M. Özdoğan 2008; M. Brami and Heyd 2011). However, it is also possible that from 6500 BCE on, active interactions among the settlements led to an increase in the exchange of ideas and material culture.

3.4. DNA Studies

The question of whether the first inhabitants of these settlements were local hunter gatherers or immigrants from other parts of Anatolia or from the Levant is still valid. However, our interpretations of this period can quickly change in the following years, thanks to the new studies on ancient genes. Very recently, several DNA studies on the Neolithic skeletons from Anatolia, including genetic evidence from Boncuklu, Barcın, Tepecik-Çiftlik, and Menteşe, have been completed (Hofmanová et al. 2016; Kılınç et al. 2016; 2017; Mathieson et al. 2015). They have shown that the populations from Western

Anatolia are genetically related to those from Central Anatolia (Kılınç et al. 2016). Interestingly, certain genetic traits are shared between the European Neolithic farmers (Linearbandkeramik, Starcevo, and Early Hungarian Neolithic farmers) and the Aegean early farmers. Genetic evidence suggests that some groups which share the same DNA markers with the Barcın population migrated to Central Europe after 6000 BCE. However, it should be noted that it is not possible to distinguish whether the Central European Neolithic people descended specifically from the Anatolian or the Greek Neolithic populations (Hofmanová et al. 2016). The data also shows evidence for two independent migration routes for the spread of farmers into Europe. The first route is through the Aegean into southwestern Europe and the second is towards Germany via Hungary (Hofmanová et al. 2016). They show that mixing between local hunter-gatherer populations and the newcomer farmers in Europe occurred sporadically at low levels throughout the Neolithic period and everywhere in Europe.

3.5. Why spread towards the West?

Why did the Neolithic spread? I believe it is essential to address different points of view concerning why the Neolithic spread towards the west. Several articles have discussed this question (Perlès 2005; Schoop 2005; Clare et al. 2008; Düring 2013; Weninger et al. 2014). While farming and the sedentary lifestyles began in Central Anatolia as early as the first half of the ninth millennium, it did not expand towards the west for about at least 1500 years, until after around 7000 BCE or the first half of the seventh millennium. Various models for the Neolithic expansion have been put forth so far, such as migration and rapid population growth (Bocquet-Appel and Bar-Yosef 2008; Ç. Çilingiroğlu 2005). But, these models do not work in Anatolia because the Neolithic spread "was not gradual but episodic" (Düring 2013, 81; Özdoğan 2019). Düring suggests that the breakup of clustered neighborhood communities and building continuity, in other words cultural elements, might be at play at the sudden spread of the Neolithic (Düring 2013). Moreover, the spread might have been enabled by the appearance of domesticated plants and animals that are better adapted to the climatic and ecological conditions of Western and Northwestern Anatolia. Evidence for dairy production as early as the mid-seventh millennium BCE in Anatolia points to changes in subsistence strategies as well.

Many scholars suggested that the 8.2 ka event might be responsible for the collapse of the system in Central Anatolia. It may have become necessary for these people to migrate to previously unexplored lands (Clare et al. 2008; Weninger et al. 2014). It is proposed that the climatic event led to social turbulence and even warfare in the Lake District, resulting in mass migrations and intensification of the Neolithization process (Clare et al. 2008). Maxime Brami (2014) challenges the warfare hypothesis because while this hypothesis sees the burnt down villages and houses in the Lake District as evidence for inter or intra-regional warfare, house or settlement conflagrations are a common practice throughout Anatolia and Southeastern Europe and might have been deliberate actions filled with symbolic meanings. Düring, on the other hand, objects to the influence of this climatic event on the spread of the Neolithic. The effects of this climatic event on Central Anatolia have not been studied thoroughly and are not visible in the pollen diagrams for the time being (Düring 2013).

It has been argued that the 8.2 ka event was a part of a more extended period of climate change between 6600 and 6000 BCE and has been labeled as "Rapid Climate Change" (Weninger et al. 2014; Clare et al. 2008). Considering this is the approximate period when the number of settlements in Western and Northwestern Anatolia dramatically increased, these two cases might be related. However, Düring underlines that the climatic effects of this event were probably more pronounced in the Aegean and the Marmara than in Central Anatolia (Clare et al. 2008),[9] and it should have deterred people from migrating to these regions but possibly compelled the hunter-gatherers to change their food procuring strategies (Düring 2013).

3.6. The Early Chalcolithic Transition

At the end of the seventh millennium BCE, occupation at both inland and coastal sites in Northwestern Anatolia seem to come an end: Barcın, Aktopraklık C, Pendik and Fikirtepe were no longer occupied (Gerritsen, Özbal, and Thissen 2013b; Karul and Avcı 2011), and new sites emerged in the area such as Ilıpınar, Aktopraklık B, and Yenikapı (Roodenberg 1993; Kızıltan and Polat 2013). Weninger et al. (2014) suggest that the end of the Rapid Climate Change might have played an essential role in this transition and relocation of the settlements. Domesticated pigs became an integral part of the subsistence both at Ilıpınar post-dating level X and Yenikapı, showing a clear shift from

[9] Sediment cores from the Aegean Sea suggest a temperature drop of 2-3ºC between 8600-8000 cal BP. This has been extensively discussed in Clare et al. 2008, 67-70.

non-existing domesticated pig remains in the former Neolithic sites in this region (Buitenhuis 2008, Fig. 14; Çakırlar 2013, 68).

On the other hand, Western Anatolia does not seem to be affected by the Rapid Climate Change as much as the Marmara Region. The region continued to be occupied without a hiatus until about 5700 BCE (Çevik 2016; Çevik and Abay 2016; Horejs et al. 2015; Sağlamtimur 2012). During this period, the standard "Neolithic Package" is visible at the sites in the region[10]. After 5700 BCE, cultural elements associated with the Neolithic completely disappeared from the region. They were replaced by a new group of people who inhabited the region between 5650/5600-5500 BCE with a completely distinct cultural horizon with its unique architecture and pottery styles (Çevik and Abay 2016, 188; cf. Ç. Çilingiroğlu 2019).

3.7. Introduction to Case Studies in this Study

The previous sections in this chapter have provided a general picture about origins and development of the Neolithic way of life in Western and Northwestern Anatolia. Despite the similarities shared by these communities, each site seems to have developed its own traditions that can be traced through the archaeological record. Although the idea of understanding labor division in clay object production throughout the whole region is important, this dissertation only focuses on three case studies, Barcın Höyük from Northwestern Anatolia and Ulucak and Ekşi Höyük from Western Anatolia in order to form an idea about gender and age-based labor division in west of Anatolia. The selection of these case studies is due to several reasons. These three sites have been occupied around the same time period and located on the western part of Anatolia. Although they share some common Neolithic elements that has been mentioned in the previous sections, they are also significantly different from each other in terms of their architecture, burial customs, and material assemblages which will be discussed in the following sections. These similarities and differences might reflect their lifestyles and communities of producers at these sites, which potentially can provide a snapshot of the Neolithic mosaic in the seventh and early sixth millennia in this region. This section aims to provide an introduction to the three case studies I concentrate on in the following chapters.

[10] For a discussion on this, see Çevik and Abay 2006, pp. 192-195.

3.7.1. Barcın Höyük

Located in the Yenişehir Plain, Bursa, Barcın Höyük is a small twin mound covering an area of approximately 1.7 ha (Gerritsen and Özbal 2019, 59). Jacob Roodenberg started archaeological excavations on the eastern mound in 2005, and Fokke Gerritsen and Rana Özbal excavated the site between 2007 and 2015 (Gerritsen, Özbal, and Thissen 2013b; Gerritsen et al. 2010; Gerritsen and Özbal 2016; 2019). The site was occupied mainly in the Neolithic period, but following an abandonment period, the site was partially reoccupied briefly during the Middle Chalcolithic Period, the Late Chalcolithic Period (Gerritsen et al. 2010), the Early Bronze Age and the Early to Middle Bronze Age transition (Gerritsen and Özbal 2019). Finally, it was used as a cemetery in the Byzantine Period (Alpaslan Roodenberg 2009).

Architecture and Settlement Pattern

The Neolithic occupation at Barcın Höyük has been divided into seven subphases: VIe (oldest), VId1, VId2, VId3, VIc, VIb, and VIa (youngest) (Gerritsen and Özbal 2019). Based on more than 80 radiocarbon dates, the occupation period can be dated between 6600 – 6000 cal BCE (Gerritsen, Özbal, and Thissen 2013b; Weninger et al. 2014, Fig. 14). To some extent, the site shows continuity throughout the Neolithic occupation in terms of building style and settlement pattern. Buildings are rectangular with entrances located on the long side of the structure; their walls are made of loam and wood with structural beams placed in foundational ditches. The roof is carried by larger, roof-bearing posts in central areas of the structures. The lack of clear evidence for wattling on the walls is striking. The earliest building phase, level VIe, is slightly different from the later phases as the buildings were built with large, individual posts rather than smaller posts in foundational ditches (Gerritsen and Özbal 2016, 201; 2019, 60). This level is characterized by two rectilinear buildings (Structures 24 and 25) built in the east-west orientation, adjacent to each other, and sharing one of their shorter walls (**Figure 3.2**) (R. Özbal and Gerritsen 2019b).

The settlement pattern consists of a row of houses built in East-West orientation and facing an open courtyard that probably had another row of houses on the southern end (Gerritsen and Özbal 2019, 60). The layout of the initial settlement pattern continued uninterrupted for approximately four hundred years until Level VIb as structures in the following levels VId1 to VIc were built on top of Structures 24 and 25 with the same orientation (**Figure 3.3**) (van den Bos 2021, 172).[11] Houses built in this period were facing towards the south and connected to the shared open courtyard with an annex (R. Özbal and Gerritsen 2019a, 293). The Barcın inhabitants used the courtyard for various outdoor activities such as using fire pits and other installations and burying their dead (Alpaslan Roodenberg, Gerritsen, and Özbal 2013). The settlement seems to have been encircled by a shallow boundary ditch on the North in level VIe, but it was quickly filled up and replaced by a boundary wall in level VId1 (Gerritsen and Özbal 2016, 201–2). In level VIb, around 6200 cal BCE, new buildings standing alone appear inside the courtyard, suggesting a radical reorganization of the settlement pattern in this period (Gerritsen, Özbal, and Thissen 2013a, 96).

Figure 3.2 Plan of Level VIe at Barcın Höyük. From (van den Bos 2021, Fig. 7.6)

[11] For a detailed discussion on the architecture and settlement layout of Barcın Höyük see van den Bos 2021.

Figure 3.3 Superimposed row of architecture at Barcın Höyük, levels VIe to VIc. From (van den Bos 2021, Fig. 7.8)

Within these occupation phases Structures 2a, 2b, and 21 from level VId1 (**Figure 3.4**) were burnt down in a fire that helped the preservation of many artifacts and installations as well as a set of footprints (**Figure 3.5**) *in situ* (Gerritsen and Özbal 2016, 202; Atamtürk et al. 2018). Structure 2a from level VId1 yielded a complete bovine skull with incomplete horn cores still attached intentionally placed beneath the house floor, just 60 cm inside the entrance (Gerritsen and Özbal 2016, 202). Almost immediately on top of the animal skull, a pair of barefooted human footprints were pressed on the plaster of the house floor as if exiting the structure (Atamtürk et al. 2018). Thanks to a fresh layer of floor plaster carefully covering the prints, the footprints were preserved. This new floor plaster was subjected to fire and hardened when the building burnt down, preserving the prints below. Anthropological analyses of these footprints suggest that they belonged to an adult male on average weighing 71.9 kg and 169.9 cm tall although this value is a rough estimate (Atamtürk et al. 2018).

Figure 3.4 Barcın Höyük Level VId1 plan from (Gerritsen and Özbal 2019, Fig. 2)

Figure 3.5 Two footprints found on the floor of Structure 2a in Barcın Höyük. From (Atamtürk et al. 2018, Fig. 3).

Another interesting building from level VId1 is Structure 19, with its red floor. The walls of the building incorporated a large number of burnt mudbrick fragments, while the floor of this building was prepared with pulverized burnt material, possibly mixed with powdered red stones or ochre (Gerritsen and Özbal 2016, 203). Typically linked with special purpose or communal buildings, red plastered or terrazzo floors have been found at various Neolithic sites in Anatolia and the Near East (Özbaşaran 2012; A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012; Umurtak 2005), but they are usually prepared with lime. Considering that this is the only structure with a red floor that probably required intensive work to prepare and its larger size, Structure 19 might have a different purpose and use from the other Barcın Höyük buildings at this time period.

Level VIb, ca. 6200 BCE, marked the cultural break from architectural continuity and settlement pattern at Barcın. Structures 5, 13, and 11 that date to this occupation level were freestanding and were built on the open courtyards rather than the previous row of buildings (van den Bos 2021, 173). Buildings, on the other hand, continued to be built in the same way with post-row structures and wattle and daub technique, and an annex area was present at least in Structures 5 and 13 on the northwestern side of the houses (**Figure 3.6**).

Level VIa is mainly known from pits, as architectural remains are very fragmentary and do not yield information on the settlement layout in this period (Gerritsen and Özbal 2019, 60). At the end of this occupation level, the Barcın Höyük settlement was abandoned ca. 6000/5900 BCE, effectively ending the site's 600 years of Neolithic occupation.

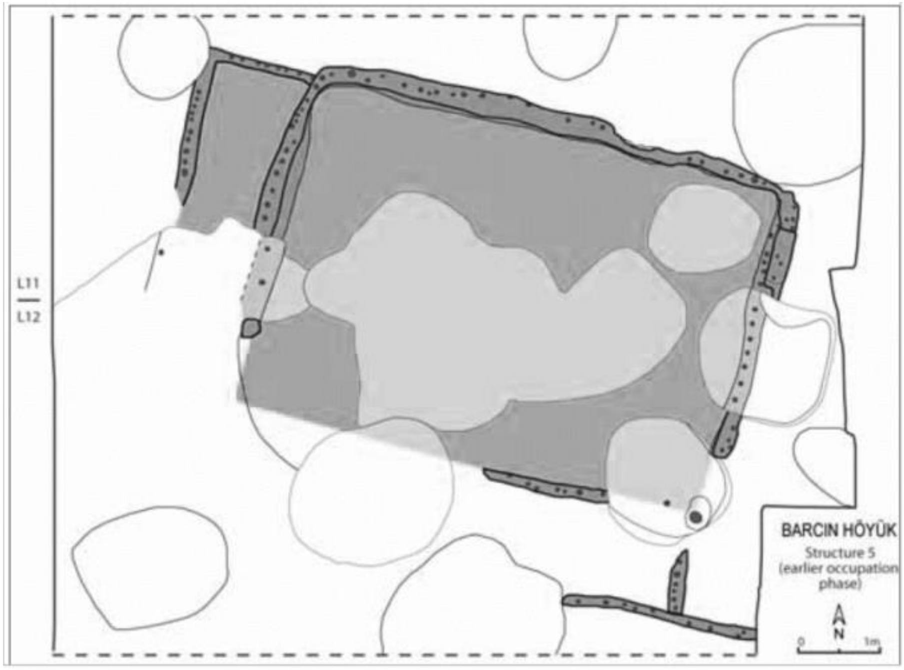


Figure 3.6 Structure 5 from Barcın Höyük level VIb. From (Gerritsen, Özbal, and Thissen 2013a, Fig. 9)

Burials and Ancient DNA

Approximately 130 complete or nearly complete Neolithic burials have been excavated at the site. There seems to be an age-based division when it comes to burials, as the adults were buried in a flexed position in simple pit graves in the courtyard while infants tended to be buried inside or close to the houses, probably after the abandonment of the house (Alpaslan Roodenberg, Gerritsen, and Özbal 2013, 95). Burial customs do not show any standardization when it comes to the orientation of the body or the presence of grave goods (Gerritsen, Özbal, and Thissen 2013a, 97).

Recent DNA studies suggest that the inhabitants at Barcın Höyük were genetically closely related to the 9th and 8th millennia populations at Central Anatolia (especially Boncuklu Höyük), but with a more diverse genetic background, possibly including a small influx from the Levant (Kılınç et al. 2016; 2017). The Anatolian farmers, to whom Barcın Höyük samples helped create a genetic profile, also seem to be the primary genetic ancestry of the European Neolithic farmers (Mathieson et al. 2015; Hofmanova et al. 2016).

Subsistence

The archaeobotanical analyses represent a broad range of cultivated and wild plants being consumed at the site, including cereals such as einkorn, emmer, bread/hard wheat, hulled and naked barley, and pulses such as lentil, pea, and chickpea, as well as bitter vetch, flax, hazelnut, and blackberry (Balcı et al. 2019). Archeozoological investigations show that the inhabitants of Barcın Höyük kept domesticated cattle, sheep, and goats, while the domesticated pig is absent in the faunal assemblage (Galik 2013). Wild animals make up of about 15% of the assemblage; among these are roe deer, wild boar, hare, fox, birds, small rodents, terrapins, fish, and molluscs (Gerritsen and Özbal 2019, 61).

Pottery

Pottery is present from the earliest level onwards, albeit in small quantities in level VIe. At the earliest level, large quantities of fire-cracked stones were excavated, but the number of these artifacts drastically diminished after level VIe (Gerritsen, Özbal, and Thissen 2013b, 72–73). These stones have been suggested to be used for hot-rock cooking technique, but this technique was abandoned once more heat-resistant pottery was developed (Gerritsen, Özbal, and Thissen 2013b, 73). Pottery traditions developed from a more restricted range of holemouth pots and bowls to those with slight S-profiles, and finally, a wider range of forms with vertically pierced lugs became widespread (Gerritsen and Özbal 2019, 61). Additives for temper increased in variety through time as well. In terms of pottery assemblage, levels VIb and VIa show greater similarities to the Fikirtepe traditions while comparative material for the earliest pottery form Barcın can be found at Demircihöyük and Keçiçayırı (Sari and Akyol 2019). Lipid residue analyses on the Barcın Höyük pottery demonstrate that vessels were used for milk processing from the earliest levels onward (Thissen et al. 2010; H. Özbal et al. 2012).

Lithic Assemblage

The lithic assemblage of Barcın Höyük consists mainly of flint, while obsidian is also present, making up of as much as a quarter of the assemblage at some occupation levels (Gerritsen and Özbal 2019, 62). Unidirectional blade cores, bullet cores, blades, bladelets, semi-circular and circular end-scrapers, sickle blades, perforators, drills and trapezes are commonly found at the site (Gatsov and Nedelcheva 2011b; 2016). It shows typological and technological similarities with the other Neolithic sites in the region, such as Menteşe, Fikirtepe, Ilıpınar, and Pendik at the later phases (Gatsov and Nedelcheva 2011a) and Keçiçayırı at the earlier occupation phases (Gatsov and Nedelcheva 2016, 3). Central Anatolia seems to be the main source area for procuring obsidian with the addition of Melos obsidian to some extent (Milić 2014).

Small Finds

Barcın Höyük's small finds assemblage is rich in bone tools and implements. Awls, pins, spoons, and spatulas are an important part of the assemblage (Erdalkıran 2015; Gerritsen, Özbal, and Thissen 2013a, 98). Anthropomorphic figurines made of baked or unbaked clay and zoomorphic figurines made of baked clay are also present in lower numbers throughout the occupation at the site (Gerritsen, Özbal, and Thissen 2013a, 99; Gerritsen and Özbal 2019, 62). Among the clay finds, sling missiles make up the majority of the whole assemblage, with their number increasing significantly in levels VIb and VIa. Beads made of shell or stone are also present; turquoise-colored beads replace the dentalium shell beads that were more dominant in the earlier levels, probably made of bone in the later levels (E. Baysal 2014; Bursalı et al. 2017). Ground stone tools and axes show a slow development in shapes, types, and raw materials throughout the Neolithic occupation (Gerritsen and Özbal 2019).

3.7.2. Ulucak Höyük

Ulucak Höyük is a Neolithic and Early Chalcolithic settlement in İzmir. It is considered one of the critical sites in understanding the Neolithization of the region as it has continuous Neolithic deposits covering over a millennium (Çevik and Abay 2016, 187). The site is divided into six main levels, but due to heavy agricultural activities and erosion, the most well-preserved layers are levels VI, V and IV (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012, 141). These levels are briefly discussed below.

Architecture

Level VI, dating to 6800-6600/6500 BCE, is the initial Neolithic level of the site (Çevik and Abay 2016, 187). Only two structures –Buildings 42 and 43 – and an open space have been exposed, making it difficult to understand the settlement layout of this initial phase (Çevik and Abay 2016, 190). These buildings had mud-slab walls, partially painted in red and cream, red plastered floors, and were occupied contemporaneously at some point (Çevik and Abay 2016, 188; Çevik 2019, 221–23). Both structures had red plastered floors that were characterized by tightly placed small pebbles and one cm thick lime plaster with grit temper (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012, 149). To the south of these buildings is an open space where thirteen circular hearths and ovens and two neonate burials were found in this area (Çevik and Abay 2016, 189). In addition, fragments of two neonate skeletons were found in the fill of Building 43 and by the entrance of Building 42. These burials are significant because they are the only human burials found in the Neolithic layers of Ulucak to date.

The occupation from the second half of the seventh millennium can be divided into two: Early Neolithic I occupation levels Vf to Vc (6500-6200 cal BCE, 7^{th} Mill Early / Before 6200 BCE in this analysis) and Early Neolithic II occupation levels Vb and Va (7^{th} Mill Late / 6200-6000 BCE in this analysis). This division is not arbitrary and can be followed through changes in the architecture and the gradual introduction of clay finds into the assemblage (Çevik and Erdoğu 2020, 81). The most informative ones, however, are the final Va and Vb subphases dating to 6200-6000 BCE, as they were built on top of each other without a hiatus and yielded information about the settlement pattern. Buildings in this phase were characterized by rectangular, one-roomed structures whose walls were constructed with wattle and daub or mud-slabs with stone foundations (Çevik and Abay 2016, 191; Çevik 2019; Derin 2005, 85–86 Fig. 1). Each house was equipped with fire installations (ovens/hearths) and clay bins for individual storage purposes. Moreover, the buildings in these two layers no longer seem to have been built in the same spot, closely following the previous houses (Çevik and Erdoğu 2020, 82).

Buildings in level IV, dating to 6000-5700 BCE, were built with sun-dried mudbricks. The layout of the settlement was exposed in a wide area on this level; the houses in level IVb were constructed along a narrow street and had internal divisions as well as benches and platforms (Çevik and Abay 2016, 192).

Pottery

Except for a few small pottery fragments, clay objects were virtually absent in the initial Neolithic levels of Ulucak (Çevik and Abay 2016, 190), which seems to be a widespread phenomenon for many sites in the region during the Initial Neolithic phase (other examples include Barcın (Gerritsen and Özbal 2019), Bademağacı (Duru 2012, 15–16), Çukuriçi (Horejs 2016, 146)). From level V onwards, typical holemouth globular jars, bowls with "S" profiles, and short-necked and vertically placed tubular lugged globular jars became present in the pottery assemblage (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012, 147). Large storage jars replaced the storage bins and clay boxes of the earlier periods in level IV (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012, 147).

Subsistence

Analyses of animal remains suggest the four-tiered herding system, including sheep, goat, cattle, and pig was in place from the beginning of the settlement (Çakırlar 2012, 84), while wild animals made up a tiny percentage of the settlement's subsistence except in level IV when wild game consumption increased. The botanical remains point to a fully developed farming community even at the earliest levels of Ulucak (Çevik and Abay 2016, 190). Among the archaeobotanical remains are cereals and pulses, including einkorn wheat, durum wheat, emmer wheat, barley, free-threshing wheat, lentil, and pea (Çevik and Abay 2016).

Lithic assemblage

The chipped stone assemblage primarily consists of flint, but a small number of obsidian flakes that come from Melos have also been found in level VI (Çevik and Abay 2016, 190). The amount of obsidian, most of which comes from Melian sources (Milić 2014), sharply increases to 20 percent of the whole assemblage in level V.

Small Finds

Clay objects such as animal and human figurines, stamped seals, spindle whorls, loom weights, and sling missiles have been found from level V onwards, but their number significantly increases towards the later phases of level V and continues through level IV (Çevik and Abay 2016). Bone tools such as pins, awls, needles, spatulas, stone tools such as polishers, grooved stones, axes, and beads made of shells or various stones become common in level IV (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012, 144).

3.7.3. Ekşi Höyük

Located in Çal, Denizli, Ekşi Höyük is a mainly Neolithic – Early Chalcolithic settlement. Due to heavy damage from intensive agriculture and illegal digs, rescue excavations at the site started in 2015 by the Denizli Museum under the scientific advisory of Fulya Dedeoğlu (Dedeoğlu et al. 2018, 553). The site lies on a natural hill of about 2 ha in size. A small, seasonal lake is on the south, and the Büyük Menderes River is on the north of the settlement (Dedeoğlu et al. 2018, 554). Archaeological excavations yielded mainly Neolithic and Early Chalcolithic levels dating between 6700-5700 BCE, but a small part of the site was also used as a burial ground in the 13th and 14th centuries. The site's prehistoric levels can be discussed in three main occupation levels.

Occupation phases dating to 6700 – 6500 BCE

The earliest occupation levels 7 and 6 at Ekşi Höyük date to the first half of the seventh millennium BCE and are characterized by two rectangular lime plastered floors delimited by a relatively narrow (25 cm) wall in a Northwest-Southeast orientation, the latter of which was painted with cream bands and black triangular decorations, and an almost complete lack of finds on the floors (Dedeoğlu et al. 2019, 3–4; 2018, 557).[12] The plastered floor was replastered at least four times, the first three of which were decorated with red, cream, and black bands. Each floor was plastered over a thin layer of sand and pebbles, and only a few bone and pottery fragments have been recovered from the floor (Dedeoğlu et al. 2018, 559). An animal bone found on this floor has been radiocarbon dated to 6640 (±30) BCE (Dedeoğlu et al. 2018, 558). Similar plastered floors have been found in the first half of the seventh millennium in Western Anatolia, especially in Hacılar aceramic level (Mellaart 1970) and Bademağacı EN 8 (Duru 2008, 26, Figs 35-36) in the Lakes Region as well as in Ulucak level VI (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012, 149) and Çukuriçi level XIII (Horejs et al. 2015) in İzmir. By Level 5, the architecture transforms into apsidal buildings in a northeast-southwest direction.

[12] A round token was found on the lime plastered floor from level 6 (Dedeoğlu et al. 2019, 4), but this single find does not yield any evidence for fingerprints.

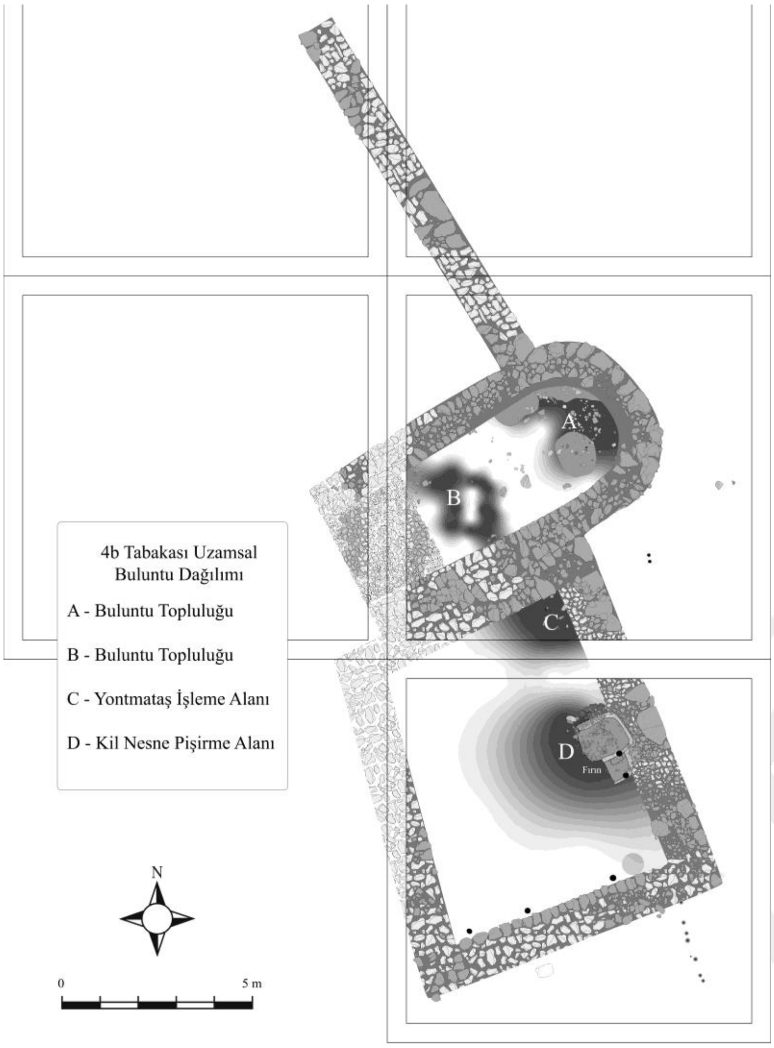


Figure 3.7 Apsidal building and the associated rectilinear structures in level 4b at Ekşi Höyük. Caches of finds were found inside these structures. From (Dedeoğlu et al. 2019, Fig. 8).

Occupation phases dating to 6400 – 6000 BCE

The occupation is characterized by U-planned mudbrick buildings with stone foundations and multiple renewal phases, but a rectangular mudbrick structure has also been identified next to a well-defined U-planned building on this level (Dedeoğlu et al. 2018, 555). In this period, apsidal buildings were surrounded by rectilinear structures on both sides. The same structural pattern continues through Level 4 until 6000 BCE, but Level 4 is divided into two, 4b being the earlier (**Figure 3.7**) and 4a being the latter. The space within and outside the building seems to have been altered and repurposed throughout the occupation phases. A hearth and open spaces with multiple floors are found adjacent to the building. Numerous *in situ* artifacts have been recovered both inside and outside the structure. Among the small finds found inside the U-planned building, sling missiles are the most common, as a total of 248 sling missiles have been recovered from the building in just two years (Dedeoğlu et al. 2018, 556). Among other finds from this level are loom weights and spindle whorls, tokens, lithic tools, axes and various groundstone tools, animal and human figurines, and various types of bone tools.

A possible workshop has also been found in this level dating to 6200-6000 BCE (Dedeoğlu et al. 2018, 557). Moreover, a second U-planned building of similar size was also uncovered at the site. Pottery from this level shows similarities to the Lakes region and the İzmir region.

Occupation phases dating to 6000 – 5700 BCE

A large, rectangular structure and some patches of floor associated with the building have been exposed on this level (Dedeoğlu et al. 2018, 554). The walls were made of mudbrick, and there was an oven floor just outside this structure. This building was connected to other contemporaneous buildings with a door. Further architectural remains belonging to two other spaces were also found in this level. One of these has mudbrick walls on top of a course of stone foundations and a plastered storage area. A well-plastered open space associated with the structure in the southeast yielded numerous artifacts. This level has been dated to 5845 (±30) BCE.

Pottery from this level includes painted examples similar to the Hacılar, Kuruçay, Höyücek, and Bademağacı, burnished monochrome examples with red and brown slip (Dedeoğlu et al. 2018, 555). Among the paint decorated pottery from this level, there are horizontal and vertical bands, wavy lines, net designs, and figurative elements such as goat heads.

3.8. Conclusion

Current research on the Neolithization of Western and Northwestern Anatolia shows that the process was multifaceted and much more nuanced than approaches that propose a single model, be it migration or local adaptation. For the time being, Keçiçayırı, Barcın, Bahçelievler, Çukuriçi, Ulucak, and Girmeler seem to be the key sites where the concept of the Neolithic spread is being discussed. Further research and excavations at a site from the Ağaçlı group, Musluçeşme and Çalça need to be done in order to get a complete picture. This would give us more comprehensive and substantial information about the Mesolithic/Epipaleolithic occupation in the Marmara region and possibly a new perspective on the Neolithization process for the whole region. Especially beneficial are the ancient DNA analyses in this debate. Further research can potentially help us understand how the Neolithic spread happened, which routes were used, and the relationship between various settlements in Anatolia and the neighboring regions. The Neolithization process in Western and Northwestern Anatolia resulted in similar material assemblages in clay objects such as animal and human figurines, sling missiles, and conical tokens, which will be discussed in more detail in Chapter 5. The similar nature of the neolithization of these regions makes it possible for a comparative analysis of labor division in clay object production in these two regions. The case studies I examine in this dissertation show that the initial settlers founded these sites in the second quarter of the seventh millennium BCE. These initial migrants seem to have been already familiar with village life, farming and animal husbandry from the beginning of these occupations. They not only conformed to the newly developed regional trends but also established their own traditions visible from their material culture.

Chapter 4

4 METHODOLOGY: DERMATOGLYPHICS

Humans interact with the world by touching and grasping the objects around them. The palms of the hands and the soles of the feet are covered with furrows that enable us to do so. These furrows create a rough surface with enough resistance between the things people grasp or touch and their hands and feet (Daluz 2015, 4). When the palms or soles come into contact with an object, they leave marks called friction ridges or epidermal ridges. The impressions on the last finger joints are called fingerprints. Each individual's epidermal ridges are considered unique, so in the last century they have become the primary source of personal identification in the modern world. Epidermal ridges have been formed by evolutionary development over the millions of years and can be found in human hands and feet and in other primates – and where applicable, embedded in prehensile tails (Daluz 2015, 4).

This chapter first discusses the history of fingerprint analysis over time. From this point, the nature and development of epidermal ridges during gestation are explained. Variations in fingerprint patterns corresponding to growth periods are explained. From this point, the analysis moves towards a discussion of paleodermatoglyphics as a research method and relevant examples. Finally, a step-by-step explanation is provided for the methodological framework of this analysis.

4.1 History of Fingerprints

The earliest friction ridge skin impressions that have been identified were found on birch resin used as an adhesive for gluing an arrowhead to its shaft and probably belonged to a Neanderthal in Germany from the Middle Paleolithic ca. 80.000 BP (Koller, Baumer, and Mania 2001). Evidence for modern humans' earliest friction ridge impressions come from the Upper Paleolithic Gravittean open-air sites in Pavlov, Czech Republic and Krems in Austria. They date to 27,000 to 24,000 BP (Svoboda et al. 2004, 256). These fingerprints, the most famous of which is the one on the back of the Venus of Dolni Vestonice, are found on clay objects such as anthropomorphic and zoomorphic figurines, clay balls, and amorphous clay blobs. Most interesting for this thesis is that the prints seem to have been left on the surfaces unintentionally. If not intentional, we also have the opportunity to study fingerprints because clay is malleable. The materiality of it allows for fingerprints to be embossed on the surface. Due to the processes of production and human action, fingerprints on clay are now part of the archaeological record and increasingly constitute a viable area of scientific analysis (Sanders 2015; Aström and Erikson 1980; Branigan, Papadatos, and Wynn 2002; Hruby 2011; Králík, Urbanova, and Hložek 2008; Cummins 1941; Lichtenberger and Moran 2018; Fowler et al. 2019; Mull, Püschel, and Jopp 2011; Kantner et al. 2019; Stróżyk et al. 2018; Blaževičius 2019). For example, many fingerprint impressions are known from clay sealings from numerous archaeological sites in ancient Mesopotamia from the Late Uruk to the Early Dynastic III periods (ca. 3200 – 2350 BCE) (Moran, n.d., 3).

When people started using fingerprints as a form of identification is currently beyond our knowledge, but archaeological records suggest that this practice might have considerable antiquity, perhaps as old as thousands of years. The Chinese were the first to use epidermal ridge impressions for personal identification during the Qin dynasty, with the earliest examples dating to 221 BCE (Xiang-Xin and Chun-Ge 1988 in Barnes 2011, p.9). Fingerprints were impressed on both sides of sealings in Ancient China to verify one's identity further. The practice was intended to prevent people from breaking the seal and thus ensure confidentiality of the message. Moreover, anthropometric records of the shape and the dimensions of fingers and hands were common throughout the Han Dynasty and Six Dynasties (206 BCE to 589 CE) (Daluz 2015b, p.15) and continued into the Tang Dynasty (617 – 907 CE) (Barnes 2011, 9). Anthropometric records and the measurements of epidermal ridges were used to keep official records such as army rosters, deeds for land and house ownership, IOUs, marriage and divorce certificates, as well as criminal and civil disputes and testimonies (Xiang-Xin and Chun-Ge 1988; Barnes 2011, 9; Daluz 2015, 15).

The idea of using friction ridges for identification might have spread from China to various parts of Asia in the 8th century. Japan enacted a 'Domestic Law' in 702 CE mentioning finger impressions: "In case a husband cannot write, let him hire another man to write the document and after the husband's name, sign with his own index finger" (Barnes 2011, 9). Moreover, handprints were used by nobility in India as proof of authenticity or signatures on some 17^{th}-century documents (Sodhi and Kaur 2003).

Nehemiah Grew was the first researcher to perform a scientific analysis on epidermal ridges in the western world (Barnes 2011, 9; Daluz 2015, 16). In 1684, he published his observations. In *The Description and Use of the Pores in the Skin of the*

Hands and Feet, he described and illustrated the structure of the fingerprints, including friction ridges and sweat pores (Grew 1684). Grew's contemporary, Marcello Malpighi, studied the ridged skin with a microscope and noted that the ridges increased the friction between the object and the skin's surface and in so doing were vital for walking and grasping (Barnes 2011, 9–10). The first person to write that epidermal ridged skin is unique in each person was the German doctor J. C. A. Mayer in 1788 (Barnes 2011, 10). In his book, Mayer underlined that although epidermal ridges might look similar among some people, their arrangement is never duplicated (Cummins and Midlo 1943, 13).

Anthropologist Hermann Welcker (1822-1898) led the earliest study on the permanence of epidermal ridged skin. He printed his right hand in 1856 and again in 1897, proving that once formed, epidermal ridges never change (Barnes 2011, 11). Around the same time, Sir William James Herschel experimented with the individualization and permanence of epidermal ridges while he was working in India. In 1916, he published his own prints taken in 1859, 1877, and 1916 and thus effectively demonstrated their permanence (Herschel 1916, 22–31).

Dr. Henry Faulds was the first European to propose that visible fingerprints, such as the greasy, bloody, or sooty ones, could be used for crime scene investigations. He published his work entitled "On the Skin-Furrows of the Hand" in *Nature* in 1880. This article became among the most cited and thus served as a pivotal reference (Faulds 1880). Sir Francis Galton was another essential researcher in the history of dermatoglyphics. He wrote the first book on fingerprints, entitled *Finger Prints,* in 1892. Here he described the minutiae, patterns and structures unique to each fingerprint (Galton 1892), and in fact today we know minutiae as his namesake, the Galton details. From the end of the 19th century forward, recording fingerprints took on a standard form of classification, especially for criminal records. Chosen over Bertillon's method of anthropometry, Galton's methods presented a more fluid process for measuring the biological characteristics and thus more suitable for classifying criminal records. Bertillon's method jettisoned: it was more difficult, required some form of standard knowledge and special equipment as well as cooperative suspects. Even when the conditions were ideal to get the anthropometric measurements of the suspects, it was always possible for two people to have very similar appearances. This, however, is never a problem for fingerprints because they are unique to each individual.

4.2.The Nature and Development of Epidermal Ridges

Epidermal ridges are formed during gestation by the fourth month of prenatal development. This occurs as the fetus places pressure on the fingers to touch, thereby creating friction ridges. Once fingerprints are formed, they do not change. Both genetic and environmental factors affect the formation of fingerprints, which is why each fingerprint is unique. Not even identical twins, who share the same DNA, have the same fingerprints (Holder Jr., Robinson, and Laub 2011, chap. 3).

In order to understand how and why fingerprints are unique to every person, it is essential to understand the physiology of the skin. The largest organ in the body is the skin; it performs various tasks, such as protecting the body, synthesizing vitamin D, regulating body temperature, hydrating, sensing and excreting water and waste products through the sweat pores (Daluz 2015, 31).

There are three main anatomical layers within the skin: epidermis, dermis, and hypodermis (Maceo 2011, 3). The outer layer is called the epidermis. It has five sub-layers: *stratum corneum*, *stratum lucidum*, *stratum granulosum*, *stratum spinosum*, and *stratum basale*. The epidermis protects the skin from water loss through evaporation and acts like a receptor and a barrier for the rest of the tissues (Maceo 2011, 4). This layer is also in charge of synthesizing vitamin D. The dermis supports the epidermis and nourishes it with the necessary blood vessels, fibers, and gelatinous material. It also has a vital role in sensory perception and body temperature regulation. The hypodermis, on the other hand, is a connective tissue made out of primarily adipose cells, and it provides the necessary energy to the organ (Maceo 2011, 4).

The ridges and furrows of the friction ridge skin are formed in the upper layer of the dermis by primary (those under the surface ridges) and secondary (those under the valleys) ridges (Maceo 2011, 4; **Figure 4.1**). Apart from these, sweat glands are rooted in the dermis and extend to the surface of the epidermis. Although sweat glands are found everywhere on the skin, the eccrine sweat glands are more densely populated on the friction ridge skin (Maceo 2011, 4). Moreover, the eccrine sweat glands here are the largest ones in the body. These glands play an essential part in regulating body temperature and excreting metabolic waste.

The formation of friction ridge skin occurs within the first and second trimesters of fetal development (Daluz 2015, 33). The sequence of the developmental stages is set, but the timeline differs for each individual, and sometimes these processes overlap and create even more variations. The hands and feet start developing fingers in the 6th and 7th weeks of gestation (See **Figure 4.2** for a list of developments by week). Between weeks 6 and 10, volar pads grow on the fingertips, palms, toes, and soles (Daluz 2015, 33–36).[13] After the 10th week, volar pads start to deflate, initiating the development of primary friction ridges. While the volar pads are deflating and the friction ridges are being formed, the formation of the epidermal layers begins. In the 14th and 15th weeks, sweat glands are formed and extend from the dermis up to the epidermis connecting these two layers. Formation of the primary ridges is completed by the 19th or 20th week, and they become visible on the surface. Secondary ridges also develop between the 15th and the 17th week. These ridges are formed in the valleys, or furrows, between the primary ridges. Note that they do not contain sweat glands. The formation of friction ridges is completed by the 25th week. At this point, the prints of the fetus become permanent (Daluz 2015, 33–36).

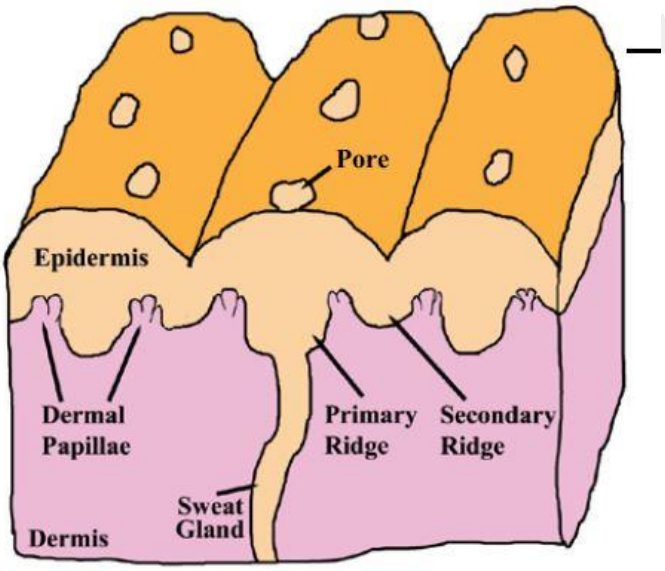


Figure 4.1 Cross-section and the structure of friction ridged skin (Maceo 2011, Fig.2-2)

[13] Volar pads are soft swellings; they can be found on many mammals such as dogs and cats even during adulthood. These swellings work like padding at the paws and enable animals to walk on all fours easily. Since most mammals do not use their paws to grasp and handle objects, they do not require friction ridges.

Another important note about the development of epidermal ridges is that they are made out of hundreds of friction ridge units, each containing a sweat gland and a sweat pore (Daluz 2015, 36–37). The friction ridges do not always follow the same contour while being formed as three main types of minute details called minutiae are formed during this process: bifurcations, ending ridges / short ridges, and dots (**Figure 4.3**). *Bifurcations* are forking or splitting one primary ridge into two. *Ending ridges* and *short ridges* are formed when the development of that primary ridge starts closer to the termination of ridge development during gestation. The length of the short ridge can sometimes be as small as only one friction ridge, which is usually called a *dot*.

Weeks	Developmental Processes
6–7	Webbing between cartilaginous "fingers" begins to dissipate. Volar pads appear.
7–10	Volar pads grow. Volar pads vary in position, size, and shape.
10–15	Volar pad regression begins. Epidermal ridge cells begin to replicate in basal layer. Primary ridges form. Sweat glands form.
15–17	Secondary ridge formation initiates. The top layer of the epidermis (stratum corneum) forms.
17–25	Secondary ridges form between all primary ridges. Ridges are apparent on skin surface. Dermal papillae form. Friction ridges have adult morphology.

Figure 4.2 Embryological development of friction ridges over time (Daluz 2015b, 34 Table 3.1)

The minutiae play a vital role in the uniqueness of the fingerprints. Moreover, Daluz underlines that several other factors contribute to the uniqueness, such as "genetics, epigenetic factors (nutrition, position, environment), growth stresses due to differential growth, volar pad topography (thickness, height, width, and contour), compression due to volar pad recession, metacarpal bone formation and morphology, timing and rate of ridge maturation, vessel-nerve pairs in the dermal papillae" (Daluz 2015, 38–39).

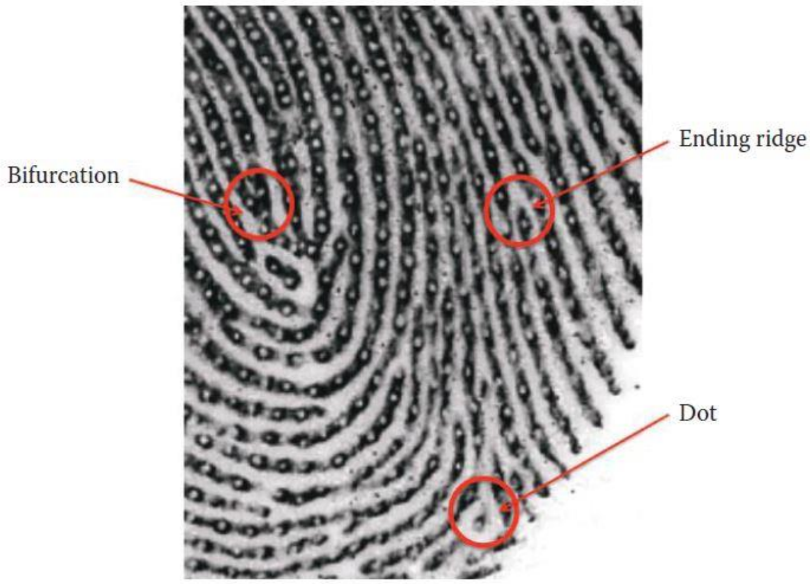


Figure 4.3 Fingerprint with visible minutiae shown: bifurcation, dot, ending ridge (Daluz 2015b, p.37 Fig. 3.9)

Another critical premise for fingerprint identification is the notion that fingerprints are permanent throughout an individual's lifetime. The basis of the fingerprints is formed on the basal layer (*stratum basale*), and as this layer holds the blueprints for building friction ridges, any damage to the upper layers does not affect the structure of the fingerprints because every cell in the basal layer generates identical daughter cells through mitosis (Daluz 2015, 39). Once these scars are healed, the fingerprints go back to the same pattern. However, it is possible to disrupt the ridge pattern permanently if the cut, burning, or mutilation goes deeper than the basal layer. This forms a permanent scar on the ridged skin. Although the dermis and the epidermis will heal eventually, the epidermal ridges will not develop again because the blueprint is damaged in that specific area of the skin. However, these scars can also be helpful for fingerprint identification precisely because they are permanent, and their shape and size would also be unique.

Although their shape and arrangement would never change, when people get older, the surface ridges become more flattened and seem to be less sharp, and wrinkles might be formed on the skin (Maceo 2011, 16). Although flattening of the ridges does not affect the epidermal ridge pattern, it might impact the difficulty of following the ridges and furrows in an impression. Moreover, when people get older, the size of the sweat pores in epidermal friction increases (Nagesh, Bathwal, and Ashoka 2011), and their hands become larger, widening their fingers in both sexes (Silva et al. 2016; Sánchez-Andrés et al. 2018). These result in wider epidermal ridge breadth as people get older. The only area that is not affected by this change in hand size is the proximal counting area of the finger (**Figure 4.4**).

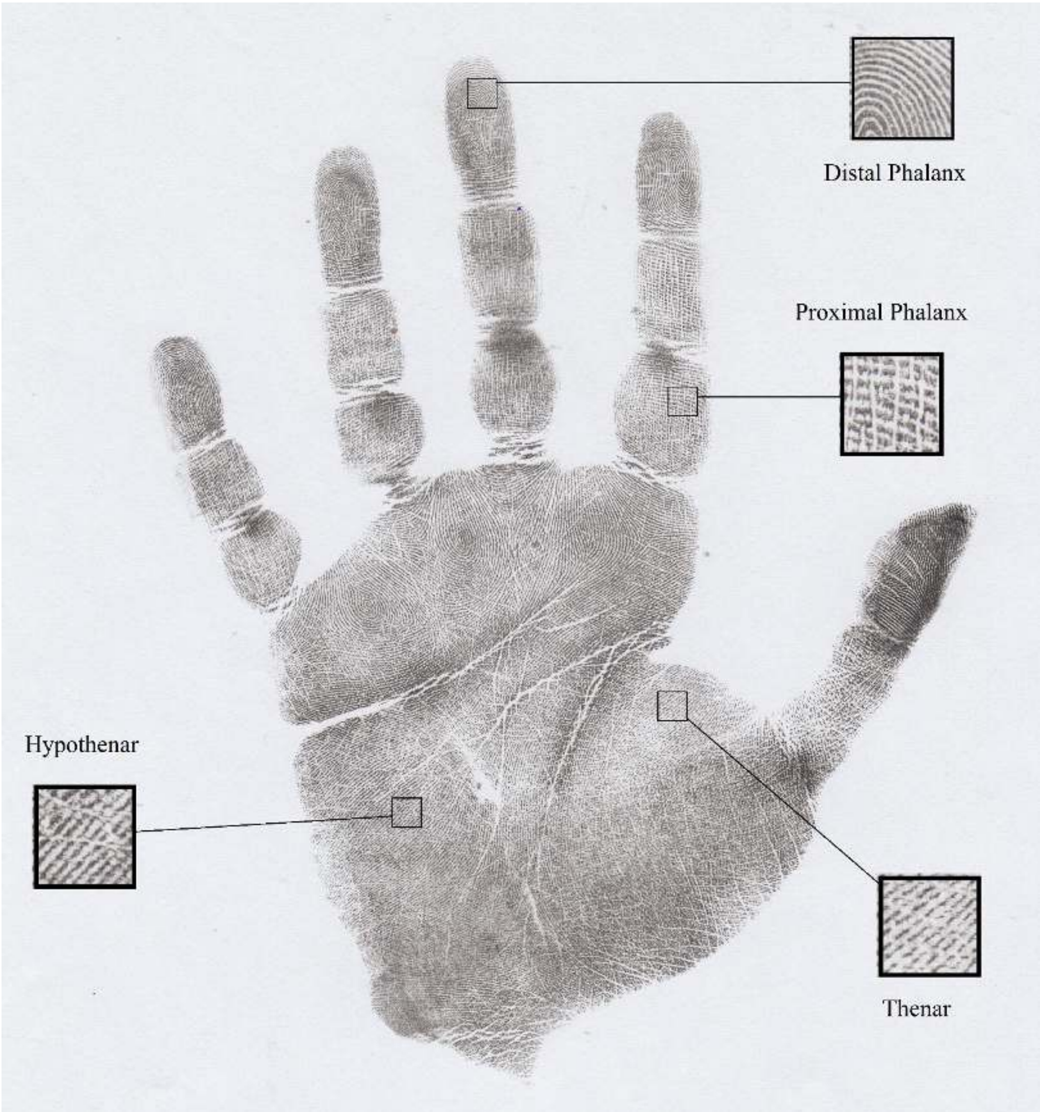


Figure 4.4 Epidermal ridges on different sections of the hand (handprint belongs to the author)

While developing in the womb, fingerprints form one of the three main pattern types: an arch, a loop, or a whorl (**Figure 4.5**). Each pattern type can be divided into several sub-patterns (**Figure 4.6**). It has been hypothesized that the height and symmetry of the volar pad have an important influence on the pattern types as early as 1924 (Bonnevie 1924, 4). While high and symmetrical volar pads form whorls, low and symmetrical pads form arches. On the other hand, high but asymmetrical ones form loops.

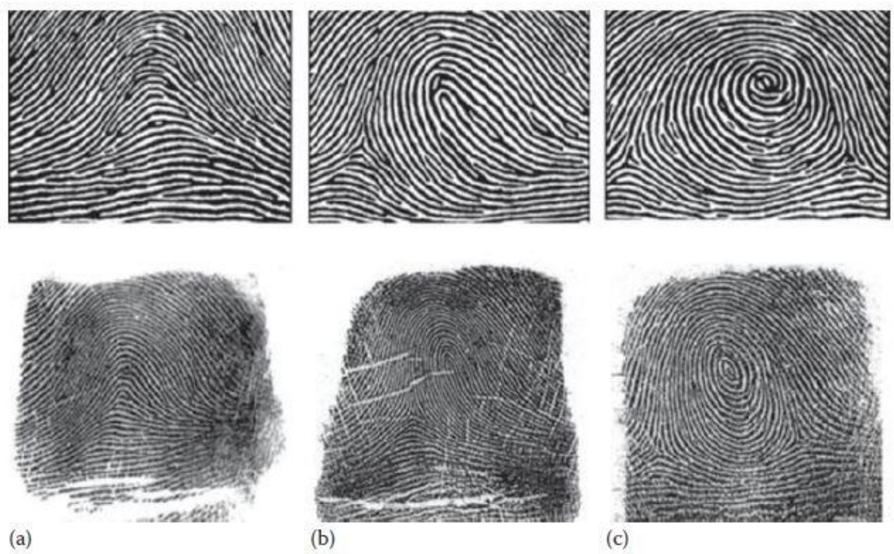


Figure 4.5 Basic fingerprint pattern types: (a) arch, (b) loop, (c) whorl (Daluz 2015b, 44 Fig. 4.1)

While the minutiae are unique characteristics of the fingerprints, fingerprint patterns might be inherited through genetics (Daluz 2015, 44; Wertheim 2011, 18–21). Since the height and symmetricity of the volar pads are essential for the main fingerprint pattern, children can inherit their parents' volar pad formations and the rate of friction ridge development, but most probably not the actual ridges themselves. However, environmental factors such as stress due to malnutrition during prenatal development may affect these patterns.

The loop pattern is the most common among the population, as approximately 60%-70% of the fingerprints are loops (Daluz 2015, 45). A loop pattern is formed when the friction ridges enter from one side of the finger, make a U-turn and leave on the same side. There are two types of loops: ulnar loops and radial loops, named after the bones on the lower arm. The ulnar loops flow towards the elbow while the radial loops flow towards the thumb (Daluz 2015, 47). Loop patterns can be characterized by ridge count from the delta to the core of the fingerprint. Whorls are the second most widely-found pattern type, with 30%-35% of such fingerprints existing in the population (Daluz 2015, 49). The epidermal ridges in this pattern make a complete circle. Whorls have at least two deltas, and the pattern can be characterized by tracing whorls. Plain whorls, double-loop whorls, central pocket whorls, and accidentals comprise the four categories of whorl patterns. Finally, arches are the least common fingerprint patterns as only approximately 5% of the population has them (Daluz 2015, 51). In order to form arches, the ridges enter from one side of the finger and leave on the other side, making a wave in the center. There are plain arches and tented arches.

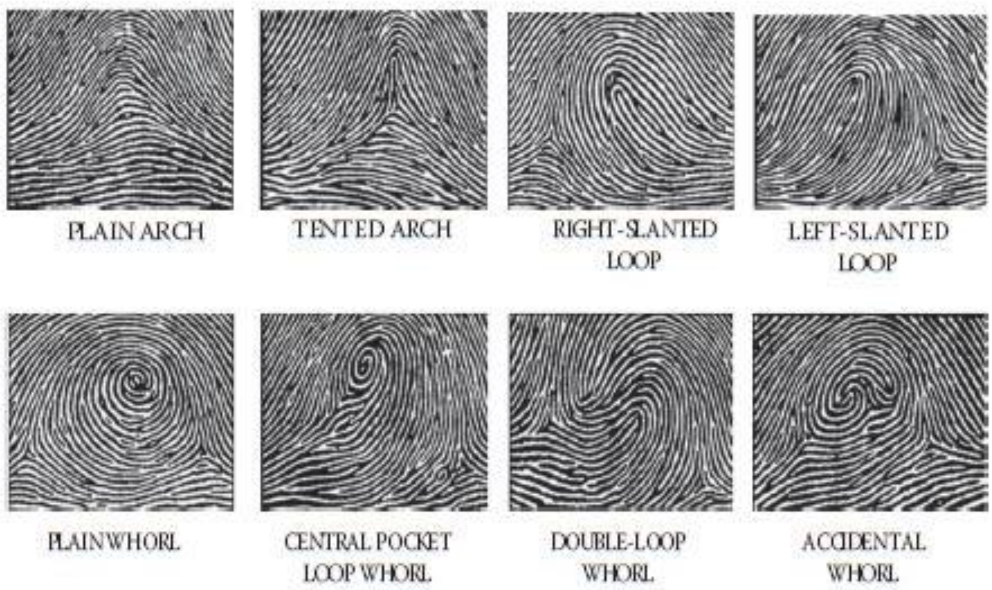


Figure 4.6 Eight fingerprint sub-patterns (Daluz 2015a, 2 Fig. 1.1)

4.3.Paleodermatoglyphics

Apart from solving criminal cases, fingerprints offer an invaluable source of information for archaeologists. Paleodermatoglyphics, the study of ancient fingerprints, combines forensic anthropological analyses of fingerprints within the scope of archaeology. Once investigated thoroughly and with a large enough sample, it is possible to:

- Estimate sex and age,
- Investigate on-site specialization,
- Identify the minimum number of individuals working at a specific production area if various people can be identified through fingerprints,
- Understand short and long-distance trade if matching sets of fingerprints can be found, but this is probably unattainable with current methods,
- Do chronological matching if matching sets of fingerprints can be found.

Although it was believed that fingerprints would be almost impossible to find in archaeological contexts, they are quite common. This is especially true when considering the abundance of clay items preserved in the archaeological record. Clay was, after all, among the most commonly used resource in prehistory that survives over time. In this respect, clay objects, pottery sherds, and painted slips are the perfect candidates for investigating fingerprints. Clay is plastic enough for the fingers to leave marks on the surface and once dry, baked clay becomes chemically stable, enabling the prints to become permanent (Králík and Novotný 2003, 6). However, the surface treatment of the object is crucial in the preservation and condition of the prints. If the object were wiped, smoothed, burnished, or polished after it was shaped, fingerprints would not preserve well. Apart from clay, archaeological fingerprints can be found on organic substances such as glue or wax, paper, photographic films, glass plates, brass or bronze objects, corroded metals that contain copper, paintings, sculptures, and various ethnographic objects, as well as the skin of mummies (Mull, Püschel, and Jopp 2011; Králík and Nejman 2007).

4.3.1. Literature Review on Paleodermatoglyphics

Despite the promising results that have been published in anthropology, especially since 1999, sex determination and age estimation through fingerprints has not been very popular among archaeologists. Even scholars criticizing gender-based assumptions in studies on prehistoric divisions of labor do not discuss the information gained from paleodermatoglyphics (see for example Bolger 2013).

Some of the earliest research on fingerprints in the western world stems from impressions of fingerprints on the archaeological material (e.g. Faulds 1880; Galton 1892), yet archaeological fingerprints had been addressed in publications only sporadically until the 1980s (Cummins 1941; Badè 1934). The first significant systematic work on fingerprints on the archaeological objects was done by archaeologist Paul Åström in collaboration with the fingerprint specialist Sven Arne Eriksson. They focused on fingerprints from Greece, Crete, and Cyprus, especially Mycenean pottery and Linear B tablets (Åström & Eriksson 1980).

Many researchers have been working on finding matching sets of fingerprints among the archaeological assemblages but with relatively limited success. Keith Branigan, Yiannis Papadatos, and Douglas Wynn (2002) examined epidermal ridges on pottery from two different sites: Ayia Kyriaki (cemetery site) and Fournou Korifi (settlement site) in Southern Crete, in order to identify matching sets of fingerprints. In the end, however, the researchers were frustrated by the small number of well-preserved fingerprints. The dataset was too small and fragmentary, and thus they could not securely identify matching sets of prints.

A similar problem occurred in Tuna Şare Ağtürk and Kimberlee Sue Moran's (2021) work on the ancient fingerprints on terracotta figurines from Assos. The researchers aimed to match 25 fingerprints located on 20 figurines from the same tomb (Tomb 4) in the Assos necropolis, but the fingerprints were not detailed enough to yield comparable results (Şare Ağtürk and Moran 2021, 101).

Some researchers have successfully found matching sets of fingerprints in archaeological contexts. Ancient oil lamps and figurines from the Late Roman ceramics workshop at Beit Nattif in Israel yielded numerous fingerprints on their internal surfaces left during the production process (Lichtenberger and Moran 2018). The researchers managed to match a single fingerprint with an arch pattern on multiple oil lamps, and these were located on the same spot and in the same orientation in each lamp. Their results show that the same individual made these lamps, and they also provide us with important information about the production process of these lamps. Based on the location and orientation of these fingerprints, they deduced that the maker was holding the mold with his left hand and pressing the clay into the mold with his right hand. The same fingerprint was also found on a figurine, suggesting that the oil lamp specialist also worked with figurines.

Paleodermatoglyphic research has generally focused on age and sex estimations based on fingerprints. Kathryn Kamp et al.'s (Kamp et al. 1999) work on figurine and pottery production among the Sinagua, an ancestral Puebloan group in northern Arizona, was the earliest work that focused on age estimations. Their study compared 26 animal figurines and 31 corrugated vessels from the Sinagua. They developed a regression equation to estimate the age of the individuals based on Mean Epidermal Ridge Breadth to identify child and adult potters. This study shows that those who made the figurines were between 8.5-18 years old with an average age of 11-13, while those who made the pots were mainly adults; only occasionally child prints were identified.

Miroslav Králík, Vladimír Novotný and Martin Oliva found a single fingerprint at the back of the Venus of Dolní Věstonice (Králík, Novotný, and Oliva 2002). Their analysis of this fingerprint gave an age estimation of 11 years, which suggests that this fingerprint cannot belong to an adult male. While providing interpretations based on a single fingerprint is not ideal, paleodermatoglyphics investigations on other clay objects such as animal and human figurines and unidentified objects also yielded evidence for the presence of children and adult females. However, adult male fingerprints were probably absent (Svoboda et al. 2004).

Miroslav Králík and Vladimír Novotný (2003) developed various methods and equations to estimate age and sex from epidermal ridge breadth. They did a blind study on estimating age and sex from fingerprints taken from modern clay objects at a ceramics workshop. This study contains three different groups. The first group consists of 56 children; the second group of 20 adult professional skilled ceramicists; and the third group of non-professional, unskilled adults and subadults. Since the surface of the artifacts made by these groups were complex, like archaeological objects, most of the fingerprints were fragmentary. The samples were collected and analyzed blindly (i.e., without knowing whose fingerprint was found on the surface of the objects). When they applied Kamp et al.'s (1999) model to estimate age, researchers realized that the results were inconsistent because Kamp et al. did not consider the clay shrinkage rate. The results were consistent once this data point was added to the calculations (Králík and Novotný 2003). They also proposed a new age estimation model that became the primary method for estimating age in future publications worldwide.[14]

Mateusz Stróżyk and his colleagues analyzed five sets of epidermal ridges found on four daub fragments in the Early Bronze Age settlement of Bruszczewo (2000-1600

[14] This method is discussed in Section 4.4 below.

BCE) (Stróżyk et al. 2018). They compared various regression models for age estimation to compare their results. While the results point towards juvenile and adolescent engagement in house construction, the authors underlined that their results might be somewhat skewed because the regression models are based on modern populations, and the shrinkage rate of clay in daub might vary. Nevertheless, it is still possible to link juveniles and adolescents with constructing houses or walls in the EBA settlement of Bruszczewo in Poland.

Povilas Blaževičius (2019) explored the scale and nature of child labor in the production of ceramic objects by analyzing the finger and palm prints on clay artifacts from the thirteenth to eighteenth centuries in the Vilnius Lower Castle, Lithuania. Out of more than 23,000 clay objects, including bricks, roof tiles, floor tiles, stove tiles, and household wares, only 1.47% yielded epidermal ridges. Age estimations were done by using Králík and Novotný's regression model (Králík and Novotný 2003). The results suggest that child prints were relatively few between the 13th and 16th centuries (ca. 33%) as opposed to the 17^{th} and 18^{th} centuries (ca. 66%) with an average of 12-13 years. The analyses show that children started working on ceramic assemblages from the ages of eight or nine. After 11-12, the number of children in the workforce grew considerably, up to 25% of total production.

Apart from age, many researchers have also focused on gender estimations in order to gain knowledge about gender-based labor division in the past. Julie Hruby's study on a ceramic production center in the Palace of Nestor at Pylos shows that the people who formed the ceramics and attached the handles to these vessels were adult males (Hruby 2011). She could not identify any fingerprints belonging to adult females or children. Another study by Hruby suggests a shift from a primarily male workforce to a primarily female one during the transition from Late Helladic IIIB to Late Helladic IIIC at Midea (Hruby 2007). She suggests that this might be related to the reasons that led to the transitional period when the Mycenean palaces collapsed and the Mycenean population relocated. Furthermore, the transition from male to female workforce might indicate a change from an industrialized mode of production to a domestic one. Such studies show that it is in fact possible to identify the sex of the potters to some extent.[15] Akiva Sanders'

[15] Although the interpretations from the article seem quite conclusive, the study only includes the prints that can be successfully assigned to a specific sex. Moreover, it may not always be possible to assign sex to each fingerprint.

work on the organization of ceramics production at Tell Leilan is another crucial contribution to ancient fingerprint studies (Sanders 2015). Specifically, in his work he focuses on determining sex from fingerprints on pottery. His analysis shows that while ceramic production was not a gendered task before state formation, it became an exclusively male-dominated task with the rise of urbanism.

Lucy Bennison-Chapman and Lori Hager (2018) employed Reflectance Transformation Imaging (RTI) on clay tokens from the Pre-Pottery Neolithic site of Boncuklu Höyük in order to understand the nature of labor division at the site. Their study concentrates on Mean Ridge Density (MRD) for sex estimations, and out of 50 diagnostic artifacts, 78% (n=39) yielded epidermal ridges probably belonging to adult females, while 20% (n=10) were adult males, and one print belonged to a child (2%). Their results suggest the existence of a gender-based labor division at Boncuklu in the production of clay objects as predominantly more fingerprints belonging to females were found. However, it should be noted that this study does not take the shrinkage rate of the clay into account, which might skew the results towards females.

Kent Fowler and his colleagues examined over 400 pottery sherds from the Early Bronze Age site Tell eş-Şâfi/Gath in Israel to understand the organization of crafts production (Fowler et al. 2019). They selected a sample of 18 sherds with 38 of the clearest fingerprints made by the impression of distal phalanges. Their analyses suggest that men tended to be more involved in the production process than women. Although their sample is small, the analysis results suggest a relationship between the sex of the potter and the type of vessels made. While only male fingerprints were found on bowls and holemouth jars, both male and female fingerprints were found on storage jars and wavy-handled jars. When fingerprints belonging to multiple prints occurred, they were older adolescent or adult prints together with young members of the potters, possibly apprentices. Their results suggest that males, females, and teenagers of both sexes were involved in pottery production to some extent at the site.

John Kantner et al.'s (2019) work aims to understand the sex-based division of labor in pottery production in the Ancestral Puebloan community dating to the 10th and 11th cent. CE at Chaco Canyon. It is traditionally believed that the women made pottery while men were responsible for other activities such as hunting and ritual preparations. While no direct evidence for such division of labor was found, these interpretations came from ethnographic analogies and the interpretations of the imagery on rock art and pottery. This article aims to find more direct evidence for who was producing pottery in the Ancient Puebloan communities at Chaco Canyon by examining various types of pottery, especially the Corrugated Vessels, for fingerprints. Since Corrugated Vessels were made by pinching coiled clay together, many fingerprints were left on the surface by the makers. The reseachers examined fingerprints on 985 corrugated pottery sherds from the Blue J Ancestral Puebloan community with Králík and Novotný's regression model (2003) and concluded that about 47% fall into the adult males category while about 40% belong to adult female or juvenile category with an overlap of 12.5% that might belong to either males or females. Their analysis suggests that both males and females were involved in the production of corrugated vessels at the Blue J Ancestral Puebloan community. However, when examined chronologically, data suggests that older corrugated vessels (produced before 1040 CE) were made primarily by males, while both sexes were equally involved in making the later ones. The shift in labor division might have been a response to the greater demand for pottery at the Chaco Canyon in the later period.

4.4. Age and Sex Estimation from Fingerprints on Clay

Studying the friction marks on the fingers (i.e., epidermal ridges) left on archaeological clay objects can yield information about the sex and age of the individual. Interpretations about age come from the idea that as the prints become larger, the breadth between the epidermal ridges becomes wider as the person gets older. Moreover, the epidermal ridge breadth changes according to sex because males generally tend to have coarser ridges than females (Králík and Novotný 2003, 9).

4.4.1. Age Estimation

Estimating age from fingerprints is done by measuring the mean epidermal ridge breadths. As the surface area of the fingers and palms expand while fingerprint patterns remain the same, the distance between the epidermal ridges on the hand increase with the growth of the individual. Although the breadth of the epidermal ridges of an individual may slightly vary between different parts of the hand, this difference is not very significant (Cummins, Waits, and McQuitty 1941, 144–46). While epidermal ridge breadth also shows variability due to ethnicity, body size, and sex (Cummins, Waits, and

McQuitty 1941; Ohler and Cummins 1942; Gutiérrez-Redomero et al. 2013), age yields the most significant variation (Králík and Novotný 2003).

In order to calculate the Mean Ridge Breadth of epidermal ridges, multiple epidermal ridges are measured perpendicularly at the same time, and then the measurements are divided by the number of the ridges. Kamp et al.'s (1999) work on the Sinagua culture in northern Arizona generated a regression equation (KA) for age estimation based on fingerprints:

KA: Age (month) = 614 x MRB(mm) -112

With 95% confidence intervals, her results provided an age estimation with an error range of 4.5 years. Králík and Novotný (2003) modified and improved this equation to minimize the error range. Based on modern professional and amateur potters, including children and adults from the Moravian population, they collected samples from 106 individuals of both sexes whose ages ranged from 5.92 to 77 years. Their samples were vessels made by each individual separately, and they calculated the mean of all prints on one vessel to determine the MRB (mean ridge breadth) of that individual. With these calculations, they understood that the number of fingerprints on one vessel does not increase the accuracy of age estimation while it portrays the range of variability in terms of the multiple prints of the same individual's ridge breadth (Králík and Novotný 2003, 26). This means that the MRB of a single individual would still be accurate even though multiple fingerprints of different digits are added to the calculations because the variability is not large enough to skew estimations. Králík and Novotný (2003) realized that the shrinkage of clay has an impact on the calculations, so they modified Kamp's equation (ModKA) by adding the shrinkage rate of clay:

ModKA: age (month) = 614 x true shrinkage (here 1.08108) x MRB (mm) – 112

In their calculations, they considered the shrinkage rate as 7.5%. However, they also proposed another equation (KN) yielding the same results:

KN: age (years) = 52.18087 x MRB (mm) – 7.89682

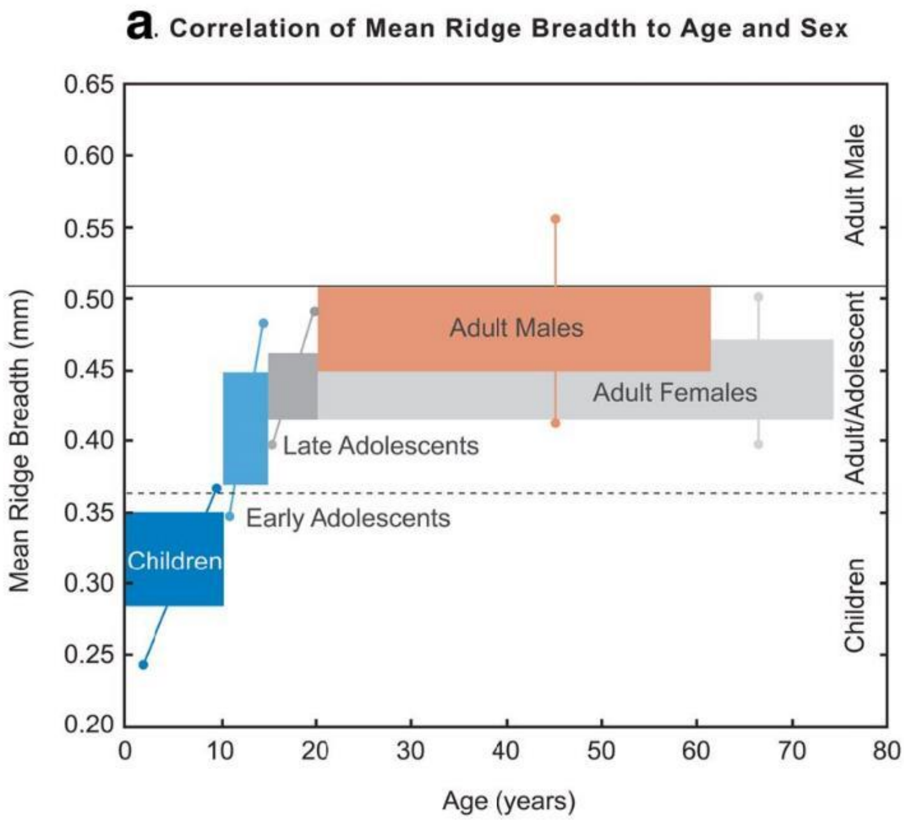


Figure 4.7 Age and sex estimations based on Králík and Novotný 2003 (Fowler et al. 2019, Fig. 3)

Their results yielded a mean of 1.87 years and a median of 1.71 years absolute error range of age estimations, somewhat better than Kamp's equation. The error range was less than four years in 91% of the cases, while it was less than five years in 96.4% of the cases (Králík and Novotný 2003, 19). It is important to note here that while adding the shrinkage rate to the calculations improves the age estimations, it does not have a significant impact on reducing the error range as it is still approximately ±2.25 years in 95% confidence. Králík and Novotný's (2003, 23) age and sex estimations of the modern European populations form the baseline of this study and are used as the comparative reference sample. Their calculations showed that all subjects with MRB below 390 µm were sub-adults below 15 years of age, while all above 520 µm were only adult males (**Figure 4.7**). The range between those two represents both sexes from 15 years old until old age.

4.4.2. Sex Estimation

The fact that there is a sex-based difference in epidermal ridges has been known since the 1920s (Hecht 1924; Cummins, Waits, and McQuitty 1941; Ohler and Cummins 1942), yet there was a significant increase in anthropological studies concentrating on sexual identification from fingerprints after the FBI specialist Mark Acree's publication on gender identification based on epidermal ridge densities (Acree 1999). Since it is not possible to confidently identify the sex of the individuals unless they are adult males with MRB above 520 μm with the Mean Ridge Breadth method discussed above, several studies (Fowler et al. 2019; Sanders 2015; Bennison-Chapman and Hager 2018) resorted to the Mean Ridge Density (MRD) method that Acree initially suggested (1999), which was developed by many scholars ever since (Gungadin 2007; Gutiérrez-Redomero et al. 2008; Rivaldería et al. 2016; Gutiérrez-Redomero et al. 2013; 2014; Sánchez-Andrés et al. 2018; Kanchan et al. 2013; Oktem et al. 2015; Dhall and Kapoor 2016). This method measures the number of ridges in a predefined area (Gungadin 2007) of usually 25 mm^2 (**Figure 4.8**). These studies showed that males' and females' mean epidermal ridge density differ significantly within the same population (Acree 1999; Gungadin 2007; Gutiérrez-Redomero et al. 2008; 2014; Oktem et al. 2015).

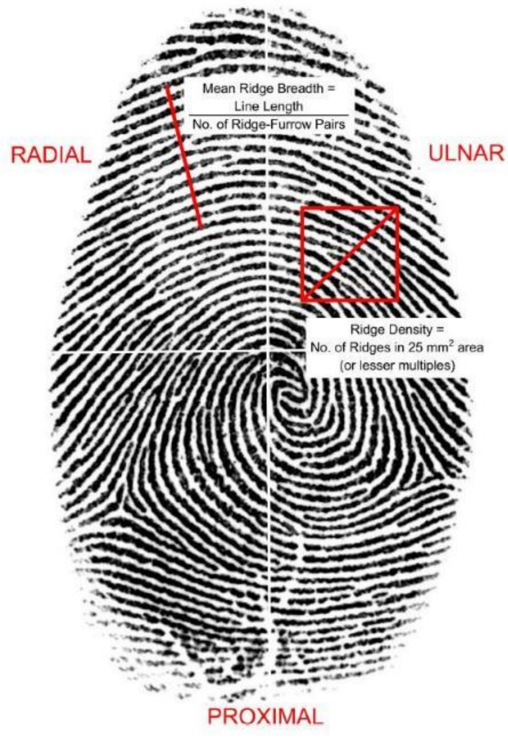


Figure 4.8 Regions of the distal phalanx and the methods of ridge breadth and ridge density for age and sex estimation (Fowler et al. 2019, Fig. 2)

However, the MRD measurements of modern populations concentrate on the radial, ulnar or proximal regions of the fingertip (**Figure 4.9**) in order to produce comparable results. Each section is compared to the corresponding areas on each fingerprint within the population. While this method has proven helpful for comparing male and female fingerprints within modern populations, it is a challenging method to apply to ancient fingerprints. The issue when it comes to the epidermal ridges on archaeological finds is that, in most cases, it is not possible to securely identify the same section of the fingerprint or even understand if the epidermal ridges belong to a fingertip or a palm. Since epidermal ridges are much coarser in some parts of the hand (**Figure 4.4**), the results might be skewed. While Dhall and Kapoor's (2016) study on the epidermal ridge density of the Punjabi population in India compares multiple sections of the fingerprint, suggesting that all areas of a print correlate to sexual dimorphism, they do not compare different sections to each other, as the comparisons are made within each section of the fingerprint samples itself. Therefore, this method for sex estimations have not been used in this analysis.

Figure 4.9 The locations of count areas in the loop, whorl, and arch patterns (Gutiérrez-Redomero et al. 2013, 421, Fig. 1)

4.5.Factors Affecting the Preservation of Fingerprints on Clay

The preservation of fingerprints and the size and shape of epidermal ridges on clay objects can be affected by various factors. Since most fingerprints are left unintentionally, they tend to be fragmentary. The manufacturing, drying, and firing processes and the texture of the clay also affect how the prints preserve. The plasticity of the clay when the object is being formed and decorated is important because fingerprints are most likely to preserve when the clay is plastic or in a leather-hard state (Fowler et al. 2019). Using tools during the manufacturing process could erase the fingerprints if tools are used to smooth or scrape the surface after the initial form is given by hand. For example, some of the large, biconical sling missiles from Ulucak have elongated scrape marks throughout the surface.[16] None of these yielded any fingerprints despite the existence of epidermal ridges on other sling missile types at the site.

Apart from the initial forming, additional fingerprints can preserve on clay objects while it is being decorated with a slip or paint or when the object is handled while the slip/paint is still wet. On the other hand, burnishing an object can effectively erase any fingerprints on the surface. For example, epidermal ridges were virtually absent from Barcın Höyük pottery because each pot was carefully burnished on the inside and outside at the site.[17] Depending on the object type, object surfaces can be treated with paint, glaze, or a second layer of plaster, enabling a new plastic surface for a new set of fingerprints to preserve, but they might also cover any prints on the initial surface.

How an object is shaped and handled also affects which part of the hand interacts with the object. For example, while the clay is being prepared for pottery production, it requires intensive kneading with hands or feet, and it is possible to find epidermal ridges belonging to different sections of these on such clay lumps if they are subjected to fire. While very large objects such as a large vessel or a heavy clay lump can be handled or carried by holding them with the whole surface of both hands, smaller objects such as animal figurines can be carried with the grip of one hand, leaving only the fingerprints of the distal phalanges. If the preservation of the print is high, it might be possible to discern between different regions of the hand (**Figure 4.4**) and understand how people interacted with the object before it was fired.

The amount of pressure applied to clay or the hardness of the clay may cause pressure deformation on the fingerprints (Králík and Novotný 2003, 12; Fowler et al. 2019). Fowler and his colleagues' experiment on pressure deformation suggests that if the finger is pressed with heavy pressure on clay, epidermal ridges might slightly deform

[16] Personal observation during 2018 excavation season.
[17] Personal observations from the 2017-2018 study seasons.

and cause overestimating the age if the Mean Ridge Density measurements are taken from the edges of the fingerprints (Fowler et al. 2019).

Last but not least, as the clay dries and is fired, it shrinks, which causes the print itself to shrink as well. If the shrinkage rate of the clay is not added to the calculations, age would be underestimated as ride breadth decreases when the clay shrinks. Moreover, sex estimations would be biased towards females because the ridge density increases as the clay shrinks. Therefore, the shrinkage rate of the clay must be considered during age and sex estimation if the fingerprint samples are compared with modern populations. For example, in their MRB equations, Králík and Novotný (2003) estimated clay shrinkage at 7.5%, but fine kaolin clay might shrink up to 30% (Rice 2015 in Fowler et al. 2019).

Apart from age and sex, different ethnicities or populations can yield different results. Also, a single fingerprint does not provide sufficient data to estimate the sex of the individual. This is the reason why it is necessary to have a large enough sample size to obtain conclusive results from fingerprints (Sanders 2015).

4.6.Methodology

This section aims to provide a step-by-step explanation of the methodology used to obtain the results in this dissertation. However, it is important to briefly touch upon the research questions and the time period before going into detail about the methodology. As has been extensively discussed in Chapter 3, the Neolithic is a transitional period in human prehistory when people started leading a sedentary lifestyle and domesticated animals and plants. This transition went beyond technological developments as significant social, ideological and economic changes must also have occurred. From the first half of the seventh millennium BCE until ca. 5700 BCE Western and Northwestern Anatolia was settled by Neolithic communities that shared a similar lifestyle (R. Özbal and Gerritsen 2019a; Ç. Çilingiroğlu 2005), but each site also developed its own traditions through time. Among these shared cultural elements was their relationship with clay. Settlements in this geographical area in this period used clay to make many of their everyday objects, such as animal and human figurines, sling missiles and pottery.

This research focuses on Western and Northwestern Anatolia from the beginning until the end of the Neolithic period in order to unravel people's relationship with clay objects in this geographical area. I aim to understand whether there was a gender and age-based labor division in the production of clay objects and how ideas and technological knowledge were transmitted throughout the generations. Studying these social aspects of technology can potentially help researchers illuminate the daily lives of the Neolithic people and understand the social and ideological changes occurred throughout the Neolithic period.

Archaeological research on clay objects from the Neolithic period in Anatolia usually focuses on the typology of these objects, stylistic comparisons of certain types within or between sites, or compositional analyses of the clay used to produce these objects. On the other hand, this dissertation uses a unique approach to this dataset by examining fingerprints found on clay objects to estimate the age and sex of those who left them to obtain ideas about labor division in clay object production. The following section discusses the selection, recording, and analysis of the fingerprint dataset used in this dissertation.

First of all, the study material has been chosen carefully according to the research questions. Although the initial purpose was to examine clay objects from Barcın Höyük, Ulucak Höyük, Yeşilova, Ege Gübre, Ekşi Höyük, Pendik, Fikirtepe, Aşağı Pınar, and Aktopraklık, the final selection of case studies only included Barcın Höyük from Northwestern Anatolia, and Ulucak Höyük and Ekşi Höyük from Western Anatolia. The researcher faced various limitations in this process, primarily due to limited permits from museums, hindering the number of objects examined at various sites. Apart from such permission issues, some sites did not yield promising results regarding the existence and quality of epidermal ridges. Eventually, it was impossible to reach many clay objects, and the analyses were done based on the material available to the researcher. Nonetheless, as a group, the three sites I focus on in this work (Barcın Höyük, Ekşi Höyük and Ulucak Höyük) are representative for the Neolithic occupations in western and northwestern Anatolia and provide extensive information about the overarching Neolithic elements and regional differences.

4.6.1. Data Collection and Sample

Clay objects have been subjected to preliminary visual examination with the naked eye, which requires proper lighting. For the purpose of fingerprint identification, bright overhead lights or natural daylight are inefficient. Instead, various basic flashlights and an Ikea Jansö gooseneck desk lamp are used to examine the surface of the objects in a dimmed room. Oblique lighting has proven to be helpful in seeing fingerprints on clay.

In this method, light is shone at a 45° or lower angle, creating shadows for a contrasting vision.

The complete sample of Barcın Höyük, Ekşi Höyük, and Ulucak Höyük consists of 2296 clay objects, 245 of which yielded one or multiple partial fingerprints (**Figure 4.10**).[18] Of this set, the quality of the images of three objects from Ulucak Höyük[19] was not sufficient to analyze the epidermal ridge breadth. These three objects have been excluded from the interpretations and the rest of the analysis.

The 242 objects (**Table 4.1**) yielded a total of 630 partial fingerprints. While the majority of these finds only had one print, especially the large clay lumps mixed with hematite at Ulucak yielded multiple ones reaching as many as 23 partial fingerprints. Recording and measuring the data were carried out per the details discussed below. This analysis did not include partial prints with less than three epidermal ridges as they would not be suitable for dermatoglyphic comparisons.

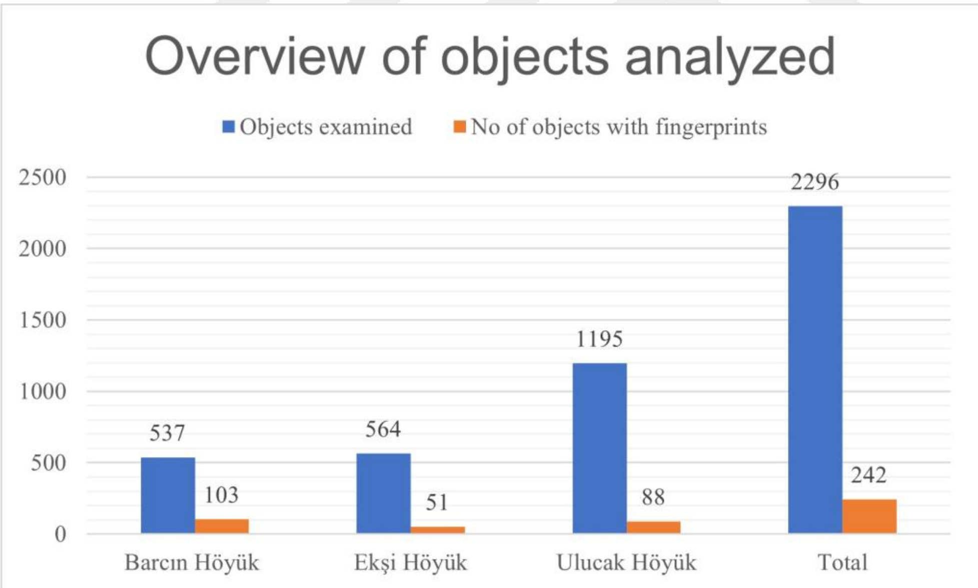


Figure 4.10 An overview of the number of clay objects analyzed in this study.

[18] 103/537 from Barcın Höyük; 53/564 from Ekşi Höyük; 88/1195 from Ulucak. A detailed analysis of the sample will be discussed in Chapter 5.
[19] Ulucak: ULU.JOC – a spoon fragment with one partial fingerprint, ULU.LUE – a sling missile with one partial fingerprint, ULU.NUN – a mudbrick fragment with two partial fingerprints

The partial fingerprints on these objects were usually impressions of the distal phalanges, while epidermal ridges belonging to the rest of the palmar papillary surface of the hands were also visible on some of the objects. Except for a few cases where reddish slip was applied on the surface of pottery sherds (Ekşi Höyük), most fingerprints were imprinted on the surfaces during plastic or leather-hard stages of drying.

Inspired by Bennison-Chapman and Hager's (2018) technique, initial attempts to record each fingerprint was made by using the Reflectance Transformation Imaging (RTI). RTI is a non-invasive computational imaging technique that was developed in 2001 by Tom Malzbender, Dan Gelb and Hans Wolters (2001). RTI enhances the visibility of the surface details on archaeological artifacts, making it a promising tool to use for recording artifacts. Since its first introduction, three different techniques have been developed, namely Highlight RTI (H-RTI), Dome RTI (D-RTI), and Virtual RTI (V-RTI) and widely used on different types of objects (Bennison-Chapman and Hager 2018; Porter et al. 2016; Greaves et al. 2020).

Figure 4.11 The RTI dome developed at Koç University Optical Microsystems Laboratory. The whole setup includes: 1. an aluminum dome of 30 cm radius, 2. 56 LEDs, 3. a tripod, 4. Nikon 7100 DSLR camera, 5. Nikon 105 mm macro lens, and 6. the electronics control unit with an Ardunio Mega chip without any extra shielding.

First attempts were made with H-RTI but this method was very time consuming as it took several hours to set up and record each fingerprint. Then, the D-RTI method was explored. In collaboration with Koç University Optical Microsystems Laboratory,[20] a dome with 56 LEDs (**Figure 4.11**) that can be used for D-RTI has been developed (Ghoushchi et al. 2016). While the dome method produced high-quality images much faster than the highlight method, it proved to be challenging due to several reasons. First, it was too time consuming to properly place each fingerprint directly below the camera because the dome and the tripod had to be moved every time. Second, the size of the dome did not allow objects larger than approximately 10 cm to be photographed properly with the dome. Third, the dome setup was difficult to transfer to excavations as it had to be carefully wrapped, packed, and shipped. Due to these reasons, it was not possible to record all fingerprints with the D-RTI method. It was important to have a standardized method of recording all fingerprints to avoid any kind of bias in the analyses, I decided to abandon using D-RTI completely and use a simpler and more straightforward method for recording fingerprints.

Once the fingerprints were spotted on the objects, they were photographed with a Nikon d71000 24.1 MP DSLR digital camera with a Nikon 105 mm Macro lens multiple times. The fingerprint on the object was situated on a sandbox or grainbox completely horizontal facing upwards. A millimetric scale was placed at the same height as the fingerprint next to the print. The camera was placed on a tripod at the 90^o angle on top of the fingerprint. In order to minimize lens distortion, the fingerprints and the scale were placed at the center of the image. The camera was connected to the laptop with a camera control program, and the images were captured using this program. While capturing fingerprint images, zooming into the object was done manually in order to get rid of blurry photos. The light was shone on the object from various lower angles on multiple sides to change the contrast and create shadows of the papillary terrain. A photo was taken at each angle, and when the image did not yield desirable or clear results, they were deleted once the photo shoot ended. When multiple fingerprints were present on the same object, each fingerprint was treated as an individual item, and they were photographed similarly. Each fingerprint is assigned a specific number under the folder of the object number.

[20] The dome concept was designed by me, the control unit and the whole setup was designed and developed by Vahid Pourreza Ghoushchi with the help of Osman Furkan Kar and Mehmet Sami Yazıcı under the guidance of Hakan Ürey and Rana Özbal.

Table 4.1 A detailed breakdown of the types of objects analyzed in this study and the number of finds belonging to that category at Barcın Höyük, Ekşi Höyük, and Ulucak Höyük.

Object Type	**Barcın**	**Ekşi**	**Ulucak**	**Total**
1. Sling Missile	40	10	28	**78**
2. Animal Figurine	31	7	12	**50**
3. Human Figurine	9	2	12	**23**
4. Unidentifiable Figurine Fragment	4	0	1	**5**
5. Token	11	6	2	**19**
6. Vessel Related	4	23	8	**35**
7. Other/Unknown	4	3	4	**11**
8. Hematite Lump	0	0	12	**12**
9. Clay Lump	0	0	9	**9**
Total	**103**	**51**	**88**	**242**

A total of 630 partial fingerprints have been measured using FIJI IMAGE J software (Schindelin et al. 2012). This is an open-source software developed for the biology research community. Since multiple photographs of each fingerprint have been taken, each image was examined carefully in order to determine the best one that clearly shows the contours of the papillary terrain. While usually only one photograph was selected for measuring the fingerprints, sometimes two photos were used if none of them could cover the whole surface of the fingerprint due to the position of the light or the angle of the print. In these cases, the measurements were recorded as the fingerprint number and a letter (for example, 1a and 1b), and both images were measured and recorded. Clearly deformed, blurry or unclear fingerprints or sections of fingerprints were not included in the measurements.

In order to measure the epidermal ridges, it was vital to set a scale for each image. First, 3mm was measured on the millimetric scale, which was calculated in terms of pixels on the image. This measurement was unique to each image, and it formed the baseline for any measurements on the image. Then, three consecutive epidermal ridges were randomly selected and measured from the beginning of the first ridge until the end of the third ridge (**Figure 4.12**). This measurement was repeated five times on five different sections of the fingerprint for each image. These measurements were logged into an excel sheet, and each measurement of three epidermal ridges was divided by three in order to get the Mean Ridge Breadth (MRB) of that individual fingerprint (Level 1 analysis). Then, the average of these five measurements was calculated in order to determine the mean of this specific fingerprint (Level 2 analysis); when more than one fingerprint was present on the object, this process was repeated for each fingerprint and the mean of all fingerprints present on the object was calculated (Level 3 analysis). If, however, there was only one fingerprint on an object, Level 2 would be equal to Level 3 (**Figure 4.13**).

As mentioned in section 4.5., the shrinkage rate of clay might affect the size of fingerprints. Therefore, before doing any comparative analyses with the reference, experimental analyses were conducted to determine the shrinkage rate of clay for each site.[21] Clay shrinkage was applied to each measurement accordingly, and the results were fitted to the shrinkage rate of the reference collection.

Once the data was obtained, it was used to create statistical charts for each site using the free R software and SPSS. The results were compared to the reference from Králík and Novotný's (2003) study on modern European populations. The reference is based on the modern Czech population and consists of six groups based on the age and sex of the participants. These groups are:

a) Children up to 6 years old, both girls and boys,
b) Children from 6 to 10 years old, both girls and boys,
c) Female adolescents from 10 to 15 years old,
d) Male adolescents from 10 to 15 years old,
e) Female adults above 15 years old,
f) Male adults above 15 years old.

[21] See Chapter 6 for a detailed explanation of this experiment.

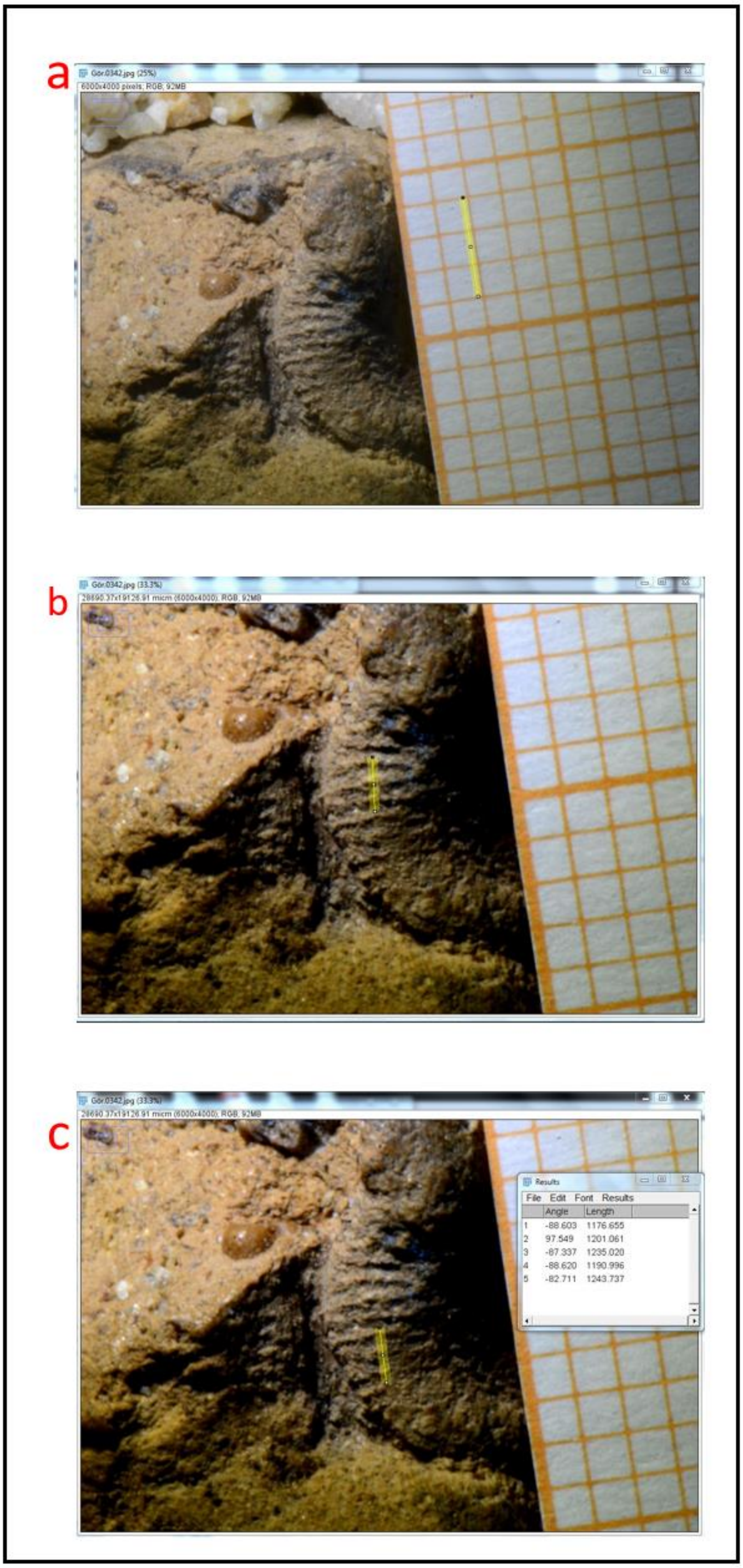
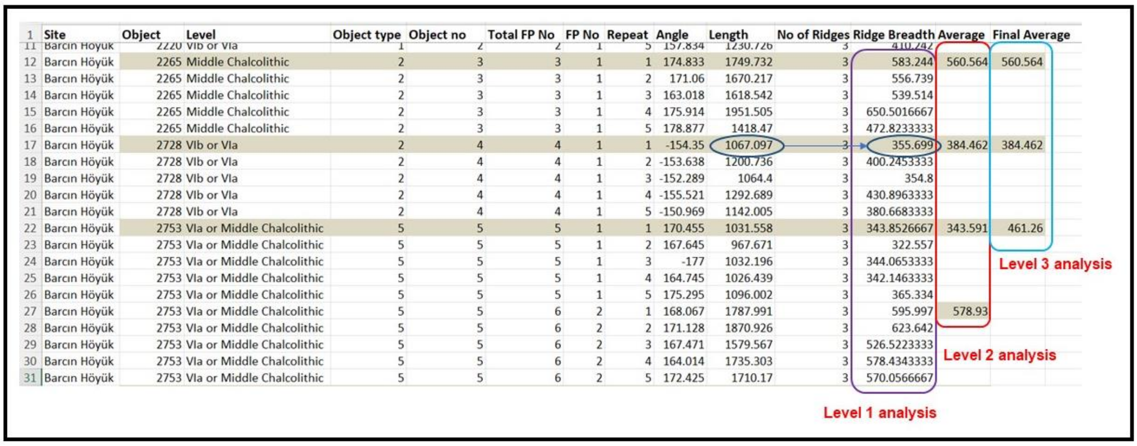


Figure 4.12 A fingerprint being measured on FIJI ImageJ. a) measurement of the scale; b) a set of three ridges are measured; c) another set of three ridges are measured



1	Site	Object	Level	Object type	Object no	Total FP No	FP No	Repeat	Angle	Length	No of Ridges	Ridge Breadth	Average	Final Average
11	Barcın Höyük	2220	VIb or VIa	1	2	2	1	5	157.834	1230.726	3	410.242		
12	Barcın Höyük	2265	Middle Chalcolithic	2	3	3	1	1	174.833	1749.732	3	583.244	560.564	560.564
13	Barcın Höyük	2265	Middle Chalcolithic	2	3	3	1	2	171.06	1670.217	3	556.739		
14	Barcın Höyük	2265	Middle Chalcolithic	2	3	3	1	3	163.018	1618.542	3	539.514		
15	Barcın Höyük	2265	Middle Chalcolithic	2	3	3	1	4	175.914	1951.505	3	650.5016667		
16	Barcın Höyük	2265	Middle Chalcolithic	2	3	3	1	5	178.877	1418.47	3	472.8233333		
17	Barcın Höyük	2728	VIb or VIa	2	4	4	1	1	-154.35	1067.097	3	355.699	384.462	384.462
18	Barcın Höyük	2728	VIb or VIa	2	4	4	1	2	-153.638	1200.736	3	400.2453333		
19	Barcın Höyük	2728	VIb or VIa	2	4	4	1	3	-152.289	1064.4	3	354.8		
20	Barcın Höyük	2728	VIb or VIa	2	4	4	1	4	-155.521	1292.689	3	430.8963333		
21	Barcın Höyük	2728	VIb or VIa	2	4	4	1	5	-150.969	1142.005	3	380.6683333		
22	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	5	1	1	170.455	1031.558	3	343.8526667	343.591	461.26
23	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	5	1	2	167.645	967.671	3	322.557		
24	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	5	1	3	-177	1032.196	3	344.0653333		
25	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	5	1	4	164.745	1026.439	3	342.1463333		
26	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	5	1	5	175.295	1096.002	3	365.334		
27	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	6	2	1	168.067	1787.991	3	595.997	578.93	
28	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	6	2	2	171.128	1870.926	3	623.642		
29	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	6	2	3	167.471	1579.567	3	526.5223333		
30	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	6	2	4	164.014	1735.303	3	578.4343333		
31	Barcın Höyük	2753	VIa or Middle Chalcolithic	5	5	6	2	5	172.425	1710.17	3	570.0566667		

Figure 4.13 Three levels of fingerprint analysis. Level 1 refers to the measurement of a single epidermal ridge, Level 2 refers to the mean epidermal ridge breadth of a single fingerprint, and Level 3 refers to the mean epidermal ridge breadth of all fingerprints on one object.

Here, it is necessary to underline that age and sex estimations based on epidermal ridge breadth vary among ethnic groups (Králík and Novotný 2003; Acree 1999; Gungadin 2007). Therefore, comparing modern population estimations with the ancient ones to infer age and sex in Neolithic populations is not ideal. This is because they are temporally, spatially, and genetically distinct populations. On the other hand, Králík and Novotný's work is among the few extensive samples gathered from fingerprints on modern clay objects. As the same reference is used to compare the whole dataset, this should suffice to make the comparisons. The final measurements collected from Barcın, Ulucak, and Ekşi Höyük clay objects have been compared to the reference by using a one-way analysis of variance (ANOVA) test followed by a Tukey's HSD post hoc test.[22] The results of these statistical calculations have formed the basis of the subsequent interpretations of the nature of labor division in making clay objects at Barcın, Ulucak, and Ekşi Höyük.

[22] See Chapter 7 for the results of the statistical tests.

4.7.Conclusion

Fingerprints are situated at the basal layer of the epidermis and are formed between the 6^{th} and 25^{th} weeks of fetal development. Although genetic factors play an essential role in forming fingerprint patterns, the minutiae are unique to each individual. The uniqueness and permanence of fingerprints make them useful for personal identification. Various cultures made use of fingerprints for this purpose throughout history.

Fingerprints are helpful in solving criminal cases, and they are also helpful for understanding craft specialization and the organization of craft production in the past. Epidermal ridges found on various artifacts, especially clay, make it possible for us to analyze them and make interpretations about the age and sex of these individuals and understand the minimum number of individuals working at a specific workshop or track movements of trade goods. The preservation of fingerprints on clay depends on various factors such as clay's texture, at what stage of the production process the fingerprint was left, and the shrinkage rate of the clay used to make the object.

Apart from providing a background on the study of fingerprints, this chapter has also provided an overview of the sample and a step-by-step guide to analyzing fingerprints found in archaeological excavations. The following chapter concentrates on the various object groups in the sample with a site-based overview of each category.

Chapter 5

5 MATERIALS

The previous chapter focused on this dissertation's methodology to estimate age and sex from the epidermal ridges on clay objects. Analyzing fingerprints on archaeological objects is a multi-level process. First, each clay object is examined, and possible imprints are identified. Then, these imprints are examined in detail in order to determine whether they come from human papillary terrain, i.e., human hands or feet. Once dermatoglyphic patterns are localized, mainly based on the curvature of the imprint, the presence of minutiae, or the presence of the bead-like character of the sweat pores, they are recorded and measured in order to generate estimations on age and sex. Fingerprints are helpful in terms of providing us with clues about the production process, as well. It is possible to estimate how an object was held and handled as well as how it was shaped based on the position and nature of the fingerprints on it.

While the plasticity of clay enables its surface to preserve imprints, not all clay objects that have been examined in this research yielded epidermal ridges. While some partial fingerprints could be located on certain types of objects such as figurines, sling missiles, and tokens from all three sites, the rigorous examination did not produce any results from certain types of objects at some sites. Various factors play a role in how fingerprints preserve. The first one is the water to clay ratio of the clay paste. This ratio, which will be extensively discussed in chapter 6, significantly affects the plasticity of clay. When there is too much or too little water, fingerprints would not be preserved.

The second factor is the type of inclusions present in the clay. While fingerprints can easily be preserved on pure clay, any small inclusions or temper, such as sand or grit, that do not disrupt the smoothness of the finished surface of the object or create uneven surfaces after they are fired do not significantly affect the visibility or preservation of fingerprints on the finished surface.[23] Moreover, most of the clay finds that yielded evidence for partial fingerprints did have some inclusions either added on purpose or already present in the clay. However, identifying fingerprints on objects that have plant-based tempers, such as chaff, has been the most challenging. These objects, chaff-tempered pottery or mudbrick, usually have small cracks on their surface. Even if there

[23] It should be mentioned that the number of inclusions does have an effect on how much the clay shrinks. This shrinkage would change the measurements, but it does not necessarily distort the fingerprint itself.

were some fingerprints on these objects, such tiny cracks obscure epidermal ridges, making it difficult to distinguish them with certainty from the background noise created by the chaff temper.

The third factor in the preservation of fingerprints on a clay object is the amount of use-wear on the surface. When an object was not used heavily, any fingerprints that were present would continue to be preserved. However, the original surface of a heavily used object might chip away through time, erasing any prints that might have been present on the initial surface. Spindle whorls from Ulucak are excellent examples of such heavy erosion. They seem to have been used so much that their initial surface had slowly chipped away while still being used in the Neolithic period. One hundred and one randomly selected spindle whorls from Ulucak have been examined in this analysis.[24] While most of these were complete or nearly complete, they all showed heavy erosion on their overall surfaces and yielded zero fingerprints.

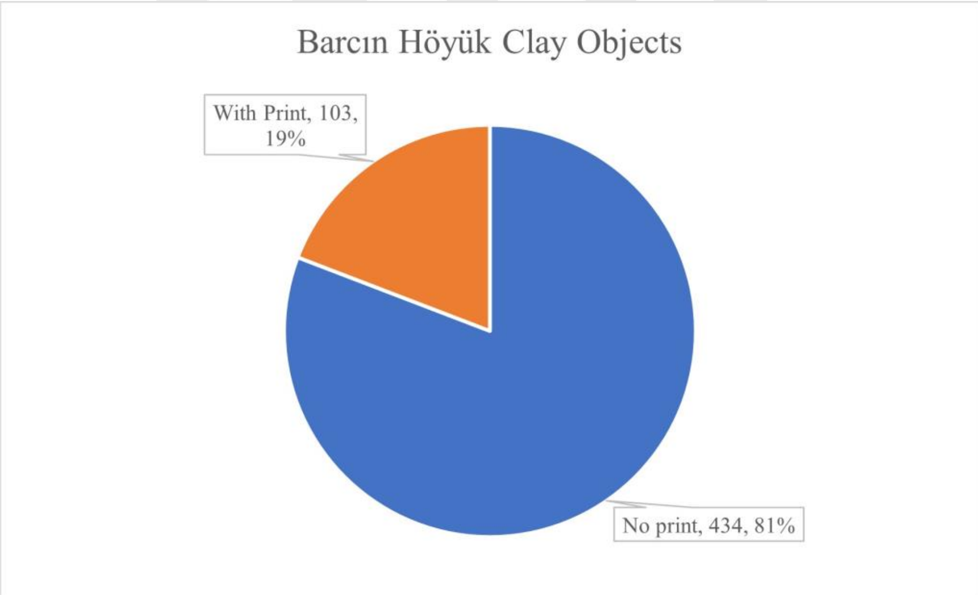


Figure 5.1 Clay objects from Barcın Höyük with or without fingerprints

Finally, any kind of finish, such as final smoothing or burnishing, might remove fingerprints left from the previous steps of the production. Pottery from the Barcın Höyük assemblage is an excellent example of this process. Despite the detailed examination of approximately two thousand sherds from the Neolithic layers of Barcın Höyük, these did

[24] This work was conducted during the 2018 season.

not yield any clear traces of epidermal ridges except for one sherd with very slim traces because the vessels were carefully burnished inside and outside.

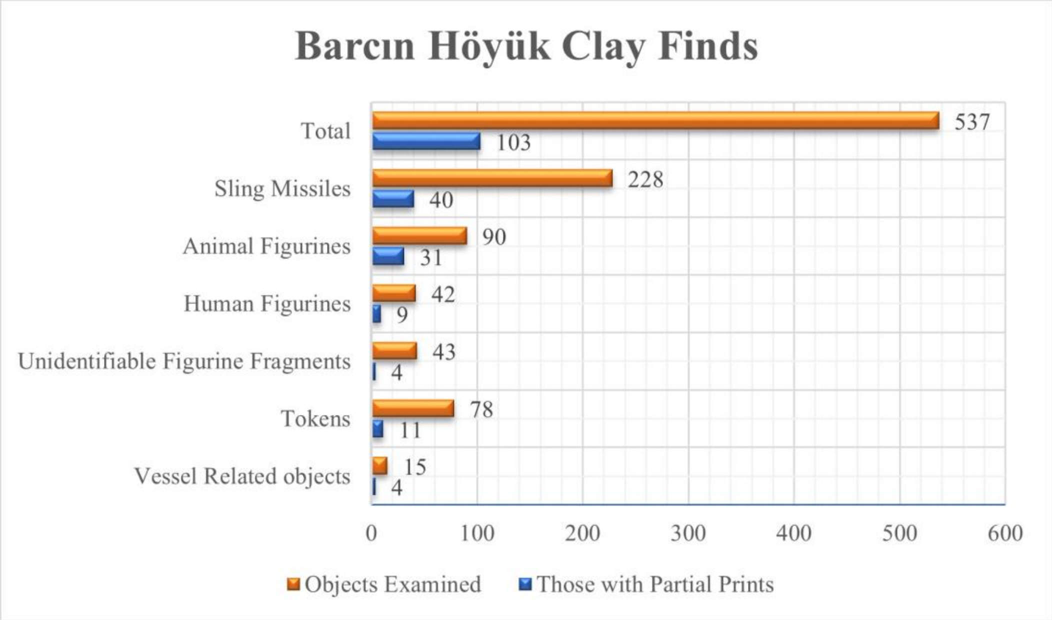


Figure 5.2 A bar graph showing the number of objects examined in each category in comparison with those that yielded partial fingerprints from Barcın Höyük

Table 5.1 The data from the case studies are divided into four categories in this dissertation. This table shows which category equals to which occupation layers at Barcın, Ulucak and Ekşi Höyük.

Categories	Barcın Höyük	Ulucak Höyük	Ekşi Höyük
7th Mill Early / pre-6200 BCE	VIe – VIc	Ve – Vc	4b
7th Mill Late / 6200 – 6000 BCE	VIb – VIa	Vb – Va	4a
6th Mill / 6000 – 5700 BCE	-	IV	3
Other	VIa or Middle Chalcolithic(unclear), Middle Chalcolithic, Late Chalcolithic, Bronze Age, Byzantine, mixed periods/ cleaning	Levels after Layer IV, mixed contexts	Levels after Layer 3, mixed contexts and cleaning layers

Despite these hurdles, a total of nine object groups from the three case studies, Barcın, Ulucak, and Ekşi Höyük, showed evidence for successfully preserved partial fingerprints. This chapter introduces these object types by focusing on Barcın, Ulucak, and Ekşi Höyük, respectively.

5.1. Barcın Höyük

A total of 537 Clay objects[25] from Barcın Höyük were examined between the 2016 and 2019 study seasons in order to identify and localize any possible epidermal ridges on the surface (**Figure 5.2**, **Figure 5.3**). Nineteen percent of the 537 clay objects, in other words, 103 objects, yielded 250 fingerprints altogether (**Figure 5.1** and **Figure 5.4**).

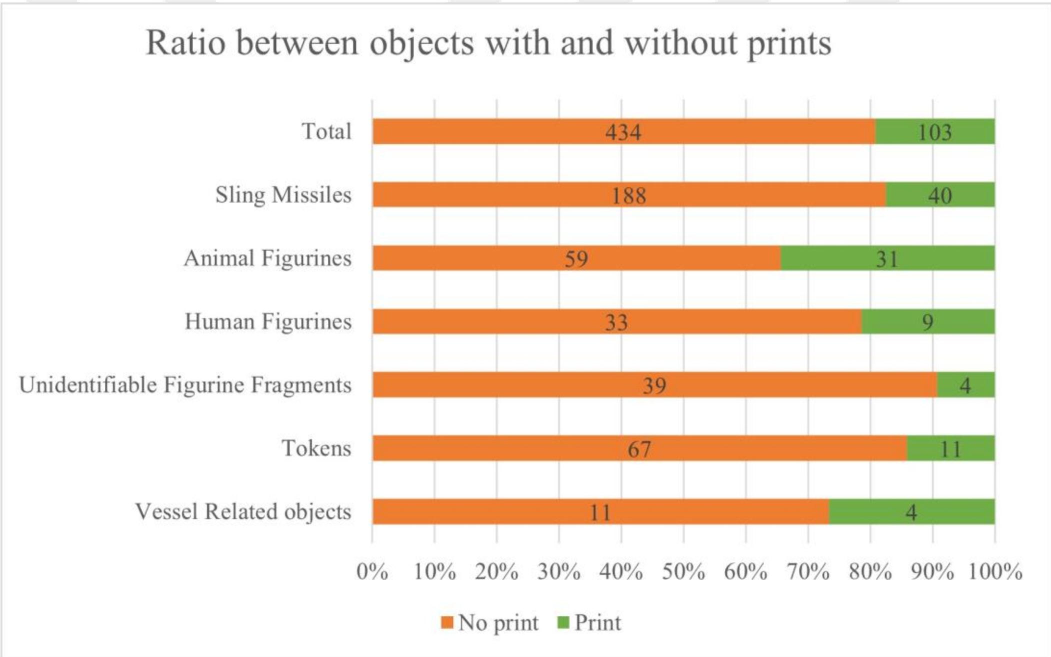


Figure 5.3 The ratio between clay objects with and without fingerprints from Barcın Höyük

The Barcın Höyük samples have been divided into three groups based on their contextual information (**Table 5.1**). Objects found in levels VIe through VIc are marked as "7th Millennium Early / pre-6200 BCE," and those found in levels VIb and VIa are marked as "7th Millennium Late / 6200-6000 BCE". These divisions are not arbitrary

[25] In addition, a few hundred pottery sherds were examined yet excluded from this analysis due to the almost complete lack of fingerprints on pottery at the site as a result of the production techniques.

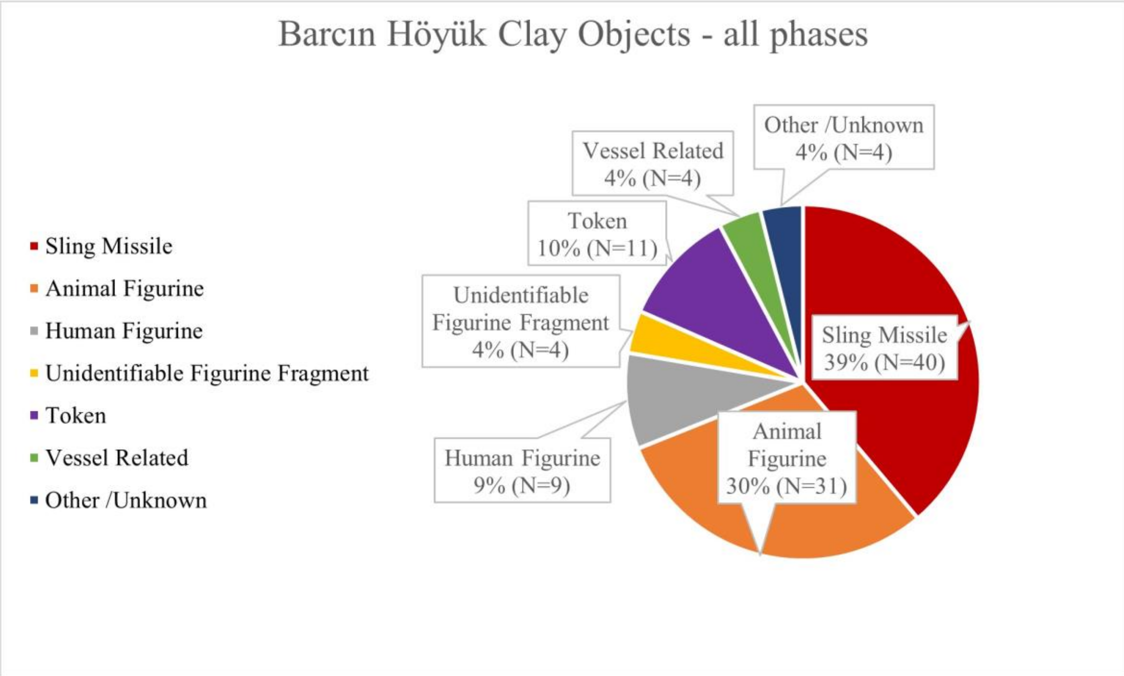


Figure 5.4 A pie chart showing the distribution of clay finds that yielded partial fingerprints from Barcın Höyük

but instead follow the transformations at the site in terms of settlement patterns. While throughout levels VIe to VIc, the site had a distinct settlement pattern where houses with adjacent or shared walls were built in a row, facing a shared courtyard, and rebuilt in the same spot over generations, this settlement pattern completely changed in level VIb when individual houses started occupying the previous courtyards (Gerritsen and Özbal 2019, 60). This break in the settlement pattern tradition might also reflect transformations at the social level, urging changes in labor division for the production of clay objects. Objects found at later or mixed levels are marked as “Other” to prevent any contamination in the analysis.[26] Whenever the dating of an object is not definitely from the earlier or the later Neolithic occupation, they are placed in the “Other” category.

[26] **7th Mill. Early**: VIe, VId1, VId2, VId3, VIc; **7th Mill. Late**: VIc or VIb, VIb, VIa; **Other:** VIa or Middle Chalcolithic (unclear), Middle Chalcolithic, Late Chalcolithic, Bronze Age, Byzantine, mixed periods/cleaning

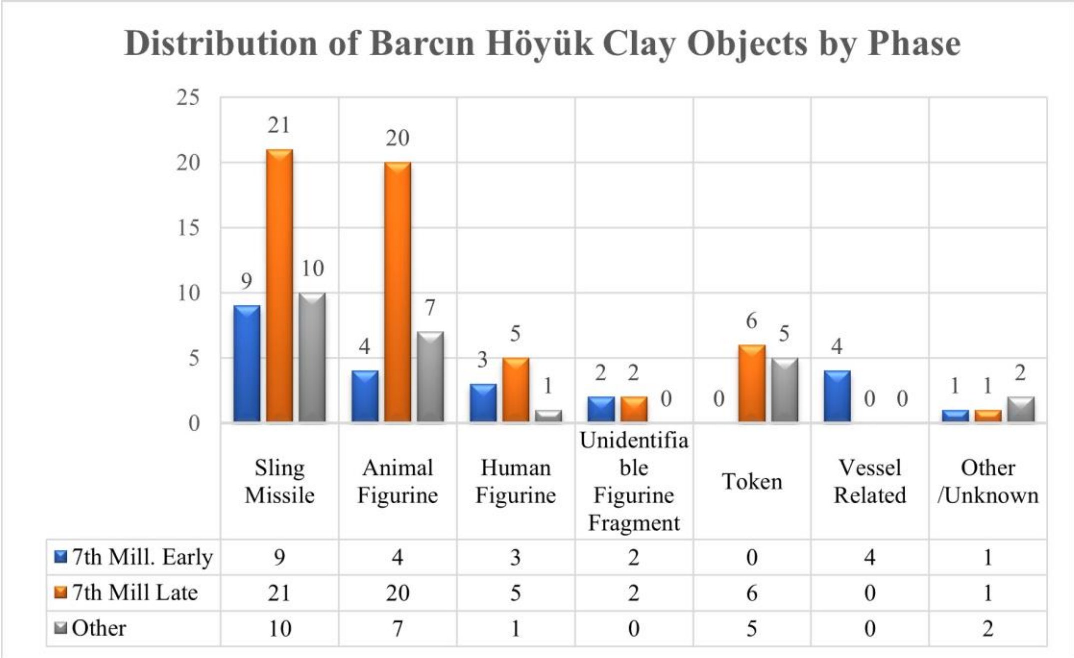


Figure 5.5 The distribution of Barcın Höyük clay objects by phase used in this study

5.1.1. Sling Missiles

Sling missiles constitute 42% of the whole clay objects assemblage of Barcın Höyük, while the group that yielded epidermal ridges equals 39% of the Barcın Höyük fingerprints assemblage (**Figure 5.4**). I have identified 40 complete or fragmented sling missiles with one or more partial fingerprints from levels VIe through VIa and the later occupation layers from the site.[27] These objects yielded 78 partial fingerprints in total.

[27] See Appendix 1 for details on phases.

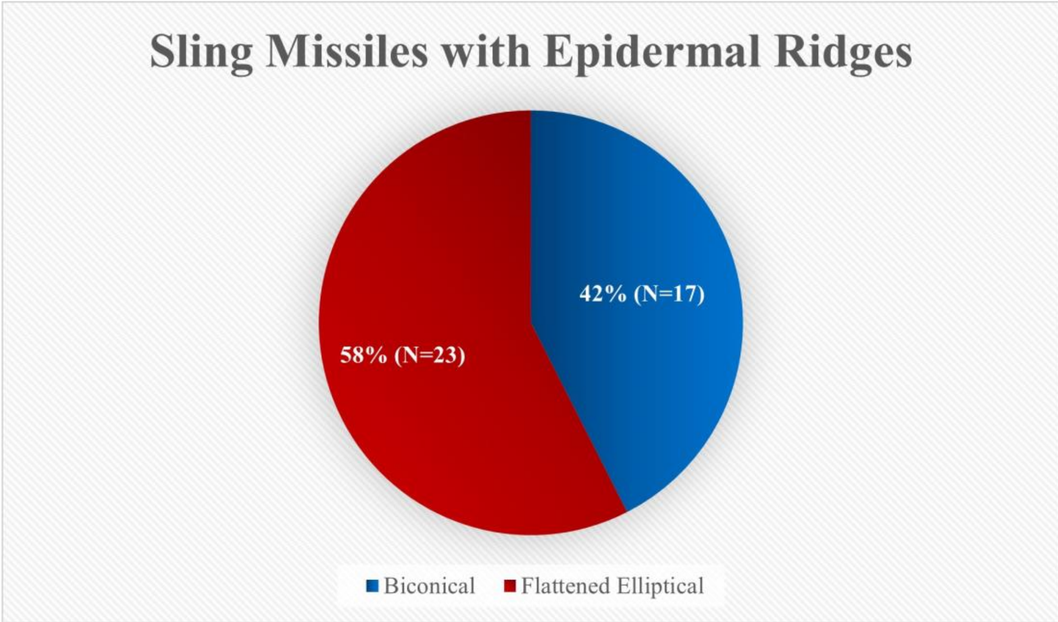


Figure 5.6 Sling missiles from Barcın Höyük have two main types

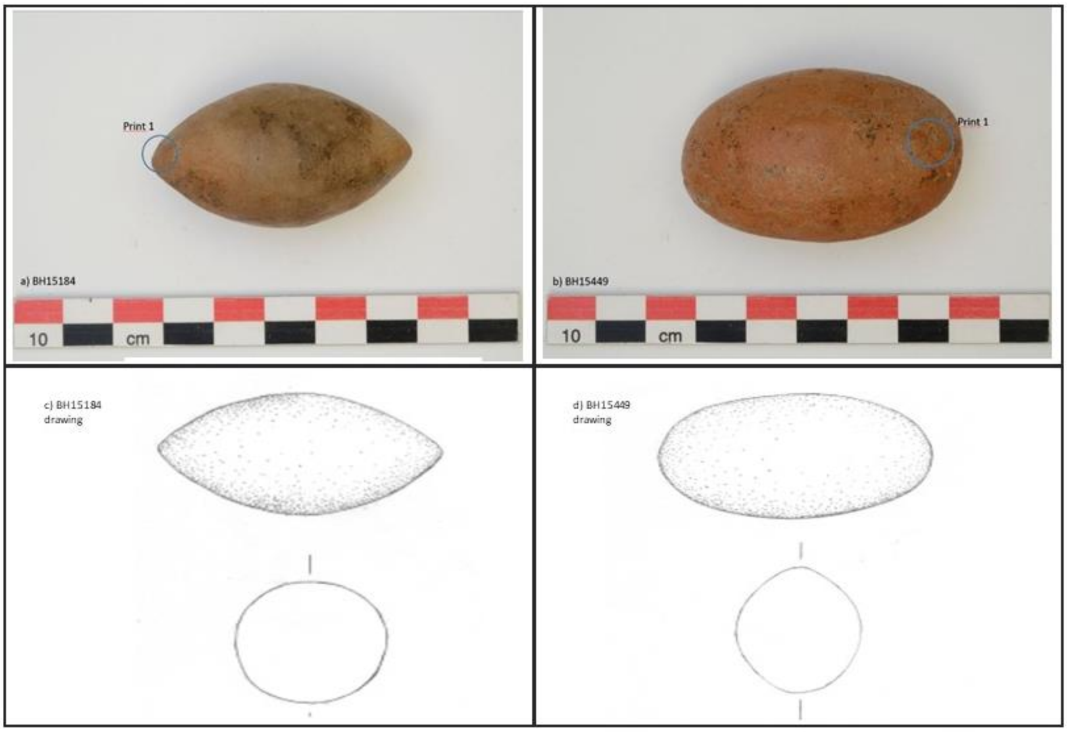


Figure 5.7 Examples of biconical and flattened elliptical sling missiles from Barcın Höyük: a) BH15184, b) BH15449, c) drawing of BH15184, d) drawing of BH15449 (Courtesy of the Barcın Höyük Project Archive)

In terms of typology, the sling missiles from Barcın Höyük can be divided into *biconical* and *flattened elliptical* based on visual observations (**Figure 5.6** and **Figure 5.7**). The biconical sling missiles have pointed, usually elongated tips, and they are almost symmetrical around the axis going through from one tip to the other. The central cross-section of these missiles is circular (**Figure 5.7**). On the other hand, the flattened elliptical sling missiles are flattened along the mid-section and have rounded tips.

Both types were initially formed by rolling clay in the palm between hands or on a flat surface until a cylindrical form was achieved. This cylindrical clay was pinched at both ends to create the biconical pointed tips. On the other hand, the flattened elliptical missiles are also flattened at the mid-section with fingers, and the tips are fashioned into a more rounded shape. As a result of rolling between the palms, pinching, and squeezing to form these particular shapes, both types were imprinted with epidermal ridges on the surface. Some of these finger or palm prints were embossed on top of each other, especially around the mid-section of the object (**Figure 5.8**).

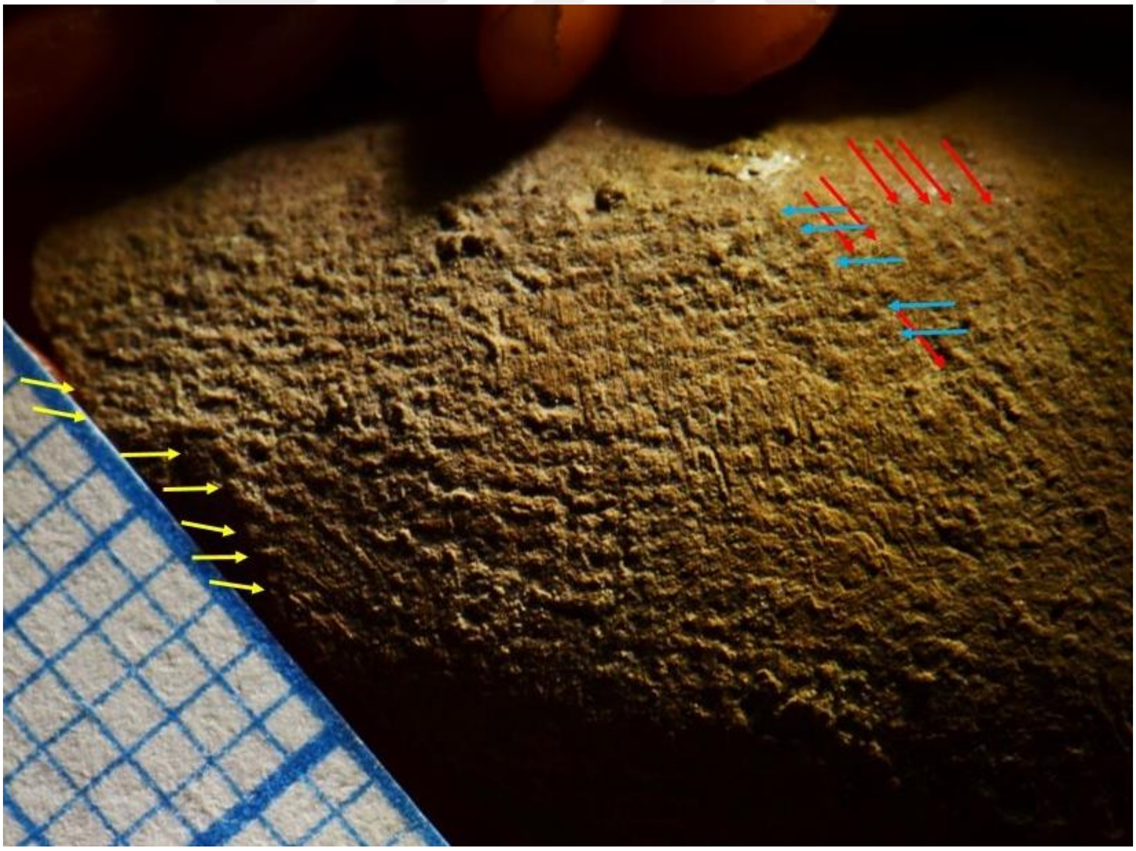


Figure 5.8 A close-up on Print 1 of BH2857. Arrows indicate the direction of the epidermal ridges. A second fingerprint (ridges pointed in red) is impressed, overlapping the first one (ridges pointed in blue and yellow) at an angle

Since these fingerprints are placed on top of each other, sometimes creating a crisscross pattern, they are usually distorted; therefore, it is difficult to measure their ridge breadth with current methods. However, the continuous, elongated epidermal ridges suggest that the main cylindrical form of the object was given to the missiles inside the palm, while the conical or flattened edges are flattened by the distal phalanges, i.e., finger ball or fingertips. This fine-shaping can be visible on the edges of many sling missiles thanks to a few thin, usually fragmentary lines of epidermal ridges (**Figure 5.9**). Moreover, the elliptical sling missiles are flattened around the mid-section, where it might be possible to determine a distinct fingerprint.

Figure 5.9 Clear epidermal ridges at the tip of a flattened elliptical sling missile fragment. a) BH3272, the location of the fingerprint is shown in red, b) Close-up of Print 1 of BH3272 (Image a, Courtesy of the Barcın Höyük Project Archive)

5.1.2. Figurines

Figurines can be divided into three subcategories based on their typology: animal, human, and unidentifiable fragments (**Figure 5.11**). The largest category that yielded partial fingerprints among the Barcın Höyük clay assemblage is figurines. All figurines from the site constitute 31% of the clay object assemblage. In comparison, partial fingerprints were identified on 44 figurines or fragments from the site, equaling 42% of the dataset. Compared to other sites, it is clear that the clay figurine assemblage of Barcın is prone to yield more partial fingerprints. Almost a quarter of the whole figurine assemblage had evidence of one or multiple partial fingerprints at Barcın Höyük (**Figure 5.10**).

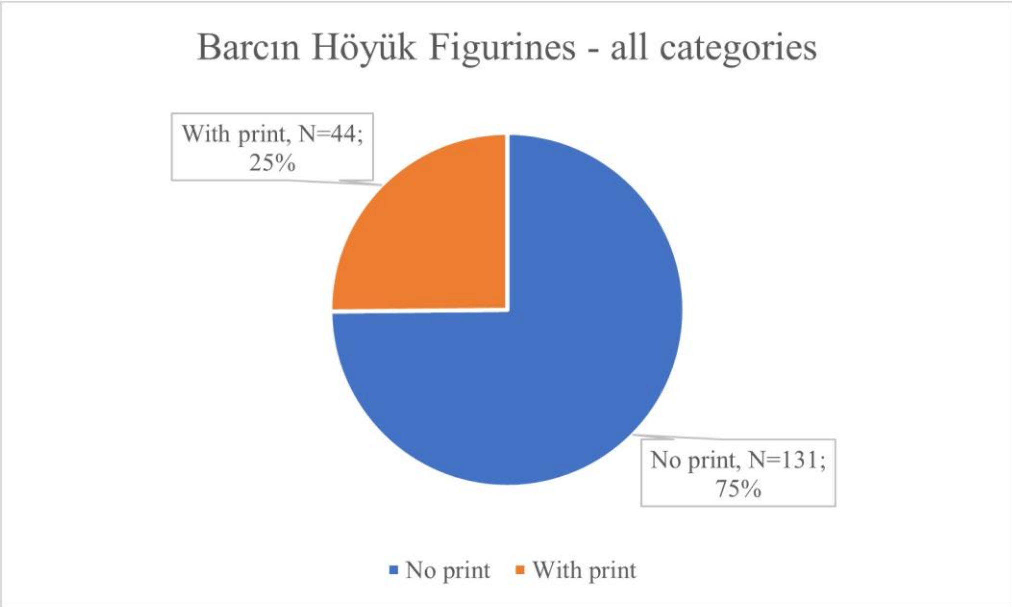


Figure 5.10 Barcın Höyük figurines from all categories. The pie chart shows the ratio of those with and without partial fingerprints

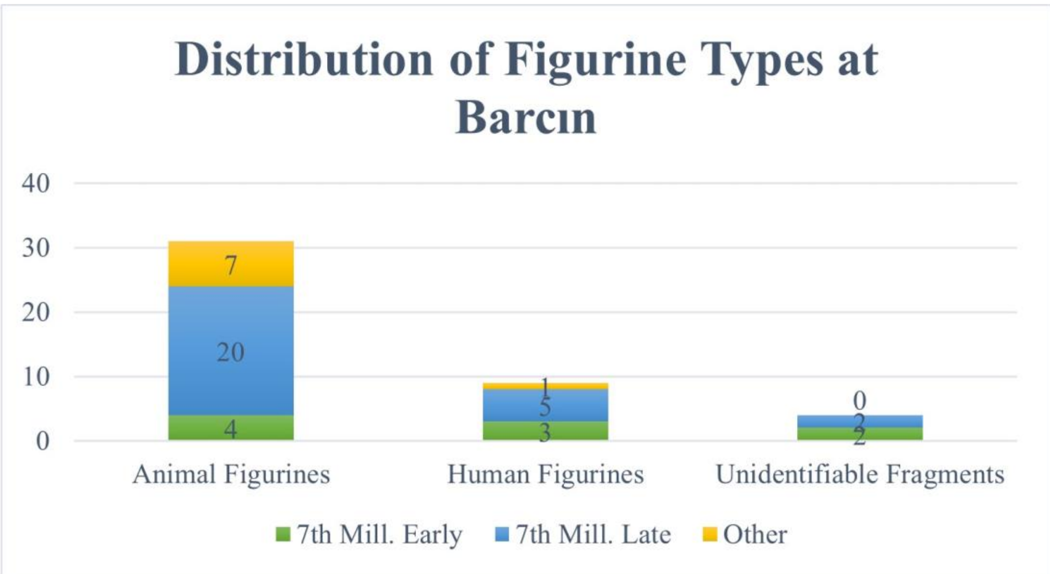


Figure 5.11 Distribution of figurines by phase at Barcın Höyük

Animal Figurines

Animal Figurines are the second largest category of clay finds that yield epidermal ridges at Barcın Höyük. 31 animal figurines made up 30% of the whole assemblage analyzed here. While some are complete figurines, some are identifiable animal figurine fragments such as bull horns and the upper or lower body of a standing quadruped.

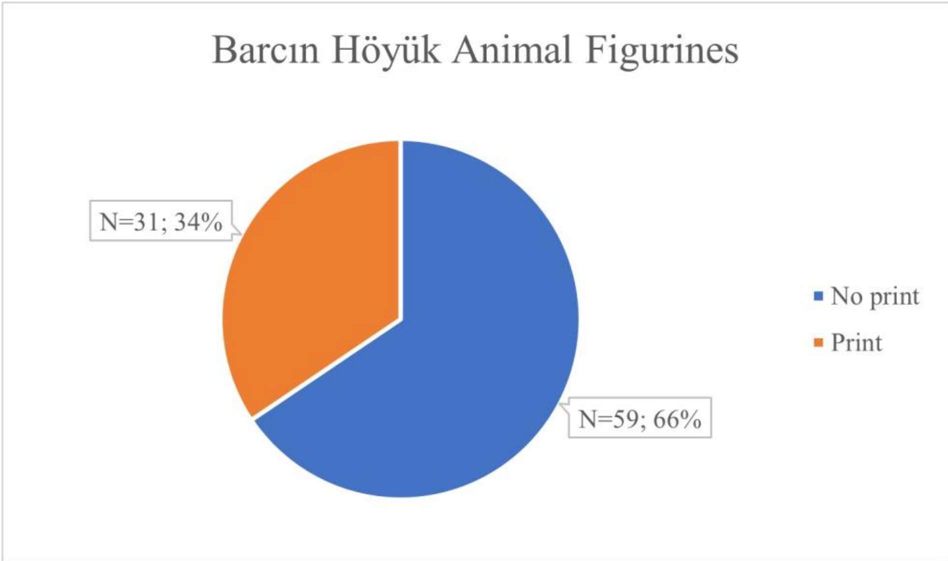


Figure 5.12 The ratio of zoomorphic figurines with fingerprints at Barcın Höyük

Fingerprints can be found almost anywhere on these figurines; however, they are most prevalent around the animal's head, face, neck, and tail, as these sections are usually shaped by pinching the clay (**Figure 5.13**). Furthermore, it is common to see epidermal ridges between the legs and buttocks as the belly is usually fixed with the fingertips. As none of the animal figurines seem to have any slip, all the fingerprints were probably embossed during the initial shaping of the object while the clay was still plastic or leather hard. Some animal figurines show signs that the torso and the legs were made individually and attached later based on the surface of the breaks (For example, BH3312).

Figure 5.13 Location of fingerprints on BH8659. A total of 14 fingerprints are recorded on a) the right side, b) the left side, c) the front below the head, d) the back

Human Figurines

This category includes anthropomorphic representations, including complete anthropomorphic figurines, possible human figurine fragments such as part of a leg or a head, and anthropomorphic vessel fragment such as the so-called Fikirtepe Box feet. These feet look identical to anthropomorphic figurine legs except for extensive burnishing. Thirty-two anthropomorphic figurines have been examined as a part of this research, but only nine of them yielded fingerprints (**Figure 5.14**). Out of these, three come from the earlier Neolithic levels VIe through VIc at Barcın, while five come from the later Neolithic levels VIb and VIa, and only one is from the Middle Chalcolithic Period (**Figure 5.11**).

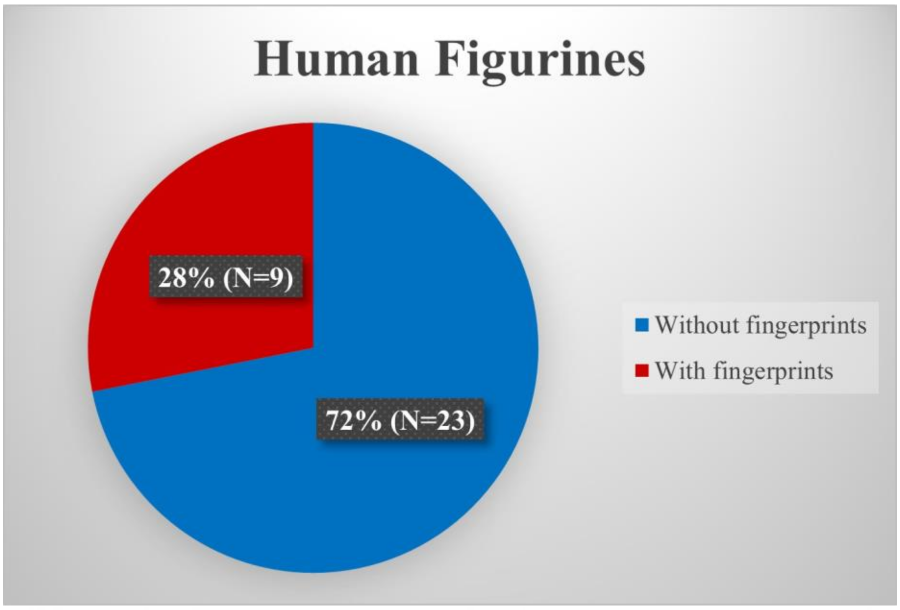


Figure 5.14 The ratio of anthropomorphic figurines with fingerprints at Barcın Höyük

Even though the makers of these human figurines at Barcın Höyük were usually meticulous about smoothing out the surface of the figurine before baking them, we come across partial fingerprints at locations where it is difficult to see or reach these partial prints, such as under the arms, below the feet or between the legs (**Figure 5.15**, **Figure 5.16**). The fact that Barcın Höyük people were more careful about obtaining a smooth surface on human figurines while they were care-free about leaving many fingerprints on the animal figurines points to an intentional differentiation between the animal and human figurines, possibly related to their different functions in the household.

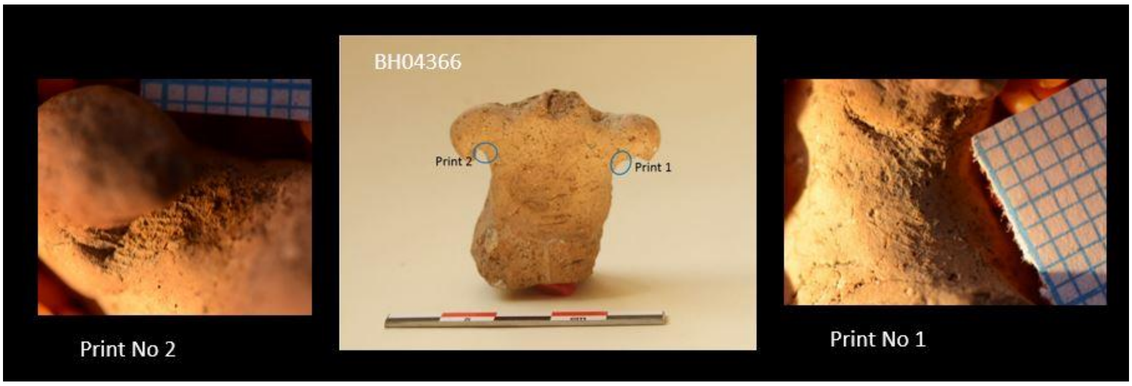


Figure 5.15 Anthropomorphic figurine BH04366 with close-up views of the two fingerprints present under the arms

A group of unbaked anthropomorphic figurines with intricate and colorful decorative patterns around the hips and the waists were recovered as a cache in one of the buildings at Barcın Höyük.[28] Despite careful examinations, no fingerprints could be identified on these figurines. It is challenging to identify fingerprints on unbaked clay coming from archaeological contexts as their surface tends to be uneven, heavily fragmented, or eroded.

Figure 5.16 A selection of anthropomorphic figurines and the location of fingerprints on them. a) BH4366 with two prints below the arms, b) BH6333 with one print on the shoulder, c) BH6561 with one print on the inner ankle of a right leg, d) BH38475 with one print below the arm

Unidentifiable Figurine Fragments

The unidentifiable figurine fragments are small fragments that could not be identified with certainty whether they were a part of an animal or a human figurine. These are usually tiny fragments that lack a large enough surface to retain recognizable fingerprints. Only four of such objects had identifiable partial fingerprints. All of them come from the Neolithic layers of the mound; two are from VId1, categorized as “7th Mill.

[28] These unbaked figurines were found in level VId3/VIc, Structure 10. A more in-depth discussion of these figurines is provided in Section 8.2.1.

Early," while the rest come from levels VIb and VIa, both categorized as "7th Mill. Late" (**Figure 5.11**).

BH8766, from level VIb, seems to be the most notable find among these fragments, as it yielded eight partial fingerprints (**Figure 5.17**). This piece of clay seems to be formed by a collection of smaller clay pieces joined together to form possibly a lumpy torso or the base of a figurine and got fired similarly to other figurines. The outer surface of the object has multiple fingerprints. Moreover, other epidermal ridges are visible on the breaks where small clay pieces were attached. The presence of epidermal ridges inside the breaks suggests that different parts of the figurine might have been shaped separately and attached afterward.

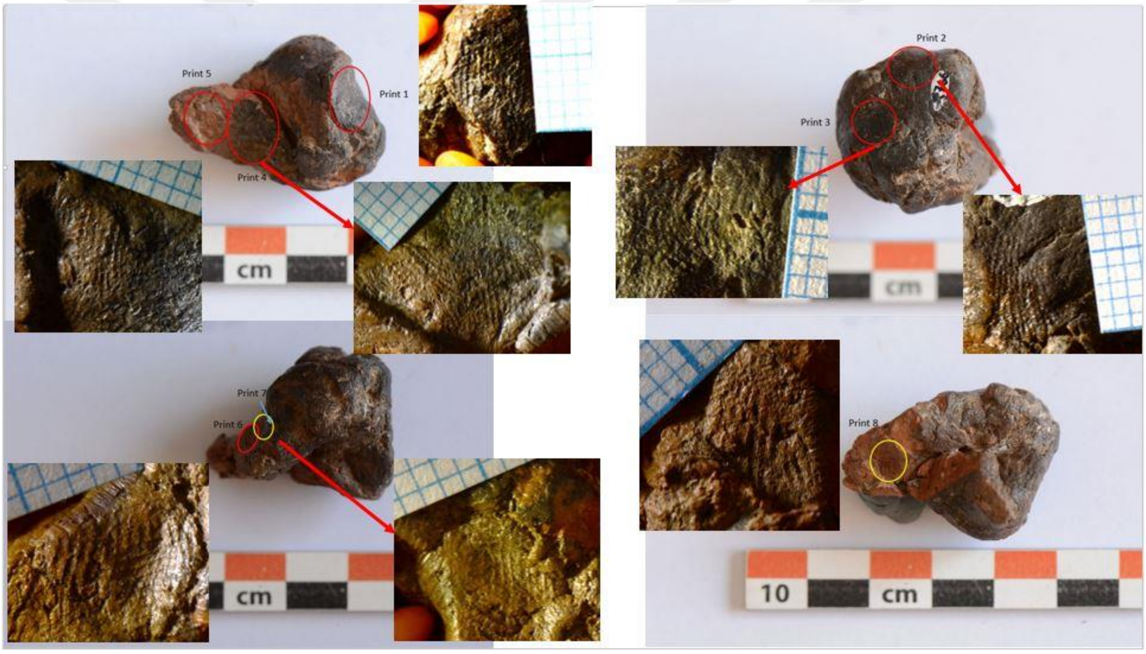


Figure 5.17 BH8766 from different perspectives. The location of the 8 partial fingerprints are shown in detail

5.1.3. Others

This section focuses on the remaining 19 miscellaneous objects with partial fingerprints from Barcın Höyük (**Figure 5.18**). This section will briefly introduce tokens, vessel-related clay finds such as jar stoppers, and other clay finds that could not be securely identified.

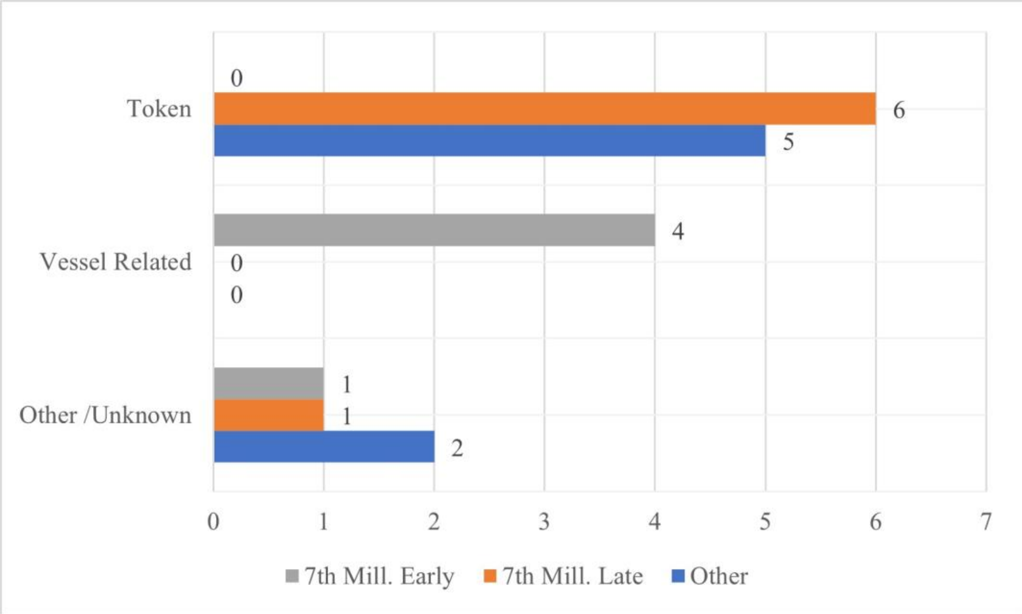


Figure 5.18 Distribution of clay finds discussed in this section

Tokens (Geometric clay objects)

Geometric objects such as conical objects and small clay balls constitute 14% of the clay objects assemblage at Barcın Höyük (N=78). These have been examined as a separate group under the category of "Tokens" in this research. Eleven tokens with partial epidermal ridges have been identified and measured as a part of this study. While two of them are small, flattened clay balls, one is a spherical clay ball, and all of the others are conical in form (**Figure 5.19**). Partial fingerprints on these objects were left during the initial forming process when the clay pieces were still in the plastic or leather-hard stage.

Figure 5.19 BH2753, a conical token. The locations of the two partial fingerprints are indicated

Vessel Related Objects

These are four baked clay objects, all of which come from the earlier Neolithic levels of the site. Among these are a clay pot lid (**Figure 5.20**), two stoppers or sealings (e.g., **Figure 5.21**), and a possible pottery sherd. The fingerprints on these seem to be left unintentionally at the plastic stage of clay before they became bone dry.

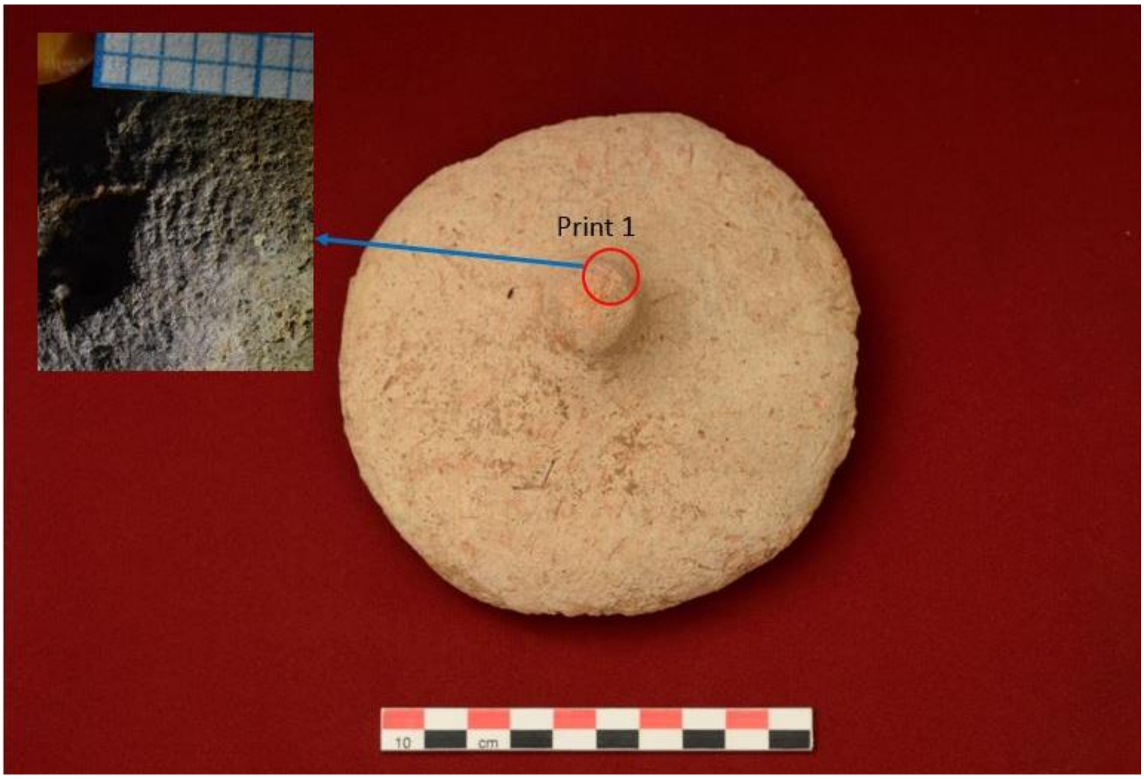


Figure 5.20 Fingerprint on BH17376, a complete clay lid from Structure 2a in level VId1

Others / Unidentified

Four miscellaneous objects, two large clay discs, a clay lump pierced through, and an unknown clay object have been evaluated in this category.[29] These objects do not form a proper group regarding their date or type. Therefore, the results from this group are not as informative as the rest of the sample.

[29] BH17375 is a fist-sized clay lump pierced through from level VId1 / 7th Mill. Early; BH18382 is a flattened clay disc from level VIb / 7th Mill. Late; BH 18572 is another clay disc from VIa or Middle Chalcolithic levels / Other; BH47891 is an unidentified clay fragment from Middle Chalcolithic levels / Other.

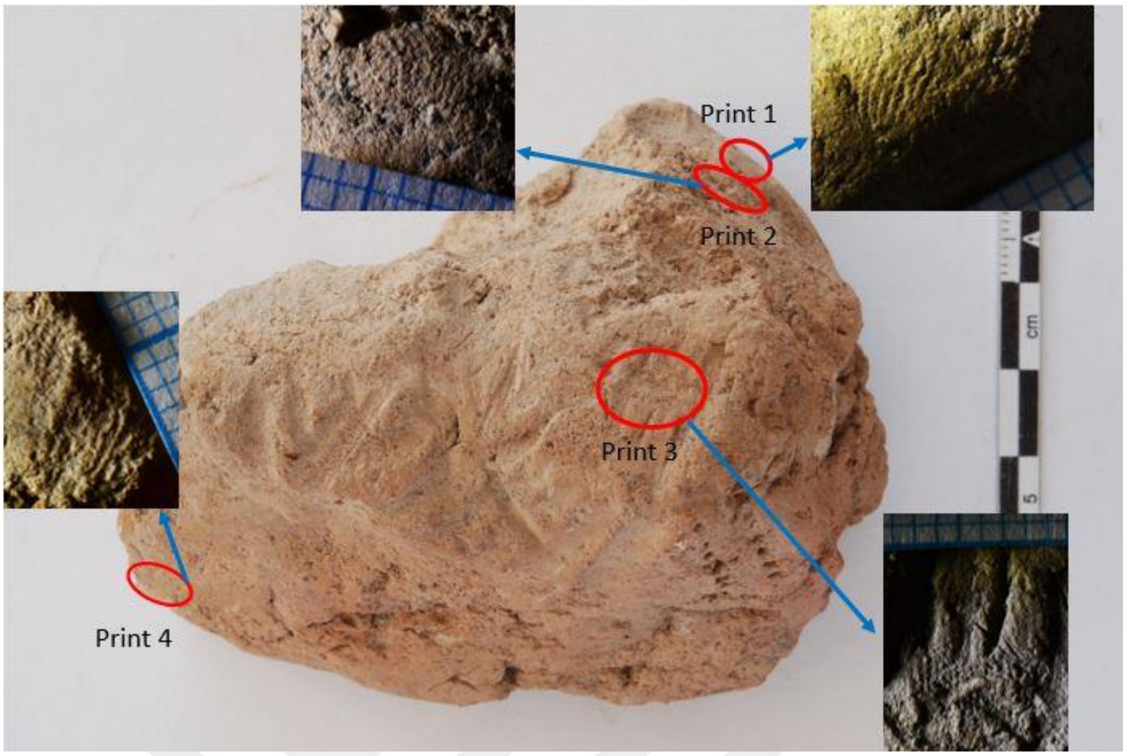
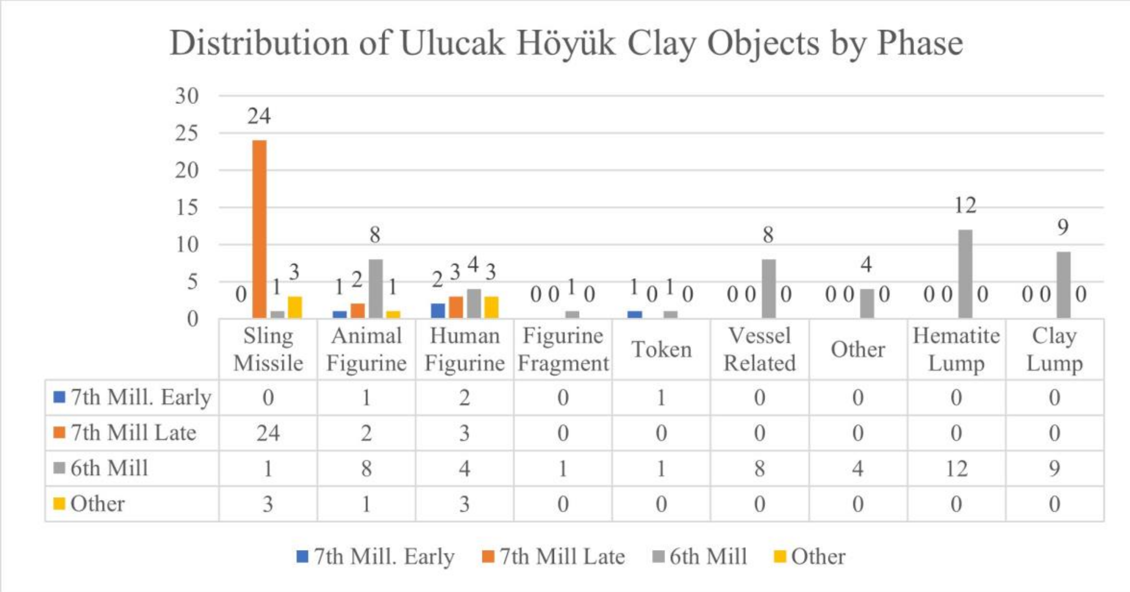


Figure 5.21 BH44422, clay stopper. Four partial prints are present on the surface

5.2. Ulucak Höyük

Despite the relatively high number of finds that were studied, only 88 clay finds (**Figure 5.22**) out of 1195[30] (approximately 7%) had identifiable partial fingerprints that can be used in this research. These have been carefully examined and recorded during the 2018-2019 excavation seasons. These 88 objects provided us with 273 partial fingerprints.

[30] This calculation excludes the 630 pottery sherds examined for epidermal ridges. If they had been included, the relative percentage of finds with fingerprints would have appeared much lower due to the significantly low number of fingerprints present on Ulucak pottery. Most of those that did yield prints were unfinished pottery fragments.



	Sling Missile	Animal Figurine	Human Figurine	Figurine Fragment	Token	Vessel Related	Other	Hematite Lump	Clay Lump
7th Mill. Early	0	1	2	0	1	0	0	0	0
7th Mill Late	24	2	3	0	0	0	0	0	0
6th Mill	1	8	4	1	1	8	4	12	9
Other	3	1	3	0	0	0	0	0	0

Figure 5.22 A detailed breakdown of objects with fingerprints based on their phase from Ulucak Höyük

The Ulucak Höyük samples were divided into four categories based on their dating and in comparison, to the Barcın Höyük samples (**Table 5.1**). Therefore, finds from layers Ve to Vc were recorded as "7th Mill. Early" as they date to 6500-6200 BCE.[31] Levels Vb and Va (6200-6000 BCE) of Ulucak represented a slight change in terms of material culture, despite similar construction techniques and these layers fall into the "7th Mill. Late" phase of this study.[32] Ulucak's level IV has been identified as Late Neolithic for Western Anatolia and dates to 6000-5700 BCE (Çevik and Erdoğu 2020, 84). This period is identified as the "6th Mill" in this dissertation. While Barcın Höyük was not occupied during this period, the occupation Layer 3 at Ekşi Höyük provides excellent comparative materials dating approximately to the same period. Finds coming from later levels or mixed contexts are considered in the "Other" category in the analysis.

5.2.1. Sling Missiles

Five hundred ninety-nine complete and fragmented sling missiles have been examined at Ulucak, but only 28 (5%) had identifiable epidermal ridges (**Figure 5.23**). These yielded 87 partial prints, most of which come from the 7th Mill Late contexts dating

[31] This period has been identified as Early Neolithic I at Ulucak (Çevik and Erdoğu 2020, 81).
[32] These occupation levels have been identified as Early Neolithic II (Çevik and Erdoğu 2020, 82).

to 6200-6000 BCE, and only one from the 6th Millennium, while three are from later periods (**Figure 5.24**).

Figure 5.23 Sling missiles from Ulucak, only 5% yielded fingerprints

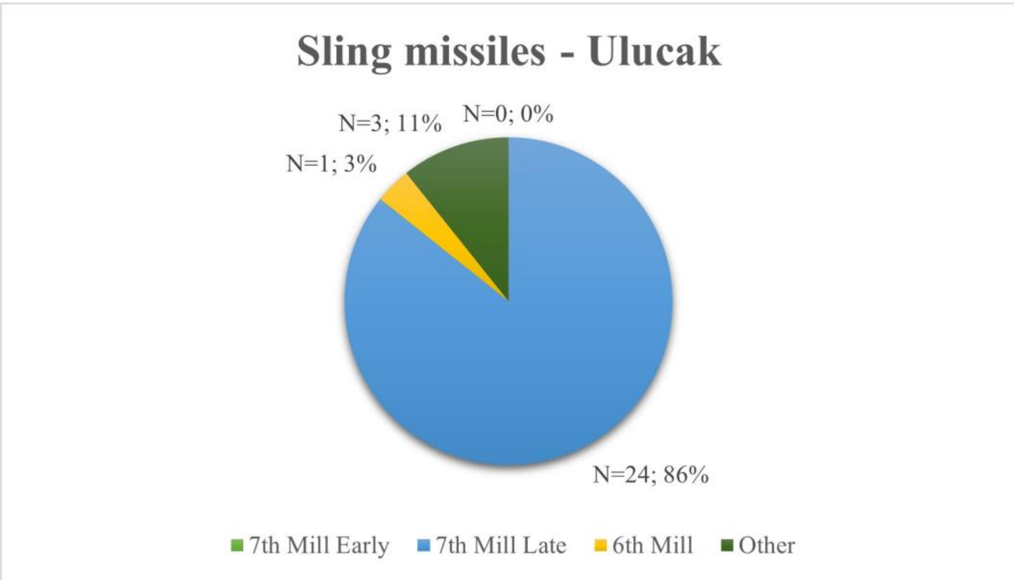


Figure 5.24 Breakdown of sling missiles with fingerprints from Ulucak

In terms of typology, the sling missiles from Ulucak can be divided into four main categories (**Figure 5.25**):

Type 1: biconical, standardized in size and shape

Type 2: biconical, standardized, but much smaller in size than Type 1

Type 3: biconical, crudely made

Type 4: teardrop-shaped or conical, small, similar in size to Type 2.

Among these four types, Type 4 is the smallest group. There are only a few of these, and they are about half the size of the larger types, Type 1 and Type 3. However, they are complete and not cut from larger sling missiles. Some have rounded bottoms, while others are flat. This group yielded no epidermal ridges. Type 1 consists of the largest group of sling missiles. In terms of production methods, Types 1 and 2 are very similar. After being shaped, the surface is smoothed with a tool from the center of the object towards the tips. Tool marks are clearly visible on these objects, which probably eliminated most fingerprints.

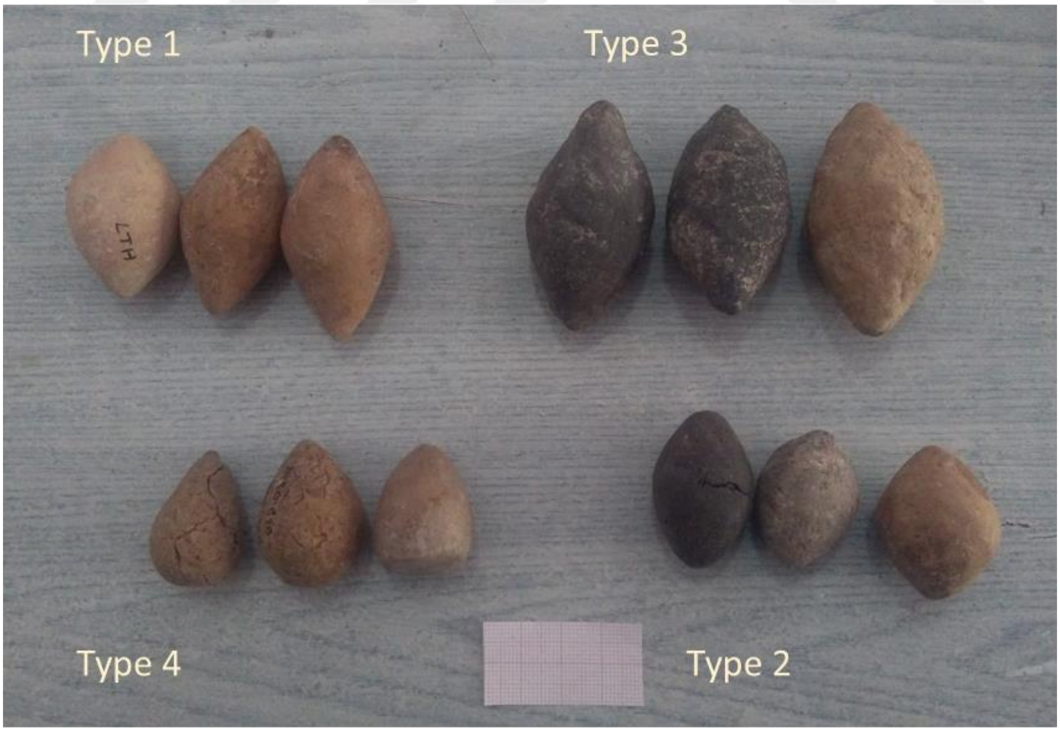


Figure 5.25 The four types of sling missiles from Ulucak. Top left to right: Type 1, Type 3. Bottom left to right: Type 4, Type 2

Type 3, on the other hand, includes sling missiles somewhat larger in size and shape than Type 1. However, these are cruder in terms of production and show no tool marks or smoothing on their surface. Sling missiles in the Type 3 category might represent unfinished objects, perhaps in an earlier phase of the production process, which would eventually be fixed up and smoothed to become Type 1. Almost all high-quality, measurable fingerprints on sling missiles belong to Type 3. Another possibility is that those who made missiles in Type 3 were a different group of people, either in terms of age or specialization.

5.2.2. Figurines

Figurines are an essential group of artifacts on which we find fingerprints at Ulucak. Of the 219 animal and human figurines, including anthropomorphized clay spoons and pottery fragments and unidentified figurine fragments, 25 (11% of the figurine data) yielded identifiable, partial fingerprints (**Figure 5.26**).

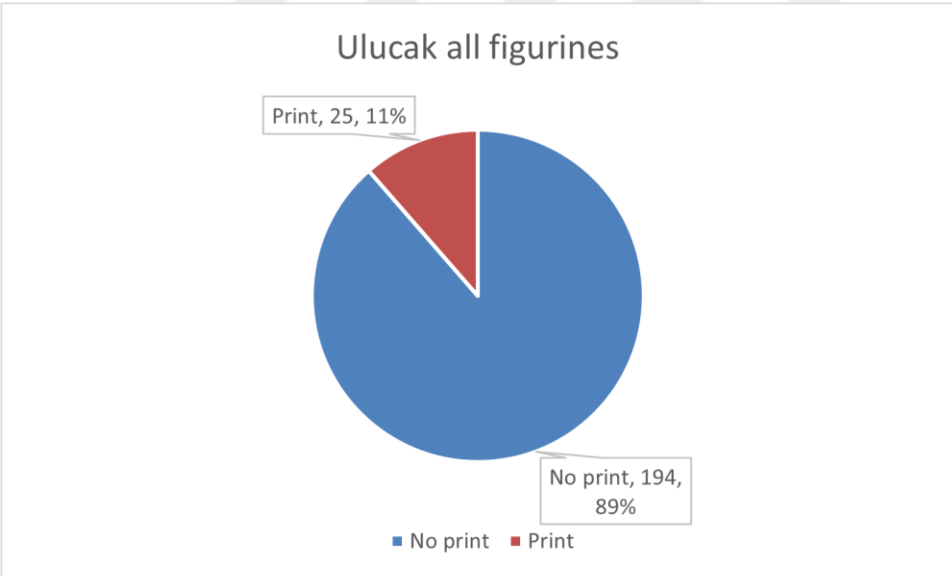


Figure 5.26 15% of the Ulucak figurine assemblage yielded partial fingerprints

Animal Figurines

Figure 5.27 ULU.17.40 / PZF.5004. An animal figurine head with one of the partial fingerprints in close-up

Twelve animal figurines yielded 46 partial fingerprints in total. The majority of these come from the later Neolithic levels, such as Level IV (6^{th} Mill in this analysis), but some are also found in the earlier 7^{th} millennium layers.[33] While some of these are complete figurines, most are fragments such as animal horns, heads, and half of the animal torsos. They vary in their shape, style, and details, and they are seldom burnished compared to their human counterparts. Fingerprints can be located anywhere on the surface of animal figurines, but they are most frequently found between the legs, near the belly and around the head and the face, where facial features were created by pinching the clay (**Figure 5.27**).

[33] One comes from Level Vc (EN1, contemporary with 7^{th} Mill Early), two comes from Levels Vb and Va (EN2, contemporary with 7^{th} Mill Late), and one is found in later layers (Other).

Human Figurines

This sub-category of figurines includes anthropomorphic figurine heads, torsos and legs, and clay spoon handles. These spoons are produced in a similar way to human figurines as both were carefully smoothed, burnished, and almost shiny. The handles of these spoons look precisely like the legs of human figurines, making it difficult to differentiate between the two without the presence of the spoon bowls. Making clay spoon handles look like anthropomorphic figurine legs is clearly a conscious choice of style among the Ulucak community; hence, this dissertation analyzes these spoons together with the human figurine fragments.

Although there are 12 anthropomorphic figurine fragments (including two spoon handles) that provide us with 15 fingerprints, the quality of these differs from those found on animal figurines, probably due to the difference in their production techniques. Human figurines seem to be made with the utmost care, and their surface is smoothed and burnished with great detail. As a result, the remaining fingerprints are only some shallow lines of epidermal ridges at relatively obscure locations or near attachments to other limbs (**Figure 5.28**). These figurines come from all Neolithic phases, but their number increases through time following the increasing number of clay objects in later Neolithic layers.[34]

Unidentified Figurine Fragment

Only one unidentified figurine fragment, a possible figurine leg, yielded partial fingerprints. It comes from the Late Neolithic Ulucak layer IVc. This object had one partial fingerprint that was used in this research.

[34] Two human figurines come from Vd and Vc (EN1 / 7th Mill Early), three are found in levels Vb and Va (EN2 / 7th Mill Late), four come from level IV (LN /6th Mill), three are found in later or unidentified layers (Other).

Figure 5.28 ULU.06.32 / ESA.3004. An anthropomorphic figurine leg with a small partial print

5.2.3. Pottery Workshop: Clay Lumps and Vessel Fragments

Twenty-nine objects, including pottery sherds, unfinished vessel fragments, and large clay lumps, come from Level IV, especially from contexts related to the Pottery Workshop (**Figure 5.29**), and they provided us with 100 partial fingerprints in total. All of these objects come from the 6th Mill category.

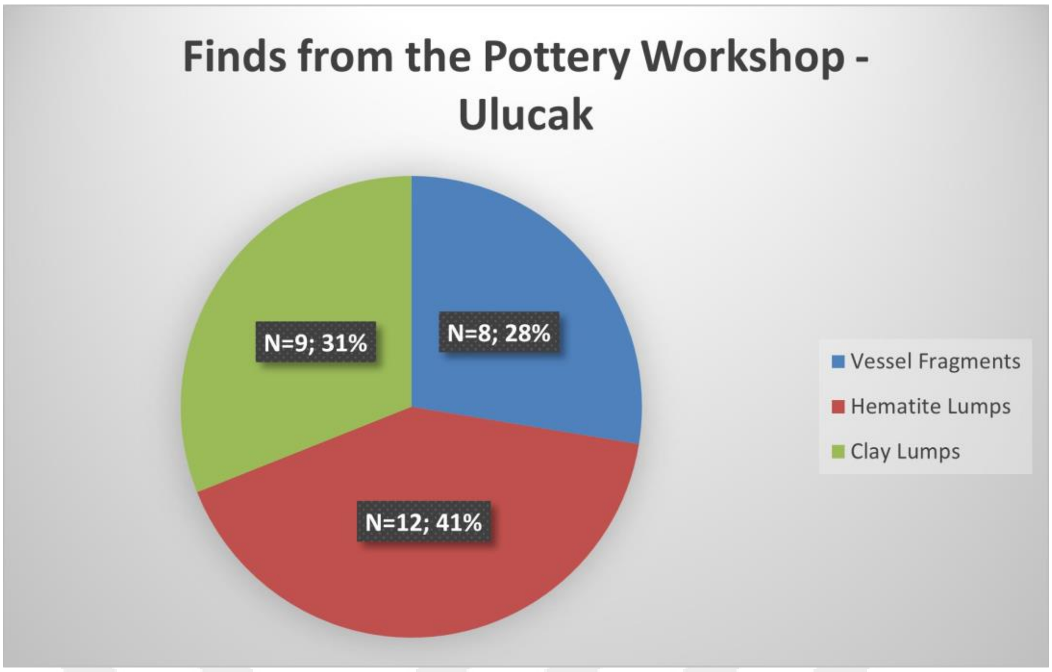


Figure 5.29 The ratio of finds with fingerprints related to pottery production from the Ulucak Pottery Workshop, 6th Mill

Clay and Hematite Lumps

Many large clay lumps[35] were found at Ulucak (**Figure 5.30**) and have been examined carefully for any fingerprints and finger or nail impressions. These large objects seem to be different in shape, size, and inclusions, but all of them were burnt and well preserved. A total of 81 such clay lumps have been examined, 21 of which yielded one or multiple fingerprints and finger impressions. The number of fingerprints on one object ranges from one to 23, and they provided a total of 74 partial fingerprints.

[35] Also defined as “clay loaves” by the excavation director (Çevik and Erdoğu 2020, 84)

Figure 5.30 A selection of clay lumps, some rich in hematite inclusions, from Ulucak (Çevik 2016, Fig. 4). The scale is 40 cm long.

These clay lumps seem to be mixed with either chaff or hematite, which affects their texture and the degree of preservation of epidermal ridges. The more chaff these lumps included, the more difficult it is to identify any epidermal ridges because it is almost impossible to distinguish fingerprints from chaff marks. However, it is much easier to pinpoint fingerprints when the hematite inclusion is high, possibly because the clay mixed with hematite is finer in texture. These clay and hematite mixtures might have been prepared with a different purpose from those with more chaff inclusions. Apart from fingerprints, there are some finger impressions on these clay lumps (**Figure 5.31, Figure 5.32**) that were probably left while kneading the clay dough or turning it to its side. Although these did not yield measurable epidermal ridges, they provide essential information in understanding the hand size of the people working on these objects.

Figure 5.31 Clay lump PLT with four finger impressions and two of the partial fingerprints from its surface.

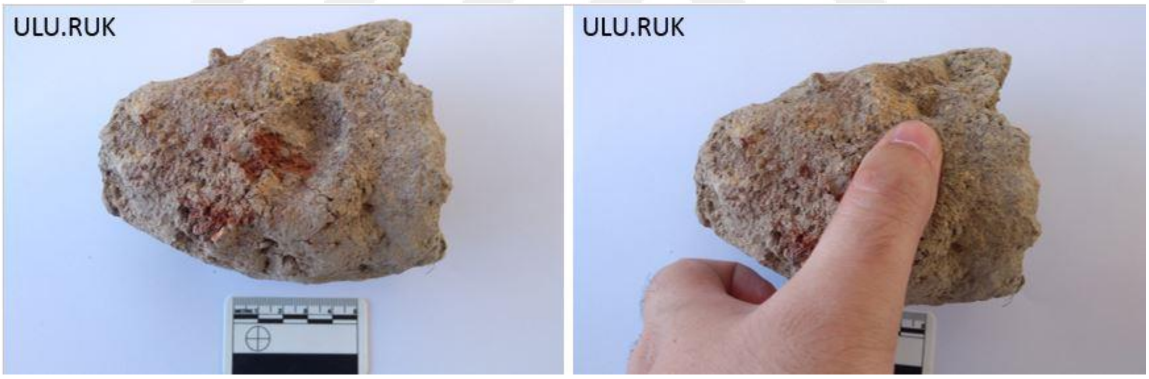


Figure 5.32 A smaller clay lump with a finger impression from Ulucak

Vessel Fragments

Another important find group from the pottery workshop is the vessel fragments. A total of 630 pottery sherds and incomplete vessel fragments from contexts dating to the sixth millennium have been examined, and only eight of them yielded epidermal ridges. The bottom of an incomplete vessel (OEU) is a direct example of the coiling technique and yielded six partial fingerprints (**Figure 5.33**). These fingerprints show that many fingerprints might have been present in different parts of the production process and were eventually removed from the surface.

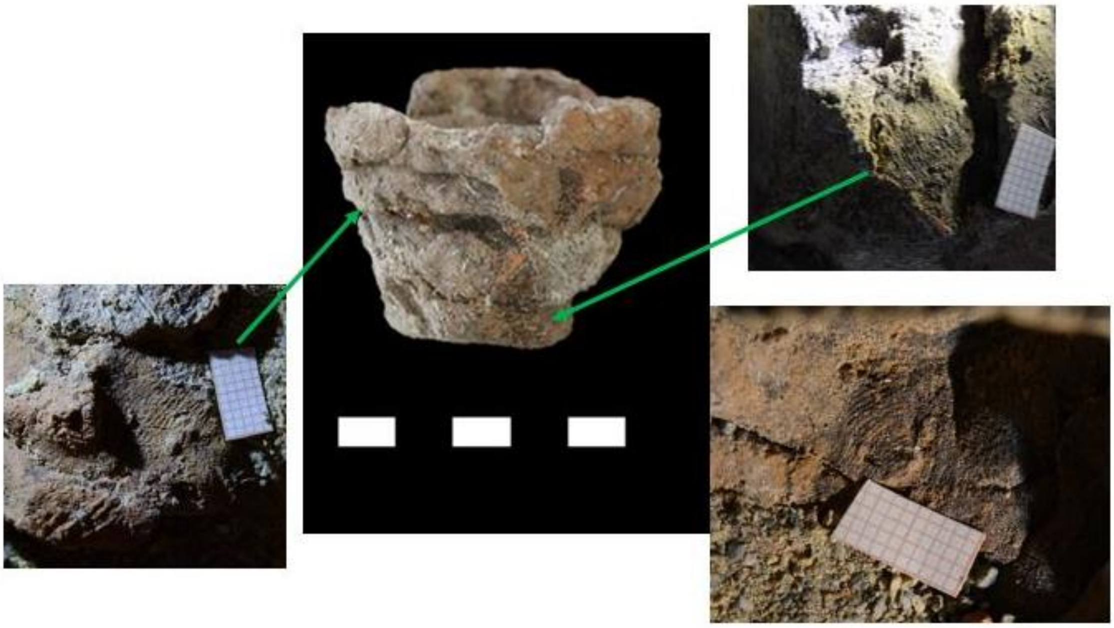


Figure 5.33 ULU.OEU. An incomplete vessel fragment showing the coiling process (Çevik 2016)

5.2.4. Other Object Types

Tokens (Geometric Clay Objects)

Compared to Barcın, Ulucak has many fewer geometric clay objects. Only seven clay balls have been examined at Ulucak, two of which yielded multiple fingerprints on the surface. However, these had as many as 15 partial fingerprints. One of these small clay balls was flattened between fingers, creating a flattened disc shape with eight partial prints (dating to 6th Mill). On the other hand, the other clay ball was crudely made with many cracks on its surface (dating to 7th Mill Early).

Others / Unknown

Apart from the clearly defined object groups, the Ulucak clay object assemblage also yielded 289 miscellaneous objects, most of which either could not be clearly identified or did not yield any fingerprints that can be included in this study. Four clay finds from Level IV (6th Mill category in this dissertation) provided us with nine partial fingerprints. These are objects that do not fall into any category discussed above.[36]

[36] These objects are CAL 809 ULU.01.22 (a clay disc), LUS 4533 ULU.61.13 (loom weight), MAB 4548

5.3. Ekşi Höyük

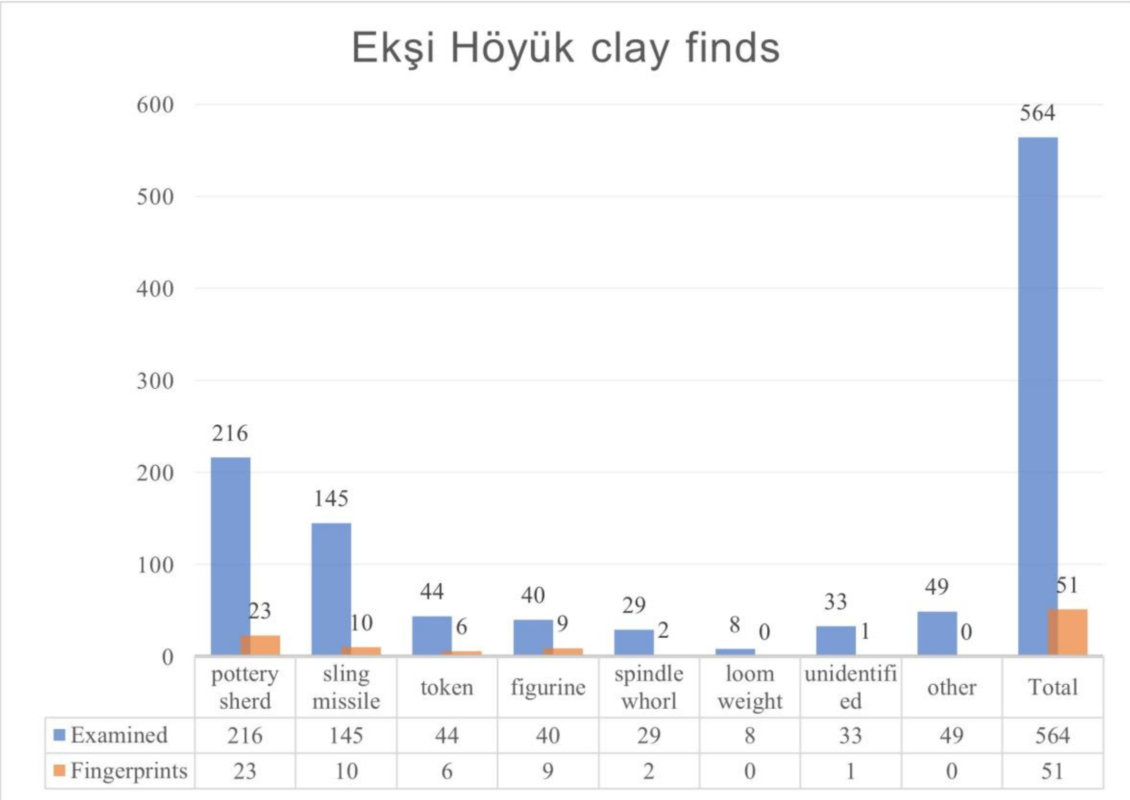


Figure 5.34 Distribution of Ekşi Höyük clay objects analyzed in this study

Compared to Barcın and Ulucak, fewer clay objects were examined from Ekşi Höyük. In addition to 348 clay objects, 216 pottery sherds were analyzed during the 2018 and 2019 excavation seasons, yielding 51 objects with one or multiple partial fingerprints (**Figure 5.34** and **Figure 5.35**). Of these 51 objects, 28 (8% of the whole assemblage) come from the general clay object assemblage, while 23 (10% of all sherds analyzed) belong to pottery sherds. A total of 107 fingerprints have been recorded, measured, and analyzed from Ekşi Höyük.

No clay finds with fingerprints have been found in the earliest layers 7, 6, or 5, possibly due to the low number of artifacts in these occupation levels.[37] The earliest finds

ULU.51.13 (a brush), RUK O10 B7 (unidentified)

[37] Recent radiocarbon dates from Ekşi Höyük are as follows: **Layer 7** dates to 6780-6593 calBCE at 93.6% and 6806-6786 calBCE at 1.8%; **Layer 6** dates to 6680-6590 calBCE at 95% and 6645-6600 calBCE at 68%; **Layer 5** is currently undated; **Layer 4b** is currently undated; the sub-phases of **Level 4a** date to (from oldest to youngest) 6248-6078 calBCE at 95.4%, 6217-6047 calBCE at 95.4%, 6211-6031 at 95.4%, and 6066-5977 calBCE at 86.8% and 5947-5921 calBCE at 8.6%; **Layer 3** dates to 5970-5950 and 5915-5765 calBCE at 95%, and 5890-5835 and 5825-5810 calBCE at 68%; **Layer 2** is currently undated; **Layer 1**

that yielded partial prints come from Layer 4b, followed by the sub-phases of 4a. Layers 4b and 4a approximately correspond to the 7th Mill Early (Before 6200 BCE) and 7th Mill Late (6200-6000 BCE) division of this study. Further samples, especially pottery sherds, were found in Layer 3, which dates to the 6th Mill category in this study. This period is contemporary with Level IV at Ulucak Höyük, where some pottery workshops have been uncovered. Accordingly, the Ekşi Höyük samples have been divided into four groups based on the layer they were found in, their context, and the dating of the comparative samples from the Neolithic layers of Barcın Höyük and Ulucak as 7th Mill Early (finds from Layer 4b), 7th Mill Late (finds from Layer 4a), 6th Mill (finds from Layer 3), and Other (surface finds as well as finds from layers 1 and 2) (**Table 5.1**).

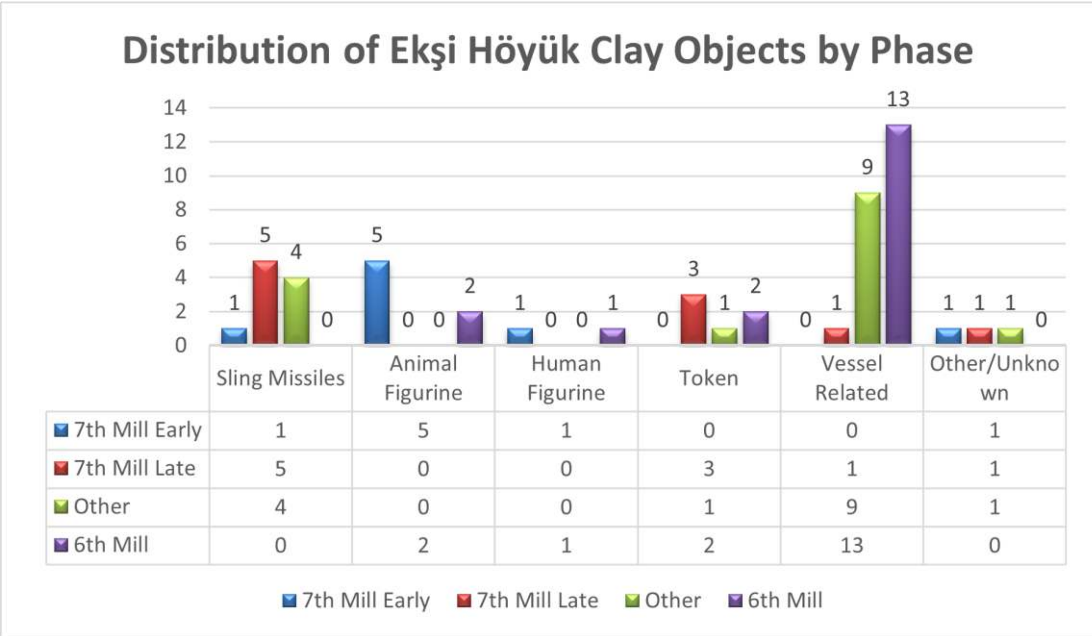


Figure 5.35 A detailed distribution of clay finds from Ekşi Höyük used in this study

5.3.1. Sling Missiles

Out of 145 complete or fragmented sling missiles, only ten (6.9%) yielded epidermal ridges at Ekşi Höyük. While one of these dates to a pre-6200 BCE context (7th Mill Early), five are contemporary with the later Neolithic levels (7th Mill Late), dating to 6200 and 6000 BCE. On the other hand, four are found on the upper layers at the site (Other) (**Figure 5.36**). These provided 33 partial fingerprints in total.

dates to historic periods.

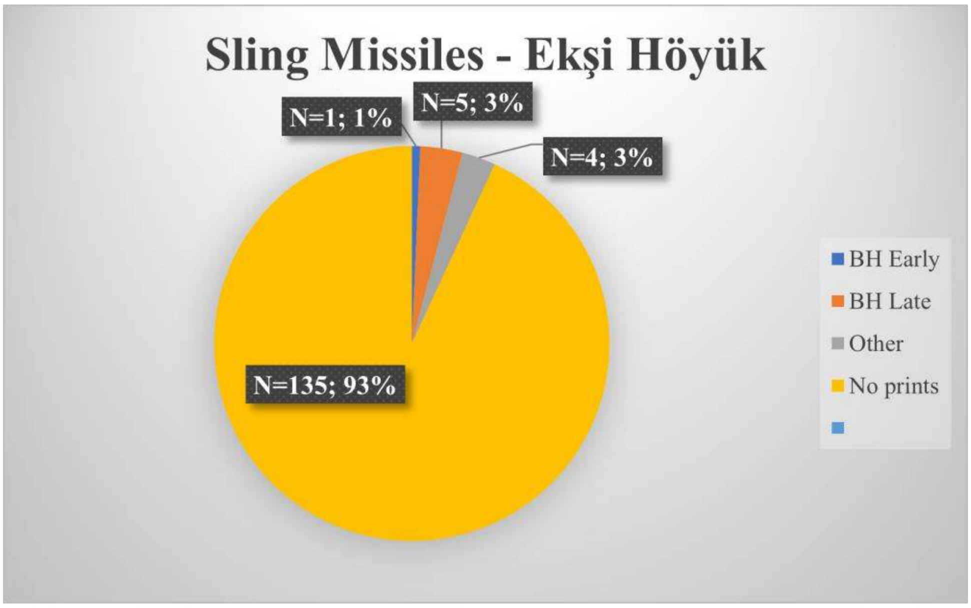


Figure 5.36 Sling Missiles examined from Ekşi Höyük. Results are grouped by the temporal categories of this dissertation.

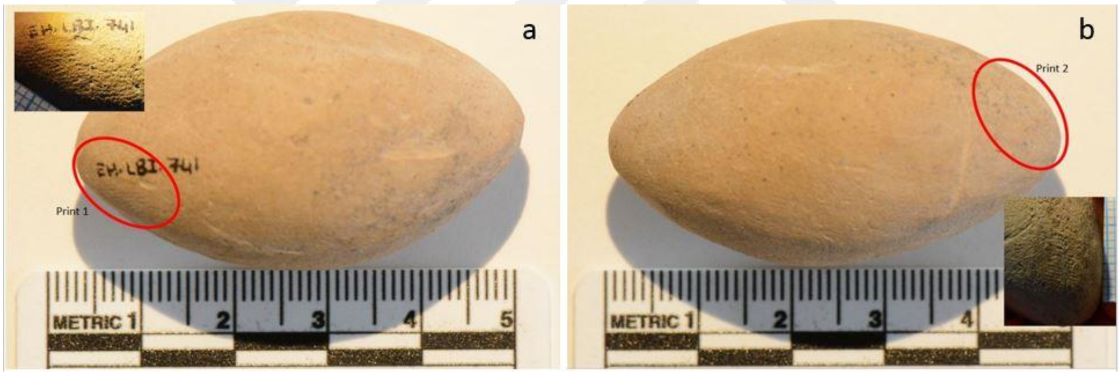


Figure 5.37 EH.LBI.741, a complete sling missile from Ekşi Höyük. The location of fingerprints is indicated on both sides of the object (a and b)

The sling missiles at Ekşi Höyük are biconical, prepared in a similar fashion to the biconical sling missiles from Barcın Höyük. The only difference between the two sites is that those from Ekşi Höyük have more rounded tips than those from Barcın. They were probably made the same way as those from Barcın Höyük and exhibited overlapping fingerprints due to the production process (**Figure 5.37**). While epidermal ridges can be found anywhere on the surface, they are more common towards the tips as these areas were probably shaped with fingertips.

5.3.2. Figurines

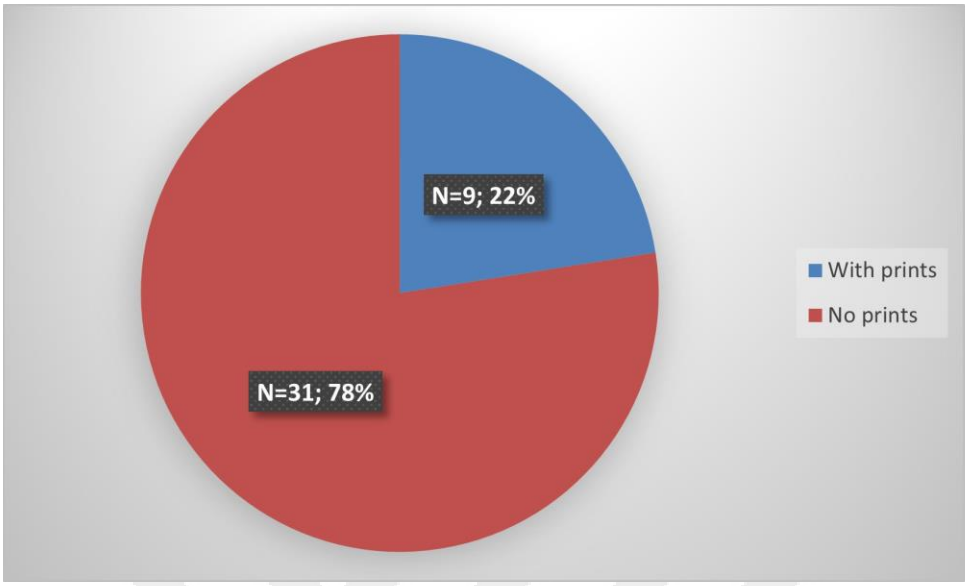


Figure 5.38 Ekşi Höyük figurines, all levels. 22% yielded fingerprints

Figurines, especially animal figurines from Ekşi Höyük, are rich in terms of partial fingerprints. Thirty-three partial fingerprints were embossed on nine figurines (animals and humans combined) out of 40 figurines examined from this site.[38]

Animal Figurines

Of 19 complete animal figurines or fragments, seven had identifiable partial fingerprints. Most of these had more than two fingerprints on their torso, belly, or head. Most notably, two finds were helpful in terms of understanding the production process and the use-life of figurines from Ekşi Höyük. Four animal quadruped figurines[39] from Layer 4b (7th Mill Early) were found with their heads and some of their legs broken off (**Figure 5.39**). These animals looked similar in style and probably were representations of a horned animal, possibly a bull.

[38] Despite the fact that 11 figurine fragments have also been examined as a part of this research, none had clear partial prints that could be added to this analysis. Therefore, this section will only cover animal and human figurines.

[39] EH.JRA.693, EH.JRB.694, EH.JPV.696, EH.JRC.695

Figure 5.39 Animal figurines found close to each other from Layer 4b of Ekşi Höyük with similar attachment scars

Apart from other fingerprints on the torso and the limbs, these figurines yielded multiple epidermal ridges on the inner surface of the break of the head and its attachment to the torso (**Figure 5.40**). Several small fingernail impressions were also visible where the head was attached to the torso, which suggests that the torso and the head (possibly also the limbs) were made separately and attached once they were relatively dry so that the fingerprints were still preserved (**Figure 5.41**). Then, the surface of the attachment was smoothed with an additional layer of clay (**Figure 5.42**) to hide the attachment scars and irregularities. However, these figurines broke at these weak attachments, revealing the production process.

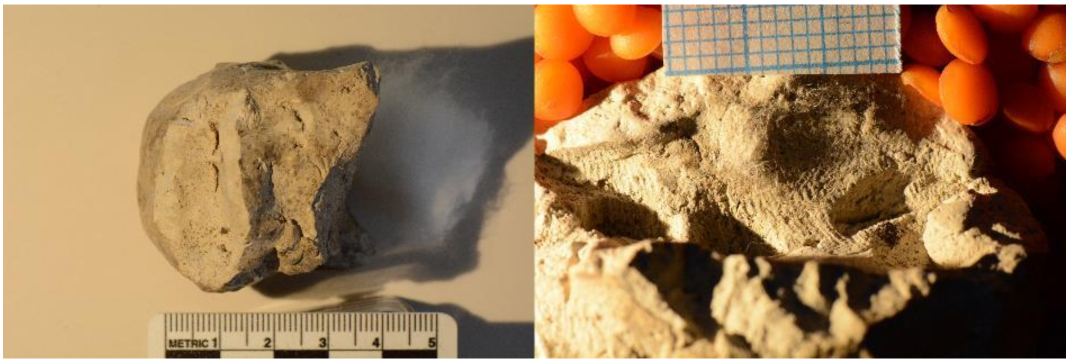


Figure 5.40 EH.JRA.693 shows the break at the neck with three fingernail impressions and fine epidermal ridges

Figure 5.41 EH.JRA.693, the head fragment was poorly attached and broke off, but it can still be easily connected to the torso

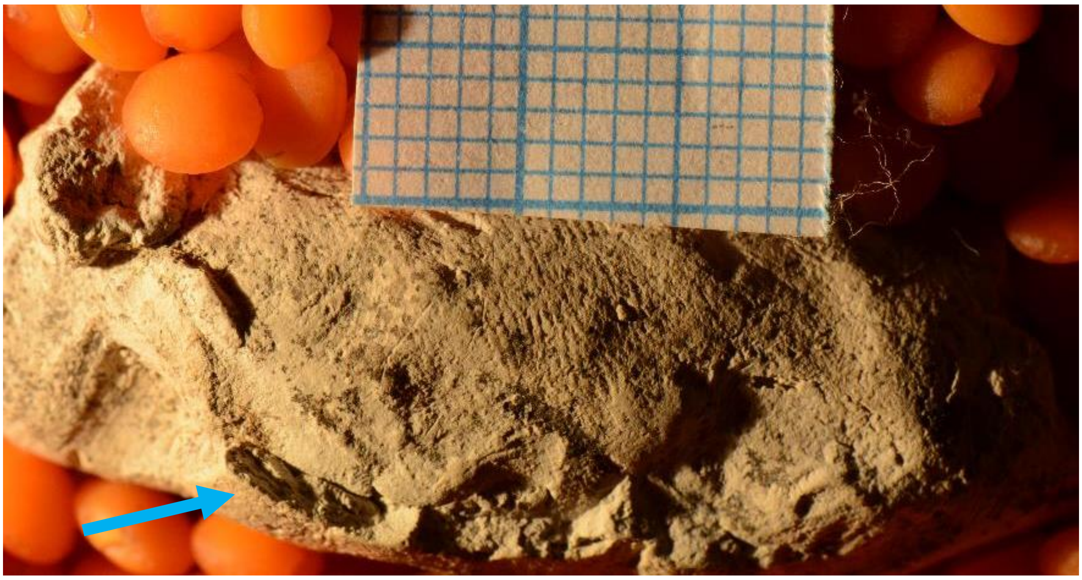


Figure 5.42 EH.JRA.693. The break of the figurine head. Apart from the clear epidermal ridges, it is possible to see the break of a thin layer of coating over the surface, indicated with an arrow

Human Figurines

Only two human figurine fragments out of ten yielded discernible partial fingerprints. One of these was a human head (**Figure 5.43**), broken at the back from Layer 4b (7th Mill Early). The facial characteristics of this figurine were depicted with two lines for eyes, two fingernails or tool marks creating the nose, and possibly a kind of cover/wrap around the mouth indicated by two parallel lines. The head of the figure has two horns or protrusions, possibly indicating some kind of headgear. One small, partial fingerprint was found just below the nose.

Figure 5.43 EH.FSO.510, a human face with a small partial fingerprint

The second figurine is from Layer 3 (6^{th} Mill) and has only one partial fingerprint by the leg (**Figure 5.44**) left at the plastic stage of clay. This is a seated human, legs folded to the sides of its body. The head, left arm, legs, and torso are present, but the right arm broke off. It seems to be holding something in its hands, possibly a baby or a small animal similar to those from the Lakes District (Duru 2008, figs. 159, 161, 177). The figure was decorated with red paint at the back and the front, with clear visible marks.

Figure 5.44 EH.JOA. Almost complete seated anthropomorphic figurine with one partial fingerprint from Ekşi Höyük

5.3.3. Vessel Related Finds (Pottery Sherds)

This category represents any object related to pottery, including pottery sherds, sealings, and jar stoppers. However, it is explicitly used for pottery sherds at Ekşi Höyük as this is the only find group directly linked to vessels at the site. Two hundred and sixteen sherds have been examined from the site, 23 of which had 31 partial fingerprints. The fingerprints come from diagnostic sherds with a rim, base, or handle. These locations seem to be more promising in finding accidental fingerprints as a part of the production process.

Some of these fingerprints, especially those near the rim, appear to be from the palm, not the fingers themselves (**Figure 5.45**). This might be because of how the vessels themselves were handled before they were fired. Most of the prints might be from the initial forming of the vessel when the clay was still plastic, but others were probably left when a red slip was added to the vessels or when they were being carried to the fire with hands smudged with clay when the vessel was bone dry.

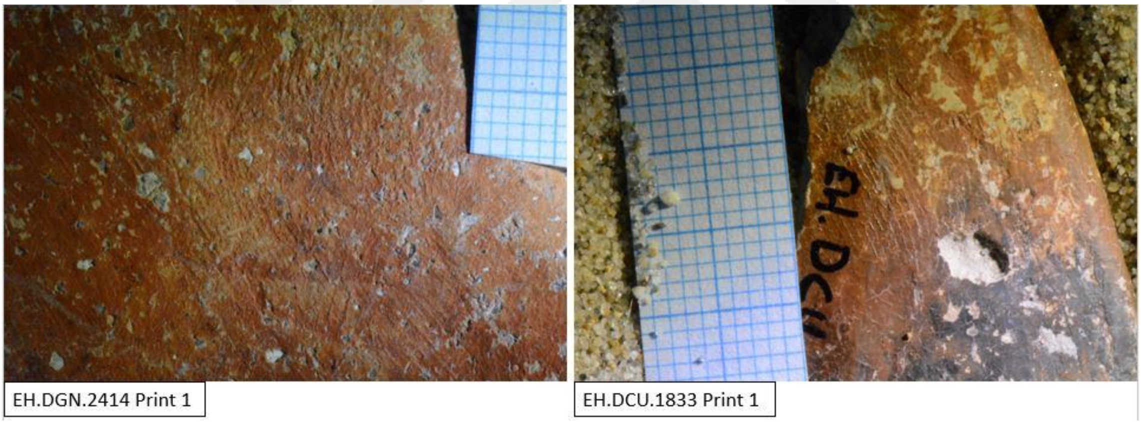


Figure 5.45 Diagnostic rim sherds with partial palmar prints from Ekşi Höyük

5.3.4. Others

This group includes geometric clay objects such as conical tokens and some miscellaneous finds that did not provide us with enough evidence to form their own category.

Tokens (Geometric Clay Objects)

The geometric clay object assemblage at Ekşi Höyük is quite extensive. Of the 44 tokens that have been examined so far, only six of them had epidermal ridges that could be used in this analysis (**Figure 5.46**). These are conical in form, and fingerprints were left during the initial forming process of the tokens. No tokens from the earlier occupation levels (7th Mill Early) yielded evidence for partial fingerprints so they will be excluded from the comparative analyses.

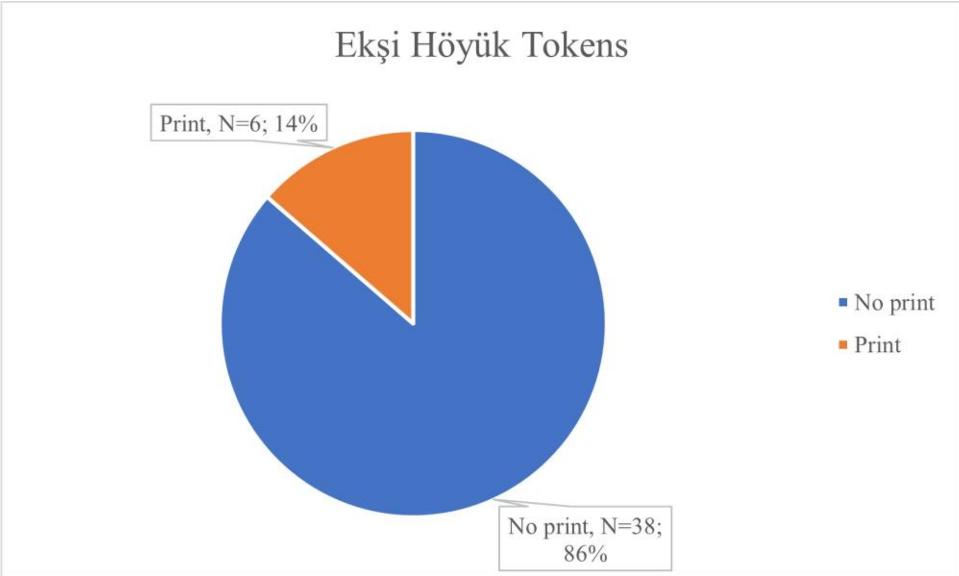


Figure 5.46 Tokens from Ekşi Höyük. 14% of the whole assemblage yielded partial fingerprints

Others

Only three objects from this analysis fall into this category. They are half of a spindle whorl from Layer 1 (CTH.342), a clay ball that might have been an unfinished spindle whorl from Layer 4A (7th Mill Late; EZI.461), and an unknown clay object with a triangular base from Layer 4B (7th Mill Early; FPV.493). These do not seem to yield any discernible pattern.

5.4. Conclusion

This chapter introduces each category of objects that have been analyzed in this dissertation. Each site I focus on here seems to have its own unique characteristics in the preservation and distribution of fingerprints. The Barcın Höyük community was evidently more prone to leaving imprints on the objects they made, except for when it comes to pottery, in comparison to the Ulucak and Ekşi Höyük communities. Sling missile is a category that yielded extensive information in all three case studies. Interesting information about the production techniques on top of the fingerprint data could be discerned from figurines. Vessel-related objects such as pottery sherds, stoppers, and clay lumps yielded interesting yet very different results when considering the presence or absence of imprints on their surface. While pottery sherds are absent from the Barcın Höyük fingerprints assemblage, those from Ekşi Höyük and Ulucak did have some epidermal ridges. Finding clay lumps with fingerprints at Ulucak has given us further insight into the operational steps in pottery production, as they could potentially have been prepared by those who were not the pottery makers. The following chapter will focus on the experimental analysis to determine the shrinkage rate of clay collected from Barcın, Ulucak and Ekşi Höyük.

Chapter 6

6 EXPERIMENTAL ANALYSIS OF CLAY SHRINKAGE

Clay is a plastic material that can be molded into anything, and once an object made of clay is dry and baked at a specific temperature, it becomes solid and durable. This enables any marks such as fingerprints on its surface to become durable, allowing researchers to study the fingerprints left on clay objects millennia ago. However, one of the properties of clay is that it shrinks as it dries. This shrinkage directly affects any imprints on the object's surface because they would also shrink together with the object itself.

The fact that fingerprints on clay shrink is an important issue when a researcher studying these imprints compares them with modern populations or other imprints from other sites that exploited different clay resources. This issue arises because fingerprints on clay become smaller than the actual fingers, making the print appear to belong to an individual with smaller hands. Also, each clay would shrink differently. Therefore, if the measurements of fingerprints are taken at face value without considering the shrinkage rate, the results would be skewed and more biased towards younger individuals and females. To obtain more accurate results, it becomes necessary to experiment with clay to determine how much it shrinks. Therefore, this chapter concentrates on the experimental analyses performed on clay collected from the vicinity of Barcın, Ulucak, and Ekşi Höyük in order to calculate the shrinkage rate at each site.

6.1. Clay Shrinkage

In order to turn clayey soil into a plastic, moldable paste, water is mechanically added to it. Since pure clay and water mixtures are highly plastic and sticky, temper is usually introduced to the mixture to get a more workable and durable paste (Velde and Druc 1999, 152). Once the clay paste is ready, objects can be formed, treated, and left to dry. The added mechanical water evaporates at room temperature, drawing clay particles closer together and causing the object to shrink.

Any clay would shrink to some extent when it dries, but clay's shrinkage rate heavily depends on the clay type, pore size, and the size and number of inclusions in the clay paste (Velde and Druc 1999, 154). Clays with fine particle size would require more water to become plastic (Rice 2015, 92), while objects made with such clay would lose more water and shrink further in the drying process. Based on its clay/water ratio, clay can be divided into the following five stages:

a) **Wet Stage:** This type of clay has a high amount of water added to it and is of watery consistency. Therefore, the resulting clay mixture can be used as a slip for decorating finished surfaces. It is easy to leave fingerprints on dry or leather hard surfaces if hands are smeared with wet clay.
b) **Plastic Stage:** In this category, the water to clay ratio allows the paste to be used for forming and molding objects. It is still relatively sticky but moldable. It is possible to leave fingerprints on the objects at this stage.
c) **Leather Hard Stage:** Objects formed by plastic clay need to air-dry at room temperature for a short period of time before they can be handled, fixed, treated, or decorated. Leather hard objects are not completely dry but strong enough to be handled without being damaged. It is still possible to leave fingerprints on objects with some force with dry hands. However, wet fingers can easily leave marks on clay objects at this stage.
d) **Bone Dry Stage:** At this stage, molded and decorated objects lose all of their plasticity and can break easily. Clay objects would have lost most of their mechanical water and have shrunk in size at this point. It is not possible to leave fingerprints on the object with dry hands; however, fingers smeared with wet slip would quickly leave imprints on bone dry objects.

There are four kinds of water in plastic clay: "shrinkage film water, pore water, surface-adsorbed water, and interlayer and crystal lattice water" (Rice 2015, 89). Two of these, shrinkage film water and pore water, are lost during air-drying until it becomes bone dry. The shrinkage of clay objects can be measured in linear and volume dimensions. A clay object loses most of its film water and shrinks very quickly until it becomes leather hard; however, the evaporation of water slows down after this point, partially due to the lower concentration of water (mainly pore water) in clay and the shrinkage would be much lower at this stage (Rice 2015, 90 Fig. 5.1). A bone dry object would have lost most of its water content, and even preheating (100-120^{o}C) would not significantly affect the size reduction (Rice 2015, 91).

6.2. Experimental Analysis: Determining Clay Shrinkage of Archaeological Finds

Since clay shrinkage might significantly affect the breadth of epidermal ridges, this could skew the results in favor of smaller fingerprints in the data. Without the necessary adjustments, sex estimations based on fingerprints would provide more females among the adults, while age estimations based on these fingerprints would result in a higher number of younger children among the subadults than the actual population. Hence, it is necessary to devise an experimental analysis to determine how much the clay used to make these archaeological objects shrinks so that the epidermal ridge breadth measurements can be adjusted accordingly.

In order to tackle this problem, a two-step experiment has been devised. The first step of this experiment aims to understand whether the shape and size of the object and the duration and temperature of the fire impact the shrinkage rate. The second step of this experiment focuses on determining the shrinkage rate of clay at four different types of fingerprints left at different stages of the drying process:

a) Plastic prints left on plastic clay,
b) Prints left by dry hands on leather hard clay,
c) Prints left by fingers smeared with wet clay on leather hard clay,
d) Prints left by fingers smeared with wet clay on bone dry clay.

An additional third step of this experiment is performed on the clay collected from Ulucak Höyük. This third step aims to understand if the amount of inclusions, hematite in this experiment, affect the shrinkage rate. The experimental analysis was conducted for clay collected from the vicinity of Barcın Höyük, Ekşi Höyük and Ulucak Höyük, and a step-by-step explanation is discussed below in detail.

6.2.1. *Clay collection and preparation*

While where the Neolithic communities of Barcın Höyük and Ulucak Höyük extracted the clay that they used in their daily lives is currently unknown, a nearby riverbed provided evidence for a possible clay source for Ekşi Höyük.[40] In order to determine the clay shrinkage at each site, clay was collected from possible clay sources at or near Barcın Höyük, Ekşi Höyük, and Ulucak Höyük.

[40] Personal communication with Dr. Fulya Dedeoğlu, 2019.

The Barcın Höyük clay sample is collected from the soil that was dug out for the Marmaracık Lake Drainage Canal, a nearby deep canal that passes through the Yenişehir Plain (**Figure 6.1**). Clay was collected in two bags weighing approximately 6.6 kg and is very lumpy, hard, and orangey yellowish in color.

Figure 6.1 Marmaracık Lake Drainage Canal Clay (left), Ekşi Höyük Riverside Clay (middle), clay from Ulucak Höyük (right)

Most of the Ekşi Höyük finds were made from light grayish clay. The excavation team provided me with a bag of (approximately 1.5 kg) light gray clay that they collected from a nearby riverside while surveying the region. This riverside clay had a fine texture, and it was mixed with tiny white stones.[41]

Clay sample from Ulucak Höyük, on the other hand, was collected directly from the excavation. This sample comes from a thick layer sealing level IV. It is very lumpy yet fine in texture. Apart from this, some hematite was also collected from the nearby hematite source that the inhabitants of Ulucak also utilized for their needs.[42]

The samples were weighed and transferred into a new container (**Figure 6.2** left), where the chunky clay lumps were beaten with a pestle until they became finer with minimal inclusions. In this process, any inclusions such as twigs and small stones were removed manually. The beaten soil was sieved with a 5x5 mm grid sieve and then with a

[41] This clay source is currently being analyzed by Dr. Barış Semiz from Pamukkale University Department of Geological Engineering in order to determine whether this clay source was exploited by the Ekşi Höyük community in the Neolithic period.

[42] Personal communication with Dr. Özlem Çevik, the excavation director of Ulucak Höyük in 2018.

1x1 mm grid sieve in order to get rid of the small stones (**Figure 6.2** middle) until the desired very fine, clayey soil was obtained (**Figure 6.2** right).

Figure 6.2 Marmaracık Lake Drainage Canal Clay before beating (left), sieving with a 1x1 mm grid sieve (middle), after sieving (right)

Once sieving was completed, water, approximately three times the volume of the clay, was added to the clay, and the contents of the container were mixed by hands (**Figure 6.3** left). After a 15-minute waiting period, the heavy sandy fraction of the clayey soil settled to the bottom of the container. At the same time, tiny plant particles floating on the water were collected from the top.

Figure 6.3 Mixing clay with water (left), pouring the mixture through a sieve (middle left), pouring the remaining mixture into a cloth bag (middle right), hanging the cloth bag to dry out excess water (right)

After that, the mixture was transferred into another container, where a 5x5 mm sieve was used again to catch any larger stones or sands. However, more minor inclusions were intentionally left in the mixture in order to mimic the inclusions of clay found at the Neolithic sites of Barcın, Ekşi, and Ulucak. Finally, the mixture of clay and water was transferred into a cotton cloth bag and hung to dry so that the excess water could evaporate (**Figure 6.3**). The result was plastic, moldable clay with very small inclusions that look similar to the Neolithic clay objects in texture. This process was repeated for the clay collected from each site. Once the samples were prepared this way, it became possible to proceed with the experiment.

6.2.2. Step One: External Factors Affecting Clay Shrinkage

Table 6.1 First step of the experiment. The table shows the measurements of the samples when they are plastic, after preheating, and after they are baked in a pottery kiln.

Clay Source	Sample No	Object type	Initial Length (cm)	Initial Height (cm)	Initial Width (cm)	Initial Weight (gr)	Preheating Length (cm)	Preheating Height (cm)	Preheating Width (cm)	Preheating Weight (gr)	Post-Firing Length (cm)	Post-Firing Height (cm)	Post-Firing Width (cm)	Post-Firing Weight (gr)
BH	1	Clay plaque	15.5	6	2	352	14.1	5.8	1.9	257	14.1	5.8	1.9	239
BH	2	Clay plaque	12	7.5	2	324	10.6	6.8	2	235	10.6	6.8	2	229
BH	3	Clay plaque	6	5.8	3	175	5.6	5.5	2.6	130	5.6	5.5	2.6	122
BH	4	Clay plaque	13	6	1	258	12	5.44	1.65	190	12.1	5.44	1.64	184
BH	5	Animal Figurine	5.5	3	2	33	4.95	2.7	2.2	24	4.9	2.5	2.2	23
BH	6	Sling missile	6.5	3.5	2	78	6.1	3.35	2.4	57	6	3.35	2.4	56

The main aim of the first phase of the experiment was to determine if the baking process affects the shrinkage rate of clay objects. The clay was kneaded to remove air bubbles, and once the clay was ready to be formed, the first set of experimental samples was prepared. The first step of the experiment was only performed on the clay collected from the vicinity of Barcın Höyük. Four rectangular blocks of different dimensions, one quadruped animal figurine, and one flattened elliptical sling missile were formed and left to dry for seven days (**Table 6.1**, **Figure 6.4**). Once the samples became completely bone dry and stopped shrinking, they were baked in an oven[43] at 150°C for one hour to get rid

[43] For preheating, I used a household oven due to Covid-19 restrictions in Turkey.

of the remaining pore water. The objects cooled off inside the oven to prevent sudden temperature changes that might lead to cracks on the surface of the objects. No cracks or breakages were present at the end of preheating. Then, the samples were baked in a pottery kiln at Boğaziçi University between 500ºC and 700ºC for various hours (**Table 6.2**). The duration of the fire was intentionally selected to range between 2.5 hours to 8 hours to understand whether the length or temperature of the heat affected how much the clay would shrink.

Table 6.2 Barcın Höyük samples were prepared to compare the shrinkage rate after preheating and kiln baking.

Clay Source	**Sample No**	**Line Initial (cm)**	**Line Preheating (cm)**	**Line Post Firing (cm)**	**Firing Temperature (Celsius)**	**Fire Duration (Hours)**	**Shrinkage Rate (%)**
Barcın Höyük	1	10	8.96	8.96	700	8 h	10.4
Barcın Höyük	2	10	8.91	8.9	500	2.5 h	11
Barcın Höyük	3	5	4.5	4.5	700	8 h	10
Barcın Höyük	4	10	9.09	9.05	500	8 h	9.5
Barcın Höyük	6	1	0.85	0.9	500	2.5 h	10

Experimental pottery analyses calculate clay shrinkage based on the initial preheating between 110-150ºC as this would be enough to remove all the excess pore water from clay (Rice 2015, 91–92; Cordell, Wallis, and Kidder 2017). The results of the first step of the experiment in this dissertation also yield similar results. They show that no significant changes occur in clay shrinkage after preheating, regardless of the duration and temperature of baking. It should be noted that the firing temperature for this experiment did not go above 700ºC because the firing temperature for Barcın Höyük pottery might have been below 650-750ºC (B. de Groot et al. 2017, 550).

Figure 6.4 Barcın Höyük clay, first stage samples. Samples are at the bone dry stage (left) and after they are baked in the kiln (right)

6.2.3. Step Two: Determining Clay Shrinkage

The second step of the experimental analysis involved determining the shrinkage rate of fingerprints left on clay objects at different stages of the production process. Fingerprints can be left on a clay object while it is being formed and is still plastic, while the object is leather hard but handled with pressure or with fingers smeared with wet clay, and finally, when the object is bone dry but handled with hands daubed with wet clay. Because the object itself would have already shrunk to a certain degree at each stage, fingerprints left at these stages would shrink at different percentages. Therefore, it is possible to determine the shrinkage range for fingerprints left at the plastic stage (which would yield the highest shrinkage rate) and at the bone dry stage with wet clay (which would yield the lowest shrinkage rate).

Table 6.3 The second step of the experiment. Fingerprints and 10 cm lines were left at different stages of drying. The shrinkage rate ranges from 9% to 1% for Barcın Höyük, from 8.4% to 0.3% for Ekşi Höyük, and 10.2% to 0.4% for Ulucak Höyük

Clay Source	Object No	Clay Stage	Line Initial (Cm)	Fingerprint Initial Size (cm)	Line Dried (Cm)	Fingerprint Dried Size (cm)	Line Preheated (Cm)	Fingerprint Preheated (cm)	Shrinkage Rate (%)
Barcın Höyük	7	wet print on plastic clay	10	2.1cm long 1.5cm wide	9.1	1.7cm long 1.46cm wide	9	1.44cm wide 1.74cm long	10
Barcın Höyük	8	plastic print on plastic clay	10	1.6cm long 1.56cm wide	9.1	1.5cm wide 1.5cm long	9.1	1.45cm wide 1.45cm long	9
Barcın Höyük	9	leather hard clay	10	1.3cm long 1.45cm wide	9.2	1.36cm wide 1.27cm long	9.18	1.36cm wide 1.25cm long	8.2
Barcın Höyük	10	leather hard clay wet print	10	1.4cm long 1.5cm wide	9.21	1.5cm wide 1.35cm long	9.2	1.44cm wide 1.33cm long	8
Barcın Höyük	11	bone dry clay wet print	10	BH: 2cm long 1.55cm wide; Modern: 2.34cm long 1.6cm wide	9.93	BH: 1.94cm long 1.53cm wide; 2.3cm long 1.56cm wide	9.9	BH: 1.55cm wide 2.04cm long; 1.57cm wide 2.3cm long	1
Ekşi Höyük	12	plastic print on plastic clay	10	2.8cm long 1.77cm wide	9.2	2.4cm long 1.5cm wide	9.16	2.4cm long 1.5cm wide	8.4
Ekşi Höyük	13	leather hard clay	10	2.65cm long 1.61cm wide	9.25	2.46cm long 1.61cm wide	9.19	2.5cm long 1.61cm wide	8.1
Ekşi Höyük	14	leather hard clay wet print	10	a. 2.9cm long 1.64cm wide b. 2.32cm long 1.35cm wide	9.23	a. 2.7cm long 1.52cm wide b. 2.12cm long 1.33cm wide	9.2	a. 2.7cm long 1.56cm wide b. 2.14cm long 1.33cm wide	8
Ekşi Höyük	15	bone dry clay wet print	10	2.66cm long 1.8cm wide	10	2.3cm wide 1.81cm long	9.97	2.68cm long 1.8cm wide	0.3
Ulucak Höyük	16	plastic print on plastic clay	10	2.96cm long 1.64cm wide	8.98	2.66cm long 1.44cm wide	8.98	2.66cm long 1.47cm wide	10.2
Ulucak Höyük	17	leather hard clay	10	1.41cm long 1.6cm wide	9.15	1.33cm long 1.43cm wide	9.14	1.31cm long 1.44cm wide	8.6
Ulucak Höyük	18	leather hard clay wet print	10	2.96cm long 1.50cm wide	9.12	2.7cm long 1.365cm wide	9.12	2.7cm long 1.38cm wide	8.8
Ulucak Höyük	19	bone dry clay wet print	10	3.47cm long 1.74cm wide	9.96	3.47cm long 1.72cm wide	9.96	3.47cm long 1.72cm wide	0.4

Ulucak Höyük	20	5% hematite 95% clay, plastic print on plastic clay	10	2.7cm long 1.6cm wide	8.96	2.44cm long 1.4cm wide	8.99	2.46cm long 1.41cm wide	10.1
Ulucak Höyük	21	10% hematite 90% clay, plastic print on plastic clay	10	1.76cm long 1.61cm wide	9.08	1.59cm long 1.46cm wide	9.08	1.57cm long 1.465cm wide	9.2
Ulucak Höyük	22	15% hematite 85% clay, plastic print on plastic clay	10	2.8cm long 1.55cm wide	9.06	2.535cm long 1.41cm wide	9.08	2.53cm long 1.4cm wide	9.2
Ulucak Höyük	23	20% hematite 80% clay, plastic print on plastic clay	10	3.1cm long 1.64cm wide	9.21	2.87cm long 1.51cm wide	9.21	2.87cm long 1.52cm wide	7.9
Ulucak Höyük	24	30% hematite 70% clay, plastic print on plastic clay	10	2.76cm long 1.68cm wide	9.21	2.55cm long 1.55cm wide	9.21	2.55cm long 1.55cm wide	7.9
Ulucak Höyük	25	50% hematite 50% clay, plastic print on plastic clay	10	2.91cm long 1.65cm wide	9.38	2.71cm long 1.55cm wide	9.38	2.72cm long 1.55cm wide	6.2

Figure 6.5 Barcın Höyük (above), Ekşi Höyük (middle), and Ulucak Höyük (below) standardized clay plaques prepared for the second step of the experiment

To determine the minimal and maximal range of shrinkage rate for clay collected from Barcın Höyük, Ekşi Höyük, and Ulucak Höyük, four standardized test plaques[44] with similar dimensions have been prepared for each site (**Figure 6.5**, see **Table 6.3** for

[44] Sample Object No 7 (also visible in Figure 4) was prepared as a back-up test plaque but not baked in the oven. Therefore, it was omitted in Table 3 and in the discussion.

detailed measurements). A finger impression was pressed on each plaque at a different stage of drying, following the specifications mentioned above, and a 10 cm line was drawn on the plaque together with the fingerprint to measure how much it would shrink once it was completely dry (**Table 6.3**). The edges of the fingerprints were marked with a pen to ensure that the same areas would be measured in the future. Once these objects were completely dry, they were baked in a household oven for one hour at 120°C. They were placed in the oven before heating it, and they were left in the oven overnight after it was turned off to let the samples cool off slowly to prevent sudden temperature changes that might lead to cracks on the surface.

In order to calculate the linear drying shrinkage rate, Prudence Rice's calculation method, as explained in *Pottery Analysis: A Sourcebook* (Rice 2015, 93 Table 5.1), was used:

$$\text{Shrinkage rate \%} = \frac{100 \times \ (Length\ wet - Length\ dry)}{Length\ wet}$$

Based on the equation above, the shrinkage rate for the clay collected from Barcın Höyük is 9% when the fingerprints are left at the plastic stage (maximum shrinkage for Barcın Höyük) and 1% if the fingerprints are left at the bone dry stage (minimum shrinkage for Barcın Höyük). On the other hand, the clay collected from the survey in the vicinity of Ekşi Höyük shrinks 8.4% if the fingerprints are left at the plastic stage (maximum shrinkage for Ekşi Höyük) and 0.3% if the fingerprints are left at the bone dry stage (minimum shrinkage for Ekşi Höyük). Finally, the Ulucak Höyük clay shrinks 10.2% when fingerprints are left when the clay is still plastic (maximum shrinkage rate of Ulucak Höyük) and 0.4% if the prints are left at the bone dry stage (minimum shrinkage for Ulucak Höyük). However, these results should be adjusted to the shrinkage rate of Králík and Novotný's (2003) reference used for comparison in this analysis. This adjustment is necessary because Králík and Novotný's reference was collected from fingerprints on clay objects. This clay shrunk 7.5% (Králík and Novotný 2003, 17), so their statistical calculations and reference values were calculated based on this shrinkage rate. As a result, the following equation was prepared to adjust the shrinkage rate of the archaeological samples:

$$Adjusted\ Shrinkage = \left(\frac{100 - \text{KN2003 Shrinkage}}{100 - \text{Experiment shrinkage}}\right) \times Data$$

Based on the equation above, the maximum and minimum shrinkage rate for the Barcın Höyük, Ekşi Höyük, and Ulucak Höyük samples can be adjusted to the archaeological finds for the analysis as below:

$$Adjusted\ Shrinkage\ BHmax = \left(\frac{100 - 7.5}{100 - 9}\right) \times Data$$

$$Adjusted\ Shrinkage\ BHmin = \left(\frac{100 - 7.5}{100 - 1}\right) \times Data$$

$$Adjusted\ Shrinkage\ EHmax = \left(\frac{100 - 7.5}{100 - 8.4}\right) \times Data$$

$$Adjusted\ Shrinkage\ EHmin = \left(\frac{100 - 7.5}{100 - 0.3}\right) \times Data$$

$$Adjusted\ Shrinkage\ UHmax = \left(\frac{100 - 7.5}{100 - 10.2}\right) \times Data$$

$$Adjusted\ Shrinkage\ UHmin = \left(\frac{100 - 7.5}{100 - 0.4}\right) \times Data$$

6.2.4. Step Three: Hematite Inclusions in Clay

Besides what stage of the production a fingerprint was left, the type of inclusions in clay might play a role in how much a fingerprint will shrink. Most objects in the dataset did not seem to have additional temper apart from the natural grit or sand already present in the clay. The only object group that seemed to have an additional temper was a group of clay lumps from the Pottery Workshop at Ulucak (6^{th} Mill layers). Hematite was added to some of the large clay lumps at the site, while others lacked this temper. As a result, it became necessary to understand whether different people in terms of age or sex made these. However, even if there was a difference, it was impossible to reject hematite's impact on these results. Therefore, understanding whether there was a significant difference between the two types of clay lumps and determining how hematite affects clay shrinkage was necessary. Apart from determining the minimal and maximal shrinkage rate of clay, an additional step was taken in the experiment for the Ulucak clay in order to solve this problem.

Six new clay plaques with varying amounts of hematite mixed with clay have been prepared. The hematite to clay ratio ranged from 5% to 50% (**Table 6.3**). A fingerprint was pressed on each plaque during the plastic stage, and the edges of these prints have been marked for future measurements.

Figure 6.6 Step three of the experiment. Six clay plaques were prepared by mixing clay and hematite collected from Ulucak

Visual observations show that the higher the hematite inclusions, the more pigmented the final object is. Moreover, this experiment clearly shows that the amount of hematite in clay significantly affects the shrinkage rate. If there is only 5% hematite in the mixture, the shrinkage rate changes by only 0.1% (10.2% to 10.1%). However, when as much as 50% hematite is in the mix, the shrinkage rate decreases to 6.2%. This shows that hematite might have significantly impacted how much the clay lumps shrink when they dry. Although it is impossible to speculate on how much hematite was added to clay to form the clay lumps, it is clear that the fingerprints on clay lumps rich in hematite would appear larger than those without any inclusions.

6.3. Discussion and Conclusion

As I have briefly discussed in Chapter 4.5, the shrinkage rate of clay might significantly affect the size of fingerprints. Clay loses its water content and shrinks when it dries. This could change the size of the epidermal ridges left on clay objects as they would also get smaller. If clay shrinkage is not taken into consideration, it could lead to biased results because the size of these prints would be smaller, increasing the number of female prints among adults and child prints among subadults.

The three-step experiment discussed in detail above aims to understand whether clay shrinks after it is preheated above 110ºC or not, second, the shrinkage rate for the clay collected from Barcın, Ekşi, and Ulucak at different stages of the production process, and third, whether hematite inclusions have a significant effect on clay shrinkage. The first step of the experiment supports the idea that preheating objects or brisque firing above 100ºC is sufficient to calculate the shrinkage rate of clay because the dimensions (**Table 6.1**) and the reference lines (**Table 6.2**) did not change when they are fired in a pottery kiln for a long time. Since they lost some of their water content, on the other hand, the weight of the experimental objects was reduced by a few grams.

For the second step of the experiment, I concentrated on determining the shrinkage rate of clay collected from the archaeological sites mentioned above by preparing four standardized test plaques for each site. Intentional or accidental fingerprints can be left on clay objects at different stages of the production process. While it is possible to leave fingerprints when a person is initially forming the object at the plastic stage of clay, one can leave fingerprints while transferring or fixing the object at its leather hard stage. Although clay is relatively more durable at the leather hard stage, it is possible to leave marks if the object is held or pinched too tight with dry hands or if the hands are daubed with wet clay, paint, or slip. Moreover, fingers can leave marks when the object is entirely bone dry or after the initial fire-treatment (preheating) by adding a layer of decoration, glaze, paint or slip. Fingerprints left at the plastic stage would shrink along with the clay itself, while for those left at the bone dry stage, shrinkage would be very minimal because the object itself would have lost its water content before the print was left on the surface. Fingerprints are expected to shrink between these maximum and minimum shrinkage rates.

The third step of the experiment only focused on how adding hematite to clay affects the shrinkage rate at Ulucak Höyük. The inclusions in clay can potentially significantly affect how much a lump of clay would shrink. The experimental results show that the object will shrink less if the hematite ratio is high in the clay mixture. This is because some materials, such as hematite, do not hold as much water as clay and when they dry, they do not lose as much water as a similar type of object made out of pure clay.

This experiment demonstrates that not only the clay type and source but also the kind and amount of inclusions in the mixture play a role in how much clay shrinks. While these results are striking, they also show that there might be multiple factors at play in the millimetric changes in the dimensions of fingerprints on clay objects. This is why it is essential not to base one's interpretations of age and sex on the measurements of a single fingerprint or to pinpoint a specific age/sex category by using a single fingerprint. Instead, multiple fingerprints should be analyzed together to have an idea about the possible age/sex range they might belong. The following chapter concentrates on the results of the statistical analyses performed on the fingerprint measurements from the case studies. Statistical analyses could be computed once the shrinkage rate of clay from each site was adjusted to the reference (Králík and Novotný 2003).

Chapter 7

7 RESULTS FROM STATISTICAL ANALYSES

The fingerprints recorded from Barcın, Ulucak, and Ekşi Höyük were carefully measured, and the results were fitted to the maximum shrinkage rate based on the results from the previous chapter. Then, various statistical tests were performed on these results to gather age and sex estimations. This chapter discusses the results of the statistical analyses on fingerprints that come from the case studies.

The comparative reference material for this fingerprint analysis has been provided by Králík and Novotný (2003). The reference comes from the modern Czech population, grouped into six categories based on the age and sex of the participants at the time of the experiment. These groups are:

a) 0-6 yr: Children up to 6 years old, both girls and boys,
b) 6-10 yr: Children between 6 and 10 years old, both girls and boys,
c) F10-15 yr: Female adolescents from 10 to 15 years old,
d) M10-15 yr: Male adolescents from 10 to 15 years old,
e) F15- yr: Female adults above 15 years old,
f) M15- yr: Male adults above 15 years old.

Ideally, a dermatoglyphic study should not compare two distinct populations, such as the modern Europeans and Neolithic Anatolians, for estimating age and sex because there could be differences between these ethnically, geographically, and temporally distinct groups at the fingerprints level that might affect these estimations. However, Králík and Novotný's work is currently among the few extensive samples gathered from fingerprints left on modern clay objects that we can use as reference because they have been collected in a natural setting from actual objects shaped by people without any prior knowledge or directions that might impact how they press their fingers on the clay. Therefore, this reference set provides information about which parts of the hand people tend to use to shape clay objects that can be used as a guide for the dataset studied in this dissertation.

First, descriptive statistics of data from each site were calculated at the level of each object type and compared with the reference sample.[45] As more than one person can

[45] Results of the statistical calculations have been provided in Appendix 1.

leave fingerprints on a clay object, it is necessary to understand whether multiple prints on an object belong to the same individual. The modern reference samples this dissertation uses for comparisons were collected in a controlled environment where multiple imprints from different parts of the hands were present, but these imprints strictly came from a single individual.[46] Therefore, the standard deviations of the modern samples are not very high and only reflect the different parts of the hand rather than multiple people handling these objects. The mean epidermal ridge breadth shows variations in different sections of human hands; for example, the epidermal ridges on the palm, especially those in the thenar, are wider than the fingertips. Thus, the standard deviations of the samples from each site were compared with the reference. The general results point to a lower standard deviation among the archaeological samples, which indicates that the multiple fingerprints on the same objects probably belonged to the same individuals (**Figure 11.1**, **Figure 11.5**, **Figure 11.9**).

A one-way analysis of variance (ANOVA) test was performed for each site in order to determine whether statistically significant differences exist among the groups of objects with fingerprints and the six groups from the reference. Results for each site yielded a $p<.001$, confirming a statistical difference between at least two groups.[47] A summary of the results from each site discussed individually is provided below.

7.1. Barcın Höyük

This study analyzed 103 objects from three different periods from Barcın Höyük. The statistical comparison between fingerprints found on these objects with the reference is presented in the boxplot in **Figure 7.1**. The object groups in the boxplot have been divided into three periods as in 7th Mill Early (pre-6200 BCE contexts), 7th Mill Late (6200-6000 BCE contexts), and Other in order to understand if there has been a change in labor division through time. The comparisons of these groups with the reference show that most object groups seem to have been made by adolescents or adults, as the boxplots fall between the upper and lower horizontal lines. The mean epidermal ridge breadth (MRB) values equal to and above 520 micrometers (represented by the red horizontal line on the graph) represent only adult male fingerprints. On the other hand, the MRB values equal to and below 390 micrometers (represented by the green horizontal line on the

[46] Information about the modern reference comes from Králík and Novotný's 2003 article and personal communication with Miroslav Králík in 2017 about data collection.
[47] Results of ANOVA and the Post-hoc tests performed afterwards are provided in the Appendix in detail.

graph) represent subadults younger than 15 years old. However, values between these two lines are more challenging to interpret without further statistical tests (A more detailed comparison of means is provided in **Figure 11.2**).

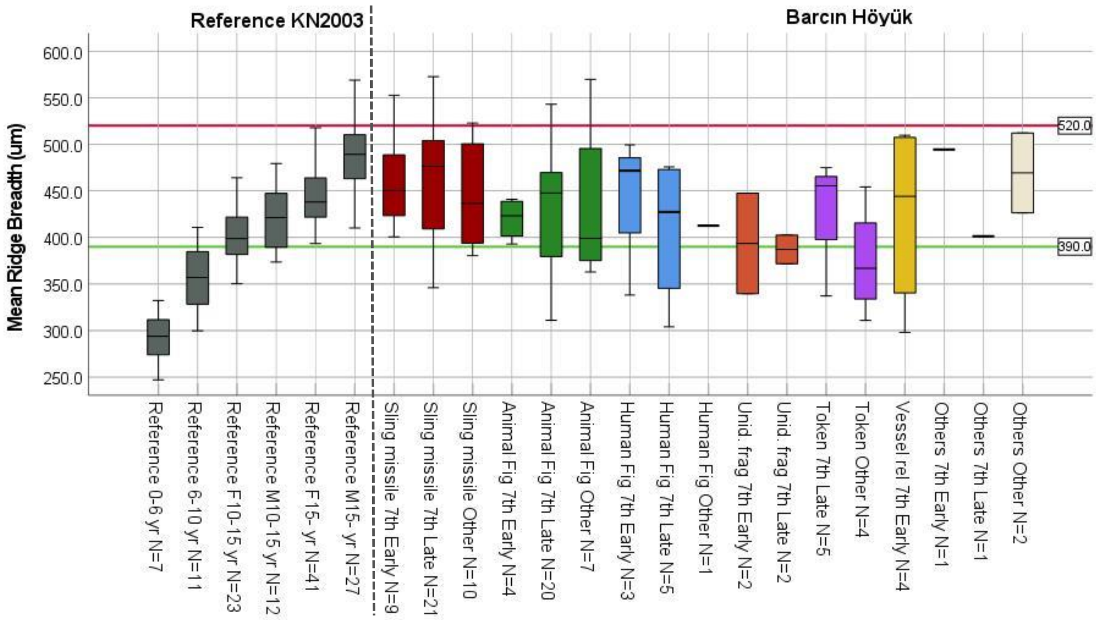


Figure 7.1 The comparison of Barcın Höyük finds grouped by levels with the reference. The green horizontal line and below represents only subadults below 15 years old. The red horizontal line and above represents only adult males.

A one-way analysis of variance (ANOVA) test was performed on the samples from Barcın Höyük and the reference from Králík and Novotný (2003).[48] Tukey's HSD post-hoc test revealed multiple significant pairwise differences between the Barcın Höyük samples and the reference discussed below. Due to the nature of the statistical method employed in this work, the results below exclude object groups with less than two finds.[49]

The statistical calculations suggest that children up to 6 years old were probably not involved in the production of clay objects (**Table 11.5**). Some fingerprints statistically

[48] The alpha level is .05 for all statistical tests performed in this analysis. Levene's homogeneity of variances test as well as the one-way ANOVA has a p-value < 0.001 indicating that we should reject the null hypothesis (H_0) as there is a statistically significant difference between at least two groups that have been compared in terms of mean epidermal ridge breadth ($F(18)=8.227$, $p< .001$). H_0 is there is no statistically significant difference between the means of the groups being compared in this analysis; H_1 is that the means of two groups or more are statistically significantly different from each other.
[49] Therefore, the object category "Others" and the human figurine from a context outside the Neolithic

match 0-6 year-olds (low significance), but they show a much better match with children 6-10 years old. Children between 6 and 10 seem to be more involved in the production process, especially when it comes to human figurines and tokens from non-Neolithic contexts (**Table 11.6**). These objects come from either occupation layers that date to later than the Neolithic or poor contexts such as section cleaning. It is possible that the objects found in these contexts were initially made in the Neolithic period, but they have been evaluated separately in this work to ensure that they do not affect the results.

Fingerprints belonging to male and female adolescents aged between 10 and 15 and adult females above 15 years old statistically overlap with most of the object groups from Barcın Höyük (**Table 11.7**, **Table 11.8**, **Table 11.9**). This might be because they were heavily involved with producing almost all object types at the site. For example, they probably made animal and human figurines, tokens, and vessel-related objects. It should be noted that the mean ridge breadths of adolescents and adult females are relatively close to each other (as can also be seen in **Figure 7.1**). Therefore, the results of these three groups usually yield overlapping results. The fingerprints on sling missiles from the Neolithic contexts, on the other hand, are relatively larger than the rest of the find groups. Therefore, they are the only object category that overlaps with adult males and females (**Table 11.9**, **Table 11.10**).

7.2.Ekşi Höyük

Ekşi Höyük yielded 51 clay objects with measurable fingerprints that can be analyzed in this study. The final measurements have been compared to the modern reference collection and presented in a boxplot in **Figure 7.2**. The object groups in the boxplot have been divided into four periods in order to understand if there has been a change in labor division through time: 7th Mill Early (pre-6200 BCE contexts), 7th Mill Late (6200-6000 BCE contexts), 6th Mill (6000-5700 BCE), and Other. The boxplot in **Figure 7.2** shows that clay finds from Ekşi Höyük mainly fall into the adult and adolescent categories. However, smaller fingerprints point to the involvement of children between 6 and 10 years old, which can be seen even more clearly in the comparison of

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layers (Human Figurine Other) are excluded from the discussion.

means in **Figure 11.10**.[50] Several object types have been excluded from the ANOVA post-hoc tests because they are represented with a single sample.[51]

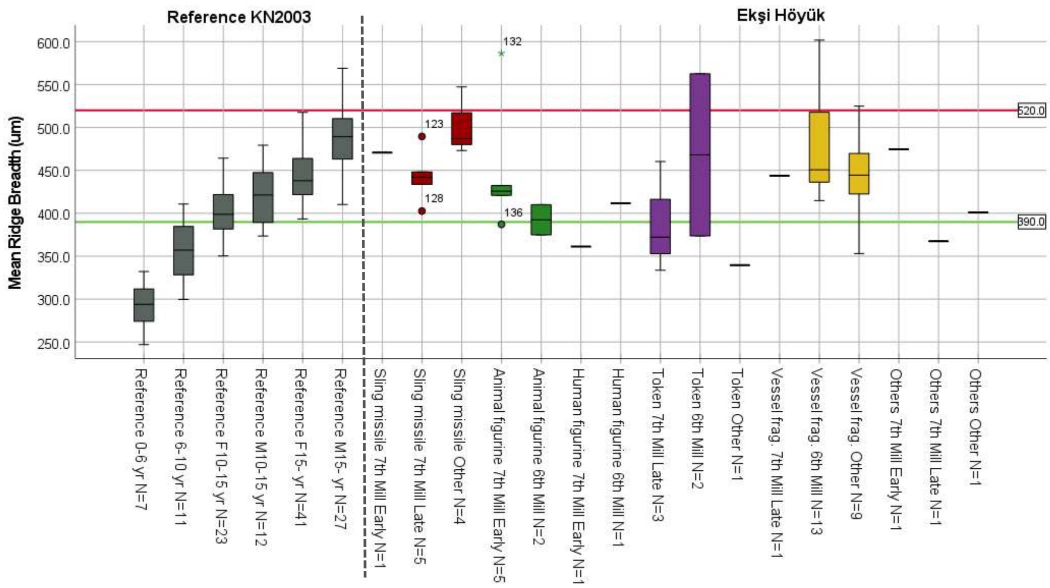

Figure 7.2 The comparison of Ekşi Höyük finds grouped by levels with the reference. The green horizontal line and below represents only subadults below 15 years old. The red horizontal line and above represents only adult males.

Tukey's HSD post-hoc analysis was performed to interpret the Ekşi Höyük ANOVA results.[52] The post-hoc test suggests that children up to 6 years old were not actively involved in producing clay objects, possibly except for animal figurines from the 6th millennium contexts (**Table 11.33**). However, results from this category better match children aged between 6 and 10 and 10 and 15 of both sexes. Children between 6 and 10 might have also made tokens in the late 7th millennium (**Table 11.34**).

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[50] A token found in a later context labeled as "Token Other" in Figure 6 and a human Figurine from the 7th millennium Early (EH level 4B) seem to be made by younger individuals.

[51] The following object groups have been excluded from the post-hoc analysis: Sling missile 7th mill Early, Human figurine 7th mill Early, Human figurine 6th mill, Token Other, Vessel fragment 7th mill Late, Others 7th mill Early, Others 7th mill Late, and Others Other.

[52] The alpha level is .05 for all statistical tests performed in this analysis. Levene's homogeneity of variances test as well as the one-way ANOVA has a p-value < 0.001 indicating that we should reject the null hypothesis (H_0) as there is a statistically significant difference between at least two groups that have been compared in terms of mean epidermal ridge breadth ($F(13)= 17.187$, $p< .001$). H_0 is there is no statistically significant difference between the means of the groups being compared in this analysis; H_1 is that the means of two groups or more are statistically significantly different from each other.

Fingerprints found on most object groups match those of 10 to 15 year-old adolescent males from the reference (**Table 11.36**). They probably made animal figurines and tokens, which also statistically overlap with adolescent and adult females (**Table 11.35**, **Table 11.37**). Sling missiles and vessel fragments are some categories that seem to show an interesting change in terms of mean ridge breadth when grouped by levels. The fingerprints found on sling missiles from the late 7th Millennium contexts (Level 4a of Ekşi Höyük) are slightly smaller in their epidermal ridge breadth than those from the later or poorer contexts (Sling Missile Other in the analysis). Fingerprints on sling missiles from level 4a (7th mill Late) statistically match adolescent males and adult females, while sling missiles from later or mixed contexts match adult males the best. Several explanations can be made for a change like this. It might point to a change in the communities of practice as the people making these objects might have changed through time, but it might also be due to population differences.[53] Adults, especially adult males, also seem to be involved in pottery production at Ekşi Höyük. When divided by levels, vessel fragments from the 6th millennium match more closely with adult males than females. At the same time, those coming from mixed or later contexts show a better match with adult females and adolescent males. Some discrepancies in data interpretation could result from the overlap in the means of epidermal ridges between adult females and adolescent males.

7.3.Ulucak Höyük

This study analyzed 88 clay finds from Ulucak Höyük, which show variety in age and sex between object types and time (**Figure 7.3**). An Object groups represented by only one sample were not included in the ANOVA post-hoc tests.[54] After performing the ANOVA, Tukey's HSD post-hoc test was performed to interpret the results.[55] While the

[53] If a new population moved to Ekşi Höyük after the Neolithic occupation, they might have had different hand and fingerprint dimensions that would have affected their epidermal ridge breadth.

[54] The following object groups have been excluded from post-hoc tests: Sling missiles 6th mill, Animal figurines 7th mill early, Animal figurines Other, Unidentified fragments 6th mill, Tokens 7th mill early, and Tokens 6th mill.

[55] The alpha level is .05 for all statistical tests performed in this analysis. Levene's homogeneity of variances test as well as the one-way ANOVA has a p-value < 0.001 indicating that we should reject the null hypothesis (H_0) as there is a statistically significant difference between at least two groups that have been compared in terms of mean epidermal ridge breadth ($F(17)= 12.687$, $p< .001$). H_0 is there is no statistically significant difference between the means of the groups being compared in this analysis; H_1 is that the means of two groups or more are statistically significantly different from each other.

object groups mostly fell into adolescent and adult categories, some smaller fingerprints suggest the presence of children in the production of these objects.

Similar to the results from Barcın Höyük and Ekşi Höyük, children up to 6 years old do not seem to be heavily involved in clay object production at the site (**Table 11.18**) while some animal and human figurines might have been made by these young children. Nevertheless, these results show a much better match with older children aged between 6 and 10 and adolescents (**Table 11.19**).

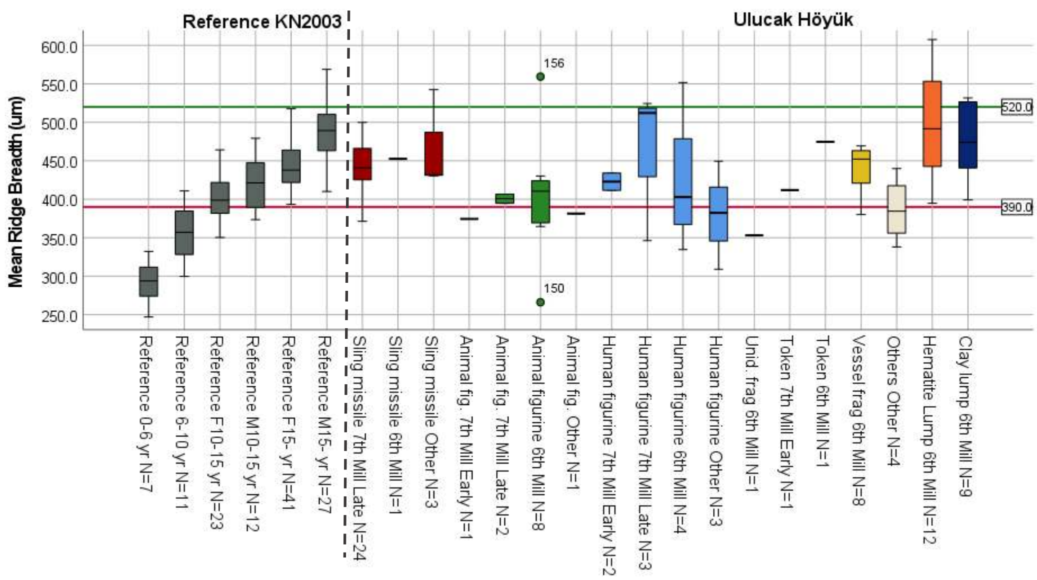

Figure 7.3 The comparison of Ulucak Höyük finds grouped by levels with the reference. The green horizontal line and below represents only subadults below 15 years old. The red horizontal line and above represents only adult males.

Results from adolescents of both sexes as well as adult females were active in the production of most objects. Adolescent males might have produced all types of objects, including sling missiles, figurines, and vessel fragments from all levels except for the hematite and clay lumps from the Ulucak pottery workshop. On the other hand, these two categories best overlap with adult males (**Table 11.23**). Especially the clay lumps that were mixed with hematite yielded some of the largest fingerprints at the site. These results might indicate the presence of task differentiation in pottery production at the site. However, it should be noted that this category of clay lumps does have higher amounts of hematite mixed with the clay paste than the other clay lumps. As has been extensively discussed in the previous chapter, adding inclusions to clay might have an impact on the shrinkage rate, causing the clay to shrink less. Fingerprints found on hematite lumps are expected to be slightly larger than those on clay lumps without hematite inclusions. This issue will be discussed in detail in the following chapter.

7.4.Conclusion

This chapter explored the outcomes of the statistical analyses performed on 242 clay objects from Barcın, Ulucak, and Ekşi Höyük. The clay objects were divided into nine categories based on typology, and then they were divided into four based on their dates. These results were compared to the reference collected from the modern Czech population by comparing the means of each object group with ANOVA and Tukey's HSD post-hoc test.

While each site seems to have its traditions, some trends will be addressed in the following discussions. Among these are the limited presence of very young children in the production of clay objects at all sites, the nature of gender and age-based labor division in the seventh and sixth millennia in Western and Northwestern Anatolia, and a comparison of the seventh and sixth millennium occupations in terms of clay object production.

Chapter 8

8 NEOLITHIZATION AND CLAY PRODUCTION IN THE WEST OF ANATOLIA

The previous chapter presented the results of the statistical analyses. This part of the dissertation focuses on these results and compares them from a temporal perspective to understand if there is change or continuity within the occupations of Barcın, Ulucak, and Ekşi Höyük as well as in comparison to each other.

This chapter first presents a comparison between the sites in terms of their dating and the location of the settlements. Then it moves to compare the seventh and sixth millennium occupations at these sites. All three sites were occupied during the seventh millennium BCE. This period has been divided into two phases: Early (Before 6200 BCE) and Late (6200-6000 BCE), based on changes in settlement organizations. So, settlements will also be compared to each other within and between these two sub-phases. During the sixth millennium, however, Barcın Höyük in Northwestern Anatolia was abandoned, while Ekşi Höyük and Ulucak continued to be settled for a few hundred years. Therefore, Barcın Höyük is excluded from the sixth millennium comparisons.

8.1.Comparative Analysis of the Sites

8.1.1. Dates

While Ulucak's radiocarbon results suggest slightly earlier dates for the initial occupation, C14 wiggle-matching results point to a later date of ca. 6650 calBCE for the initial occupation (Weninger et al. 2014, 17; Çevik and Erdoğu 2020). Barcın Höyük, Ekşi Höyük, and Ulucak were settled around the same time in the first half of the seventh millennium BCE. The architectural traditions and settlement organization continued uninterrupted until ca. 6200 BCE when a significant reorganization and dispersal from the previous traditions are seen in all of them. Barcın Höyük is the first one to be abandoned, with the occupation coming to an end ca. 6000/5900 BCE, while Ekşi Höyük and Ulucak continued to be settled until ca. 5700 BCE.

8.1.2. Locations

Barcın Höyük was located on a natural elevation by a stream in close proximity to a retreating lake (Groenhuijzen et al. 2015, 59). Geoarchaeological sediment core analysis by Groenhuijzen et al. (2015) indicates that the initial settlers of Barcın Höyük chose to settle in a region with similar environmental conditions as those in Çatalhöyük in Central Anatolia. Throughout the Neolithic occupation at the site, the edge of the lake retreated further away from the edge of the settlement (Gerritsen and Özbal 2019, 59). The location of the site in the Yenişehir valley, surrounded by hills, enables access to the İznik valley to the north with two passes and to İnegöl, Bilecik, and Bursa regions, respectively to the south, east, and west of the valley (Gerritsen, Özbal, and Thissen 2013a, 93). These access routes make the valley an attractive location and provide the means for the inhabitants of Barcın to interact with other regions easily and expand their networks.

Ekşi Höyük was settled on a natural elevation by a former lake basin in the Upper Menderes River Basin, with the Büyük Menderes River on the north and a small lake on the southwest in Çal, Denizli (İlhan, Vardar, and Öner 2020). Surrounded by plenty of water supplies, including the lake basin and the river, the immediate surroundings provided means of subsistence and beds for harvesting clay to manufacture various tools and constructions at the site. Its geographic location at the entrance of a natural route connecting the Çivril and Baklan plains to the Çal plateau gives the site an excellent opportunity to expand its network and interact with other settlements in the area (Dedeoğlu et al. 2019, 2).

Ulucak Höyük is located in the Upper Nif Valley, 2.5 km east of Belkahve Pass, that forms a passage between Izmir and the inland Gediz river valley (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012, 139). The initial settlers of Ulucak settled on a fertile and arable land above the alluvial deposits carried by the Nif stream (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012, 139). While the site is far from the Aegean coastline today, it was probably even further inland during the initial settlement as the sea reached its current level much later (Kayan 2004).

The fact that various other Neolithic sites in Western (Hacılar) and Northwestern Anatolia (Aktopraklık, Ilıpınar, Menteşe), as well as Central Anatolia (Çatalhöyük) were initially settled on natural elevations near water sources such as lakes, streams or springs underline the importance of such locations for early sedentary groups in this period. Various factors must have played a role in choosing such locations to settle: the natural elevation would give the inhabitants a good vantage point to see any possible threats, and the water source nearby would provide the fresh water and other aquatic resources for the survival of the group while also being reasonable hunting grounds for wild animals, the alluvial plains and drier lands by the settlements would provide the fertile land to grow their staple crops. Last but not least, clay sources in the retreating lake beds and beds of rivers and streams might have been an essential factor in choosing the initial location of the settlements.

8.2.Seventh Millennium Occupations

8.2.1. 7th Millennium Early (Before 6200 BCE)

Barcın Höyük

The earliest occupation at Barcın Höyük, Level VIe, dates to 6600-6500 calBCE, (Weninger et al. 2014, Fig. 14; Gerritsen and Özbal 2019). Although scarce, pottery has been present since the initial occupation layer at the site (Gerritsen, Özbal, and Thissen 2013b, 60). While Level VIe does not yield much in terms of clay finds, animal figurines, as well as other clay assemblages seem to be present from the beginning at the site. The fire in Structure 2a from level VId1 helped preserve some clay finds otherwise that would have disintegrated; a complete pot lid and a fist-sized pierced clay come from the burnt phase of 2a, while two other clay objects were found in association with the building (a sling missile and a figurine fragment in the annex of the building). Except for the figurine fragment, all of the objects from this building seem to have been made by adult individuals with large fingerprints.

The workshop in Structure 10 from level VId3/VIc is especially noteworthy because apart from the high number of hammer and polishing stones and other associated tools, a cache of at least six unbaked anthropomorphic clay figurines was found tightly packed underneath a large, worn-out anvil that was turned upside down to the south of this room (R. Özbal and Gerritsen 2019a, 297). Thanks to the anvil covering them, these unbaked, sun-dried figurines were preserved until today, yet no fingerprints can be spotted on these figurines due to the cracks and damage on them. They were made in a similar fashion with wide shoulders, narrow and flat torsos, and wide hips and legs. Incised decorations with red and black paint were present from the waist to the knees, similar to ones found among other anthropomorphic figurines from the Neolithic occupation layers at the site. Some of the latter did, in fact, yield fingerprints. Anthropomorphic figurines at Barcın are relatively rare and almost always found as single finds, so the context and the number of figurines in the cache are extraordinary for the site. On the other hand, it is clear that these figurines were only preserved due to special conditions, and we cannot rule out the presence and use of unbaked clay figurines widely at the settlement.

Apart from the unique cache of anthropomorphic figurines discussed above, we lack conclusive evidence for a specialized production area for clay objects in the earlier occupation layers at the site. Courtyards and annexes might have been where at least some of the production took place. The possible workshops in Structures 10 and 3, and maybe also in 21 and 2a[56], might have also been where the production of clay objects took place. Although much smaller in size, Structures 21 and 2a were equipped with fire installations just like the larger "domestic" structures 2b and 19 (**Figure *3.4***), where clay objects might have been baked. The unbaked figurines and lids discussed above make it clear that unbaked clay objects were present at the site, suggesting that clay objects might have been formed in these workshops but baked in a different part of the settlement, perhaps in a communal oven in the courtyard. Similarly, there is no evidence of large kilns for firing pottery at the site. While the inhabitants of Barcın Höyük developed a distinct pottery tradition (Gerritsen, Özbal, and Thissen 2013b; R. Özbal and Gerritsen 2019a), the location of the pottery kilns is still unknown.

While the Barcın Höyük inhabitants were already making things out of clay as early as the initial occupation in level VIe, this relationship seems to have become more pronounced with the increase in the number of clay finds throughout the occupation. Twenty-three clay objects of various types come from the occupation layers discussed in this section. Apart from those mentioned above in relation to Structure 2a, three other clay objects with partial fingerprints were found associated with structures: two sling missiles from Structure 4 (VId3), one found in the house fill and the other in a wall ditch, and an animal figurine from the Southern wall ditch of Structure 14.

Animal figurines and sling missiles are the two main object categories that seem to be present from the initial occupation onwards, without much change in terms of style. Similar types of animal figurines can be found in all layers, although only four from level VIc had fingerprints that match adult females from the reference set embossed on their surface. Both types of sling missiles, elliptical and biconical, seem to be present from the earlier levels onwards, and they seem to be made by the same group of people, either

[56] Due to the proportional size of these buildings to the workshops in the later levels.

adult males or females in this period. In terms of the production of clay objects, Barcın Höyük yields evidence for the presence of a wide variety of age groups. While adult males, adolescents, and older children might have also participated in producing various object types, the Mean Ridge Breadths of all object groups closely overlap with adult females from the reference set.

Ekşi Höyük

The only comparative material for this study (for contexts predating 6200 BCE) comes from Level 4b (**Figure** ***3.7***). A cache of sling missiles was found inside the apsidal building from this level, yet only one of them had well-preserved partial fingerprints. This sling missile had five fingerprints on it, with a mean ridge breadth that corresponds with those of adult males from the reference set. However, a single find cannot be considered statistically significant. Apart from sling missiles (N>300), pottery sherds, figurines as well as bone awls and flakes were cached in the apsidal building, but the structure lacks evidence for production (Dedeoğlu et al. 2019, 5). This structure yielded no fire installations, so the clay objects must have been fired elsewhere. One potential production location may be the rectilinear buildings with ovens such as the one in front of the east wall of the building to the south of the apsidal building. The ash pit in front of the oven yielded discarded clay objects and refuse from clay production, suggesting that it may have been used for firing clay (Dedeoğlu et al. 2019, 5–6).

Anthropomorphic figurine fragments, including two painted human heads and a human head with a horned mask, were found in the apsidal building. The horned masked figurine was the sole one to yield a fingerprint. Though it was a single partial print, its size suggests that a younger individual may have made it, perhaps a child between 6 and 10 years old.[57] On the other hand, animal figurines yield more reliable evidence for the involvement of adult females or adolescent males in the production process. Four bull figurines were found buried in a cache in front of the south wall of the rectilinear building (Dedeoğlu et al. 2019, 6). These figurines were made by using fine sun-dried white clay. Given their stylistic similarity, it is likely they were made together. The horns, legs, and necks were found broken, but together with the torso. The close examination of the breaks shows either that they were made intentionally weak at these attachment points or the

[57] Nevertheless, such interpretations are always problematic when the sample size is only one partial print.

small fragments were prepared individually but left to dry for too long before they could be adequately attached to the torso. If the second scenario is true, the makers' effort to cover the figurines with a thick coat of clay to mask the attachment scars were unsuccessful. If, instead, they were made to break at specific locations intentionally, their find spot and context might suggest some ritualized behavior. Please see Chapter 9.1 for a discussion of the manufacturing process of these figurines.

Ulucak Höyük

A few pottery sherds and the complete lack of other clay finds characterize the initial occupation dating the the first half of the seventh millennium at Ulucak (Çevik 2019, 225; Çevik and Abay 2016, 190).[58] Evidence for architecture is scanty until level Vb, yet an open space with two ovens and shallow storage pits was found in these layers (Çevik and Erdoğu 2020, 81). It is possible to see an increase in connections with the Aegean islands through a sharp increase in Melian obsidian in the lithic assemblage (Milić 2014; Çevik 2019, 227).

The number of clay objects also gradually increases during these occupation layers, while the preceding levels Ve through Vc only yielded four clay objects with impressions of epidermal ridges in total.[59] Fingerprints are very scarce for the levels predating 6200 BCE, making the analysis results less reliable and the interpretations, in turn, less certain. None of the objects analyzed here were found in special contexts or in association with other finds.[60] They seem to have been made by adolescents of both sexes or adult females, while the involvement of children and adult males in the production is less likely.

[58] Therefore, I do not have any materials from this layer; the discussion and interpretations focus on levels V and IV in this research.

[59] These are two human figurines, one flattened clay ball, and one animal figurine. These all together yield nineteen partial fingerprints.

[60] The animal figurine DGV and the human figurine fragment ESA come from fill layers from Vc; a spoon handle shaped like a human leg (OCH) was found during the excavation of B54 in the house fill in level Vd. The flattened clay ball FIR3469 / ULU.07.94 is the earliest clay find from Ulucak; it was found in a fill layer in level Ve.

8.2.2. 7th Millennium Late (6200-6000 BCE)

Barcın Höyük

In level VIb, the settlement organization underwent a major change as freestanding buildings started to be built and there was a clear break from the architectural continuity. The change in architecture, however, does not reflect the material culture in which the way figurines and sling missiles continued to be made in the same way by the same groups of people. Despite the long occupation history of approximately 400 years, the number of clay finds that yielded fingerprints from levels VIe through VIc is much lower (N=23) than those found in the last two hundred years of occupation until its abandonment (N=55). This is mainly because the number of clay finds in the last 200 years of occupation is much higher than the previous layers, reflecting an increasing entangled relationship between humans and clay through time.

Sex and age seem to be some of the determining factors in deciding who does what types of objects at the site. While adolescents and adult females seem to be primary craft producers, adult males might not have been heavily involved in the production process except for making sling missiles, which adult females might have also crafted at the site. A more detailed discussion on the gender and age of the producers is given in Section 9.2.

Ekşi Höyük

The apsidal building in 4b was intentionally burnt, and the building floor was filled in with mudbricks upon its abandonment. Thereafter, two smaller apsidal buildings were built in the same orientation as their predecessor (Dedeoğlu et al. 2019, 5). These buildings were equipped with rectangular ovens and were flanked by courtyards on the north and south (**Figure 8.1**).

Baked and unbaked clay objects were found on the floor of the apsidal building in the south; a lithic production area was also present in this building (Dedeoğlu et al. 2019, 7). The area around the oven was probably the center of production activities, as many sling missiles, spindle whorls, loom weights, other clay objects, and a kneaded clay lump were recovered on the oven floor. The other apsidal building on the north, however, yielded numerous bone tools, which indicates either that this building was a specialized production area for bone tools or that this was an area where bone tools were heavily used (Dedeoğlu et al. 2019, 7).

The presence of distinct manufacturing areas might indicate specialized production centers for sling missiles at different locations within site. While adult females and adolescent males were probably the groups most likely involved in making sling missiles at Ekşi Höyük, tokens found in this layer had much smaller fingerprints, suggesting the presence of adolescent females or children between the ages of 6 and 10. The results of the analyses point to sex and age-based specialization in production in which children were also actively participating in making specific types of objects.

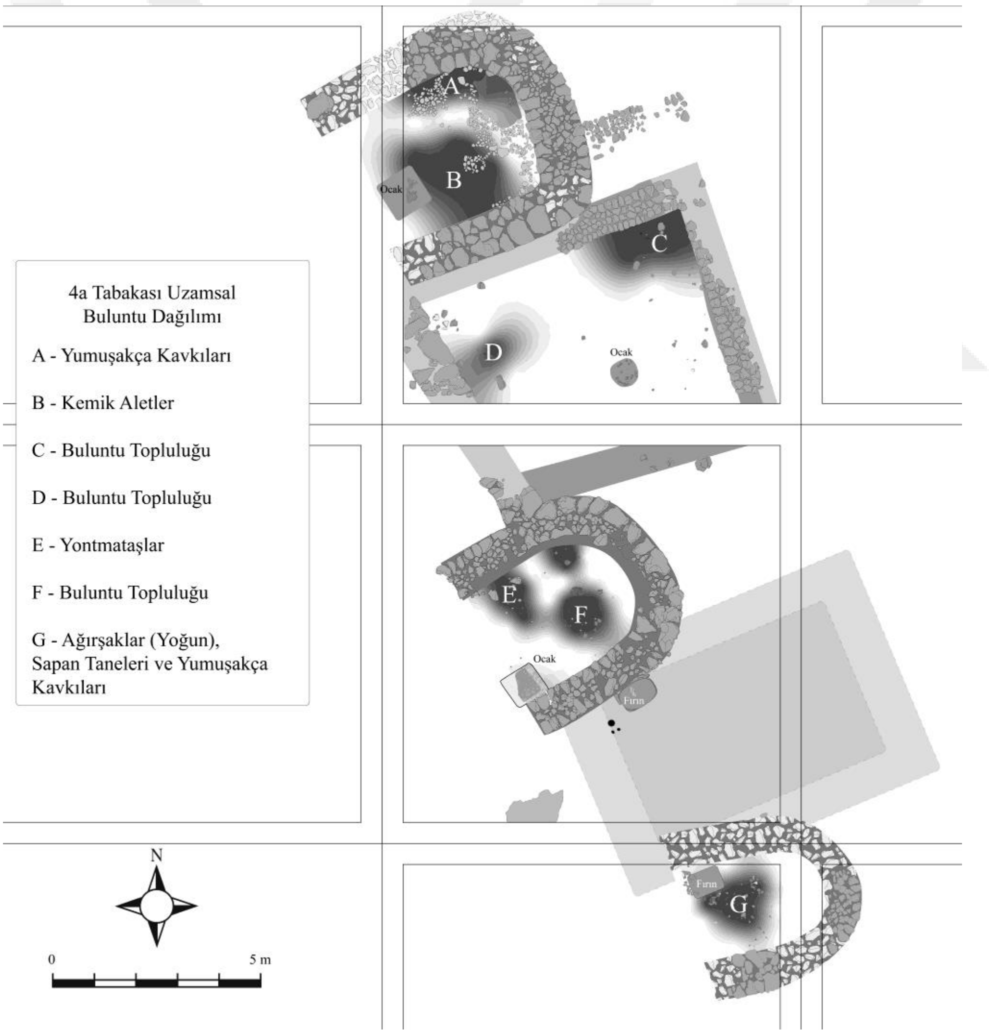

Figure 8.1 The plan of Ekşi Höyük level 4a shows two apsidal buildings and rectilinear structures. Locations of caches and collections of finds inside the buildings are indicated. From (Dedeoğlu et al. 2019, Fig. 11)

Ulucak Höyük

While the building patterns show continuity at Ulucak, the last two layers of Level V (Vb and Va) are examined as a separate group as they serve as a comparison to Barcın and Ekşi Höyük. The excavation team identified these layers as Early Neolithic II, and the material culture from this period is similar to the subsequent level IV (Late Neolithic in Ulucak occupation) (Çevik and Erdoğu 2020, 82–85). In a way, the evidence from this phase can be seen as a transition from a society where clay objects and pottery were introduced to one that developed established traditions for pottery production by the early 6th Millennium.

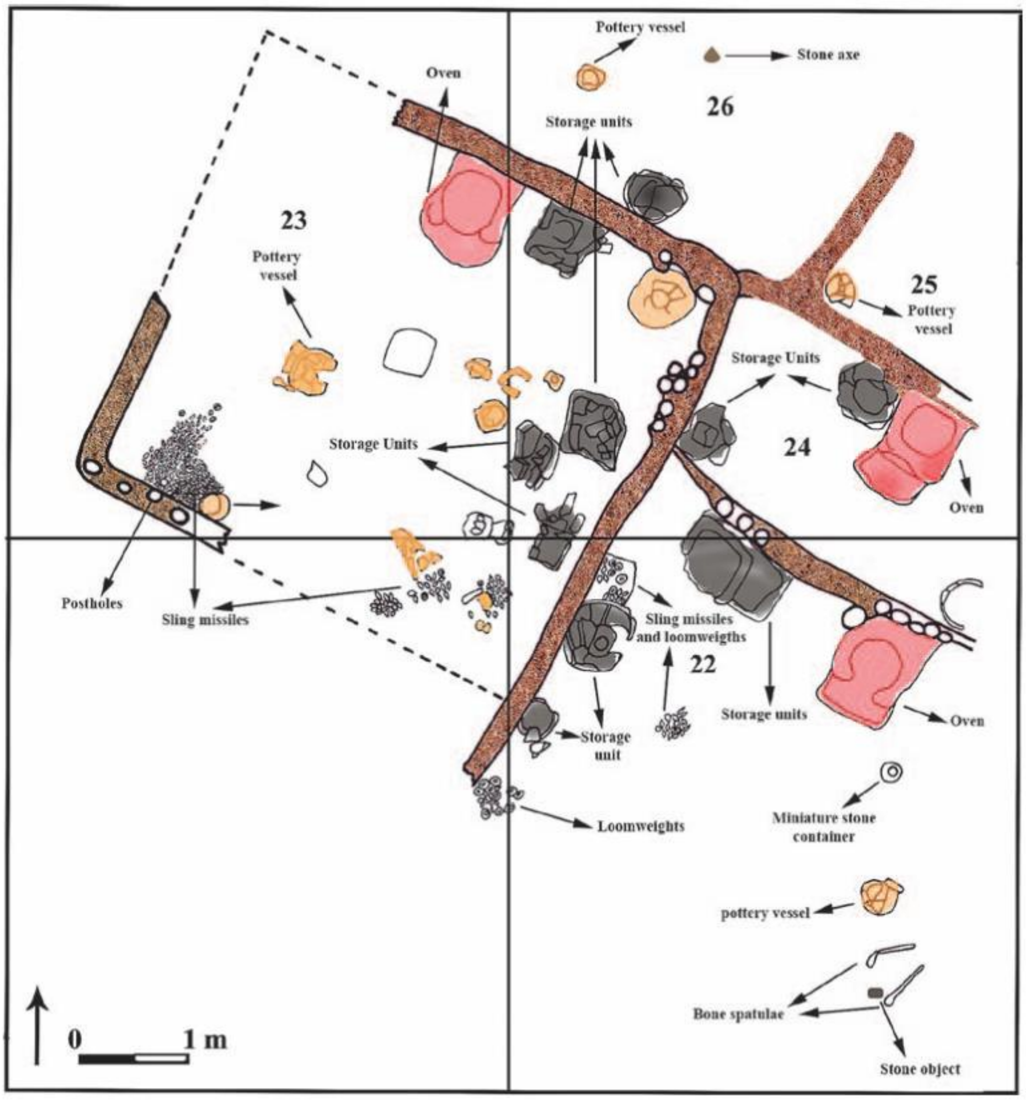

Figure 8.2 Ulucak level Va settlement plan showing caches of sling missiles in buildings 22 and 23. From (Ç. Çilingiroğlu 2011, Fig. 6)

Pottery and clay objects such as animal and human figurines, stamps, anthropomorphized clay spoons, and spindle whorls, assemblages commonly known as parts of the "Neolithic Package" (Ç. Çilingiroğlu 2005), either appear for the first time or become more abundant at the site. This phase of occupation at Ulucak yielded significantly more evidence for fingerprints.[61] It is essential to note that large caches of sling missiles (total N>570) have been recovered together in four buildings in level Va (A. Çilingiroğlu, Çevik, and Çilingiroğlu 2012, figs. 18–19 p.166; Korfmann, Dedeoğlu, and Eralkıran 2007, 43), some of which yielded epidermal ridges (**Figure 8.2**).

In terms of clay object production, adult females and adolescent males seem to be most involved in the production process. The fingerprints on these caches of sling missiles suggest that adult females or adolescent males were probably in charge of their manufacture.[62] Excavation reports underline that most of the sling missiles from level Va were found close to ovens, unbaked, but subjected to fire due to a conflagration at the settlement (Korfmann, Dedeoğlu, and Eralkıran 2007, 43). The context and state of these finds indicate that the manufacturing process was probably not finalized.

Compared with the Pre-6200 BCE levels, the clay finds assemblage becomes more abundant after 6200 BCE contexts. Large caches of sling missiles are also a new addition to the material culture. The same groups of people (adolescents and adults) continued to be linked to clay object production at Ulucak in the 7th Millennium. While comparative materials were scarce in the first quarter of the Seventh Millennium, it is possible to see a gradual increase in the assemblage in the second half. As a distinct category, anthropomorphic figurines might have been made by various age/sex groups except for children, while anyone might have made animal figurines, perhaps except adult males and very young children below six years old. While this distinction might be related to human figurines requiring more dexterity than animal ones, it might also result from the low number of comparative samples for figurines, as only two animal and three anthropomorphic figurines could be compared in this section.

[61] While most of these belong to sling missiles (N=24), three human figurines and two animal figurines also come from this phase.
[62] Epidermal ridges of adult males are statistically significantly different from those on the sling missiles ($p<.05$)

8.2.3. Summary of the Seventh Millennium Occupations

At all three sites, the number of finds increases through time, potentially caused by the size of the excavation area. Earlier or initial layers are sometimes excavated in a much narrower area, while the later occupation layers are usually widely exposed (Çevik 2019, 221).[63] Another possibility for the difference between the number of clay finds in the earlier and later occupation layers at these sites might be that the settlers gradually became more entangled with clay by making more and more things through time. This idea is further supported by the low number of pottery sherds coming from the initial occupation layers as opposed to the high volumes of pottery in the later levels.

Hundreds of clay objects have been excavated at each site. Although Ulucak yielded twice as many clay finds as Barcın, most are from later contexts, especially the sixth millennium, making comparisons difficult. Ekşi Höyük is the most recent excavation, while excavations at Ulucak have been ongoing for more than two decades, ultimately yielding more finds. In terms of fingerprints, though, Barcın yielded the most evidence, and the inhabitants at the site seem to be more carefree about leaving prints on surfaces, except for when it comes to pottery.[64]

In terms of the clay objects assemblage, all sites show similar types of artifacts throughout the occupation. All object types seem to be present from approximately 6500 BCE onwards in the occupations.[65] Caches of sling missiles have been attested at Ekşi Höyük at a slightly earlier date (Level 4b, before 6200 BCE), while similar caches also come from level Va at Ulucak. The increase in wild animal remains in layers Vb and Va (Ç. Çilingiroğlu and Çakırlar 2013, 26) might, to some extent, justify the increase in sling missiles but still leaves the mass production of these objects unexplained. Considering that a widespread fire burnt down some of the structures in these layers at Ulucak, we cannot rule out the possibility of conflict towards the end of the seventh millennium in this region. Such caches were either absent at Barcın Höyük or the specialized production area for these objects was not found during the excavations. Nonetheless, the cache of anthropomorphic figurines in a building from Barcın Höyük and a small cache of animal

[63] It should be noted that levels VIe and VId1 from Barcın Höyük were exposed in a relatively large area but the number of clay finds were much lower than the later levels.
[64] The percentage of the objects with fingerprints is 19% in Barcın Höyük, 8% in Ekşi Höyük and 7% in Ulucak Höyük.
[65] Although few in number, animal figurines and sling missiles were present in level VIe at Barcın Höyük.

figurines from the earlier levels of Ekşi Höyük indicate that caching objects might be done for different purposes.

Adults and adolescents seem to be highly engaged in making clay objects at all three sites. Still, children might have been present in the production and seem to have made some types of objects, but the very young individuals did not make those requiring some specialization such as sling missiles and figurines.

8.3.Sixth Millennium Occupations

8.3.1. Ekşi Höyük

Level 3 at Ekşi Höyük (6000-5700 BCE) was heavily damaged by modern farming activities and yields fragmentary evidence for the sixth millennium occupation at the mound. Open spaces from Level 4a continued to be used through Level 3, but a rectilinear structure with stone foundations and mudbrick walls was found to the west of the exposed area (Dedeoğlu et al. 2019, fig. 19).

Given preservation issues, this occupation level yielded no production areas so far. Nonetheless, the analysis of clay objects from level 3 suggests that adolescents or children between 6 and 10 years old were involved with the production of animal figurines. On the other hand, tokens were likely made by adults and adolescents, though they are represented by only two examples. Pottery was probably a specialized production reserved for adult males or possibly females, as the fingerprints on pottery sherds from this level are relatively large.

8.3.2. Ulucak Höyük

Material culture and subsistence mostly show continuity during the transition from level Va in the late Seventh Millennium into level IV in the Sixth Millennium at Ulucak (Çevik and Erdoğu 2020, 84). However, the emergence of anthropomorphic and storage vessels and new construction techniques with mudbrick walls on stone foundations are among the most notable changes in the settlement (Çevik 2019, 227).

A building complex of five rooms (Buildings 55, 56, 60, 61, and 62) dating to 6005 – 5840 calBCE, Ulucak level IVc, has been discovered (Çevik 2016; Çevik and Erdoğu 2020, 84). The excavation of these buildings yielded many kneaded clay lumps, unfinished vessel fragments, red hematite lumps and pigments, and many grinding stones, mortars, pestles, polishing stones, and vessels. Red pigment plays an essential role in the workshop, as many artifacts listed above were covered with it. Moreover, two vessels were filled with red pigment lumps, possibly hematite (**Figure 8.3**). Since this specialized production area is probably one of the earliest examples in the Near East, it provides a unique example to understand the sex and age division in task differentiation in pottery production.

Figure 8.3 Above: Large clay and hematite lumps from Building 55. Below: two vessels filled with red pigment From (Çevik 2016, Fig. 4)

First of all, the inclusion of adult males in the production process at this level is noteworthy. Statistical analyses suggest that adult males probably prepared and kneaded large lumps of clay at the pottery workshops (such as **Figure 8.3** above). Although relatively smaller examples have also been recovered, these objects were typically large and heavy and likely required some effort to mix the inclusions with clay and water. These lumps were found ready to be used but burnt *in situ,* and some of them were mixed with high percentages of hematite, resulting in an even more red and firm texture. The comparison of mean epidermal ridges between clay lumps with and without hematite inclusions initially suggested that people who kneaded lumps rich in hematite had larger fingerprints than those who kneaded clay lumps without hematite. However, experimental analyses performed demonstrated that a 10% inclusion of hematite reduces the shrinkage rate by 1%, but the addition of 20% hematite reduces it by 2.3%. While we do not know the exact ratio of hematite to clay in the clay lumps, it is probably fair to assume that the same people were in charge of kneading and preparing the clay lumps to be used in pottery production. They were likely adult males, although adult females cannot entirely be excluded. The possibility of task-differentiation can be observed between the production of plain clay lumps and hematite-rich clay lumps. Pottery, on the other hand, seems to be made by adult females or adolescent males as the fingerprints on pottery sherds from this level, both finished and unfinished examples, have relatively smaller fingerprints than the above-mentioned clay lumps. Adolescents might have made animal and human figurines at these levels at the site. The lack of children in the pottery production areas is striking and might be explained by their involvement in the production process via legitimate peripheral participation, such as performing tasks to aid the primary producers.

8.3.3. Summary of the Sixth Millennium Occupations

Barcın Höyük was no longer occupied in the early sixth millennium BCE, while Ekşi Höyük was excavated in a limited area. The sixth millennium occupation at Ulucak with multiple buildings and open areas has been widely exposed. Ulucak suggests the involvement of adults, especially adult males, in different stages of pottery production. A similar picture can be gleaned from the little available data from Ekşi Höyük. A good example of variability in terms of practices in the sixth millennium occupations is the presence of children; they seem to be making animal figurines at Ekşi Höyük in this period, while children are utterly absent from the pottery production workshops at Ulucak. This suggests that children were probably more involved in specialized production at some sites than at others, but the lack of evidence does not automatically point to the absence of children at Ulucak, as they might have been occupied with peripheral activities that would not leave fingerprint traces of their presence at the workshops.

8.4.Discussion and Comparison of Seventh and Sixth Millennia in terms of Clay Production

While all sites were settled around the same time, the occupation at Barcın Höyük in Northwestern Anatolia ended earlier than its counterparts in Western Anatolia. It is possible to compare occupations from the seventh millennium phases, but evidence for the sixth millennium is absent at Barcın and scanty at Ekşi Höyük. Ulucak is the only site with substantial architecture during this time. Around 6200 BCE, some changes in the organization of settlements can be observed at all sites. The reasons for the change are still being investigated, but they might have been related to the 8.2 ka event and/or the increased interaction and networks between the Neolithic communities in Anatolia.

Despite the virtual absence of figurines and sling missiles in the earliest occupation contexts in Ulucak and Ekşi Höyük, they are present in Barcın Höyük from the initial occupation onwards, albeit in low numbers. This might be explained by the suggested origins of the initial settlers in these regions; settlements in northwestern Anatolia might have migrated from Central Anatolia already equipped with the knowledge of how to make these objects, but the people who settled in Ekşi Höyük and Ulucak might have come from the Lakes Region with distinct traditions and quickly adopted these assemblages in a few centuries.

Changes in settlement patterns and architecture at Ulucak and Barcın also reflect on the clay finds assemblage. The well-preserved structures from levels Vb and Va in Ulucak, as well as occupation layers from levels VIb and VIa in Barcın from 6200-6000 BCE, were accompanied by the increase in material culture, especially in terms of clay objects, groups of sling missiles and loom weights (Ç. Çilingiroğlu 2011, 72)

The significant increase in clay finds, among other assemblages, in the last two centuries of the seventh millennium might have been a result of the increase in the population, which would also explain the break in settlement patterns. The standardized households with structured building patterns would require a relatively standard number of occupants and would not be forgiving to overpopulation as there would be a fixed number of houses/spaces that could be utilized. If the population increase were too strenuous, changes in the architectural layout or dispersal of the settlement would be unavoidable. In such a scenario, more people would need more objects, boosting the production of clay finds.

Despite the changes in settlement patterns, there seems to be continuity in communities of practice in all sites. People from the same age/sex categories usually continued making the same types of objects, even though new age groups were sometimes also involved in making some object types. Adolescents and adults made almost all objects throughout occupations at all sites, while children up to 6 years old were virtually absent. This might be understandable as the motor functions of young children would not allow them to perform some tasks (E. V. Brown 1975). When an object requires standardization and expertise throughout the occupations, specific groups (perhaps specialists) seem to be making them and child prints would be absent.

It should be noted here that the term "craft specialization" is used more loosely, in this work. Based on Emma Baysal's criteria (E. Baysal 2013, 239) for a production activity to be called a specialized production, not all types of objects could be categorized as specialized productions. When reviewed as assemblage groups it seems more plausible that sling missiles and pottery were specialized productions while the other object categories examined in this work such as figurines and tokens may not have been as specialized. Both pottery and sling missiles required some surplus to make, probably had a specific value attached and might have been a part of an exchange. They definitely required modification of raw materials, certain knowledge and know-how to be produced properly, were standardized and repeatedly produced as needed. In both cases the producers seem to be a certain group of people, not everyone in the community, were culturally specific and recognizable objects.[66] Figurines, on the other hand seem to be less standardized although they do follow specific cultural patterns in terms of their production and style.

Designated production/workshop areas seem to start as early as the second half of the seventh millennium in western and northwestern Anatolia. Possible workshops have been present at Barcın since level VId1 (Structures 21 and 2a, for example) and the high number of tools from Structure 10 indicate multiple activities happening, perhaps simultaneously, in this area. Based on the cache of anthropomorphic figurines, we can propose that clay objects might have been made here as well. However, they clearly were not baked in the building as we lack evidence for fire installations here. However, a more likely scenario is that there might be a specialized production area, a different workshop

[66] In conjunction with the manufacturing process, the issue of the identity of the makers of sling missiles and pottery will be further discussed in Chapter 9.1.

with fire installations, or a distinct location near kilns in the courtyard for making clay objects such as sling missiles that have not been excavated yet. Both Ekşi Höyük and Ulucak have substantial evidence for caching large quantities of sling missiles (initially unbaked at Ulucak), while this is so far absent at Barcın Höyük.

While these workshop areas can be identified as evidence for specialized household production, the pottery workshop from the sixth millennium levels at Ulucak might be among the earliest pieces of evidence for task differentiation in pottery production. This analysis suggests differentiation in terms of those who prepared the clay for pottery production and those who made the actual pottery. Adult males seem to be the ones to knead large lumps of clay to get them ready for the potters, who appear to be adult females at Ulucak. Children were absent from the workshop as they did not leave any marks that could confidently be linked with their presence here. However, they might have been involved in the production in other ways that would not leave any traces in the archaeological remains, such as collecting and bringing fuel for the fire, carrying water, chaff, and other additives to the workshops, and collecting clay from the clay sources with the specialists. Ethnoarchaeological studies show similar practices occur when apprentices start with legitimate peripheral participation when learning a craft (Lave and Wenger 1991; Wendrich 2013c; Fassoulas, Rossie, and Procopiou 2020).

Chapter 9

9 CLAY PRODUCTION, A COMMUNITY OF PRACTICE

Making clay objects such as figurines and sling missiles the same way over several centuries is an example of how social memory and know-how are transferred through generations. This chapter discusses clay object production in western and northwestern Anatolia from two viewpoints with this idea in mind. The first section focuses on production as a form of social memory. This can be followed by examining the manufacturing process of sling missiles, figurines, and vessel-related objects. After that, the issues of age and cultural transmission will be discussed. Age seems to be a determining factor in task allocation in production. The final focus of this chapter will be the role gender in relation to age plays in communities of practice in this region of the world during the seventh and sixth millennia.

9.1.Production as Social Memory: Manufacturing Process

This section evaluates the manufacturing process of the various categories examined in this work. While they have been evaluated in four temporal categories in the previous chapters, this chapter assesses sling missiles, figurines, and vessel-related objects without the temporal dimension. Therefore, this section reviews the object categories from all occupation levels together.

9.1.1. Sling Missiles

The inhabitants of Barcın Höyük made sling missiles in two primary forms – *biconical* and *flattened elliptical*. Both types were present throughout the Neolithic occupation at the site. There was some standardization in terms of their size and weight following their types. However, smaller versions, about half the size and weight of the regular sling missiles, were also present.

The initial steps of their *chaîne opératoire* were the same; a small lump of clay was rolled between palms or on a flat surface to create a cylindrical form. While tiny stones might have been added to the clay while preparing the paste, organic temper was intentionally avoided. Once the desired cylindrical shape was ready, the clay was rolled from the middle point to the tip or pinched at both ends until it gained the biconical form at the tips. When the maker acquired the desired form, the center of the missile would be almost completely circular, with the tips of the missile being approximately equidistant from the center. On the other hand, the flattened elliptical missiles were slightly flattened between the makers' hands, forming an oval shape in the center in which the distance between the top and bottom was slightly shorter than that of the two sides. In the meantime, the edges of the sling missile were also flattened by pinching the clay. In both cases, fingerprints seem almost unavoidable as these missiles were formed by pinching and rolling the clay between hands. Still, a large percentage of them (82% of all sling missiles) did not yield any epidermal ridges, possibly because fingerprints and other marks were wiped from sling missiles before they were baked. Nonetheless, many fingerprints have been spotted on 18% of the whole sling missile assemblage.

Regardless of the presence or absence of fingerprints or their type, sling missiles come from various contexts at the site. While it is possible to find them associated with structures, they also come from courtyards, general fill layers, and pyrotechnic features. In this sense, they do not seem to be significantly exceptional or cached in a unique context at the site. On the other hand, the presence of sling missiles in or around hearths and ovens (both in houses and in the courtyard)[67] might indicate that they were made in small batches and fired in the ovens and hearths nearby without a specially designated firing location.

Table 9.1 Barcın Höyük Sling Missiles comparison table. Results in red represent those who definitely did not make these objects ($p<0.05$), green represents probable matches with the reference ($p>0.95$), yellow represents possible matches with low significance

Barcın Höyük Sling Missiles			
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**Other Contexts**
0-6 year-olds	Definitely not (p<0.05)	Definitely not (p<0.05)	Definitely not (p<0.05)
6-10 year-olds	Definitely not (p<0.05)	Definitely not (p<0.05)	Definitely not (p<0.05)
10-15 year-old females	Possible (low significance)	Definitely not (p<0.05)	Possible (low significance)
10-15 year-old males	Possible (low significance)	Possible (low significance)	Probable (p > 0.95)
15+ females	Probable (p > 0.95)	Probable (p > 0.95)	Probable (p > 0.95)
15+ males	Probable (p > 0.95)	Probable (p > 0.95)	Possible (low significance)

[67] For example, a sling missile (BH31636) was found in a hearth in Structure 4 from level VId1; another one (BH25090) was found near an oven in the courtyard from level VIc or VIb.

Despite the changes in the settlement organization discussed in the previous section, the Barcın Höyük people continued making sling missiles with the same two types in the same way for six hundred years until the end of the Neolithic occupation. While children up to 10 years old were definitely not involved with making these objects, adult males and/or females seem to be the ones who produced the sling missiles at Barcın during the Neolithic period (**Table 11.11**,**Table *9.1***). The traditional way of making sling missiles in specific forms with specific methods points to continuing communities of practice for centuries.

While the biconical missiles are present at Ulucak, the flattened elliptical ones do not seem to be a major category. Instead, *teardrop-shaped* missiles accompany the biconical ones. What is more, a large majority of biconical missiles were carefully smoothed and fixed with a flat tool that scraped the missiles from the center to the tips, effectively removing any lumps and epidermal ridges while the clay was still drying. However, a small group of biconical missiles did not undergo the same treatment and were baked/subjected to fire while still lumpy and had fingerprints. Many of the ones I analyzed in this work (14 out of 24 from late 7th millennium contexts) come from the same area, where sling missiles were prepared and cached in buildings 22 and 23 in level Va. While they were found in buildings with ovens, these missiles were not intentionally baked but were subjected to fire that burnt down the settlement. This context suggests that at Ulucak in this period sling missiles were made in large batches and stored inside houses before being baked.

It is possible that the ones with partial fingerprints were incomplete missiles in that their makers shaped the general form, but the sling missiles were left unfinished because a fire burnt down the settlement and accidentally baked them. This idea sounds highly probable because almost all crudely made, incomplete sling missiles come from similar household contexts in level Va. While these are different from the smoothed ones both from this level and other seventh and sixth millennium contexts, they were probably made by adult females or adolescent males (with the addition of adult males in later contexts) (**Table 11.24**, **Table *9.2***). Then these crude missiles were probably also made by specialists, but they represent an earlier step in the production process at the site.

Table 9.2 Ulucak Höyük Sling Missiles comparison table. Results in red represent those who definitely did not make these objects ($p<0.05$), green represents probable matches with the reference ($p>0.95$), yellow represents possible matches with low significance

Ulucak Höyük Sling Missiles				
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**6th Mill Contexts**	**Other Contexts**
0-6 year-olds		Definitely not ($p<0.05$)		Definitely not ($p<0.05$)
6-10 year-olds		Definitely not ($p<0.05$)		Definitely not ($p<0.05$)
10-15 year-old females		Possible (low significance)		Possible (low significance)
10-15 year-old males		Probable ($p > 0.95$)		Probable ($p > 0.95$)
15+ females		Probable ($p > 0.95$)		Probable ($p > 0.95$)
15+ males		Definitely not ($p<0.05$)		Probable ($p > 0.95$)

Although less likely, another possibility is that a distinct group, such as those learning to make sling missiles, made these crude examples and mixed them with the others where they would be stored before baking. While this sounds like a less likely scenario as they would be mixing complete and incomplete missiles, it is possible to imagine that adequately baking the missiles was also an essential step apprentices needed to master. Ethnographic evidence suggests that those learning how to make pottery sometimes bake their products with professional potters (Ertuğ 2004). Moreover, thanks to microvariables in production, producers can identify their work and those of other producers in many crafts even if archaeologists/researchers fail to do so (Creese 2013; Longacre 1991). So, the works of the apprentices would probably be easily recognized after the baking process was completed. If this is the case at Ulucak, there was no significant age difference between the specialists and apprentices at the site.

Compared to the number of sling missiles from Ulucak and Barcın Höyük, a relatively smaller number of sling missiles have been examined at Ekşi Höyük. These are usually biconical, but the tips are slightly more rounded than those from the other sites. Both the Barcın and Ekşi Höyük sling missiles have overlapping palm prints because of the way they were made. While the way sling missiles were made did not change, those making them might have changed in the later contexts (Sling Missile Other category in this analysis). Adult females and adolescent males were probably the ones making sling missiles in the seventh millennium; in contrast, adult males seem to be the primary producers in later contexts (**Table 11.39**, **Table *9.3***). Taken at face value, this might point to a change in the communities of practice or the existence of new populations that have different epidermal ridge breadth than the Neolithic population. However, they are either surface finds or come from much later contexts; these finds might have been accidentally dug up from the earlier Neolithic contexts and mixed with the later layers.

Table 9.3 Ekşi Höyük Sling Missiles comparison table. Results in red represent those who definitely did not make these objects ($p<0.05$), green represents probable matches with the reference ($p>0.95$), yellow represents possible matches with low significance

Ekşi Höyük Sling Missiles				
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**6th Mill Contexts**	**Other Contexts**
0-6 year-olds		Definitely not ($p<0.05$)		Definitely not ($p<0.05$)
6-10 year-olds		Definitely not ($p<0.05$)		Definitely not ($p<0.05$)
10-15 year-old females		Possible (low significance)		Definitely not ($p<0.05$)
10-15 year-old males		Probable ($p > 0.95$)		Possible (low significance)
15+ females		Probable ($p > 0.95$)		Possible (low significance)
15+ males		Possible (low significance)		Probable ($p > 0.95$)

9.1.2. Figurines

Figurines from all three sites have been divided into anthropomorphic figurines and animal figurines. While this division is made to understand how the inhabitants of Barcın, Ulucak, and Ekşi Höyük saw the world around them, it also reflects a differentiation in terms of how the two object groups were treated.

Animal Figurines

Almost all animal figurines from Barcın Höyük were made of clay except for a highly polished bone fragment that might depict a bird's tail.[68] Apart from this, all

[68] BH35646; the possible figurine fragment was found in a burial from level VId3 or VIc that was buried in a simple pit in the courtyard. It was found by the torso, close to where the ribs and pelvis meet. This is a unique find for Barcın Höyük, but it is broken at one end, making it difficult to safely interpret the object.

figurines depict quadruped animals. Some animal figurines from Barcın Höyük were probably made by adding small, pre-shaped lumps of clay together to form the extremities of the animals in order to form the general layout of the figure they wanted to create. This is most clearly visible in the attachment scars where the torso's legs and horns were neatly broken off. Nevertheless, the attachments and the overall surface of the figurine were smoothed out very carefully in all cases, making it impossible to identify the attachments without a break. This is sometimes done with a layer of slip, but the slip coating is not always recognizable or present on all animal figurines from the site.

When preserved, the heads of animals were carefully depicted in most figurines. On the other hand, there is a group of quadrupeds whose heads were never depicted, although the horns and other extremities were present (**Figure 9.1**). These figurines come from all Neolithic levels from level VId onwards. It is unclear whether the face was intentionally left undepicted or a more perishable material such as leather or wood was used to complete the figurine.

Two figurines from the 6200-6000 BCE contexts (VIb/VIa), one of which is an almost complete sheep (BH8579) and the other is the lower body of a quadruped, were depicted with udders. Such depictions seem to be absent from the earlier Neolithic layers. Considering the importance of dairy products at Barcın Höyük (H. Özbal et al. 2012), finding udder depictions is not very surprising. Even though udders became a new addition in the last two centuries of the occupation, they were added to the previously accepted and widely produced figural form of the previous centuries.

Unlike the anthropomorphic figurines from the site, animal figurines were not painted or decorated. Adolescents or adult females were probably the ones who were making these figurines throughout the occupation (**Table 11.12**, **Table *9.4***). Since finalizing the figural form requires pinching and smoothing with fingertips, these people left unmistakable fingerprints, especially under the belly and around the head, but fingerprints on many figurines might have been wiped before they were fired. This, however, does not seem to be a general rule as about a third of animal figurines yielded fingerprints. Considering the continuation of the figural forms with slight changes, production techniques, and the age/sex groups that make the animal figurines, it is possible to suggest a continuation of the communities of practice throughout the seventh millennium in Barcın Höyük.

Figure 9.1 BH 8924, Animal figurine from Barcın Höyük

Table 9.4 Barcın Höyük Animal Figurines comparison table. Results in red represent those who definitely did not make these objects ($p<0.05$), green represents probable matches with the reference ($p>0.95$), yellow represents possible matches with low significance

Barcın Höyük Animal Figurines			
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**Other Contexts**
0-6 year-olds	Definitely not ($p<0.05$)	Definitely not ($p<0.05$)	Definitely not ($p<0.05$)
6-10 year-olds	Possible (low significance)	Definitely not ($p<0.05$)	Possible (low significance)
10-15 year-old females	Probable ($p > 0.95$)	Probable ($p > 0.95$)	Probable ($p > 0.95$)
10-15 year-old males	Probable ($p > 0.95$)	Probable ($p > 0.95$)	Probable ($p > 0.95$)
15+ females	Probable ($p > 0.95$)	Probable ($p > 0.95$)	Probable ($p > 0.95$)
15+ males	Possible (low significance)	Definitely not ($p<0.05$)	Possible (low significance)

Animal figurines from Ulucak were also made with fingertips to pinch the figurines to form the head, tail, and limbs. The makers of these Figurines left many fingerprints while finalizing the form, especially between the legs and around the head. While anyone might have made the two examples from occupation layers dating to 6200-6000 BCE (7th millennium Late), adolescents probably produced those from the sixth-millennium levels (**Table 11.26**, **Table *9.5***). Although further research needs to be done on animal figurines from the site, it seems possible that the same age/sex groups, adolescents of both sexes, in this case, continued making animal figurines throughout the occupation at Ulucak.

Table 9.5 Ulucak Höyük Animal Figurines comparison table. Results in red represent those who definitely did not make these objects (p<0.05), green represents probable matches with the reference (p>0.95), yellow represents possible matches with low significance

Ulucak Höyük Animal Figurines				
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**6th Mill Contexts**	**Other Contexts**
0-6 year-olds		Possible (low significance)	Definitely not (p<0.05)	
6-10 year-olds		Probable (p > 0.95)	Possible (low significance)	
10-15 year-old females		Probable (p > 0.95)	Probable (p > 0.95)	
10-15 year-old males		Probable (p > 0.95)	Probable (p > 0.95)	
15+ females		Probable (p > 0.95)	Possible (low significance)	
15+ males		Possible (low significance)	Definitely not (p<0.05)	

Just like those from Barcın Höyük, several animal figurines from Ekşi Höyük[69] provide some helpful information about how they were made by adding clay to the torso to form the limbs rather than starting with one clay lump and carving out the extremities. When done properly, attachments would not be visible to the viewers examining the object as the figurine would be coated with a slip to hide the connections. However, those who made the four animal figurines from a building in level 4b (pre-6200 BCE) seem to have failed –intentionally or accidentally– at attaching the limbs to the torso because of the heads and some of the legs broke off at these attachments. The presence of fingerprints

[69] See Section 5.3.2 for a detailed list of object numbers.

on the inside of the break of the head and at its attachment to the torso shows that the figurine fragments were attached when the clay fragments were too dry to successfully stick together (**Figure 5.39**, **Figure 5.40**, **Figure 5.41**, **Figure 5.42**). The producers of animal figurines at Ekşi Höyük seem to have changed from adolescent males and adult females in the seventh millennium to those who have relatively smaller fingerprints, such as adolescents and older children (**Table 11.40**, **Table *9.6***). This is striking because it might reflect a change in the communities of practice in figurine production, but this idea should be viewed with caution as the number of animal figurines measured in this study is especially low (N=2) in the sixth millennium.

Table 9.6 Ekşi Höyük Animal Figurines comparison table. Results in red represent those who definitely did not make these objects (p<0.05), green represents probable matches with the reference (p>0.95), yellow represents possible matches with low significance

Ekşi Höyük Animal Figurines				
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**6th Mill Contexts**	**Other Contexts**
0-6 year-olds	Definitely not (p<0.05)		Possible (low significance)	
6-10 year-olds	Definitely not (p<0.05)		Probable (p > 0.95)	
10-15 year-old females	Possible (low significance)		Probable (p > 0.95)	
10-15 year-old males	Probable (p > 0.95)		Probable (p > 0.95)	
15+ females	Probable (p > 0.95)		Possible (low significance)	
15+ males	Possible (low significance)		Possible (low significance)	

Human Figurines

Anthropomorphic figurines from Barcın Höyük were made either with articulated legs or with a flat base without any legs throughout the Neolithic period at the site. These two main types were found in all layers and shared similar characteristics, such as decorations around the waist and arms extending to both sides of the body. Facial features were usually not very detailed, but eyes were indicated with two incisions, which was also present in some cases. At least one figurine had a dowel hole through which a removable head could be inserted.[70]

Two lines of evidence point to anthropomorphic figurines from Barcın Höyük were made by adding small parts of the body together rather than sculpting the human figure out of one big chunk of clay by removing the excess. First, a group of unbaked anthropomorphic figurines was found together in Structure 10.[71] The attachment points of the limbs of some of these figurines clearly show that they were made separately and then joined together as some joints were detached from the torso. After that, the figurines were smoothed to mask the attachment points. Once they were dry enough, anthropomorphic figurines were decorated, usually around the waist and thighs. Bodily decorations were usually zig-zag, or large XX patterns incised into the body and then painted in red or black according to the location of the decoration in the body. The black color was used around the thighs and the back, while red was mainly reserved for the front and the waistlines of the body. The number of anthropomorphic figurines made from baked clay at Barcın Höyük is relatively low compared to other object types at the site. However, the presence of the unbaked examples with intricate details and decorations indicates that the inhabitants of Barcın Höyük were actively using unbaked figurines that would not preserve until today. This raises the question of whether they did not need the figurines to be preserved for a long time and whether they were making anthropomorphic figurines from more perishable materials. These, of course, are questions that cannot be answered with our current knowledge.

The second line of evidence is the presence of partial fingerprints on some figurine fragments where it would not be possible to leave a fingerprint if the figurine was made by removing clay instead of adding small parts together. For example, a figurine leg from VIa (BH6561) has one partial print by the ankle below the break (**Figure 5.16**), which would not be possible to reach with fingertips otherwise.

Several anthropomorphic figurines show that once the figurine was complete and dry, they were carefully burnished, which removed the fingerprints on the visible surfaces. Therefore, fingerprints on anthropomorphic figurines were usually located

[70] BH6333 from level VIb or VIa with a partial print on its shoulder. Similar figurines with removable heads are also found at Çatalhöyük (Meskell et al. 2008) and the Lake District (Duru and Umurtak 2005, 93).
[71] Contextual information of these figurines is discussed in Section 8.2.1 Barcın Höyük.

where it is difficult to reach once the object was complete such as under the arms, between legs, or below the feet. Similarly, human figurines, especially those in the form of clay spoon handles from Ulucak, were also burnished and only had fingerprints at hard-to-reach locations.

Table 9.7 Barcın Höyük Human Figurines comparison table. Results in red represent those who definitely did not make these objects ($p<0.05$), green represents probable matches with the reference ($p>0.95$), yellow represents possible matches with low significance

Barcın Höyük Human Figurines			
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**Other Contexts**
0-6 year-olds	Definitely not ($p<0.05$)	Definitely not ($p<0.05$)	
6-10 year-olds	Possible (low significance)	Probable ($p > 0.95$)	
10-15 year-old females	Probable ($p > 0.95$)	Probable ($p > 0.95$)	
10-15 year-old males	Probable ($p > 0.95$)	Probable ($p > 0.95$)	
15+ females	Probable ($p > 0.95$)	Probable ($p > 0.95$)	
15+ males	Probable ($p > 0.95$)	Possible (low significance)	

Based on these partial fingerprints, adolescents and adults of either sex could have made the anthropomorphic figurines at Barcın Höyük throughout the Neolithic period (**Table 11.13**, **Table** ***9.7***). The mean epidermal ridge breadth of the fingerprints from 6200 – 6000 BCE seems to be slightly smaller than their earlier counterparts, showing greater variety. This might be because slightly more figurines yielded fingerprints in the later Neolithic period (N=5) as opposed to pre-6200 BCE contexts (N=3). The age and sex of those making figurines at Ulucak also do not seem to change much throughout the seventh and sixth millennium occupations (**Table 11.26**, **Table** ***9.8***). Adolescents and adults and possibly older children were involved with making these objects at Ulucak. If we compare the wide range of people who were making anthropomorphic figurines at both sites to those making other types of objects such as sling missiles, vessels and pottery related objects, it becomes even more striking to see the involvement of most age and sex groups to the production of anthropomorphic figurines.[72]

[72] Only two anthropomorphic figurines from Ekşi Höyük had measurable fingerprints. Because these do not come from the same levels, it was not possible to compare them.

Table 9.8 Ulucak Höyük Human Figurines comparison table. Results in red represent those who definitely did not make these objects (p<0.05), green represents probable matches with the reference (p>0.95), yellow represents possible matches with low significance

Ulucak Höyük Human Figurines				
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**6th Mill Contexts**	**Other Contexts**
0-6 year-olds	Definitely not (p<0.05)	Definitely not (p<0.05)	Definitely not (p<0.05)	Possible (low significance)
6-10 year-olds	Possible (low significance)	Definitely not (p<0.05)	Possible (low significance)	Probable (p > 0.95)
10-15 year-old females	Probable (p > 0.95)	Possible (low significance)	Probable (p > 0.95)	Probable (p > 0.95)
10-15 year-old males	Probable (p > 0.95)	Probable (p > 0.95)	Probable (p > 0.95)	Probable (p > 0.95)
15+ females	Probable (p > 0.95)	Probable (p > 0.95)	Probable (p > 0.95)	Possible (low significance)
15+ males	Possible (low significance)	Probable (p > 0.95)	Possible (low significance)	Definitely not (p<0.05)

9.1.3. Vessel fragments and related objects

Table 9.9 Ekşi Höyük Vessel Fragments comparison table. Results in red represent those who definitely did not make these objects (p<0.05), green represents probable matches with the reference (p>0.95), yellow represents possible matches with low significance

Ekşi Höyük Vessel Fragments				
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**6th Mill Contexts**	**Other Contexts**
0-6 year-olds			Definitely not (p<0.05)	Definitely not (p<0.05)
6-10 year-olds			Definitely not (p<0.05)	Definitely not (p<0.05)
10-15 year-old females			Definitely not (p<0.05)	Possible (low significance)
10-15 year-old males			Definitely not (p<0.05)	Probable (p > 0.95)
15+ females			Possible (low significance)	Probable (p > 0.95)
15+ males			Probable (p > 0.95)	Possible (low significance)

The presence or absence of fingerprints on pottery heavily depend on the treatment of pottery during production. For example, the pottery from Barcın Höyük was neatly burnished both on the inside and outside throughout the Neolithic period. Despite rigorous examination of over 2000 pottery sherds from the site, faint traces of fingerprints could only be found on the inner surface of one sherd from the earliest occupation layers (VIe or VId1).[73]

Table 9.10 Ulucak Höyük Vessel Fragments comparison table. Results in red represent those who definitely did not make these objects (p<0.05), green represents probable matches with the reference (p>0.95), yellow represents possible matches with low significance

Ulucak Höyük Vessel fragments 6th mill				
Age / Sex Categories	**7th Mill Early Contexts**	**7th Mill Late Contexts**	**6th Mill Contexts**	**Other Contexts**
0-6 year-olds			Definitely not (p<0.05)	
6-10 year-olds			Definitely not (p<0.05)	
10-15 year-old females			Possible (low significance)	
10-15 year-old males			Probable (p > 0.95)	
15+ females			Probable (p > 0.95)	
15+ males			Possible (low significance)	

On the other hand, pottery from the sixth millennium contexts at Ekşi Höyük and Ulucak Höyük were relatively more abundant in terms of fingerprints. Pottery from neither site was as well-burnished as we find at Barcın Höyük. Moreover, the Ekşi Höyük people also applied a red slip on the vessels, making them a more suitable candidate for accidental fingerprints. Because they did not burnish the vessels before applying the slip, the potters left fingerprints during the initial formation of the vessel, while applying the slip decoration, and perhaps when they were carrying these vessels to be fired if their hands were smudged with wet clay. Because these fingerprints were left at different stages of the manufacturing process, they probably shrunk differently. The analysis results in **Table 9.9** only represent the scenario if all of them were left while the clay was still plastic, so they overestimate the results. If we accept this scenario, adult males might have been the potters during the early sixth millennium at the site.

[73] Since a single example does not make a large enough sample, it will not be discussed in this section.

Table 9.11 Ulucak Hematite and Clay Lumps comparison table. Results in red represent those who definitely did not make these objects (p<0.05), green represents probable matches with the reference (p>0.95), yellow represents possible matches with low significance

Ulucak Höyük Clay Lumps		
Age / Sex Categories	**Hematite-rich Lumps 6th Mill Contexts**	**Clay Lump 6th Mill Contexts**
0-6 year-olds	Definitely not ($p<0.05$)	Definitely not ($p<0.05$)
6-10 year-olds	Definitely not ($p<0.05$)	Definitely not ($p<0.05$)
10-15 year-old females	Definitely not ($p<0.05$)	Definitely not ($p<0.05$)
10-15 year-old males	Definitely not ($p<0.05$)	Possible (low significance)
15+ females	Definitely not ($p<0.05$)	Possible (low significance)
15+ males	Probable ($p > 0.95$)	Probable ($p > 0.95$)

Pottery sherds from Ulucak are especially important in showing the specific techniques used to make vessels; the inhabitants of Ulucak made them by coiling the vessel form (Çevik 2016). Several fragments were found incomplete in the workshops and with multiple fingerprints still clearly visible on the inner and outer walls of the vessel fragment. These vessels might have been coiled on flat plates, some of which had recognizable fingerprints, specifically made for this activity (Çevik 2016).

Apart from the incomplete vessels and flat plates, kneaded clay lumps, pulverized and chunks of hematite, bone tools, numerous polishing, and grinding stones —a complete pottery production assemblage— found in these structures further support the idea that these locations were specially reserved for making pottery in the early sixth millennium (Çevik 2016). The assemblage provides tools for every step of the production process, from preparing the clay paste and the red slip to forming, burning, and decorating the vessels. Despite the lack of comparative samples from the seventh millennium contexts, we can compare the pottery sherds with the kneaded clay lumps (both those with heavy hematite inclusions and those without hematite) that come from the same contexts. Age and/or sex-based labor division seems to be at play in the workshops at the site because adult females or adolescent males, both of which have largely overlapping fingerprint dimensions, were probably the primary makers of vessels, while adult males were probably preparing the clay paste by kneading the clay lumps and probably even mixing hematite to clay (**Table 11.27, Table 9.10, Table 9.11**). Children were either completely excluded from the workshop or were in charge of peripheral tasks through which they would observe and internalize the methods employed by potters from Ulucak Höyük.

9.2.Social Memory and Communities of Practice

The previous sections focused on detailing the manufacturing techniques and how certain groups of people were involved with the production of different types of clay objects in the seventh and sixth millennia BCE in Barcın, Ulucak, and Ekşi Höyük. It seems as if both the manufacturing techniques and the main styles continued without much change for several centuries at these sites in western and northwestern Anatolia in this period. The only exception to this is pottery, which seems to have undergone transformations at all three sites (Gerritsen and Özbal 2019; Dedeoğlu et al. 2019; Ç. Çilingiroğlu 2009). The clay objects I concentrate on in this thesis were conceptualized and created by craftspeople, consisting mainly of adults and adolescents, throughout the seventh and early sixth millennia according to the social contexts and traditions of the sites under study.

A sling missile, a figurine or a vessel was the manifestation of the mindset, knowledge, and world views of the producer(s). It was also probably used by the people living in that region and became a part of social engagements through which it acted as a conductor of cultural transmission of ideals and mindsets to the community and the future generations. This is mainly because apprentices grow up in the same community and are inevitably influenced by the ideas these objects convey. Combined with an expert producer conveying certain ideals and world views to the apprentice, the same world views can be passed on for several centuries as apprentices keep recreating the same types of objects with the same method and style.

The degree of involvement by children in the communities of practice has been one of the areas researchers have focused on in the last few decades. Ethnographic research that gathered results from 91 standard cross-cultural sample societies suggested that the gender of the child determines what kind of work children do (Bradley 1993). They usually did activities linked to their adult counterparts, yet children of both genders were doing women's work while girls rarely performed men's activities. Bradley's work showed that children younger than six rarely took over responsibilities, but children over ten years old performed most tasks adults did in their societies. Children between six and ten years old, on the other hand, had the most versatile results as they were active contributors to the economy in some societies but not so much in others. The most cross-culturally common child activities were child care, water carrying, fuel gathering, and housekeeping (Bradley 1993, 79).[74] Building on Bradley's (1993) work, Ember and Cunnar (2015) focused on children between 6 and 10 years old in order to understand why and to what degree the work they do varies from society to society. To do this, they not only investigated the tasks children perform based on the ethnographic data from the eHRAF World Cultures database but also the types of playtime activities children do in these societies. Their results demonstrated that girls generally did more economic activities than boys in this age range, while the amount of work children did differ according to their society (Ember and Cunnar 2015, 90). While a hunter-gatherer child did not substantially contribute to the economy, children's contribution in pastoral societies was very high. Their work also showed that the playtime activities children performed prepared them for adulthood, and children tended to use everyday objects in creative ways for different purposes (Ember and Cunnar 2015, 99). This is another indication that even if fingerprints that belong to children are missing in the archaeological record, it does not mean that children were not using these objects for various purposes.

Despite the fact that the cross-cultural studies on the workload children at different age groups undertake suggest that children younger than six seldom work, some studies point to the presence or involvement of children in various activities, especially pottery production in archaeology and ethnography. Füsun Ertuğ's (2004, 83) article on pottery production at Uslu village in Elazığ shows that gender-based task allocation was at work. While only women were producing the pottery, girls as young as 3-4 years old were accompanying their mothers and trying to create their own pottery by imitating the actions of their parents. Men, on the other hand, helped with preparing the fire, stacking up the pottery for firing, digging up the clay, and bringing it to the village (Ertuğ 2004), all of which are crucial parts of pottery production. Patricia Crown's (2014a) study on the Pueblos shows that pottery production was a female-gendered task and girls started learning the process while they are as young as 5 years old. Laura Gagné's work on

[74] Even though children are an important contributor in the labor force in most pre- industrial societies, they were seldom reported on by previous anthropological studies. Therefore, the data gathered by Bradley in her study is not as comprehensive as the one done by Murdock and Provost in 1973 on sexual division of labor.

Middle Bronze Age pottery in Cyprus also suggests that children as young as 4-7 years old might have been making crude vessels by imitating the older potters, while even younger children might have been playing with clay, but their products would not be fired (Gagné 2014, 26).

Considering the absolute lack of child prints younger than six in vessels and other vessel-related objects, as well as other clay objects such as sling missiles and figurines from the sites discussed in this research, it is not possible to claim active participation of young children in the production process for Barcın, Ulucak or Ekşi Höyük. The limited presence of children between six and ten years old and the lack of children younger than six points to either an actual absence of very young children in the communities of clay object producers because the craftspeople might have waited to include them as apprentices until they were old enough, or a preservation issue as they might have been working or playing with clay, but the things they made were not eventually baked or could not be preserved until today. Alternatively, children might have been a part of the production to some extent as child prints belonging to 6-10 year-olds were sometimes present on especially unidentifiable figurine fragments. These might have been objects made by children as a part of their learning process in becoming successful craftspeople.

Interestingly, the Boncuklu Höyük clay objects assemblage also yielded a low number of child prints (Bennison-Chapman and Hager 2018). As this study does not take the shrinkage rate of clay into account, their analysis should be slightly biased towards smaller fingerprints as they would end up with more younger children and adult females. Even then, child prints seem to be very rare.[75]

Combined with the Boncuklu Höyük results, it might be able to suggest that the lack of young children in clay object production in the Neolithic period in Anatolia was possibly related to what it meant to be a child or the assumed responsibilities of children at various stages of their lives. While very young children up to six years old were not involved in clay object production or the related workshops, they might have been taking up responsibilities as they grew older in and around the production areas. Children might have started learning particular skills and know-how related to making these objects when they were older (perhaps after 6-7 years old) and developed their skills until they were

[75] Out of 50 diagnostic artifacts they analyzed only one clay ball yielded a child print (Bennison-Chapman and Hager 2018, 118). However, the possible age of the child is not provided in the study.

considered old enough adolescents after about ten years of age when they would take up more responsibilities. The results from the fingerprint analyses are in line with the cross-cultural studies about childhood that show that children older than ten years old were taking over adult responsibilities (Bradley 1993; Ember and Cunnar 2015) as both adolescent (over ten years old) and adult fingerprints were consistently found on the same types of objects at Barcın, Ulucak and Ekşi Höyük. Although our current knowledge of the rites of passage, lifecycle rituals and at what age people were considered to be adults in western and northwestern Anatolia in the Neolithic period is fairly limited, it is perhaps possible to imagine a change in the way they were seen by the society when they reached puberty in early teens. Although the research is still ongoing, burials from Barcın Höyük further elucidate a social differentiation in terms of age at this site; while neonates and infants were buried inside houses, perhaps after the abandonment of these buildings, children were interred in the annex area and adults in the courtyard (Alpaslan Roodenberg, Gerritsen, and Özbal 2013, 95). This differentiation might be a symbolic representation of the liminal nature of children and childhood for the Barcın Höyük community.

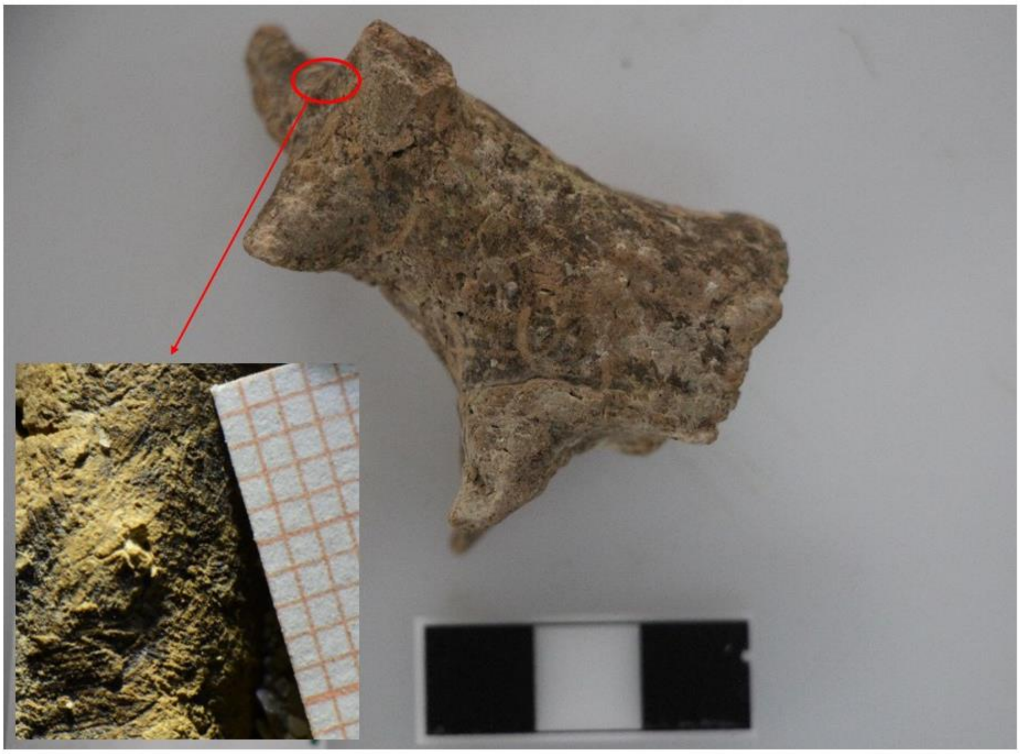

Figure 9.2 CAN1305 / ULU.01.104, an animal figurine that has very small fingerprints from Ulucak (Object photo by Coşkun Sivil, Courtesy of the Ulucak Höyük Archaeological Project Archive)

Children between 6 and 10 years old might have been making some of the animal and human figurines at Ulucak, Barcın and Ekşi Höyük. Nevertheless, larger fingerprints that probably belong to adolescents or adults were also found on figurines. The case of an animal figurine (CAN1305/ ULU.01.104) from Ulucak is especially striking (**Figure 9.2**) because this figurine has the smallest fingerprints that belong to a child, probably younger than six years old from that site. This figurine shows that very young children were also present in figurine production areas. The existence of children and adult/adolescent prints on the same types of objects might mean two different things; either figurine production was not very standardized, or children were present and possibly participating in figurine production through legitimate peripheral participation. As figurines were not as standardized as some of the other clay objects analyzed in this work, it seems possible that the knowledge transfer was household-based. Based on the limited variability in the types of clay objects throughout several centuries, it is perhaps possible to suggest that the apprenticeship models included a master or a specialist working together with the apprentice or the student. In this apprenticeship model, the specialist can correct the students' mistakes and make sure that they successfully produce the desired styles and forms accepted within the community. The cultural transmission methods might have been through an older generation, possibly the parents or the grandparents transmitting the information to the children of a certain age.

However, the child print on the animal figurine mentioned above also brings up the question of whether the fingerprints found on clay objects actually belong to the makers of these objects. This question can be solved by examining whether the same types of fingerprints continue to appear on the same types of objects, i.e., the consistency of analytical results for the same object types. While for sling missiles, vessel fragments and pottery sherds, that appears to be the case, figurines do present a greater variety with more involvement of children. In the case of CAN1305, the figurine might have been made by a very young child, or just held by one, but it is currently not possible to have conclusive interpretations.

9.3. Gender and Communities of Practice

9.3.1. Ulucak

Decades of research underline the importance of gender and age when it comes to the division of labor in pre-industrialist societies (J. K. Brown 1970; Murdock and Provost 1973; Costin 2013; 2000; 1991; Wendrich 2013b; Byrne 1994; Sassaman 1992; Wright 1991). Yet, ethnographic evidence shows that such divisions are not universal and show variability through time and among populations. Pottery production is mainly considered a female activity by many scholars (Murdock and Provost 1973; J. K. Brown 1970; D. E. Arnold 1985) because it allows interruption by children and housework. However, when pottery production provides profit, it can become a full-time profession for males (D. E. Arnold 1985, 106). However, such Eurocentric claims have been extensively criticized recently (Costin 2013; Bolger 2013).

The pottery workshop at Ulucak seems to be drawing a more nuanced picture of the subject. While it is a workshop that seems to have a specific purpose of pottery production, it is not dominated solely by one sex. Instead, the fingerprints evidence points to the inclusion of adult males and females, albeit performing different tasks, participating in different steps of the *chaîne operatoire* of pottery production at the pottery workshops in Ulucak in the sixth millennium BCE. While adult males seem to be heavily involved with preparing the clay paste, adult females or adolescent males were probably the ones in charge of preparing the vessels themselves. It is perhaps useful to mention once again that the mean ridge breadths of adult female fingerprints and adolescent male fingerprints highly overlap, which makes interpretations about sex differentiation difficult. Nonetheless, distinct groups of adults/adolescents were probably doing specific tasks at the workshop. If pottery production had been considered something that can be managed while taking care of children by the Ulucak community, we might have come across some fingerprints belonging to smaller children. However, as has been also mentioned previously, child prints, especially very young children are completely absent in the fingerprints record. While we see the participation of adult males and females in the production, the exclusion of children is striking. It seems as if not only sex but also age was an essential component of being a part of the communities of potters at Ulucak.

The exclusion of children and the presence of subadult males might further be related to the cultural and social norms the Ulucak community shared. It might have been impossible for those below a certain age or social position to become a part of the workshop at Ulucak. For example, there is some ethnographic evidence for women to start learning or relearning how to make pottery. Dietler and Herbich (1994, 465) studied the production and the learning processes among the Luo of Kenya, where women start learning to make pottery only after they get married, and they learn it from their mothers-in-law or the other wives of their husbands. While learning how to make pottery, the young wife also internalized the social conducts and the habitus through practice for several years under guidance.

Fingerprints evidence on pottery sherds point to both adult females and adolescent males as potters from the workshop at Ulucak, either working together or only one of those groups working there. Biological sex seems to be an integral component of task differentiation in either case, but each possibility implies a different interpretation. If those who were making the pottery were solely adult females, only adults whose tasks were defined by their sex would be working at these workshops as those who make the pots (females) and those who prepare the clay (males). Such gender-based task allocations are present in other ethnographic research from various parts of the world (Ertuğ 2004; Halliwell, Yankowski, and Chang 2016). If, however, the potters were adolescent males, it would mean that pottery production might have been a predominantly male-gendered activity at the site. In this scenario, task allocations would be based on age as younger males would be making pottery while adult / older males would be preparing the clay while females were excluded from the production process. This kind of more complex labor division involving both age and gender as well as other social positions is also present in the ethnographic record (Harry and Huntington 2010). A combination of both scenarios in which adult females and adolescent males were working together to prepare the vessels is also possible.

Then, what can we say about the identity of the potters at Ulucak? A clear age and sex-based labor division among the communities of potters is visible in all scenarios. As I have discussed in Chapter 2, ethnographic analyses show that who can become a specialist of specific tasks or crafts changes from culture to culture and is probably based on that culture's ideas, world views and norms about which tasks are gendered. In that sense, a task (making pottery) performed by both sexes might have been less likely for the Ulucak community as well, but these examples are not absent in ethnography (Kelly and Ardren 2016, 8; Neff 2002, 39). For example, in a society where pottery production is considered a female activity, males can produce the same vessels or work together with female potters but they would not be able to receive the same societal recognition as their female counterparts because their actions and productions are outside the idealized gendered behaviors in that society (Kelly and Ardren 2016, 9). From this point of view, both adult females and adolescent males might have been making pottery together in these workshops. One of these groups, females or adolescent males, might have received recognition from the community while the other could not gain that.

The scenario in which adult females were in charge of pottery making and adult males mixing and preparing the clay fits to the gender-based task differentiation approach in many other societies. Pottery production was a group activity with the involvement of males and females, all of whom perform some integral part of the production process. Allocation of tasks in this way suggests a relatively strict age-based differentiation in production as the members of the pottery workshop seem to consist of adults without any younger individuals. The absence of children and adolescents in the workshops might have been due to preservation issues or the fact that younger individuals performed tasks that could not leave archaeological traces as well as an actual absence.

If, on the other hand, adolescent males were making the vessels while adult males were preparing the clay paste, both gender and age seem to play an important role in the division of labor. This would mean that pottery production was completely a male-gendered activity at Ulucak and females and children below 10 were possibly absent from the workshops. Of course, absence of evidence does not automatically mean evidence of absence, because they might have been contributing to the production in other ways, such as preparing the fire, digging up clay and hematite, collecting water and other inclusions to be mixed into clay. As adult female prints were also found on many other clay objects such as sling missiles, animal and human figurines from Ulucak, probably, they were also present in the workshops as producers. However, it is also possible that adult females were specialized in making clay objects other than pottery in this community.

Cross-cultural ethnographic studies on children's work suggest that children older than ten years old start doing the same tasks as adults according to their gender (Bradley 1993). If pottery production was a male gendered activity at Ulucak, the presence of adolescent male prints on vessels might indicate that adolescent males were learning the crafts as apprentices from the master potters or that the age-based task differentiation meant that younger males were making the vessels while older males were preparing the clay paste. As the actual task of shaping vessels is one of the more difficult steps of pottery production, however, one would expect the expert potters to perform this task rather than the apprentices. While this remains a question mark, it might be that the prints we come across in pottery sherds belong to apprentices rather than to the expert potters, as the master potters were more careful about not leaving fingerprints on the vessels they prepared.

Sling missile producers seem to be adult females or adolescent males at Ulucak. As discussed in the previous chapters, most missiles from the late seventh millennium contexts come from the same area in buildings 22 and 23 in level Va, where they were produced in large quantities (over 500 missiles in one room), possibly as batch production. The buildings were also equipped with ovens, storage units and other *in situ* finds. Some of the missiles were possibly incomplete as they were not smoothed with an implement. because they were found together with complete missiles, it is highly probable that the same people working and possibly living in buildings 22 and 23 produced batches of sling missiles at the site. It is interesting that adult males seem to be absent from the production process in these contexts while they might have been producers themselves in later contexts.[76] In general, a significantly high number of sling missiles have been found at Ulucak, 599 of which have been examined for fingerprints. Although further research needs to be done on sling missiles in this period, the batch productions as from Va contexts require some sort of specialization in missile production because their shapes and sizes are usually very standardized except for some unfinished biconical ones. Although the possibility of apprentices working together with specialists has been proposed earlier, it seems less likely as crude, unfinished missiles were not found in a separate pile but together with the finished missiles.

Figurines at Ulucak seem to be less standardized compared to sling missiles or pottery. While there are some general patterns in form and style, the producers seem to range from young children to adult females, although adult males might also have been a part of the production process in the latest levels of the seventh millennium. Especially adolescents of both sexes might have been actively involved in making both animal and human figurines at Ulucak. The lack of standardization and the wide range of producers

[76] Yet the number of sling missiles with epidermal ridges from later, non-neolithic contexts are only three. In comparison, there are 24 samples from seventh millennium late (6200-600 BCE) contexts.

that belong to all age and sex groups at Ulucak suggests that there were no age or sex-related restrictions in figurine production at the site and the communities of figurine makers probably consisted of small household groups.

9.3.2. Barcın Höyük

Clay was essential for the Barcın Höyük people in the Neolithic period. It was used as a building material, for cooking pots, hunting gear (sling missiles), and many other big and small objects necessary for their culture. Based on the fingerprint analysis, it seems that adult females and adolescents were primarily involved with making animal and human figurines, vessel-related objects, and tokens. Still, children between six and ten years old might have made some unidentifiable fragments. On the other hand, sling missiles were probably only made by adults, either male or female.

While adolescents of both sexes and adult females were probably the ones making animal figurines at Barcın Höyük, human figurines show an even greater variety as it seems almost all members of the community might have been making human figurines. The results show continuity throughout the occupation for both types of figurines. Nonetheless, when all data is examined, it seems as if adult females were most involved with making all types of objects at the site.

In comparison, adult males were probably only making sling missiles and possibly human figurines in the earlier seventh millennium levels. The sling missile results are especially noteworthy because this is the only category of objects that was definitely made by adult males and/or adult females throughout the occupation. This brings up the question of their purpose. What was their function? While archaeological research on sling missiles in prehistory is limited to a few researchers such as Korfmann and his colleagues (M. Korfmann, 1973; M. O. Korfmann et al., 2007), ethnographic research suggests that they were used for hunting, warfare, herding animals by keeping them from straying too far from the grazing area and keeping predators away from the flock.

The standardization of sling missiles manufactured from clay (and lead in later periods) in terms of shape, form, and weight almost double the range of the slinger (M. Korfmann, 1973, p. 37) while also making the slinger's job easier as they would not need to adjust their throw with each missile. Slings are simple but portable, silent, robust, and accurate tools with a good range. Despite the general assumption that males in prehistoric societies did the hunting, males do not have an advantage over females in using slings as weapons because slings are not limited by the weight or strength of the thrower. They are very lightweight and can be easily carried in a bag or someone's pocket. They are, however, dependent on the aerodynamic properties of the missile to achieve a good range and accuracy, so they need to be carefully made. Comparing sling missiles and arrows in terms of their effectiveness suggests that the sling is much more effective in its impact and accuracy than an arrow (M. Korfmann, 1973, p. 40) because sling missiles are less affected by environmental conditions than arrows.

Hunting and hence using and making weapons has been typically considered a male-gendered activity in archaeology and anthropology thanks to the Man the Hunter model proposed in the 1960s by Washburn and Lancaster (1968). This interpretation has been severely criticized by many scholars ever since because it only considers capturing large game as hunting, fails to mention the involvement of females and children in hunting small game as this is considered gathering, and disregards many steps of hunting large game crucial for a successful hunt except the act of killing the animal (Slocum 1975; Bolger 2010; Doucette 2001; J. K. Brown 1970). It is also impossible to suggest that using and throwing sling missiles was a male-gendered activity solely based on the difference in muscular strength between males and females. Since the centripetal force to throw the missile does not require a specific muscular stature, it is impossible to suggest that only males were using the sling. Anyone can use slings and become skillful sling throwers as long as they practice aiming and using it.

The clear distinction between the makers of sling missiles and the producers of the other clay objects indicates that sling missiles had a distinct, perhaps more special function than all the other types of clay objects at Barcın Höyük. It seems as if sling missile production was an activity reserved for those who use these, perhaps more seasoned herders/hunters themselves who might have been males, females, or both, but all adults. It should be noted here that hunting was not a significant part of subsistence economy throughout the occupation at the site (Galik 2012; Würtenberger 2012), so these missiles might have been used for purposes other than hunting as well. As mentioned earlier, the production of sling missiles requires some standardization to work appropriately and effectively. This might have led the users to produce them themselves as they had to be meticulous about these tools' size, shape, and weight. Since the beginning of the occupation, the production followed two primary forms of sling missiles, biconical and flattened elliptical. While some of the missiles were slightly smaller than others, the object's general shape seldom strayed from the pre-determined forms specific to Barcın Höyük.

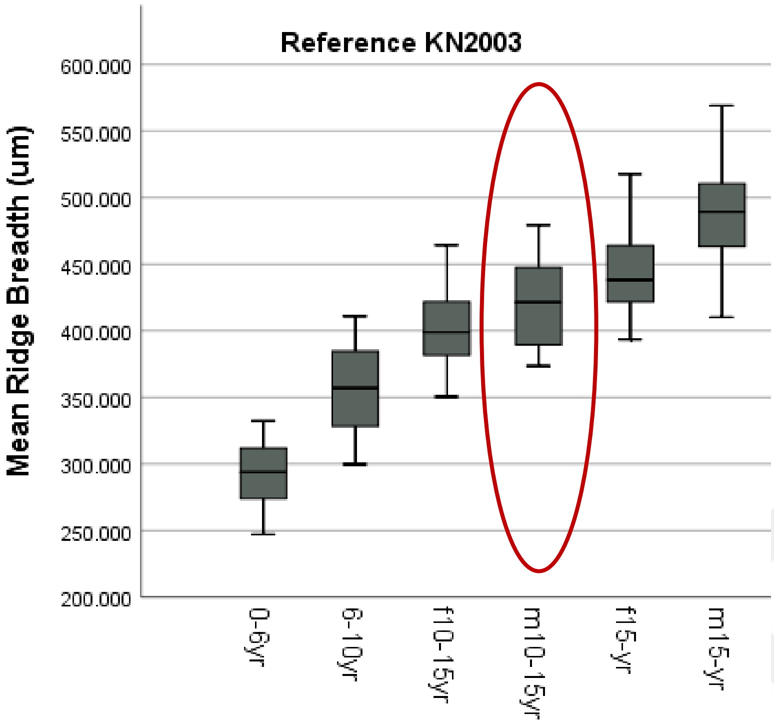

Figure 9.3 The mean range of the epidermal ridge breadth of adolescent males in the reference sample overlaps with adolescent and adult females

Apart from the specialized sling missile production, adult females and adolescents of both sexes might have made clay objects. Here, it might be possible to consider clay object production as a female activity at the site. If that was the case, it is not surprising to see adolescent and adult females doing similar types of work at the site because ethnographic studies suggest that children over ten years old usually take on the same workload as their adult counterparts (Bradley 1993). If that is the case at Barcın Höyük, the possible presence of adolescent males is also not surprising in the fingerprint data. The methodology used in this analysis cannot differentiate a male and a female fingerprint with certainty by only looking at the mean epidermal ridge breadth. Just like the size of adolescent male hands is usually somewhere between the size of adults' and adolescent females' hands, the means of their fingerprint measurements also tend to overlap with those of adolescent and adult females (Figure 9.3). Therefore, even when only adolescent and adult female fingerprints are present in the fingerprints' data, they overlap with parts of the adolescent males in the reference sample, creating a false positive for the adolescent males.

An alternative but less likely hypothesis would be a very clear-cut age division in clay object production with adult males only making sling missiles and adolescent males making everything else at the site. When we consider the cross-cultural ethnographic data on labor division and childhood, it seems less likely for adults and adolescents of the same sex to be involved in entirely different jobs/tasks. On the contrary, it seems more likely for adolescent males to take on the jobs and responsibilities of their adult counterparts. Therefore, if adult males were actively involved in the production of all or most clay objects, the presence of adolescent males would have made more sense.

That being said, we cannot completely rule out the presence of adolescent males in the production process. The analysis results suggest that sex, and maybe gender or the production of adulthood, might have been related to the production of clay objects at Barcın Höyük. Judith Butler theorizes that through social production and reproduction of material culture and certain gestures, gender is also reproduced within the society. The reproduction of citational precedents multiple times creates and reinforces gender norms in society as gender identity is "always a doing…" (Butler 1990, 33). In her own words, "[t]here is no gender identity behind the expressions of gender; that identity is performatively constituted by the very 'expressions' that are said to be its results" (Butler 1990, 33). Therefore, a person's gender identity is constituted by their actions and performance. People create their specific gender identity by acting according to the expected norms of their identity, and each performance helps recreate the concept of that specific gender identity.

At Barcın Höyük, making clay objects might have been one of the ways to make and realize gender ideals. One of the tools used as citational precedents for gender might have been the habitual act of making and shaping objects from clay at Barcın Höyük. This act might have also worked as a mechanism to transfer ideas and knowledge about gendered ideals as well as cultural and social information from one generation to the next. It is possible to imagine that older and younger females were working on making these objects together with the younger ones learning the ways of clay and the proper forms and techniques from the older generation. While this does not entirely omit the possible presence of adolescent males in the production process, it might mean that even if they were actively involved in the production, they were not socially benefiting from this job the same way as their female counterparts at the site. However, when it comes to the sling missiles, the standardization required for success created the necessity for a more specialist group of adults —male, female, or both— to be involved with their production. As clay itself is a reusable material, even if apprentices or novices copied the form and shape of the sling missiles, they might have been recycled or not fired, making it more difficult to be preserved until today.

9.3.3. Ekşi Höyük

In many aspects, the Ekşi Höyük results show similarities to Ulucak and Barcın Höyük. Biological sex seems to be an essential factor in deciding who produces certain clay objects at the site. Overall, the Ekşi Höyük data is difficult to interpret for two reasons. First, some of the object types are represented by only a few objects, making it difficult to confidently interpret the results. For example, only two human figurines have been recovered, each discovered in a different occupation layer, making comparisons difficult. On the other hand, other categories such as pottery with prints have been discovered in more than 20 examples.

Second, and perhaps in conjunction with the first reason, the analysis results notably change through occupation phases, making it difficult to find a clear sex-based labor division pattern. This may be a result of changes in the way labor division was organized in the production of clay objects through time at the site. It might be also possible that the limited number of finds that have been examined at the site makes it difficult to find a distinguishable pattern.

Compared to the Barcın Höyük results where clear patterns in terms of communities of practice are visible in the archaeological record, Ekşi Höyük paints a picture that is more difficult to decipher. On the one hand, adolescents and adults of both sexes seem to be involved in the production process; on the other hand, there is no discernible pattern that stands out where we can confidently tie one sex as the sole producer of all clay objects. This, in itself, is interesting and may suggest that both sexes participated in similar types of activities. Below I discuss some trends concerning the Ekşi Höyük data.

Sling missiles at Ekşi Höyük are an interesting category overall. The analysis of fingerprints found on these objects suggests that adult females or adolescent males were probably making sling missiles in the 7th millennium Early occupation layers, predating 6200 BCE, but the sling missiles from later or poor contexts seem to be made by adult males.[77] It seems that children up to 10 years old and probably adolescent females were not actively involved in shaping/making these objects. Apart from a clear age distinction in production, what else can we say about the makers of these? There are several possible scenarios where labor division is formulated slightly differently.

First, sling missile production might have been a male gendered activity at the site. If that was the case, it is not surprising to find prints that belong to adolescent males and adult males together. The reason why adult female prints also seem as if they are present is that the statistical method cannot differentiate between an adolescent male and an adult female prints accurately due to the overlap between the mean epidermal ridge breadths of these two groups. Cross-cultural studies on sex, age and labor division also support this scenario because children over 10 years old usually carry out the same workload as their gender counterparts in many communities throughout the world (Bradley 1993).

These sex-based conclusions bring up the question of the identities of the producers. Were the makers and users of these sling missiles the same people? This question has been discussed briefly when discussing the Barcın Höyük sling missiles as well. It might have been the case because these objects are rather standardized in terms of shape and size and the same forms continue to be made through generations without much change. If that is the case, hunting might have also been a male-gendered activity at the site where adolescents and adults work together, perhaps the young learning from the old about the hunting methods and how to prepare their tools. However, these claims are not conclusive and should be approached with caution.

In the second scenario, sling missiles might have been co-produced by adult males and females at the site. If this was the case, the presence of adolescent male/adult female prints together with adult males could be related to the shared nature of making sling missiles. The Barcın Höyük results are also similar in that sense, albeit the adult female

[77] While it is not possible to perform ANOVA test on the single sling missile from the 7th millennium early context, it also seems to be rather large, possibly belonging to an adult male or female, but probably not to a child or an adolescent female.

fingerprints are statistically different from the adolescent males at Barcın. If this scenario is true, we can suggest that sling missile production and perhaps also hunting was an activity performed by adults of both sexes. Again, specialists were probably the ones making these tools as they require standardization.

Third, it is possible that there was a change in gender relations and labor division from the 7th millennium to later levels with production switching from adult females to adult males. Such a drastic change would have significant repercussions in the social lives of Ekşi Höyük inhabitants. It also brings up the question of whether such a major change also occurred in hunting practices at the site. However, this scenario is not very likely as the statistical difference between the earlier and later sling missiles are not very large and we cannot completely rule out the presence of adult males in the earlier levels and the presence of adult females in the later contexts solely based on these results.

Another interesting switch in terms of the organization of production might involve pottery production. While adult males might have been the primary producers or makers of pottery in the early 6th millennium contexts, pottery from non-Neolithic contexts point to adult females or adolescent males as the main producers/actively involved in the production process.[78] Why was there a shift in the production?

The issue with this interpretation is that most of the vessel fragments from the later contexts come from mixed contexts or later occupation layers. These mixed results should not be compared to the more pronounced results from the 6th millennium. The 13 pottery sherds from this occupation layer (layer 3) suggest that pottery production might have been a male-gendered activity at the site.[79]

Unlike figurines, sling missiles and pottery seem to be specifically produced by adults at Ekşi Höyük. These might have been more standardized forms of labor division while animal and human figurines were not as standardized. Figurines seem to be made by adolescent males or adult females in the earlier occupation layers (pre-6200 BCE)

[78] There is only a single sherd dating to the 7th millennium late occupation layers, making it difficult to interpret the results apart from saying that the fingerprints left on the sherd probably belonged to an adult male/female or an adolescent male.

[79] It should be noted that some of the fingerprints found on these fragments have a very large ridge breadth and that some of these results might have overestimated the size of these fingerprints. This is because some of these prints might have been left when the pottery was already drying and during the application of the red slip on pottery. These prints would shrink less than those left when the object was still being formed by the potter. Nonetheless, the range of these results would still fall under the adult category, excluding children and adolescent females at Ekşi Höyük.

while children 6-10 years old or adolescents of both sexes might have also been involved in their making in the 6^{th} millennium occupation layers.

In general, biological sex seems to be an important factor in labor division in making clay objects at Ekşi Höyük as well. While we cannot pinpoint exactly who was working on certain types of objects in most cases, sling missile and pottery production might have been carried out by males.

Contemporary evidence from the Ulucak pottery workshop indicates a clear task differentiation in different production processes. While adult females might have been making pottery, adult males seem to be more involved in making and preparing the clay mixture. Further research on these two sites will further answer the question of how labor was organized in pottery production at Ekşi Höyük and Ulucak. The difference between these two contemporary, yet not too distant, sites is noteworthy. This suggests, as we already know from the way in which Neolithization manifests itself across different settlements, that each site presents a unique set of circumstances and a redefinition of gender roles. This shows how important it is not to generalize but to understand the diverse strategies towards gender roles and social organization that each site may have witnessed.

Chapter 10

10 CONCLUSIONS

This research has further unfolded the Neolithic mosaic in western and northwestern Anatolia by looking at the entangled relationship between people and things made of clay, focusing on the 7^{th} and 6^{th} millennia BCE. During the seventh millennium, the west of Anatolia received migratory groups who brought their technologies and mindsets to these newfound lands (E. Özdoğan 2015; Horejs 2016; Horejs et al. 2015; Gerritsen and Özbal 2016). The earliest occupations in these regions had limited material assemblages (Ç. Çilingiroğlu and Çakırlar 2013; Horejs et al. 2015; Gerritsen and Özbal 2016). During the first half of the seventh millennium BCE, these sites lacked the typical components of the Neolithic material culture, such as figurines, sling missiles, polished stone axes or bone spoons; and pottery was almost nonexistent (Ç. Çilingiroğlu and Çakırlar 2013; Horejs et al. 2015). However, shortly after the earliest level, data points to changes in the material assemblages, including numerous objects and a greater variety. The change from a limited material assemblage to a very numerous one seems to have happened rather quickly. During this initial settlement phase in the first half of the seventh millennium, people in these lands might have started experimenting with the clay sources and the natural resources to recreate the objects, concepts, and ideas they brought from their ancestral lands. While the three sites in question here, namely Barcın Höyük, Ulucak Höyük, and Ekşi Höyük, date approximately to the same period and share similar material culture, they present distinct patterns in labor division in craft production. This conclusion will focus on some questions regarding the nature of labor division in making clay objects in the region.

By approaching clay finds from the Neolithic contexts from Barcın, Ulucak, and Ekşi Höyük, this study aimed to understand how labor division in clay object production was organized during this period. In order to achieve this goal, this work makes use of paleodermatoglyphics, a relatively novel method in archaeology, that focuses on estimating age and sex from fingerprints left on archaeological finds. The clay assemblages from the case studies have been evaluated to find out which types of objects had the potential to provide fingerprints. These objects were examined temporally by dividing them into four groups based on their context. Each fingerprint on these objects was recorded, and the epidermal ridges on these prints were carefully measured to obtain information about the breadth of these ridges.

While sling missiles, figurines, and geometric clay objects such as conical tokens and clay balls were among those that were fruitful in providing imprints, the preservation of fingerprints on pottery heavily depended on the surface treatment of these objects. Fingerprints can be preserved while the makers are forming or doing the finishing touches. Various factors affect whether or not and to what degree fingerprints preserve on clay: the final surface treatment of an object, such as burnishing, could wipe out any existing prints, and the extreme wear on an object could chip away its surface, removing any fingerprints. Moreover, the type of clay and the inclusions added to the clay mixture could impact how much clay shrinks when it dries, changing the dimensions of the fingerprints as well. The shrinkage issue has been addressed in this dissertation, and an experiment was devised to determine how it impacts the objects analyzed in this work. The experimental analyses on clay shrinkage shows that different types of clay can shrink at different rates. Moreover, at what stage of the drying process a print was left also impacts its shrinkage rate. After fitting the clay shrinkage to the reference, the means of each fingerprint were compared to the reference collection from the modern Czech population.

Perhaps because Barcın, Ulucak, and Ekşi share some common elements in terms of their Neolithic lifestyle, there are some common characteristics in deciding who does what kind of work is worth mentioning. First of all, children, especially those younger than six years old, were almost absent from the production at all three sites. Whenever present, the child prints were very few, making them difficult to identify within the general production. This absence of young children in the production areas is unexpected because, except for those that come from the Pottery Workshop at Ulucak, one would assume that most of these objects were produced in household contexts where young children would also be present. The absence of very young children is in line with the cross-cultural studies on children and labor division. These studies also further demonstrated that children below six years of age were usually not involved in activities that contribute to the household economy and production.

Most production activities were done by adolescents or adult females at the sites. What did it mean to be an adolescent in these communities? At what age were they considered to be adults? One of the outcomes of this dissertation is that adolescents aged between ten and fifteen might have been involved in making clay objects at all three sites. Many communities consider the end of childhood at around 12-13 years old, so the results might also indicate that young adults were active in the production process. The age of reaching adulthood might have been much younger from our perspectives but was probably logical considering the shorter life expectancy in the Neolithic communities.

Despite some common elements in labor division at these sites, they were not completely identical in terms of labor division. Among the most prominent differences is in sling missile production. While the concept of manufacturing and using a missile is shared in this region in this period, the manufacturing process shows some differences when the three sites are compared to each other. Multiple interpretations are possible for each site when it comes to the makers of these objects. Due to the standardization in shape and size at each site, more specialized producers, perhaps those who actively use the sling missiles, might have been the ones making them. Barcın Höyük missiles are distinct from other clay objects such as figurines and geometric clay objects because probably only adults, male, female, or both, were making them. The Ekşi Höyük missiles draw a more complicated picture to decipher. Based on the statistical calculations, making sling missiles might have been a male-gendered activity at the site, but other interpretations of the data are also possible (see Chapter 9.3.2.). The case of Ulucak, on the other hand, is unusual because only a small percentage of the whole sling missile assemblage had identifiable fingerprints. Most of these come from the same occupation layer and might have been made by the same individuals. They seem to be left at an earlier stage of the production or prepared by less skilled producers, possibly adult females or adolescent males.

Another interesting object group worth mentioning here is pottery. Fingerprints on pottery can be preserved at different stages of production. One can leave their fingerprints during the initial forming process when the clay is still plastic or after it has dried by handling the object with hands smudged with clay. At these two extremes, the size of the fingerprints preserved differs because they would shrink at different rates. This shrinkage issue might have impacted the pottery results from Ekşi Höyük, making interpretations more difficult, yet it seems to be an activity performed by adults, possibly by adult males at the site. Ulucak provides an excellent example of age and sex-based task differentiation in the community of potters. Adults and adolescents of both sexes seem to be involved in different steps of the preparation, from preparing and mixing clay to be used to the final forming of the vessels. Finally, the Barcın Höyük pottery was not informative about who made them at all because the inhabitants of Barcın were very careful about burnishing pottery inside and outside, removing any imprints present beforehand effectively.

This dissertation demonstrated that biological sex, and possibly gender plays a role in task allocations and labor division during the Neolithic period in western and northwestern Anatolia. It is worth underlining that gender is not merely something inscribed on the sexed body, as becoming gendered is an ongoing process through repeated acts through time. Gender performance can be exhibited through interactions with the world, such as how a person moves in public, the types of labor activities they do, the kinds of things they produce, or how they interact with objects and the space around them. Here, it should be noted that gender performance is inextricably linked to each society's material lives and material culture. The way individuals interact with the material culture in conjunction with their gender performance is culturally contingent. Therefore, specific performances or practices might be associated with a particular gender in one culture at a specific time, but these connections can be very different across cultures and through time.

Visual representations of gendered performance, such as certain postures, gestures, or realistic depictions of particular gendered behavior, can be one mechanism for setting a precedence of particular gendered ideals. At all three sites, visual representations of humans were present but were relatively low in number. The depictions of bodily ornaments, dresses, and decorations, possibly a direct reflection of the clothing and bodily ornaments of the Neolithic communities in the region, might have implied a relative conservatism in bodily practices. These images would have also served as performative precedents for gender. Because the figurines seem to have been made by adolescents, the act of making these objects would have added another layer to performing and inscribing gender at these sites.

The way the knowledge of making clay objects were transferred intergenerationally in these Neolithic communities is another important question that should be addressed here. The discussion in **Chapter 8** shows that almost all object types underwent a prolonged continuity in terms of style throughout the several hundreds of years of occupation. The same types of sling missiles, animal and human figurines continued to be made the same way with the same methods, sometimes with relatively minor additions such as the addition of udders to some animal figurines in the later

Neolithic occupation layers at Barcın Höyük. At the same time, people that belonged to a similar age and sex group, adolescents and adults, usually continued making the same types of clay objects throughout the Neolithic period at the site. Based on the continuation of the same styles, relatively minor new developments, and the continuation of the same traditions in production, it might be possible to suggest that clay object production was transmitted within the household groups from older generations to the younger ones in the Neolithic communities in western and northwestern Anatolia. This conclusion is also in line with some anthropological studies that state that if something is made for household consumption, tasks are allocated based on gender and age while learning is done at home with the help of adults or older individuals (Crown, 2014, p. 73).

Apprentices/learners within the household probably become socialized to the crafts by legitimate peripheral participation by learning each craft's technical and social aspects. Those who passed on the technical information of these crafts probably also transmitted their own individual memories as well as the social memories of the community with regards to these objects because, as Williams and Janik put it, "…it is impossible for [biographic memories] to exist in a vacuum without being integrated into the social memories of the community" (Williams & Janik, 2018, p. 230). At the same time, social memories cannot exist without individuals whose memories contribute to creating and maintaining social memories (Williams & Janik, 2018, p. 230). They complement each other. During the apprenticeship period, novices not only learn about the technical methods for the production but also internalize the acceptable forms and decorations for the society they live in within the social context of learning the production techniques (Lemonnier, 1993, p. 3). This is because becoming a specialist is beyond mastering the tools and techniques as it is "based on situated negotiation and renegotiation of meaning in the world" (Lave & Wenger, 1991, p. 51).

This work has contributed to the greater debates on sex, gender, age, and communities of practice in clay object production and the Neolithic way of life in western and northwestern Anatolia. Nevertheless, there is still a gap in this field that requires future research. Our knowledge of gender and age in Neolithic Anatolia is very limited due to a lack of extensive or comprehensive research that ties strains of evidence related to these topics. Paleodermatoglyphics, the method employed in this work, is a research field that is still in its early stages. As a research method, the study of fingerprints have the potential to yield more promising results in later contexts as specialized production and specialist workshops become even more pronounced after the Neolithic period. New methods and approaches to archaeological fingerprints are being developed, which will indeed produce more precise and conclusive results in the future. Further research that makes use of new techniques will undoubtedly increase our knowledge about the nature of labor division in clay object production in the Neolithic period in western and northwestern Anatolia. Such research is necessary to shed light on the intersectional identities of prehistoric communities.

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APPENDIX I:
11 STATISTICAL ANALYSES RESULTS

Barcın Höyük Analyses

Table 11.1 Descriptive Statistics for Barcın Höyük clay objects divided into seven main categories

Descriptive Statistics – Barcın Höyük Mean Ridge Breadth for Fingerprints								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
sling missiles	41	459.32	59.62	9.31	440.50	478.13	345.99	572.77
animal figurines	30	429.76	64.71	11.81	405.59	453.92	311.15	569.80
human figurines	9	416.40	71.23	23.74	361.65	471.15	304.08	499.41
unid. figurine frag.	4	390.40	45.92	22.96	317.32	463.47	339.72	447.56
token	11	408.44	58.47	17.63	369.16	447.72	310.93	475.04
vessel & related	4	423.96	102.47	51.23	260.92	587.01	297.95	509.71
others	4	458.62	53.15	26.58	374.04	543.19	401.38	512.28

Table 11.2 Descriptive Statistics of the Mean Ridge Breadth of fingerprints from Barcın Höyük. The object groups have been divided into three sub-categories based on their dates. The statistics of the reference have also been provided.

Descriptive Statistics – Barcın Höyük Mean Ridge Breadth for Fingerprints used in Comparisons								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Reference 0-6 yr	7	292.165	30.912	11.684	263.576	320.754	247.111	332.228
Reference 6-10 yr	11	358.145	36.167	10.905	333.847	382.442	299.795	410.919
Reference F10-15 yr	23	402.449	29.047	6.057	389.888	415.010	350.371	464.223
Reference M10-15 yr	12	420.784	33.174	9.577	399.706	441.862	373.575	479.368
Reference F15- yr	41	442.138	30.217	4.719	432.601	451.676	393.453	517.740
Reference M15- yr	27	487.034	40.996	7.890	470.817	503.252	410.216	568.969
Sling Missiles - 7th Mill Early	9	462.904	51.960	17.320	422.964	502.844	400.641	552.697
Sling Missiles - 7th Mill Late	22	465.771	65.997	14.071	436.510	495.032	345.991	572.766
Sling Missiles - Other	10	441.886	52.732	16.675	404.164	479.609	380.464	522.795
Animal Figurines - 7th Mill Early	4	420.151	22.601	11.300	384.188	456.114	392.935	440.996
Animal Figurines - 7th Mill Late	19	428.355	63.088	14.473	397.947	458.763	311.154	542.997
Animal Figurines - Other	7	439.045	88.748	33.544	356.967	521.123	362.872	569.804
Human Figurines - 7th Mill Early	3	436.405	86.214	49.776	222.237	650.572	338.151	499.407
Human Figurines - 7th Mill Late	5	405.146	77.258	34.551	309.218	501.074	304.079	475.759
Unid. Fragment - 7th Mill Early	2	393.640	76.258	53.923	-291.511	1078.791	339.718	447.563
Unid. Fragment - 7th Mill Late	2	387.154	21.676	15.328	192.399	581.909	371.826	402.481
Tokens - 7th Mill Late	7	427.681	52.182	19.723	379.420	475.942	337.138	475.040
Tokens - Other	4	374.769	59.789	29.895	279.630	469.907	310.929	454.319
Vessel Fragments - 7th Mill Early	4	423.963	102.466	51.233	260.917	587.008	297.949	509.706
Total	219	430.949	62.662	4.234	422.604	439.295	247.111	572.766

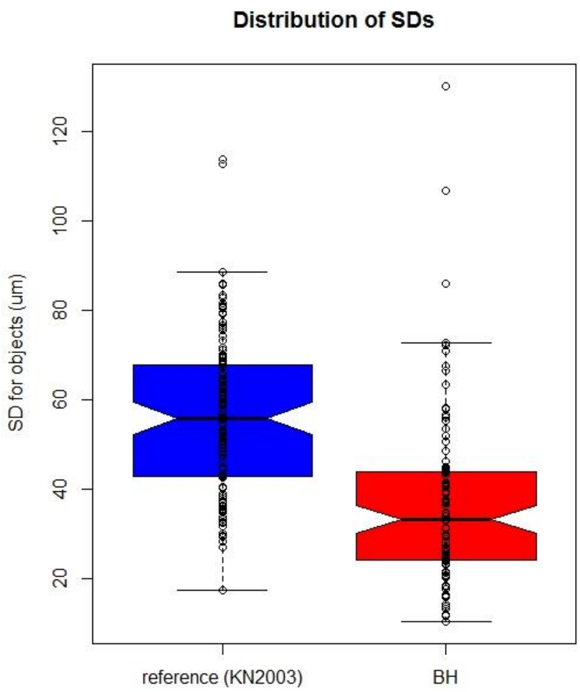


Figure 11.1 Standard deviations of Barcın Höyük samples compared to the reference. The results show that the standard deviations of the Mean Ridge Breadths of fingerprints on each clay object from Barcın are even lower than those of the reference. This suggests that each object was probably made by one individual.

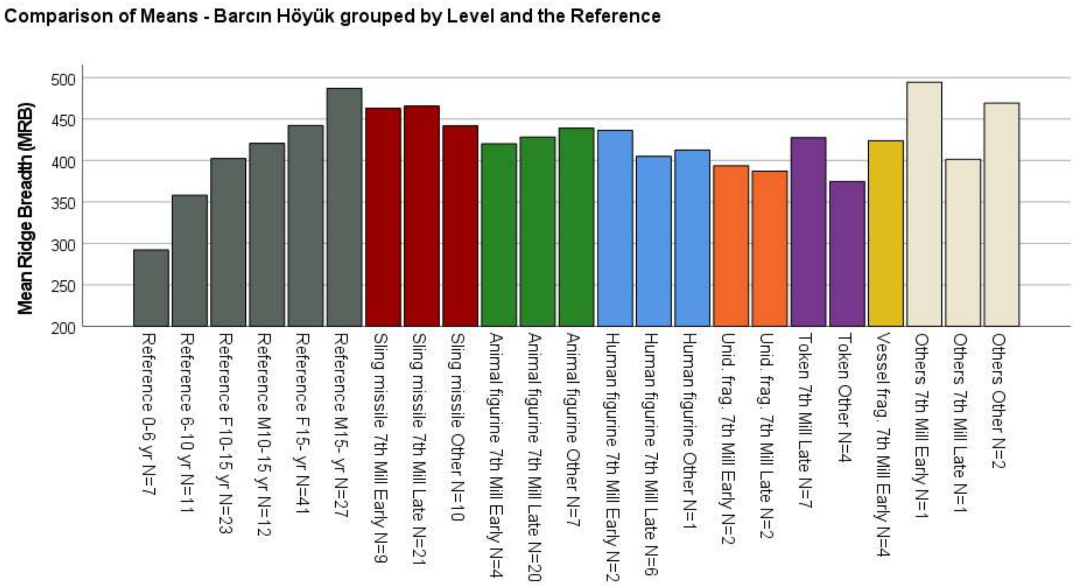


Figure 11.2 Comparison of means - Barcın Höyük results grouped by level and the reference. The gray boxes are the reference values, and the rest are from the Barcın Höyük dataset.

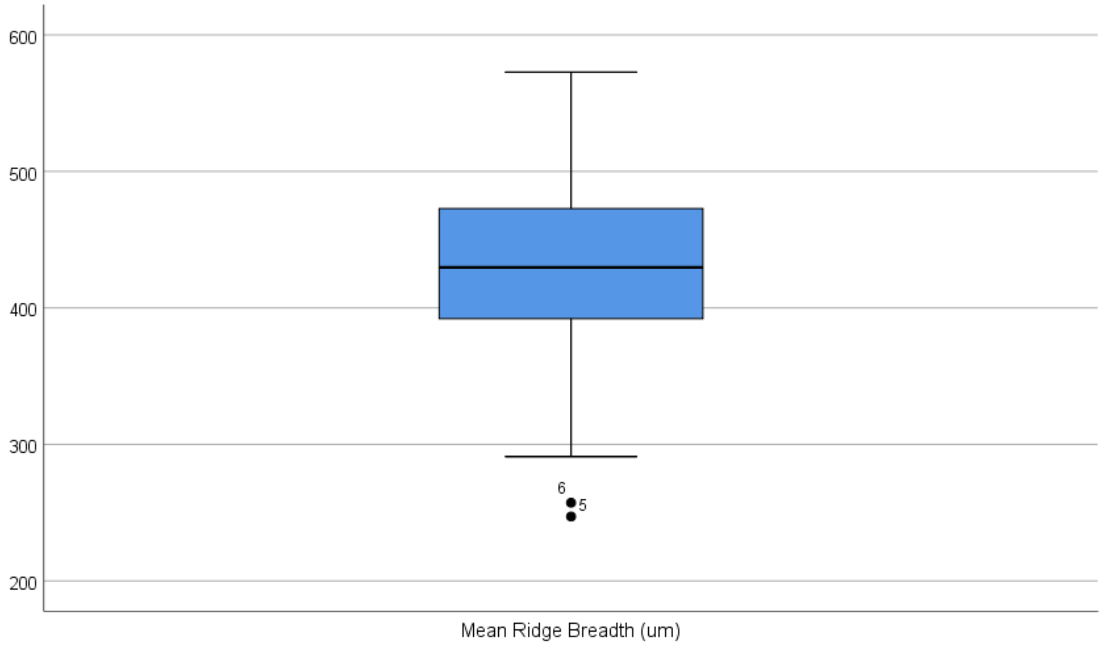


Figure 11.3 Boxplot showing some outliers in Barcın Höyük and reference data

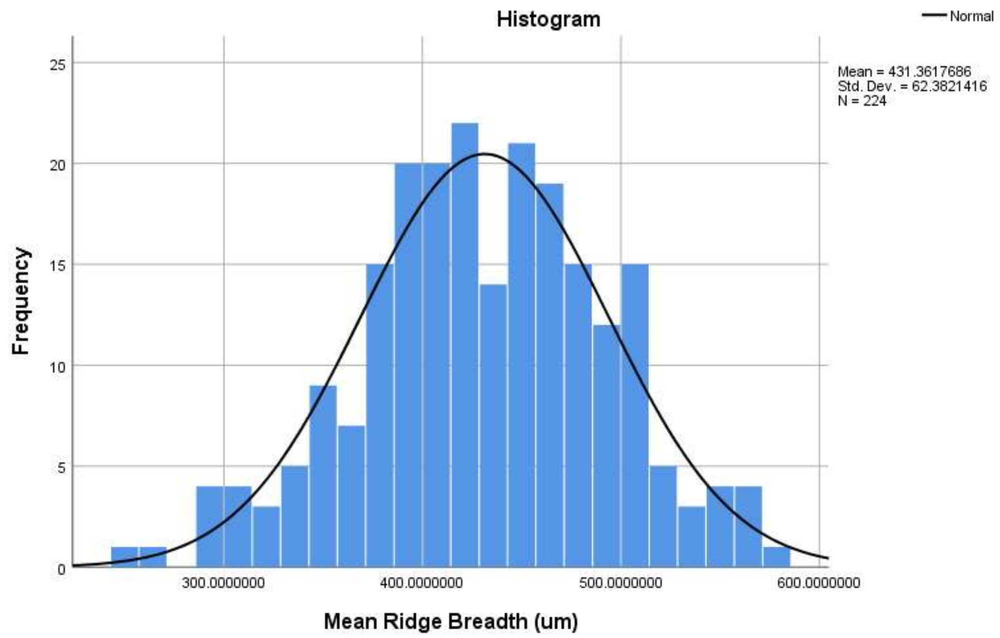


Figure 11.4 Histogram of Barcın Höyük and reference samples show a normal distribution

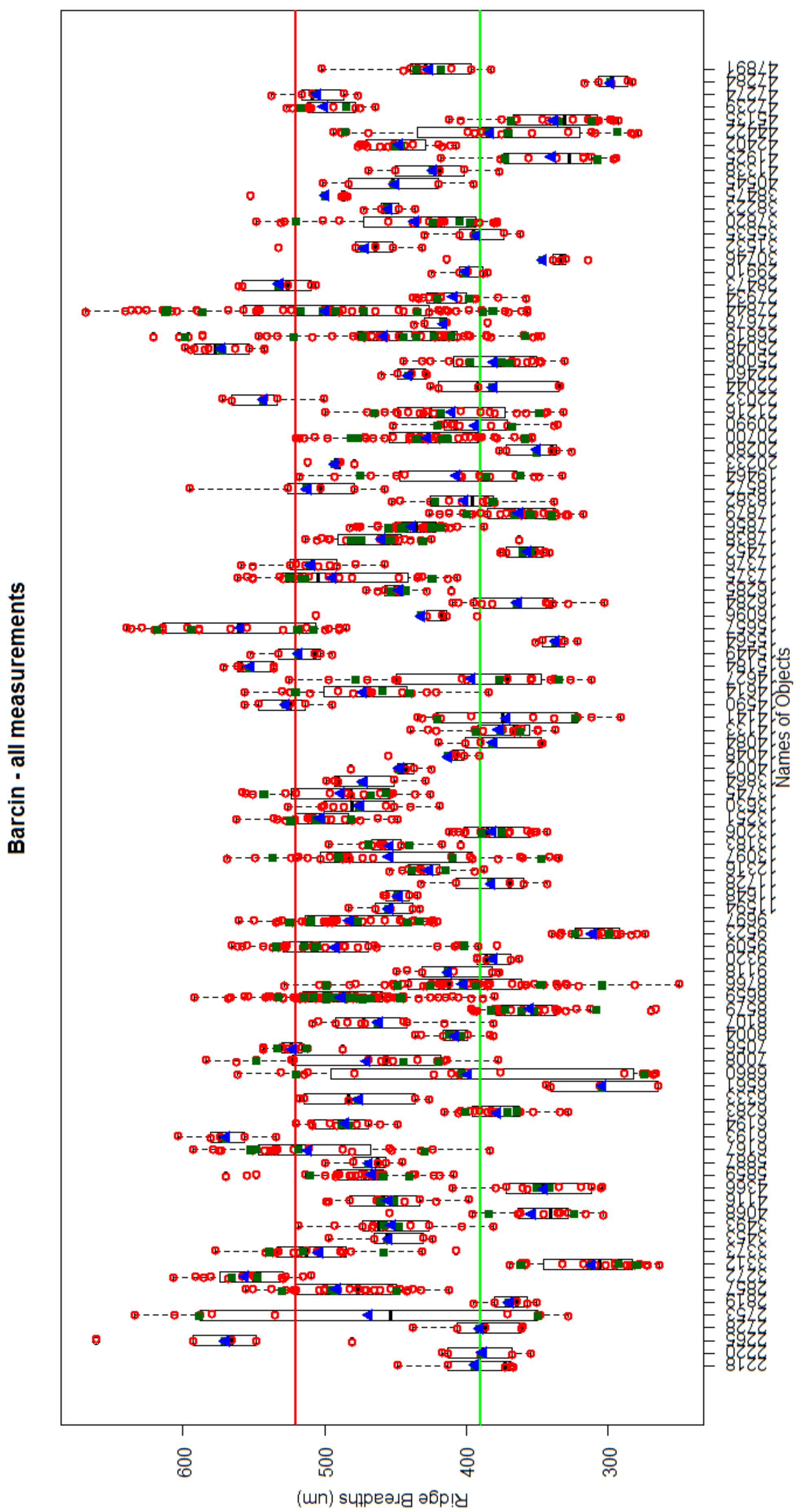

Barcin - all measurements
Ridge Breadths (um)
600
500
400
300
Names of Objects

Table 11.3 One-way ANOVA results for Barcın Höyük

ANOVA – Barcın Höyük					
MRBf					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	364166.296	18	20231.461	8.227	<.001
Within Groups	491810.679	200	2459.053		
Total	855976.975	218			

Table 11.4 Tukey's HSD post-hoc test results for Barcın Höyük

Barcın Höyük Multiple Comparisons – Tukey HSD							
Dependent Variable:	Mean Ridge Breadth per fingerprint						
(I) group by level			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
	0-6 yr	6-10 yr	-65.980	23.976	0.375	-151.442	19.483
		F10-15 yr	-110,284*	21.406	0.000	-186.585	-33.983
		M10-15 yr	-128,619*	23.584	0.000	-212.685	-44.552
		F15- yr	-149,973*	20.280	0.000	-222.261	-77.686
		M15- yr	-194.869*	21.033	0.000	-269.840	-119.898
		Sling Missile – 7th Mill Early	-170.739*	24.990	0.000	-259.818	-81.660
		Sling Missile - 7th Mill Late	-173.606*	21.519	0.000	-250.311	-96.901
		Sling Missile - Other	-149.721*	24.438	0.000	-236.830	-62.613
		Animal Fig - 7th Mill Early	-127.986*	31.081	0.008	-238.776	-17.196
		Animal Fig - 7th Mill Late	-136.190*	21.925	0.000	-214.343	-58.037
		Animal Fig - Other	-146.880*	26.506	0.000	-241.362	-52.398
		Human Fig - 7th Mill Early	-144.240*	34.220	0.005	-266.216	-22.264
		Human Fig - 7th Mill Late	-112.981*	29.036	0.017	-216.481	-9.481
		Unid Frag - 7th Mill Early	-101.475	39.760	0.520	-243.198	40.248
		Unid Frag - 7th Mill Late	-94.989	39.760	0.644	-236.712	46.735
		Token - 7th Mill Late	-135.516*	26.506	0.000	-229.998	-41.034
		Token - Other	-82.604	31.081	0.442	-193.394	28.187
		Vessel Rel - 7th Mill Early	-131.798*	31.081	0.005	-242.588	-21.007
	6-10 yr	0-6 yr	65.980	23.976	0.375	-19.483	151.442
		F10-15 yr	-44.304	18.179	0.608	-109.103	20.494
		M10-15 yr	-62.639	20.700	0.213	-136.423	11.145
		F15- yr	-83.994*	16.838	0.000	-144.014	-23.973
		M15- yr	-128.890*	17.738	0.000	-192.116	-65.663
		Sling Missile - 7th Mill Early	-104.760*	22.289	0.001	-184.207	-25.312
		Sling Missile - 7th Mill Late	-107.626*	18.312	0.000	-172.899	-42.353
		Sling Missile - Other	-83.742*	21.667	0.019	-160.974	-6.510
		Animal Fig - 7th Mill Early	-62.006	28.954	0.811	-165.212	41.199
		Animal Fig - 7th Mill Late	-70.210*	18.788	0.029	-137.179	-3.242
		Animal Fig - Other	-80.900	23.976	0.088	-166.363	4.562

		Human Fig - 7th Mill Early	-78.260	32.299	0.618	-193.391	36.871
		Human Fig - 7th Mill Late	-47.001	26.746	0.961	-142.339	48.336
		Unid Frag - 7th Mill Early	-35.495	38.119	1.000	-171.372	100.381
		Unid Frag - 7th Mill Late	-29.009	38.119	1.000	-164.886	106.867
		Token - 7th Mill Late	-69.537	23.976	0.281	-154.999	15.926
		Token - Other	-16.624	28.954	1.000	-119.830	86.582
		Vessel Rel - 7th Mill Early	-65.818	28.954	0.727	-169.024	37.388
	F10-15 yr	0-6 yr	110.284*	21.406	0.000	33.983	186.585
		6-10 yr	44.304	18.179	0.608	-20.494	109.103
		M10-15 yr	-18.335	17.659	1.000	-81.280	44.611
		F15- yr	-39.689	12.919	0.192	-85.738	6.360
		M15- yr	-84.585*	14.071	0.000	-134.741	-34.429
		Sling Missile - 7th Mill Early	-60.455	19.497	0.179	-129.953	9.043
		Sling Missile - 7th Mill Late	-63.322*	14.788	0.004	-116.034	-10.609
		Sling Missile - Other	-39.437	18.784	0.834	-106.391	27.517
		Animal Fig - 7th Mill Early	-17.702	26.864	1.000	-113.459	78.056
		Animal Fig - 7th Mill Late	-25.906	15.373	0.974	-80.704	28.892
		Animal Fig - Other	-36.596	21.406	0.970	-112.897	39.705
		Human Fig - 7th Mill Early	-33.956	30.440	1.000	-142.460	74.548
		Human Fig - 7th Mill Late	-2.697	24.469	1.000	-89.916	84.523
		Unid Frag - 7th Mill Early	8.809	36.557	1.000	-121.500	139.118
		Unid Frag - 7th Mill Late	15.295	36.557	1.000	-115.014	145.605
		Token - 7th Mill Late	-25.232	21.406	1.000	-101.533	51.069
		Token - Other	27.680	26.864	1.000	-68.077	123.438
		Vessel Rel - 7th Mill Early	-21.514	26.864	1.000	-117.271	74.244
	M10-15 yr	0-6 yr	128.619*	23.584	0.000	44.552	212.685
		6-10 yr	62.639	20.700	0.213	-11.145	136.423
		F10-15 yr	18.335	17.659	1.000	-44.611	81.280
		F15- yr	-21.355	16.276	0.998	-79.370	36.660
		M15- yr	-66.251*	17.205	0.020	-127.577	-4.925
		Sling Missile - 7th Mill Early	-42.121	21.867	0.913	-120.064	35.823
		Sling Missile - 7th Mill Late	-44.987	17.796	0.539	-108.421	18.447
		Sling Missile - Other	-21.103	21.233	1.000	-96.787	54.581
		Animal Fig - 7th Mill Early	0.633	28.630	1.000	-101.420	102.685
		Animal Fig - 7th Mill Late	-7.571	18.285	1.000	-72.749	57.606
		Animal Fig - Other	-18.261	23.584	1.000	-102.328	65.805
		Human Fig - 7th Mill Early	-15.621	32.009	1.000	-129.719	98.477

		Human Fig - 7th Mill Late	15.638	26.396	1.000	-78.450	109.726
		Unid Frag - 7th Mill Early	27.144	37.874	1.000	-107.859	162.146
		Unid Frag - 7th Mill Late	33.630	37.874	1.000	-101.373	168.633
		Token - 7th Mill Late	-6.898	23.584	1.000	-90.964	77.169
		Token - Other	46.015	28.630	0.984	-56.038	148.067
		Vessel Rel - 7th Mill Early	-3.179	28.630	1.000	-105.232	98.873
	F15- yr	0-6 yr	149.973*	20.280	0.000	77.686	222.261
		6-10 yr	83.994*	16.838	0.000	23.973	144.014
		F10-15 yr	39.689	12.919	0.192	-6.360	85.738
		M10-15 yr	21.355	16.276	0.998	-36.660	79.370
		M15- yr	-44.896*	12.290	0.038	-88.705	-1.087
		Sling Missile - 7th Mill Early	-20.766	18.254	1.000	-85.832	44.300
		Sling Missile - 7th Mill Late	-23.633	13.105	0.951	-70.347	23.082
		Sling Missile - Other	0.252	17.489	1.000	-62.090	62.594
		Animal Fig - 7th Mill Early	21.987	25.976	1.000	-70.604	114.578
		Animal Fig - 7th Mill Late	13.783	13.762	1.000	-35.273	62.839
		Animal Fig - Other	3.093	20.280	1.000	-69.194	75.381
		Human Fig - 7th Mill Early	5.733	29.659	1.000	-99.987	111.454
		Human Fig - 7th Mill Late	36.993	23.490	0.987	-46.739	120.724
		Unid Frag - 7th Mill Early	48.498	35.910	0.998	-79.502	176.499
		Unid Frag - 7th Mill Late	54.984	35.910	0.990	-73.016	182.985
		Token - 7th Mill Late	14.457	20.280	1.000	-57.830	86.745
		Token - Other	67.370	25.976	0.489	-25.221	159.961
		Vessel Rel - 7th Mill Early	18.176	25.976	1.000	-74.415	110.766
	M15- yr	0-6 yr	194.869*	21.033	0.000	119.898	269.840
		6-10 yr	128.890*	17.738	0.000	65.663	192.116
		F10-15 yr	84.585*	14.071	0.000	34.429	134.741
		M10-15 yr	66.251*	17.205	0.020	4.925	127.577
		F15- yr	44.896*	12.290	0.038	1.087	88.705
		Sling Missile - 7th Mill Early	24.130	19.087	0.999	-43.905	92.165
		Sling Missile - 7th Mill Late	21.263	14.243	0.993	-29.504	72.031
		Sling Missile - Other	45.148	18.357	0.591	-20.286	110.582
		Animal Fig - 7th Mill Early	66.883	26.568	0.547	-27.817	161.584
		Animal Fig - 7th Mill Late	58.679*	14.849	0.014	5.749	111.610
		Animal Fig - Other	47.989	21.033	0.721	-26.982	122.960
		Human Fig - 7th Mill Early	50.629	30.179	0.975	-56.943	158.202
		Human Fig - 7th Mill Late	81.889	24.143	0.083	-4.170	167.947

		Unid Frag - 7th Mill Early	93.394	36.340	0.507	-36.141	222.929
		Unid Frag - 7th Mill Late	99.880	36.340	0.377	-29.654	229.415
		Token - 7th Mill Late	59.353	21.033	0.329	-15.618	134.324
		Token - Other	112.266*	26.568	0.005	17.565	206.966
		Vessel Rel - 7th Mill Early	63.072	26.568	0.655	-31.629	157.772
	Sling Missile - 7th Mill Early	0-6 yr	170.739*	24.990	0.000	81.660	259.818
		6-10 yr	104.760*	22.289	0.001	25.312	184.207
		F10-15 yr	60.455	19.497	0.179	-9.043	129.953
		M10-15 yr	42.121	21.867	0.913	-35.823	120.064
		F15- yr	20.766	18.254	1.000	-44.300	85.832
		M15- yr	-24.130	19.087	0.999	-92.165	43.905
		Sling Missile - 7th Mill Late	-2.867	19.622	1.000	-72.808	67.074
		Sling Missile - Other	21.018	22.785	1.000	-60.198	102.234
		Animal Fig - 7th Mill Early	42.753	29.799	0.995	-63.466	148.973
		Animal Fig - 7th Mill Late	34.549	20.066	0.968	-36.977	106.075
		Animal Fig - Other	23.859	24.990	1.000	-65.220	112.938
		Human Fig - 7th Mill Early	26.499	33.059	1.000	-91.341	144.339
		Human Fig - 7th Mill Late	57.758	27.659	0.840	-40.834	156.351
		Unid Frag - 7th Mill Early	69.264	38.765	0.955	-68.916	207.444
		Unid Frag - 7th Mill Late	75.750	38.765	0.903	-62.429	213.930
		Token - 7th Mill Late	35.223	24.990	0.996	-53.856	124.302
		Token - Other	88.135	29.799	0.249	-18.084	194.355
		Vessel Rel - 7th Mill Early	38.941	29.799	0.999	-67.278	145.161
	Sling Missile - 7th Mill Late	0-6 yr	173.606*	21.519	0.000	96.901	250.311
		6-10 yr	107.626*	18.312	0.000	42.353	172.899
		F10-15 yr	63.322*	14.788	0.004	10.609	116.034
		M10-15 yr	44.987	17.796	0.539	-18.447	108.421
		F15- yr	23.633	13.105	0.951	-23.082	70.347
		M15- yr	-21.263	14.243	0.993	-72.031	29.504
		Sling Missile - 7th Mill Early	2.867	19.622	1.000	-67.074	72.808
		Sling Missile - Other	23.885	18.912	0.999	-43.529	91.298
		Animal Fig - 7th Mill Early	45.620	26.954	0.973	-50.459	141.699
		Animal Fig - 7th Mill Late	37.416	15.531	0.629	-17.943	92.775
		Animal Fig - Other	26.726	21.519	0.999	-49.979	103.431
		Human Fig - 7th Mill Early	29.366	30.520	1.000	-79.422	138.154
		Human Fig - 7th Mill Late	60.625	24.568	0.585	-26.948	148.198
		Unid Frag - 7th Mill Early	72.131	36.624	0.896	-58.415	202.677

		Unid Frag - 7th Mill Late	78.617	36.624	0.808	-51.929	209.163
		Token - 7th Mill Late	38.090	21.519	0.958	-38.615	114.795
		Token - Other	91.002	26.954	0.087	-5.077	187.081
		Vessel Rel - 7th Mill Early	41.808	26.954	0.989	-54.271	137.887
	Sling Missile - Other	0-6 yr	149.721*	24.438	0.000	62.613	236.830
		6-10 yr	83.742*	21.667	0.019	6.510	160.974
		F10-15 yr	39.437	18.784	0.834	-27.517	106.391
		M10-15 yr	21.103	21.233	1.000	-54.581	96.787
		F15- yr	-0.252	17.489	1.000	-62.594	62.090
		M15- yr	-45.148	18.357	0.591	-110.582	20.286
		Sling Missile - 7th Mill Early	-21.018	22.785	1.000	-102.234	60.198
		Sling Missile - 7th Mill Late	-23.885	18.912	0.999	-91.298	43.529
		Animal Fig - 7th Mill Early	21.735	29.337	1.000	-82.837	126.308
		Animal Fig - 7th Mill Late	13.531	19.373	1.000	-55.526	82.588
		Animal Fig - Other	2.841	24.438	1.000	-84.267	89.950
		Human Fig - 7th Mill Early	5.481	32.643	1.000	-110.876	121.839
		Human Fig - 7th Mill Late	36.741	27.161	0.998	-60.075	133.556
		Unid Frag - 7th Mill Early	48.246	38.411	0.999	-88.672	185.164
		Unid Frag - 7th Mill Late	54.733	38.411	0.996	-82.185	191.650
		Token - 7th Mill Late	14.205	24.438	1.000	-72.903	101.314
		Token - Other	67.118	29.337	0.717	-37.455	171.690
		Vessel Rel - 7th Mill Early	17.924	29.337	1.000	-86.649	122.496
	Animal Fig - 7th Mill Early	0-6 yr	127.986*	31,081	0.008	17.196	238.776
		6-10 yr	62.006	28.954	0.811	-41.199	165.212
		F10-15 yr	17.702	26.864	1.000	-78.056	113.459
		M10-15 yr	-0.633	28.630	1.000	-102.685	101.420
		F15- yr	-21.987	25.976	1.000	-114.578	70.604
		M15- yr	-66.883	26.568	0.547	-161.584	27.817
		Sling Missile - 7th Mill Early	-42.753	29.799	0.995	-148.973	63.466
		Sling Missile - 7th Mill Late	-45.620	26.954	0.973	-141.699	50.459
		Sling Missile - Other	-21.735	29.337	1.000	-126.308	82.837
		Animal Fig - 7th Mill Late	-8.204	27.280	1.000	-105.443	89.035
		Animal Fig - Other	-18.894	31.081	1.000	-129.685	91.896
		Human Fig - 7th Mill Early	-16.254	37.874	1.000	-151.257	118.749
		Human Fig - 7th Mill Late	15.005	33.265	1.000	-103.569	133.579
		Unid Frag - 7th Mill Early	26.511	42.945	1.000	-126.568	179.590
		Unid Frag - 7th Mill Late	32.997	42.945	1.000	-120.082	186.076

		Token - 7th Mill Late	-7.530	31.081	1.000	-118.321	103.260
		Token - Other	45.382	35.065	0.999	-79.606	170.370
		Vessel Rel - 7th Mill Early	-3.812	35.065	1.000	-128.800	121.176
	Animal Fig - 7th Mill Late	0-6 yr	136.190*	21.925	0.000	58.037	214.343
		6-10 yr	70.210*	18.788	0.029	3.242	137.179
		F10-15 yr	25.906	15.373	0.974	-28.892	80.704
		M10-15 yr	7.571	18.285	1.000	-57.606	72.749
		F15- yr	-13.783	13.762	1.000	-62.839	35.273
		M15- yr	-58.679*	14.849	0.014	-111.610	-5.749
		Sling Missile - 7th Mill Early	-34.549	20.066	0.968	-106.075	36.977
		Sling Missile - 7th Mill Late	-37.416	15.531	0.629	-92.775	17.943
		Sling Missile - Other	-13.531	19.373	1.000	-82.588	55.526
		Animal Fig - 7th Mill Early	8.204	27.280	1.000	-89.035	105.443
		Animal Fig - Other	-10.690	21.925	1.000	-88.843	67.463
		Human Fig - 7th Mill Early	-8.050	30.808	1.000	-117.864	101.764
		Human Fig - 7th Mill Late	23.209	24.925	1.000	-65.635	112.053
		Unid Frag - 7th Mill Early	34.715	36.864	1.000	-96.687	166.117
		Unid Frag - 7th Mill Late	41.201	36.864	1.000	-90.201	172.603
		Token - 7th Mill Late	0.674	21.925	1.000	-77.479	78.827
		Token - Other	53.586	27.280	0.899	-43.653	150.826
		Vessel Rel - 7th Mill Early	4.392	27.280	1.000	-92.847	101.632
	Animal Fig - Other	0-6 yr	146.880*	26.506	0.000	52.398	241.362
		6-10 yr	80.900	23.976	0.088	-4.562	166.363
		F10-15 yr	36.596	21.406	0.970	-39.705	112.897
		M10-15 yr	18.261	23.584	1.000	-65.805	102.328
		F15- yr	-3.093	20.280	1.000	-75.381	69.194
		M15- yr	-47.989	21.033	0.721	-122.960	26.982
		Sling Missile - 7th Mill Early	-23.859	24.990	1.000	-112.938	65.220
		Sling Missile - 7th Mill Late	-26.726	21.519	0.999	-103.431	49.979
		Sling Missile - Other	-2.841	24.438	1.000	-89.950	84.267
		Animal Fig - 7th Mill Early	18.894	31.081	1.000	-91.896	129.685
		Animal Fig - 7th Mill Late	10.690	21.925	1.000	-67.463	88.843
		Human Fig - 7th Mill Early	2.640	34.220	1.000	-119.336	124.616
		Human Fig - 7th Mill Late	33.899	29.036	1.000	-69.601	137.399
		Unid Frag - 7th Mill Early	45.405	39.760	1.000	-96.318	187.128
		Unid Frag - 7th Mill Late	51.891	39.760	0.999	-89.832	193.615
		Token - 7th Mill Late	11.364	26.506	1.000	-83.118	105.846

		Token - Other	64.276	31.081	0.851	-46.514	175.067
		Vessel Rel - 7th Mill Early	15.082	31.081	1.000	-95.708	125.873
	Human Fig - 7th Mill Early	0-6 yr	144.240*	34.220	0.005	22.264	266.216
		6-10 yr	78.260	32.299	0.618	-36.871	193.391
		F10-15 yr	33.956	30.440	1.000	-74.548	142.460
		M10-15 yr	15.621	32.009	1.000	-98.477	129.719
		F15- yr	-5.733	29.659	1.000	-111.454	99.987
		M15- yr	-50.629	30.179	0.975	-158.202	56.943
		Sling Missile - 7th Mill Early	-26.499	33.059	1.000	-144.339	91.341
		Sling Missile - 7th Mill Late	-29.366	30.520	1.000	-138.154	79.422
		Sling Missile - Other	-5.481	32.643	1.000	-121.839	110.876
		Animal Fig - 7th Mill Early	16.254	37.874	1.000	-118.749	151.257
		Animal Fig - 7th Mill Late	8.050	30.808	1.000	-101.764	117.864
		Animal Fig - Other	-2.640	34.220	1.000	-124.616	119.336
		Human Fig - 7th Mill Late	31.259	36.215	1.000	-97.828	160.346
		Unid Frag - 7th Mill Early	42.765	45.268	1.000	-118.594	204.124
		Unid Frag - 7th Mill Late	49.251	45.268	1.000	-112.108	210.610
		Token - 7th Mill Late	8.724	34.220	1.000	-113.252	130.700
		Token - Other	61.636	37.874	0.982	-73.367	196.639
		Vessel Rel - 7th Mill Early	12.442	37.874	1.000	-122.561	147.445
	Human Fig - 7th Mill Late	0-6 yr	112.981*	29.036	0.017	9.481	216.481
		6-10 yr	47.001	26.746	0.961	-48.336	142.339
		F10-15 yr	2.697	24.469	1.000	-84.523	89.916
		M10-15 yr	-15.638	26.396	1.000	-109.726	78.450
		F15- yr	-36.993	23.490	0.987	-120.724	46.739
		M15- yr	-81.889	24.143	0.083	-167.947	4.170
		Sling Missile - 7th Mill Early	-57.758	27.659	0.840	-156.351	40.834
		Sling Missile - 7th Mill Late	-60.625	24.568	0.585	-148.198	26.948
		Sling Missile - Other	-36.741	27.161	0.998	-133.556	60.075
		Animal Fig - 7th Mill Early	-15.005	33.265	1.000	-133.579	103.569
		Animal Fig - 7th Mill Late	-23.209	24.925	1.000	-112.053	65.635
		Animal Fig - Other	-33.899	29.036	1.000	-137.399	69.601
		Human Fig - 7th Mill Early	-31.259	36.215	1.000	-160.346	97.828
		Unid Frag - 7th Mill Early	11.506	41.489	1.000	-136.382	159.394
		Unid Frag - 7th Mill Late	17.992	41.489	1.000	-129.896	165.880
		Token - 7th Mill Late	-22.535	29.036	1.000	-126.036	80.965
		Token - Other	30.377	33.265	1.000	-88.197	148.951

		Vessel Rel - 7th Mill Early	-18.817	33.265	1.000	-137.391	99.757
	Unid Frag - 7th Mill Early	0-6 yr	101.475	39.760	0.520	-40.248	243.198
		6-10 yr	35.495	38.119	1.000	-100.381	171.372
		F10-15 yr	-8.809	36.557	1.000	-139.118	121.500
		M10-15 yr	-27.144	37.874	1.000	-162.146	107.859
		F15- yr	-48.498	35.910	0.998	-176.499	79.502
		M15- yr	-93.394	36.340	0.507	-222.929	36.141
		Sling Missile - 7th Mill Early	-69.264	38.765	0.955	-207.444	68.916
		Sling Missile - 7th Mill Late	-72.131	36.624	0.896	-202.677	58.415
		Sling Missile - Other	-48.246	38.411	0.999	-185.164	88.672
		Animal Fig - 7th Mill Early	-26.511	42.945	1.000	-179.590	126.568
		Animal Fig - 7th Mill Late	-34.715	36.864	1.000	-166.117	96.687
		Animal Fig - Other	-45.405	39.760	1.000	-187.128	96.318
		Human Fig - 7th Mill Early	-42.765	45.268	1.000	-204.124	118.594
		Human Fig - 7th Mill Late	-11.506	41.489	1.000	-159.394	136.382
		Unid Frag - 7th Mill Late	6.486	49.589	1.000	-170.274	183.246
		Token - 7th Mill Late	-34.041	39.760	1.000	-175.765	107.682
		Token - Other	18.871	42.945	1.000	-134.208	171.950
		Vessel Rel - 7th Mill Early	-30.323	42.945	1.000	-183.402	122.756
	Unid Frag - 7th Mill Late	0-6 yr	94.989	39.760	0.644	-46.735	236.712
		6-10 yr	29.009	38.119	1.000	-106.867	164.886
		F10-15 yr	-15.295	36.557	1.000	-145.605	115.014
		M10-15 yr	-33.630	37.874	1.000	-168.633	101.373
		F15- yr	-54.984	35.910	0.990	-182.985	73.016
		M15- yr	-99.880	36.340	0.377	-229.415	29.654
		Sling Missile - 7th Mill Early	-75.750	38.765	0.903	-213.930	62.429
		Sling Missile - 7th Mill Late	-78.617	36.624	0.808	-209.163	51.929
		Sling Missile - Other	-54.733	38.411	0.996	-191.650	82.185
		Animal Fig - 7th Mill Early	-32.997	42.945	1.000	-186.076	120.082
		Animal Fig - 7th Mill Late	-41.201	36.864	1.000	-172.603	90.201
		Animal Fig - Other	-51.891	39.760	0.999	-193.615	89.832
		Human Fig - 7th Mill Early	-49.251	45.268	1.000	-210.610	112.108
		Human Fig - 7th Mill Late	-17.992	41.489	1.000	-165.880	129.896
		Unid Frag - 7th Mill Early	-6.486	49.589	1.000	-183.246	170.274
		Token - 7th Mill Late	-40.527	39.760	1.000	-182.251	101.196
		Token - Other	12.385	42.945	1.000	-140.694	165.464
		Vessel Rel - 7th Mill Early	-36.809	42.945	1.000	-189.888	116.270

	Token - 7th Mill Late	0-6 yr	135.516*	26.506	0.000	41.034	229.998
		6-10 yr	69.537	23.976	0.281	-15.926	154.999
		F10-15 yr	25.232	21.406	1.000	-51.069	101.533
		M10-15 yr	6.898	23.584	1.000	-77.169	90.964
		F15- yr	-14.457	20.280	1.000	-86.745	57.830
		M15- yr	-59.353	21.033	0.329	-134.324	15.618
		Sling Missile - 7th Mill Early	-35.223	24.990	0.996	-124.302	53.856
		Sling Missile - 7th Mill Late	-38.090	21.519	0.958	-114.795	38.615
		Sling Missile - Other	-14.205	24.438	1.000	-101.314	72.903
		Animal Fig - 7th Mill Early	7.530	31.081	1.000	-103.260	118.321
		Animal Fig - 7th Mill Late	-0.674	21.925	1.000	-78.827	77.479
		Animal Fig - Other	-11.364	26.506	1.000	-105.846	83.118
		Human Fig - 7th Mill Early	-8.724	34.220	1.000	-130.700	113.252
		Human Fig - 7th Mill Late	22.535	29.036	1.000	-80.965	126.036
		Unid Frag - 7th Mill Early	34.041	39.760	1.000	-107.682	175.765
		Unid Frag - 7th Mill Late	40.527	39.760	1.000	-101.196	182.251
		Token - Other	52.912	31.081	0.971	-57.878	163.703
		Vessel Rel - 7th Mill Early	3.718	31.081	1.000	-107.072	114.509
	Token - Other	0-6 yr	82.604	31.081	0.442	-28.187	193.394
		6-10 yr	16.624	28.954	1.000	-86.582	119.830
		F10-15 yr	-27.680	26.864	1.000	-123.438	68.077
		M10-15 yr	-46.015	28.630	0.984	-148.067	56.038
		F15- yr	-67.370	25.976	0.489	-159.961	25.221
		M15- yr	-112.266*	26.568	0.005	-206.966	-17.565
		Sling Missile - 7th Mill Early	-88.135	29.799	0.249	-194.355	18.084
		Sling Missile - 7th Mill Late	-91.002	26.954	0.087	-187.081	5.077
		Sling Missile - Other	-67.118	29.337	0.717	-171.690	37.455
		Animal Fig - 7th Mill Early	-45.382	35.065	0.999	-170.370	79.606
		Animal Fig - 7th Mill Late	-53.586	27.280	0.899	-150.826	43.653
		Animal Fig - Other	-64.276	31.081	0.851	-175.067	46.514
		Human Fig - 7th Mill Early	-61.636	37.874	0.982	-196.639	73.367
		Human Fig - 7th Mill Late	-30.377	33.265	1.000	-148.951	88.197
		Unid Frag - 7th Mill Early	-18.871	42.945	1.000	-171.950	134.208
		Unid Frag - 7th Mill Late	-12.385	42.945	1.000	-165.464	140.694
		Token - 7th Mill Late	-52.912	31.081	0.971	-163.703	57.878
		Vessel Rel - 7th Mill Early	-49.194	35.065	0.997	-174.182	75.794
		0-6 yr	131.798*	31.081	0.005	21.007	242.588

	Vessel Rel - 7th Mill Early	6-10 yr	65.818	28.954	0.727	-37.388	169.024
		F10-15 yr	21.514	26.864	1.000	-74.244	117.271
		M10-15 yr	3.179	28.630	1.000	-98.873	105.232
		F15- yr	-18.176	25.976	1.000	-110.766	74.415
		M15- yr	-63.072	26.568	0.655	-157.772	31.629
		Sling Missile - 7th Mill Early	-38.941	29.799	0.999	-145.161	67.278
		Sling Missile - 7th Mill Late	-41.808	26.954	0.989	-137.887	54.271
		Sling Missile - Other	-17.924	29.337	1.000	-122.496	86.649
		Animal Fig - 7th Mill Early	3.812	35.065	1.000	-121.176	128.800
		Animal Fig - 7th Mill Late	-4.392	27.280	1.000	-101.632	92.847
		Animal Fig - Other	-15.082	31.081	1.000	-125.873	95.708
		Human Fig - 7th Mill Early	-12.442	37.874	1.000	-147.445	122.561
		Human Fig - 7th Mill Late	18.817	33.265	1.000	-99.757	137.391
		Unid Frag - 7th Mill Early	30.323	42.945	1.000	-122.756	183.402
		Unid Frag - 7th Mill Late	36.809	42.945	1.000	-116.270	189.888
		Token - 7th Mill Late	-3.718	31.081	1.000	-114.509	107.072
		Token - Other	49.194	35.065	0.997	-75.794	174.182
*. The mean difference is significant at the 0.05 level							

Table 11.5 Post-hoc results from BH for 0-6 year-olds. Red indicates that they are statistically significantly different from children between 0-6 years old in the reference collection

	Comparison group	Mean Difference	Std. Error	Significance
Child 0-6 years old	Sling Missile 7th mill Early	-170.739*	24.990	0.000
	Sling Missile 7th mill Late	-173.606*	21.519	0.000
	Sling Missile Other	-149.721*	24.438	0.000
	Animal Fig 7th mill Early	-127.986*	31.081	0.008
	Animal Fig 7th mill Late	-136.190*	21.925	0.000
	Animal Fig Other	-146.880*	26.506	0.000
	Human Fig 7th mill Early	-144.240*	34.220	0.005
	Human Fig 7th mill Late	-112.981*	29.036	0.017
	Unid Frag 7th mill Early	-101.475	39.760	0.520
	Unid Frag 7th mill Late	-94.989	39.760	0.644
	Token 7th mill Late	-135.516*	26.506	0.000
	Token Other	-82.604	31.081	0.442
	Vessel Rel 7th mill Early	-131.798*	31.081	0.005

Table 11.6 Post-hoc results from BH for 6-10 year-olds. Red indicates that they are statistically significantly different from children between 6-10 years old in the reference collection while green represents that they are statistically similar to children between 6-10 year-olds in the reference

	Comparison group	Mean Difference	Std. Error	Significance
Child 6-10 years old	Sling Missile 7^{th} mill Early	-104.760*	22.289	0.001
	Sling Missile 7^{th} mill Late	-107.626*	18.312	0.000
	Sling Missile Other	-83.742*	21.667	0.019
	Animal Fig 7^{th} mill Early	-62.006	28.954	0.811
	Animal Fig 7^{th} mill Late	-70.210*	18.788	0.029
	Animal Fig Other	-80.900	23.976	0.088
	Human Fig 7^{th} mill Early	-78.260	32.299	0.618
	Human Fig 7^{th} mill Late	-47.001	26.746	0.961
	Unid Frag 7^{th} mill Early	-35.495	38.119	1.000
	Unid Frag 7^{th} mill Late	-29.009	38.119	1.000
	Token 7^{th} mill Late	-69.537	23.976	0.281
	Token Other	-16.624	28.954	1.000
	Vessel Rel 7^{th} mill Early	-65.818	28.954	0.727

Table 11.7 Post-hoc results from BH for females between 10 and 15 years old. Red indicates that these groups are statistically significantly different from adolescents between 10-15 years old from the reference (p<0.05). Green represents no statistically significant difference (p>0.95)

	Comparison group	Mean Difference	Std. Error	Significance
10-15-year-old females	Sling Missile 7th mill Early	-60.455	19.497	0.179
	Sling Missile 7th mill Late	-63.322*	14.788	0.004
	Sling Missile Other	-39.437	18.784	0.834
	Animal Fig 7th mill Early	-17.702	26.864	1.000
	Animal Fig 7th mill Late	-25.906	15.373	0.974
	Animal Fig Other	-36.596	21.406	0.970
	Human Fig 7th mill Early	-33.956	30.440	1.000
	Human Fig 7th mill Late	-2.697	24.469	1.000
	Unid Frag 7th mill Early	8.809	36.557	1.000
	Unid Frag 7th mill Late	15.295	36.557	1.000
	Token 7th mill Late	-25.232	21.406	1.000
	Token Other	27.680	26.864	1.000
	Vessel Rel 7th mill Early	-21.514	26.864	1.000

Table 11.8 Post-hoc results from BH for males between 10 and 15 years old. Green represents no statistically significant difference (p>0.95)

	Comparison group	Mean Difference	Std. Error	Significance
10-15-year-old males	Sling Missile 7th mill Early	-42.121	21.867	0.913
	Sling Missile 7th mill Late	-44.987	17.796	0.539
	Sling Missile Other	-21.103	21.233	1.000
	Animal Fig 7th mill Early	0.633	28.630	1.000
	Animal Fig 7th mill Late	-7.571	18.285	1.000
	Animal Fig Other	-18.261	23.584	1.000
	Human Fig 7th mill Early	-15.621	32.009	1.000
	Human Fig 7th mill Late	15.638	26.396	1.000
	Unid Frag 7th mill Early	27.144	37.874	1.000
	Unid Frag 7th mill Late	33.630	37.874	1.000
	Token 7th mill Late	-6.898	23.584	1.000
	Token Other	46.015	28.630	0.984
	Vessel Rel 7th mill Early	-3.179	28.630	1.000

Table 11.9 Post-hoc results from BH for adult females. Green represents no statistically significant difference (p>0.95)

	Comparison group	Mean Difference	Std. Error	Significance
Adult females above 15 years old	Sling Missile 7th mill Early	-20.766	18.254	1.000
	Sling Missile 7th mill Late	-23.633	13.105	0.951
	Sling Missile Other	0.252	17.489	1.000
	Animal Fig 7th mill Early	21.987	25.976	1.000
	Animal Fig 7th mill Late	13.783	13.762	1.000
	Animal Fig Other	3.093	20.280	1.000
	Human Fig 7th mill Early	5.733	29.659	1.000
	Human Fig 7th mill Late	36.993	23.490	0.987
	Unid Frag 7th mill Early	48.498	35.910	0.998
	Unid Frag 7th mill Late	54.984	35.910	0.990
	Token 7th mill Late	14.457	20.280	1.000
	Token Other	67.370	25.976	0.489
	Vessel Rel 7th mill Early	18.176	25.976	1.000

Table 11.10 Post-hoc results from BH for adult males. Red indicates that these groups are statistically significantly different from adolescents between 10-15 years old from the reference (p<0.05). Green represents no statistically significant difference (p>0.95)

	Comparison group	Mean Difference	Std. Error	Significance
Adult males above 15 years old	Sling Missile 7th mill Early	24.130	19.087	0.999
	Sling Missile 7th mill Late	21.263	14.243	0.993
	Sling Missile Other	45.148	18.357	0.591
	Animal Fig 7th mill Early	66.883	26.568	0.547
	Animal Fig 7th mill Late	58.679*	14.849	0.014
	Animal Fig Other	47.989	21.033	0.721
	Human Fig 7th mill Early	50.629	30.179	0.975
	Human Fig 7th mill Late	81.889	24.143	0.083
	Unid Frag 7th mill Early	93.394	36.340	0.507
	Unid Frag 7th mill Late	99.880	36.340	0.377
	Token 7th mill Late	59.353	21.033	0.329
	Token Other	112.266*	26.568	0.005
	Vessel Rel 7th mill Early	63.072	26.568	0.655

Table 11.11 Post-hoc test results of Barcın Höyük sling missiles divided into three phases.

Barcın Höyük	**Sling missile 7th mill Early**	**Sling missile 7th mill Late**	**Sling missile Later Contexts**
Probably made by (p > 0.95)	Females above 15 Males above 15	Female above 15 Male above 15	10-15-year-old male Female above 15
Possibly made by (low significance)	10–15-year-old female 10-15-year-old male	10-15-year-old male	10-15-year-old female Male above 15
Definitely not made by (p<0.05)	0-6 year-olds 6-10 year-olds	0-6 year-olds 6-10 year-olds 10-15-year-old female	0-6 year-olds 6-10 year-olds

Table 11.12 Comparison table for Barcın Höyük animal figurines

Barcın Höyük	**Animal Figurine 7th mill Early**	**Animal Figurine 7th mill Late**	**Animal Figurine Later Contexts**
Probably made by (p > 0.95)	10-15 year-old female 10-15 year-old male Females above 15	10-15 year-old female 10-15 year-old male Females above 15	10-15 year-old female 10-15 year-old male Females above 15
Possibly made by (low significance)	6-10 year-olds Males above 15		6-10 year-olds Males above 15
Definitely not made by (p<0.05)	0-6 year-olds	0-6 year-olds 6-10 year-olds Males above 15	0-6 year-old

Table 11.13 Comparison Table for Barcın Höyük anthropomorphic figurines.

Barcın Höyük	**Human Figurine 7th Mill Early**	**Human Figurine 7th Mill Late**	**Human Figurine Later Contexts**
Probably made by ($p > 0.95$)	10-15 year-old female	6-10 year-old	
		10-15 year-old female	
	10-15 year-old male	10-15 year-old male	
	Female above 15	Female above 15	
	Male above 15		
Possibly made by (low significance)	6-10 year-old	Male above 15	
Definitely not made by ($p<0.05$)	0-6 year-old	0-6 year-old	

Descriptive Statistics of Ulucak Höyük

Table 11.14 Descriptive Statistics for Ulucak Höyük clay objects divided into nine categories

Descriptive Statistics – Barcın Höyük Mean Ridge Breadth for Fingerprints								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Sling missiles	28	445.785	36.091	6.820	431.791	459.780	371.34	542.482
Animal figurines	12	399.300	65.918	19.029	357.417	441.182	266.20	559.410
Human figurines	12	421.858	76.822	22.177	373.048	470.669	309.16	551.768
Unid. figurine frag.	1	353.156	.	.	.	.	353.16	353.156
Tokens	2	443.388	44.449	31.430	44.031	842.745	411.96	474.818
Vessel fragments	8	440.337	30.680	10.847	414.688	465.985	380.25	469.458
Others	4	386.833	42.542	21.271	319.140	454.526	338.20	439.931
Hematite Lump	12	496.402	65.969	19.044	454.487	538.316	394.91	607.708
Clay Lump	9	472.291	51.157	17.052	432.968	511.614	399.23	531.845

Table 11.15 Descriptive Statistics of the Mean Ridge Breadth of fingerprints from Ulucak Höyük. The object groups have been divided into three sub-categories based on their dates. The statistics of the reference have also been provided.

Descriptive Statistics – Ulucak Höyük Mean Ridge Breadth for Fingerprints used in Comparisons								
	N	**Mean**	**Std. Deviation**	**Std. Error**	**95% Confidence Interval for Mean**		**Minimum**	**Maximum**
					Lower Bound	**Upper Bound**		
Reference 0-6 yr	7	292.165	30.912	11.684	263.576	320.754	247.11	332.228
Reference 6-10 yr	11	358.145	36.167	10.905	333.847	382.442	299.80	410.919
Reference F10-15 yr	23	402.449	29.047	6.057	389.888	415.010	350.37	464.223
Reference M10-15 yr	12	420.784	33.174	9.577	399.706	441.862	373.57	479.368
Reference F15- yr	41	442.138	30.217	4.719	432.601	451.676	393.45	517.740
Reference M15- yr	27	487.034	40.996	7.890	470.817	503.252	410.22	568.969
Sling Missile 7th Mill Late	24	442.691	33.045	6.745	428.738	456.645	371.34	500.016
Sling Missile Other	3	468.289	64.258	37.100	308.662	627.915	430.40	542.482
Animal Figurine 7th Mill Late	2	400.847	8.408	5.945	325.304	476.389	394.90	406.792
Animal Figurine 6th Mill	8	404.237	81.588	28.846	336.028	472.446	266.20	559.410
Human Figurine 7th Mill Early	2	422.915	15.836	11.198	280.635	565.196	411.72	434.113
Human Figurine 7th Mill Late	3	461.050	99.537	57.467	213.787	708.312	346.33	524.540
Human Figurine 6th Mill	4	423.083	91.665	45.832	277.224	568.943	334.65	551.768
Human Figurine Other	3	380.329	70.194	40.526	205.958	554.700	309.16	449.502
Vessel Fragment 6th Mill	8	440.337	30.680	10.847	414.688	465.985	380.25	469.458
Others 6th Mill	4	386.833	42.542	21.271	319.140	454.526	338.20	439.931
Hematite Lump 6th Mill	12	496.402	65.969	19.044	454.487	538.316	394.91	607.708
Clay Lump 6th Mill	9	472.291	51.157	17.052	432.968	511.614	399.23	531.845
Total	203	433.364	60.881	4.273	424.939	441.789	247.11	607.708

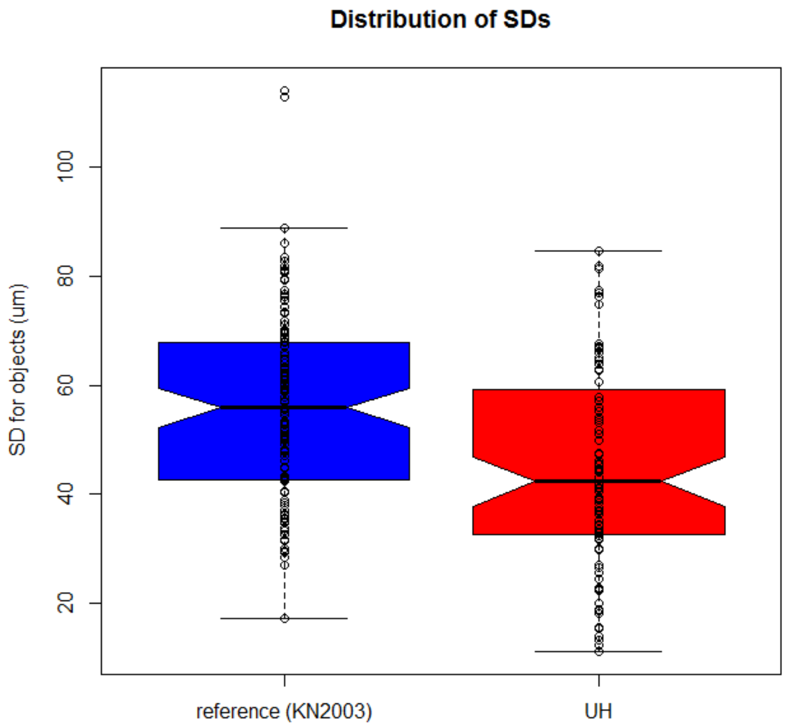


Figure 11.5 Standard deviations of the Ulucak Höyük samples compared to the reference. The results show that the standard deviations of the Mean Ridge Breadths of fingerprints on each clay object from Barcın are even lower than those of the reference. This suggests that each object was probably made by one individual.

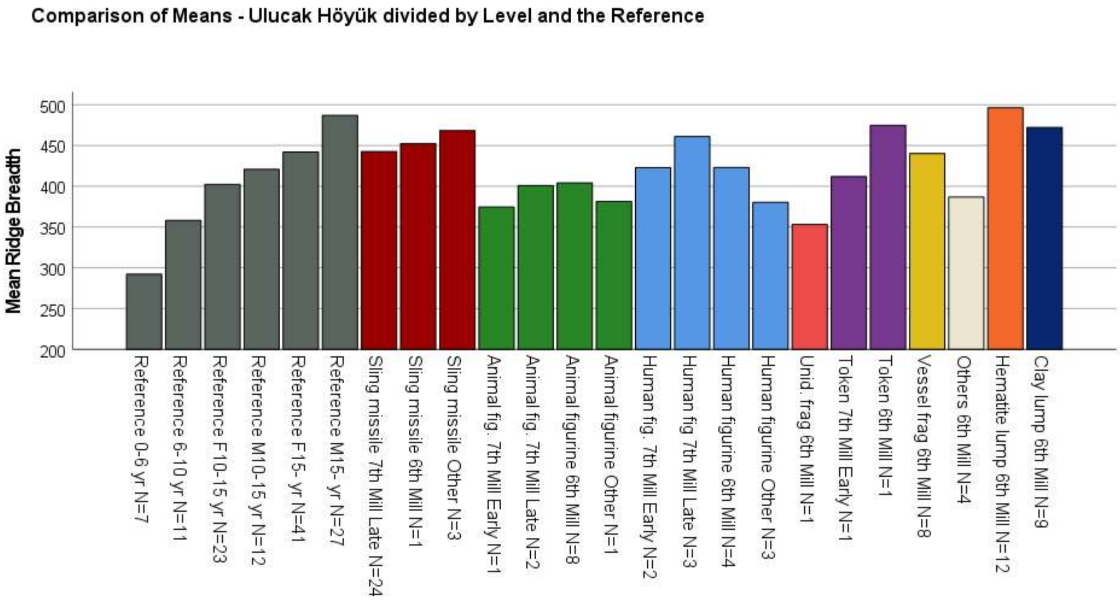


Figure 11.6 Comparison of means - Ulucak Höyük results grouped by level and the reference. The gray boxes are the reference values, and the rest are from the Ulucak Höyük dataset.

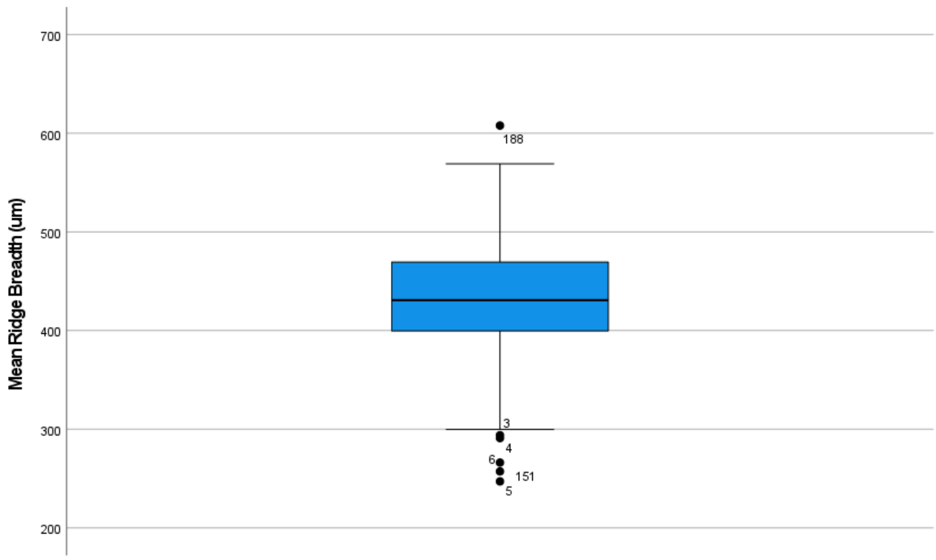


Figure 11.7 Boxplot showing some outliers in Ulucak Höyük and reference data

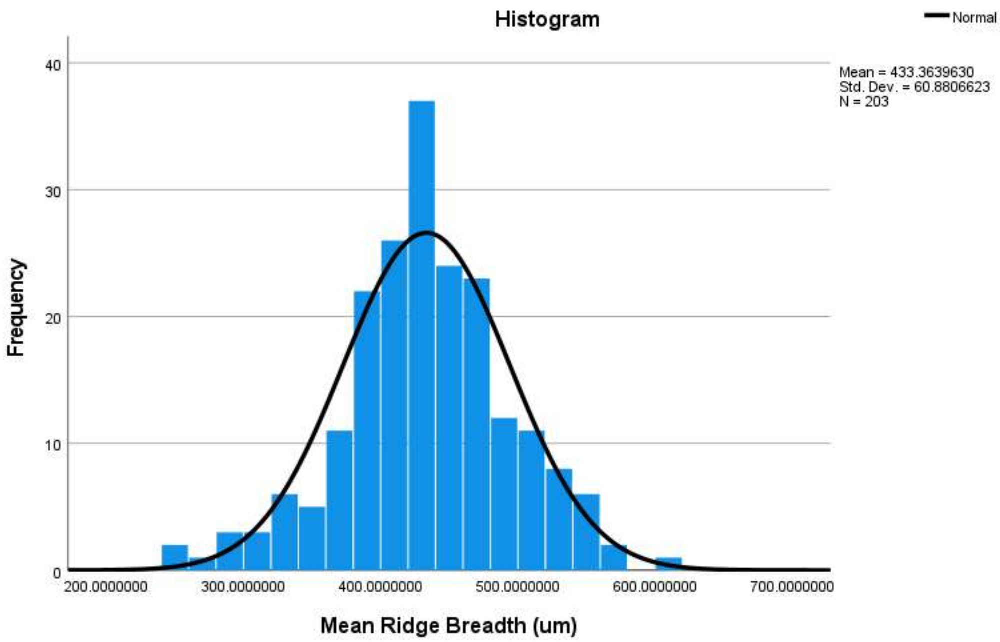


Figure 11.8 Histogram of Ulucak Höyük and reference samples show a normal distribution

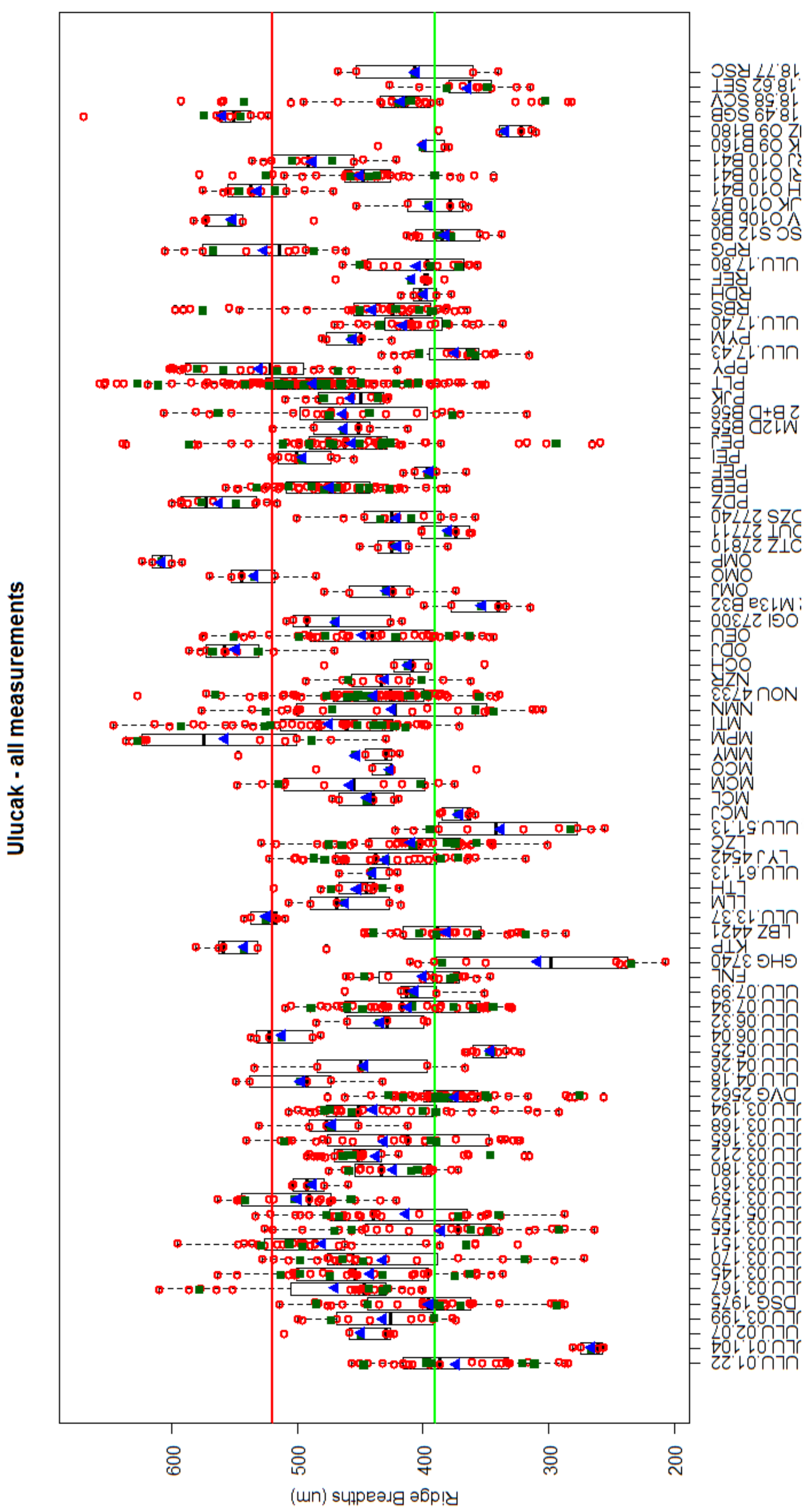

Ulucak - all measurements
Ridge Breadths (um)
200
300
400
500
600
ULU.01.22
ULU.01.104
ULU.02.107
ULU.03.199
DSG.1975
ULU.03.167
ULU.03.145
ULU.03.170
ULU.03.151
ULU.03.155
ULU.05.157
ULU.03.159
ULU.03.161
ULU.03.180
ULU.03.212
ULU.03.165
ULU.03.168
ULU.03.194
DVG.2562
ULU.04.18
ULU.04.26
ULU.05.25
ULU.06.04
ULU.06.32
ULU.07.94
ULU.07.99
FNL
GHG 3740
KTP
LBZ 4421
ULU.13.37
LLM
LTH
ULU.61.13
LY.J 4542
LZC
ULU.51.13
MCJ
MCL
MCM
MCO
MMY
MPM
MTI
NMN
NOU 4733
NZR
OCH
ODJ
OEJ
OGI 27300
M13a B32
OMJ
OMO
OMP
OTZ 27810
OUT 27711
OZS 27740
PDZ
PEB
PEF
PEI
PEJ
M12D B55
2 B+D B56
PJK
PLT
PPY
ULU.17.43
PYM
ULU.17.40
RBS
RDH
REF
ULU.17.80
RPG
SC S12 B0
V O106 B6
JK O10 B7
HO10 B41
RI O10 B41
RJ O10 B41
K O9 B160
IZ O9 B180
18.49 SGB
18.58 SCV
18.62 SET
18.77 RSC

Table 11.16 One-way ANOVA results for Ulucak Höyük

ANOVA-Ulucak Höyük					
MRBf					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	403008.624	17	23706.390	12.687	<.001
Within Groups	345695.294	185	1868.623		
Total	748703.917	202			

Table 11.17 Tukey's HSD post-hoc test results – Ulucak Höyük

Ulucak Höyük Multiple Comparisons – Tukey HSD							
Dependent Variable: MRBf							
	(I) groupbyLevel	(J) groupbyLevel	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	0-6 yr	6-10 yr	-65.980	20.900	.145	-139.944	7.985
		F10-15 yr	-110.284*	18.660	<.001	-176.320	-44.248
		M10-15 yr	-128.619*	20.559	<.001	-201.374	-55.863
		F15- yr	-149.973*	17.678	<.001	-212.535	-87.411
		M15- yr	-194.869*	18.335	<.001	-259.754	-129.985
		Sling missile 7th Mill Late	-150.526*	18.569	<.001	-216.240	-84.812
		Sling missile Other	-176.124*	29.830	<.001	-281.689	-70.558
		Animal figurine 7th Mill Late	-108.682	34.659	.153	-231.338	13.974
		Animal figurine 6th mill	-112.072*	22.372	<.001	-191.246	-32.898
		Human figurine 7th Mill Early	-130.750*	34.659	.024	-253.406	-8.094
		Human figurine 7th Mill Late	-168.885*	29.830	<.001	-274.450	-63.320
		Human figurine 6th mill	-130.918*	27.094	<.001	-226.803	-35.034
		Human figurine Other	-88.164	29.830	.233	-193.729	17.402
		Vessel frag 6th mill	-148.172*	22.372	<.001	-227.346	-68.998
		Others 6th mill	-94.668	27.094	.057	-190.553	1.216
		Hematite lump 6th mill	-204.237*	20.559	<.001	-276.992	-131.481
		Clay lump 6th mill	-180.126*	21.785	<.001	-257.220	-103.032
	6-10 yr	0-6 yr	65.980	20.900	.145	-7.985	139.944
		F10-15 yr	-44.304	15.847	.325	-100.385	11.776
		M10-15 yr	-62.639	18.044	.061	-126.496	1.218
		F15- yr	-83.994*	14.678	<.001	-135.939	-32.049
		M15- yr	-128.890*	15.462	<.001	-183.609	-74.170
		Sling missile 7th Mill Late	-84.547*	15.740	<.001	-140.248	-28.846
		Sling missile Other	-110.144*	28.156	.015	-209.785	-10.503
		Animal figurine 7th Mill Late	-42.702	33.229	.998	-160.298	74.893
		Animal figurine 6th mill	-46.092	20.086	.686	-117.175	24.991
		Human figurine 7th Mill Early	-64.771	33.229	.889	-182.366	52.825
		Human figurine 7th Mill Late	-102.905*	28.156	.035	-202.546	-3.264
		Human figurine 6th mill	-64.939	25.239	.479	-154.259	24.382
		Human figurine Other	-22.184	28.156	1.000	-121.825	77.457
		Vessel frag 6th mill	-82.192*	20.086	.008	-153.275	-11.109
		Others 6th mill	-28.689	25.239	1.000	-118.009	60.632
		Hematite lump 6th mill	-138.257*	18.044	<.001	-202.114	-74.400
		Clay lump 6th mill	-114.147*	19.429	<.001	-182.905	-45.388
	F10-15 yr	0-6 yr	110.284*	18.660	<.001	44.248	176.320
		6-10 yr	44.304	15.847	.325	-11.776	100.385
		M10-15 yr	-18.335	15.394	.999	-72.811	36.142
		F15- yr	-39.689	11.261	.052	-79.543	.164
		M15- yr	-84.585*	12.266	<.001	-127.993	-41.177

		Sling missile 7th Mill Late	-40.242	12.614	.133	-84.881	4.396
		Sling missile Other	-65.839	26.535	.548	-159.745	28.066
		Animal figurine 7th Mill Late	1.602	31.868	1.000	-111.175	114.379
		Animal figurine 6th mill	-1.788	17.743	1.000	-64.580	61.004
		Human figurine 7th Mill Early	-20.466	31.868	1.000	-133.243	92.311
		Human figurine 7th Mill Late	-58.601	26.535	.745	-152.507	35.305
		Human figurine 6th mill	-20.634	23.418	1.000	-103.508	62.240
		Human figurine Other	22.121	26.535	1.000	-71.785	116.026
		Vessel frag 6th mill	-37.888	17.743	.792	-100.679	24.904
		Others 6th mill	15.616	23.418	1.000	-67.258	98.490
		Hematite lump 6th mill	-93.952*	15.394	<.001	-148.429	-39.476
		Clay lump 6th mill	-69.842*	16.996	.007	-129.990	-9.694
	M10-15 yr	0-6 yr	128.619*	20.559	<.001	55.863	201.374
		6-10 yr	62.639	18.044	.061	-1.218	126.496
		F10-15 yr	18.335	15.394	.999	-36.142	72.811
		F15- yr	-21.355	14.188	.989	-71.564	28.855
		M15- yr	-66.251*	14.998	.002	-119.326	-13.176
		Sling missile 7th Mill Late	-21.908	15.283	.994	-75.994	32.179
		Sling missile Other	-47.505	27.903	.964	-146.252	51.242
		Animal figurine 7th Mill Late	19.937	33.016	1.000	-96.903	136.776
		Animal figurine 6th mill	16.547	19.731	1.000	-53.278	86.372
		Human figurine Early	-2.132	33.016	1.000	-118.971	114.708
		Human figurine 7th Mill Late	-40.266	27.903	.993	-139.014	58.481
		Human figurine 6th mill	-2.300	24.957	1.000	-90.622	86.023
		Human figurine Other	40.455	27.903	.993	-58.292	139.202
		Vessel frag 6th mill	-19.553	19.731	1.000	-89.378	50.272
		Others 6th mill	33.950	24.957	.997	-54.372	122.273
		Hematite lump 6th mill	-75.618*	17.648	.004	-138.071	-13.165
		Clay lump 6th mill	-51.508	19.062	.387	-118.965	15.950
	F15- yr	0-6 yr	149.973*	17.678	<.001	87.411	212.535
		6-10 yr	83.994*	14.678	<.001	32.049	135.939
		F10-15 yr	39.689	11.261	.052	-.164	79.543
		M10-15 yr	21.355	14.188	.989	-28.855	71.564
		M15- yr	-44.896*	10.714	.005	-82.811	-6.981
		Sling missile 7th Mill Late	-.553	11.110	1.000	-39.871	38.765
		Sling missile Other	-26.150	25.854	1.000	-117.647	65.346
		Animal figurine 7th Mill Late	41.291	31.303	.998	-69.488	152.070
		Animal figurine 6th mill	37.901	16.708	.705	-21.226	97.029
		Human figurine 7th Mill Early	19.223	31.303	1.000	-91.556	130.002
		Human figurine 7th Mill Late	-18.912	25.854	1.000	-110.408	72.585
		Human figurine 6th mill	19.055	22.644	1.000	-61.079	99.189

		Human figurine Other	61.810	25.854	.616	-29.687	153.306
		Vessel frag 6th mill	1.802	16.708	1.000	-57.326	60.929
		Others 6th mill	55.305	22.644	.577	-24.829	135.439
		Hematite lump 6th mill	-54.263*	14.188	.020	-104.473	-4.054
		Clay lump 6th mill	-30.153	15.912	.910	-86.465	26.159
	M15- yr	0-6 yr	194.869*	18.335	<.001	129.985	259.754
		6-10 yr	128.890*	15.462	<.001	74.170	183.609
		F10-15 yr	84.585*	12.266	<.001	41.177	127.993
		M10-15 yr	66.251*	14.998	.002	13.176	119.326
		F15- yr	44.896*	10.714	.005	6.981	82.811
		Sling missile 7th Mill Late	44.343*	12.127	.035	1.426	87.260
		Sling missile Other	18.746	26.307	1.000	-74.354	111.846
		Animal figurine 7th Mill Late	86.187	31.678	.374	-25.920	198.294
		Animal figurine 6th mill	82.797*	17.401	<.001	21.218	144.377
		Human figurine 7th Mill Early	64.119	31.678	.854	-47.988	176.226
		Human figurine 7th Mill Late	25.984	26.307	1.000	-67.115	119.084
		Human figurine 6th mill	63.951	23.160	.347	-18.009	145.911
		Human figurine Other	106.706*	26.307	.009	13.606	199.806
		Vessel frag 6th mill	46.698	17.401	.399	-14.882	108.277
		Others 6th mill	100.201*	23.160	.003	18.242	182.161
		Hematite lump 6th mill	-9.367	14.998	1.000	-62.442	43.708
		Clay lump 6th mill	14.743	16.638	1.000	-44.138	73.625
	Sling missile 7th Mill Late	0-6 yr	150.526*	18.569	<.001	84.812	216.240
		6-10 yr	84.547*	15.740	<.001	28.846	140.248
		F10-15 yr	40.242	12.614	.133	-4.396	84.881
		M10-15 yr	21.908	15.283	.994	-32.179	75.994
		F15- yr	.553	11.110	1.000	-38.765	39.871
		M15- yr	-44.343*	12.127	.035	-87.260	-1.426
		Sling missile Other	-25.597	26.471	1.000	-119.277	68.083
		Animal figurine 7th Mill Late	41.844	31.815	.998	-70.745	154.433
		Animal figurine 6th mill	38.454	17.648	.765	-23.999	100.908
		Human figurine 7th Mill Early	19.776	31.815	1.000	-92.813	132.365
		Human figurine 7th Mill Late	-18.359	26.471	1.000	-112.039	75.321
		Human figurine 6th mill	19.608	23.346	1.000	-63.010	102.226
		Human figurine Other	62.363	26.471	.642	-31.317	156.043
		Vessel frag 6th mill	2.355	17.648	1.000	-60.099	64.808
		Others 6th mill	55.858	23.346	.614	-26.760	138.476
		Hematite lump 6th mill	-53.710	15.283	.054	-107.796	.376
		Clay lump 6th mill	-29.600	16.896	.953	-89.394	30.194
	Sling missile Other	0-6 yr	176.124*	29.830	<.001	70.558	281.689
		6-10 yr	110.144*	28.156	.015	10.503	209.785
		F10-15 yr	65.839	26.535	.548	-28.066	159.745
		M10-15 yr	47.505	27.903	.964	-51.242	146.252
		F15- yr	26.150	25.854	1.000	-65.346	117.647
		M15- yr	-18.746	26.307	1.000	-111.846	74.354

		Sling missile 7th Mill Late	25.597	26.471	1.000	-68.083	119.277
		Animal figurine 7th Mill Late	67.442	39.461	.963	-72.208	207.091
		Animal figurine 6th mill	64.052	29.265	.758	-39.515	167.619
		Human figurine 7th Mill Early	45.373	39.461	1.000	-94.276	185.023
		Human figurine 7th Mill Late	7.239	35.295	1.000	-117.668	132.145
		Human figurine 6th mill	45.205	33.016	.996	-71.634	162.045
		Human figurine Other	87.960	35.295	.539	-36.947	212.866
		Vessel frag 6th mill	27.952	29.265	1.000	-75.615	131.519
		Others 6th mill	81.455	33.016	.558	-35.384	198.295
		Hematite lump 6th mill	-28.113	27.903	1.000	-126.860	70.634
		Clay lump 6th mill	-4.003	28.818	1.000	-105.988	97.983
	Animal figurine 7th Mill Late	0-6 yr	108.682	34.659	.153	-13.974	231.338
		6-10 yr	42.702	33.229	.998	-74.893	160.298
		F10-15 yr	-1.602	31.868	1.000	-114.379	111.175
		M10-15 yr	-19.937	33.016	1.000	-136.776	96.903
		F15- yr	-41.291	31.303	.998	-152.070	69.488
		M15- yr	-86.187	31.678	.374	-198.294	25.920
		Sling missile 7th Mill Late	-41.844	31.815	.998	-154.433	70.745
		Sling missile Other	-67.442	39.461	.963	-207.091	72.208
		Animal figurine 6th mill	-3.390	34.174	1.000	-124.330	117.550
		Human figurine 7th Mill Early	-22.068	43.228	1.000	-175.047	130.910
		Human figurine 7th Mill Late	-60.203	39.461	.988	-199.853	79.447
		Human figurine 6th mill	-22.236	37.436	1.000	-154.720	110.247
		Human figurine Other	20.518	39.461	1.000	-119.131	160.168
		Vessel frag 6th mill	-39.490	34.174	1.000	-160.430	81.450
		Others 6th mill	14.014	37.436	1.000	-118.470	146.497
		Hematite lump 6th mill	-95.555	33.016	.266	-212.394	21.285
		Clay lump 6th mill	-71.444	33.793	.805	-191.033	48.145
	Animal figurine 6th mill	0-6 yr	112.072*	22.372	<.001	32.898	191.246
		6-10 yr	46.092	20.086	.686	-24.991	117.175
		F10-15 yr	1.788	17.743	1.000	-61.004	64.580
		M10-15 yr	-16.547	19.731	1.000	-86.372	53.278
		F15- yr	-37.901	16.708	.705	-97.029	21.226
		M15- yr	-82.797*	17.401	<.001	-144.377	-21.218
		Sling missile 7th Mill Late	-38.454	17.648	.765	-100.908	23.999
		Sling missile Other	-64.052	29.265	.758	-167.619	39.515
		Animal figurine 7th Mill Late	3.390	34.174	1.000	-117.550	124.330
		Human figurine 7th Mill Early	-18.678	34.174	1.000	-139.618	102.262
		Human figurine 7th Mill Late	-56.813	29.265	.892	-160.380	46.754
		Human figurine 6th mill	-18.846	26.471	1.000	-112.526	74.833
		Human figurine Other	23.908	29.265	1.000	-79.659	127.475

		Vessel frag 6th mill	-36.100	21.614	.970	-112.589	40.390
		Others 6th mill	17.404	26.471	1.000	-76.276	111.084
		Hematite lump 6th mill	-92.165*	19.731	<.001	-161.989	-22.340
		Clay lump 6th mill	-68.054	21.005	.117	-142.389	6.280
	Human figurine 7th Mill Early	0-6 yr	130.750*	34.659	.024	8.094	253.406
		6-10 yr	64.771	33.229	.889	-52.825	182.366
		F10-15 yr	20.466	31.868	1.000	-92.311	133.243
		M10-15 yr	2.132	33.016	1.000	-114.708	118.971
		F15- yr	-19.223	31.303	1.000	-130.002	91.556
		M15- yr	-64.119	31.678	.854	-176.226	47.988
		Sling missile 7th Mill Late	-19.776	31.815	1.000	-132.365	92.813
		Sling missile Other	-45.373	39.461	1.000	-185.023	94.276
		Animal figurine 7th Mill Late	22.068	43.228	1.000	-130.910	175.047
		Animal figurine 6th mill	18.678	34.174	1.000	-102.262	139.618
		Human figurine 7th Mill Late	-38.135	39.461	1.000	-177.784	101.515
		Human figurine 6th mill	-.168	37.436	1.000	-132.652	132.315
		Human figurine Other	42.587	39.461	1.000	-97.063	182.236
		Vessel frag 6th mill	-17.422	34.174	1.000	-138.362	103.519
		Others 6th mill	36.082	37.436	1.000	-96.401	168.565
		Hematite lump 6th mill	-73.486	33.016	.734	-190.326	43.353
		Clay lump 6th mill	-49.376	33.793	.992	-168.965	70.213
	Human figurine 7th Mill Late	0-6 yr	168.885*	29.830	<.001	63.320	274.450
		6-10 yr	102.905*	28.156	.035	3.264	202.546
		F10-15 yr	58.601	26.535	.745	-35.305	152.507
		M10-15 yr	40.266	27.903	.993	-58.481	139.014
		F15- yr	18.912	25.854	1.000	-72.585	110.408
		M15- yr	-25.984	26.307	1.000	-119.084	67.115
		Sling missile 7th Mill Late	18.359	26.471	1.000	-75.321	112.039
		Sling missile Other	-7.239	35.295	1.000	-132.145	117.668
		Animal figurine 7th Mill Late	60.203	39.461	.988	-79.447	199.853
		Animal figurine 6th mill	56.813	29.265	.892	-46.754	160.380
		Human figurine 7th Mill Early	38.135	39.461	1.000	-101.515	177.784
		Human figurine 6th mill	37.967	33.016	1.000	-78.873	154.806
		Human figurine Other	80.721	35.295	.691	-44.185	205.628
		Vessel frag 6th mill	20.713	29.265	1.000	-82.854	124.280
		Others 6th mill	74.217	33.016	.719	-42.623	191.056
		Hematite lump 6th mill	-35.352	27.903	.999	-134.099	63.396
		Clay lump 6th mill	-11.241	28.818	1.000	-113.227	90.744
	Human figurine 6th mill	0-6 yr	130.918*	27.094	<.001	35.034	226.803
		6-10 yr	64.939	25.239	.479	-24.382	154.259
		F10-15 yr	20.634	23.418	1.000	-62.240	103.508
		M10-15 yr	2.300	24.957	1.000	-86.023	90.622
		F15- yr	-19.055	22.644	1.000	-99.189	61.079
		M15- yr	-63.951	23.160	.347	-145.911	18.009
		Sling missile 7th Mill Late	-19.608	23.346	1.000	-102.226	63.010

		Sling missile Other	-45.205	33.016	.996	-162.045	71.634
		Animal figurine 7th Mill Late	22.236	37.436	1.000	-110.247	154.720
		Animal figurine 6th mill	18.846	26.471	1.000	-74.833	112.526
		Human figurine 7th Mill Early	.168	37.436	1.000	-132.315	132.652
		Human figurine 7th Mill Late	-37.967	33.016	1.000	-154.806	78.873
		Human figurine Other	42.755	33.016	.998	-74.085	159.594
		Vessel frag 6th mill	-17.253	26.471	1.000	-110.933	76.426
		Others 6th mill	36.250	30.567	.999	-71.922	144.422
		Hematite lump 6th mill	-73.318	24.957	.243	-161.640	15.004
		Clay lump 6th mill	-49.208	25.977	.910	-141.137	42.721
	Human figurine Other	0-6 yr	88.164	29.830	.233	-17.402	193.729
		6-10 yr	22.184	28.156	1.000	-77.457	121.825
		F10-15 yr	-22.121	26.535	1.000	-116.026	71.785
		M10-15 yr	-40.455	27.903	.993	-139.202	58.292
		F15- yr	-61.810	25.854	.616	-153.306	29.687
		M15- yr	-106.706*	26.307	.009	-199.806	-13.606
		Sling missile 7th Mill Late	-62.363	26.471	.642	-156.043	31.317
		Sling missile Other	-87.960	35.295	.539	-212.866	36.947
		Animal figurine 7th Mill Late	-20.518	39.461	1.000	-160.168	119.131
		Animal figurine 6th mill	-23.908	29.265	1.000	-127.475	79.659
		Human figurine 7th Mill Early	-42.587	39.461	1.000	-182.236	97.063
		Human figurine 7th Mill Late	-80.721	35.295	.691	-205.628	44.185
		Human figurine 6th mill	-42.755	33.016	.998	-159.594	74.085
		Vessel frag 6th mill	-60.008	29.265	.840	-163.575	43.559
		Others 6th mill	-6.505	33.016	1.000	-123.344	110.335
		Hematite lump 6th mill	-116.073*	27.903	.006	-214.820	-17.326
		Clay lump 6th mill	-91.963	28.818	.133	-193.948	10.023
	Vessel frag 6th mill	0-6 yr	148.172*	22.372	<.001	68.998	227.346
		6-10 yr	82.192*	20.086	.008	11.109	153.275
		F10-15 yr	37.888	17.743	.792	-24.904	100.679
		M10-15 yr	19.553	19.731	1.000	-50.272	89.378
		F15- yr	-1.802	16.708	1.000	-60.929	57.326
		M15- yr	-46.698	17.401	.399	-108.277	14.882
		Sling missile 7th Mill Late	-2.355	17.648	1.000	-64.808	60.099
		Sling missile Other	-27.952	29.265	1.000	-131.519	75.615
		Animal figurine 7th Mill Late	39.490	34.174	1.000	-81.450	160.430
		Animal figurine 6th mill	36.100	21.614	.970	-40.390	112.589
		Human figurine 7th Mill Early	17.422	34.174	1.000	-103.519	138.362
		Human figurine 7th Mill Late	-20.713	29.265	1.000	-124.280	82.854
		Human figurine 6th mill	17.253	26.471	1.000	-76.426	110.933
		Human figurine Other	60.008	29.265	.840	-43.559	163.575
		Others 6th mill	53.504	26.471	.855	-40.176	147.183

		Hematite lump 6th mill	-56.065	19.731	.297	-125.890	13.760
		Clay lump 6th mill	-31.954	21.005	.988	-106.289	42.380
	Others 6th mill	0-6 yr	94.668	27.094	.057	-1.216	190.553
		6-10 yr	28.689	25.239	1.000	-60.632	118.009
		F10-15 yr	-15.616	23.418	1.000	-98.490	67.258
		M10-15 yr	-33.950	24.957	.997	-122.273	54.372
		F15- yr	-55.305	22.644	.577	-135.439	24.829
		M15- yr	-100.201*	23.160	.003	-182.161	-18.242
		Sling missile 7th Mill Late	-55.858	23.346	.614	-138.476	26.760
		Sling missile Other	-81.455	33.016	.558	-198.295	35.384
		Animal figurine 7th Mill Late	-14.014	37.436	1.000	-146.497	118.470
		Animal figurine 6th mill	-17.404	26.471	1.000	-111.084	76.276
		Human figurine 7th Mill Early	-36.082	37.436	1.000	-168.565	96.401
		Human figurine 7th Mill Late	-74.217	33.016	.719	-191.056	42.623
		Human figurine 6th mill	-36.250	30.567	.999	-144.422	71.922
		Human figurine Other	6.505	33.016	1.000	-110.335	123.344
		Vessel frag 6th mill	-53.504	26.471	.855	-147.183	40.176
		Hematite lump 6th mill	-109.568*	24.957	.002	-197.891	-21.246
		Clay lump 6th mill	-85.458	25.977	.102	-177.387	6.471
	Hematite lump 6th mill	0-6 yr	204.237*	20.559	<.001	131.481	276.992
		6-10 yr	138.257*	18.044	<.001	74.400	202.114
		F10-15 yr	93.952*	15.394	<.001	39.476	148.429
		M10-15 yr	75.618*	17.648	.004	13.165	138.071
		F15- yr	54.263*	14.188	.020	4.054	104.473
		M15- yr	9.367	14.998	1.000	-43.708	62.442
		Sling missile 7th Mill Late	53.710	15.283	.054	-.376	107.796
		Sling missile Other	28.113	27.903	1.000	-70.634	126.860
		Animal figurine 7th Mill Late	95.555	33.016	.266	-21.285	212.394
		Animal figurine 6th mill	92.165*	19.731	<.001	22.340	161.989
		Human figurine 7th Mill Early	73.486	33.016	.734	-43.353	190.326
		Human figurine 7th Mill Late	35.352	27.903	.999	-63.396	134.099
		Human figurine 6th mill	73.318	24.957	.243	-15.004	161.640
		Human figurine Other	116.073*	27.903	.006	17.326	214.820
		Vessel frag 6th mill	56.065	19.731	.297	-13.760	125.890
		Others 6th mill	109.568*	24.957	.002	21.246	197.891
		Clay lump 6th mill	24.110	19.062	.999	-43.347	91.568
	Clay lump 6th mill	0-6 yr	180.126*	21.785	<.001	103.032	257.220
		6-10 yr	114.147*	19.429	<.001	45.388	182.905
		F10-15 yr	69.842*	16.996	.007	9.694	129.990
		M10-15 yr	51.508	19.062	.387	-15.950	118.965
		F15- yr	30.153	15.912	.910	-26.159	86.465
		M15- yr	-14.743	16.638	1.000	-73.625	44.138
		Sling missile 7th Mill Late	29.600	16.896	.953	-30.194	89.394
		Sling missile Other	4.003	28.818	1.000	-97.983	105.988
		Animal figurine 7th Mill Late	71.444	33.793	.805	-48.145	191.033

		Animal figurine 6th mill	68.054	21.005	.117	-6.280	142.389
		Human figurine 7th Mill Early	49.376	33.793	.992	-70.213	168.965
		Human figurine 7th Mill Late	11.241	28.818	1.000	-90.744	113.227
		Human figurine 6th mill	49.208	25.977	.910	-42.721	141.137
		Human figurine Other	91.963	28.818	.133	-10.023	193.948
		Vessel frag 6th mill	31.954	21.005	.988	-42.380	106.289
		Others 6th mill	85.458	25.977	.102	-6.471	177.387
		Hematite lump 6th mill	-24.110	19.062	.999	-91.568	43.347
*. The mean difference is significant at the 0.05 level.							

Table 11.18 Post-hoc results from UH for 0-6 year-olds. Red indicates that they are statistically significantly different from children between 0-6 years old in the reference collection

	Comparison group	Mean Difference	Std. Error	Significance
Child 0-6 years old	Sling missile 7th mill Late	-150.526*	18.569	0.000
	Sling missile Other	-176.124*	29.830	0.000
	Animal Figurine 7th mill Late	-108.682	34.659	0.153
	Animal Figurine 6th mill	-112.072*	22.372	0.000
	Human Figurine 7th mill Early	-130.750*	34.659	0.024
	Human Figurine 7th mill Late	-168.885*	29.830	0.000
	Human Figurine 6th mill	-130.918*	27.094	0.000
	Human Figurine Other	-88.164	29.830	0.233
	Vessel frag 6th mill	-148.172*	22.372	0.000
	Others 6th mill	-94.668	27.094	0.057
	Hematite lump 6th mill	-204.237*	20.559	0.000
	Clay lump 6th mill	-180.126*	21.785	0.000

Table 11.19 Post-hoc results from UH for 6-10 year-olds. Red indicates that these groups are statistically significantly different from adolescents between 6-10 years old from the reference ($p<0.05$). Green represents no statistically significant difference ($p>0.95$)

	Comparison group	Mean Difference	Std. Error	Significance
Child 6-10 years old	Sling missile 7th mill Late	-84.547*	15.740	0.000
	Sling missile Other	-110.144*	28.156	0.015
	Animal Figurine 7th mill Late	-42.702	33.229	0.998
	Animal Figurine 6th mill	-46.092	20.086	0.686
	Human Figurine 7th mill Early	-64.771	33.229	0.889
	Human Figurine 7th mill Late	-102.905*	28.156	0.035
	Human Figurine 6th mill	-64.939	25.239	0.479
	Human Figurine Other	-22.184	28.156	1.000
	Vessel frag 6th mill	-82.192*	20.086	0.008
	Others 6th mill	-28.689	25.239	1.000
	Hematite lump 6th mill	-138.257*	18.044	0.000
	Clay lump 6th mill	-114.147*	19.429	0.000

Table 11.20 Post-hoc results from UH for females between 10 and 15 years old. Red indicates that these groups are statistically significantly different from adolescent females between 10-15 years old from the reference (p<0.05). Green represents no statistically significant difference (p>0.95)

	Comparison group	**Mean Difference**	**Std. Error**	**Significance**
10-15-year-old females	Sling missile 7th mill Late	-40.242	12.614	0.133
	Sling missile Other	-65.839	26.535	0.548
	Animal Figurine 7th mill Late	1.602	31.868	1.000
	Animal Figurine 6th mill	-1.788	17.743	1.000
	Human Figurine 7th mill Early	-20.466	31.868	1.000
	Human Figurine 7th mill Late	-58.601	26.535	0.745
	Human Figurine 6th mill	-20.634	23.418	1.000
	Human Figurine Other	22.121	26.535	1.000
	Vessel frag 6th mill	-37.888	17.743	0.792
	Others 6th mill	15.616	23.418	1.000
	Hematite lump 6th mill	-93.952*	15.394	0.000
	Clay lump 6th mill	-69.842*	16.996	0.007

Table 11.21 Post-hoc results from UH for males between 10 and 15 years old. Red indicates that these groups are statistically significantly different from adolescent males between 10-15 years old from the reference (p<0.05). Green represents no statistically significant difference (p>0.95)

	Comparison group	**Mean Difference**	**Std. Error**	**Significance**
10-15-year-old males	Sling missile 7th mill Late	-21.908	15.283	0.994
	Sling missile Other	-47.505	27.903	0.964
	Animal Figurine 7th mill Late	19.937	33.016	1.000
	Animal Figurine 6th mill	16.547	19.731	1.000
	Human Figurine 7th mill Early	-2.132	33.016	1.000
	Human Figurine 7th mill Late	-40.266	27.903	0.993
	Human Figurine 6th mill	-2.300	24.957	1.000
	Human Figurine Other	40.455	27.903	0.993
	Vessel frag 6th mill	-19.553	19.731	1.000
	Others 6th mill	33.950	24.957	0.997
	Hematite lump 6th mill	-75.618*	17.648	0.004
	Clay lump 6th mill	-51.508	19.062	0.387

Table 11.22 Post-hoc results from UH for adult females. Red indicates that these groups are statistically significantly different from adult females over 15 years old from the reference ($p<0.05$). Green represents no statistically significant difference ($p>0.95$)

	Comparison group	Mean Difference	Std. Error	Significance
Adult females above 15 years old	Sling missile 7th mill Late	-0.553	11.110	1.000
	Sling missile Other	-26.150	25.854	1.000
	Animal Figurine 7th mill Late	41.291	31.303	0.998
	Animal Figurine 6th mill	37.901	16.708	0.705
	Human Figurine 7th mill Early	19.223	31.303	1.000
	Human Figurine 7th mill Late	-18.912	25.854	1.000
	Human Figurine 6th mill	19.055	22.644	1.000
	Human Figurine Other	61.810	25.854	0.616
	Vessel frag 6th mill	1.802	16.708	1.000
	Others 6th mill	55.305	22.644	0.577
	Hematite lump 6th mill	-54.263*	14.188	0.020
	Clay lump 6th mill	-30.153	15.912	0.910

Table 11.23 Post-hoc results from UH for adult males. Red indicates that these groups are statistically significantly different from adult males over 15 years old from the reference ($p<0.05$). Green represents no statistically significant difference ($p>0.95$)

	Comparison group	Mean Difference	Std. Error	Significance
Adult males above 15 years old	Sling missile 7th mill Late	44.343*	12.127	0.035
	Sling missile Other	18.746	26.307	1.000
	Animal Figurine 7th mill Late	86.187	31.678	0.374
	Animal Figurine 6th mill	82.797*	17.401	0.001
	Human Figurine 7th mill Early	64.119	31.678	0.854
	Human Figurine 7th mill Late	25.984	26.307	1.000
	Human Figurine 6th mill	63.951	23.160	0.347
	Human Figurine Other	106.706*	26.307	0.009
	Vessel frag 6th mill	46.698	17.401	0.399
	Others 6th mill	100.201*	23.160	0.003
	Hematite lump 6th mill	-9.367	14.998	1.000
	Clay lump 6th mill	14.743	16.638	1.000

Table 11.24 Post hoc results of Ulucak Höyük Sling Missiles by phase

Ulucak Höyük	Sling missiles 7th mill Early	Sling missiles 7th mill Late	Sling missiles 6th mill	Sling missiles Later Contexts
Probably made by ($p > 0.95$)		10-15-year-old males Females above 15		10-15-year-old males Females above 15 Males above 15
Possibly made by (low significance)		10-15-year-old females		10-15-year-old females
Definitely not made by ($p < 0.05$)		0-6 year-olds 6-10 year-olds Males above 15 years old		0-6 year-olds 6-10 year-olds

Table 11.25 Comparison table for Ulucak Höyük Animal Figurines

Ulucak Höyük	Animal Figurine 7^{th} mill Early	Animal Figurine 7^{th} mill Late	Animal Figurine 6^{th} mill	Animal Figurine Later Contexts
Probably made by ($p > 0.95$)		6-10 year-olds 10-15 year-old females 10-15 year-old males Females above 15	10-15 year-old females 10-15 year-old males	
Possibly made by (low significance)		0-6 year-olds Males above 15	6-10 year-olds Females above 15	
Definitely not made by ($p < 0.05$)			0-6 year-olds Males above 15	

Table 11.26 Comparison Table for anthropomorphic Figurines from Ulucak Höyük.

Ulucak Höyük	**Human Figurine 7th mill Early**	**Human Figurine 7th mill Late**	**Human Figurine 6th mill**	**Human Figurine Later contexts**
Probably made by (p > 0.95)	10-15 year-old females 10-15 year-old males Females above 15	10-15 year-old males Females above 15 Males above 15	10-15 year-old females 10-15 year-old males Females above 15	6-10 year-olds 10-15 year-old females 10-15 year-old males
Possibly made by (low significance)	6-10 year-olds Males above 15	10-15 year-old females	6-10 year-olds Males above 15	0-6 year olds Females above 15
Definitely not made by ($p<0.05$)	0-6 year-olds	0-6 year-olds 6-10 year-olds	0-6 year-olds	Males above 15

Table 11.27 Comparison Table for vessel fragments from the sixth millennium occupation at Ulucak Höyük.

Ulucak Höyük	**Vessel fragments 6th mill**
Probably made by (p > 0.95)	10-15 year-old males
	Females above 15
Possibly made by (low significance)	10-15 year-old females
	Males above 15
Definitely not made by (p<0.05)	0-6 year-olds
	6-10 year-olds

Table 11.28 Comparison Table for kneaded clay lumps and those rich in hematite inclusions from the sixth millennium contexts from Ulucak Höyük.

Ulucak Höyük	**Hematite-rich Lump 6th mill**	**Clay Lump 6th mill**
Probably made by (p > 0.95)	Males above 15	Males above 15
Possibly made by (low significance)		10-15 year-old males
		Females above 15
Definitely not made by (p<0.05)	0-6 year-olds	0-6 year-olds
	6-10 year-olds	
	10-15 year-old females	6-10 year-olds
	10-15 year-old males	10-15 year-old females
	Females above 15	

Descriptive Statistics of Ekşi Höyük

Table 11.29 Descriptive Statistics for Ekşi Höyük clay objects divided into six categories

Descriptive Statistics - Ekşi Höyük Mean Ridge Breadth for Fingerprints								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Sling missile	10	468.20	39.49	12.49	439.95	496.45	402.68	547.36
Animal fig	7	433.99	70.48	26.64	368.81	499.17	374.93	586.66
Human fig	2	386.55	35.67	25.22	66.05	707.04	361.32	411.77
Token	6	407.05	88.64	36.19	314.03	500.07	333.72	562.62
Vessel frag	23	462.21	52.89	11.03	439.34	485.08	353.14	601.76
Other	3	414.39	54.81	31.65	278.23	550.55	367.46	474.63

Table 11.30 Descriptive Statistics of the Mean Ridge Breadth of fingerprints from Ekşi Höyük. The object groups have been divided into three sub-categories based on their dates. The statistics of the reference have also been provided.

Descriptive Statistics – Ekşi Höyük Mean Ridge Breadth for Fingerprints used in Comparisons								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Reference 0-6 yr	7	292.165	30.912	11.684	263.576	320.754	247.11	332.228
Reference 6-10 yr	11	358.145	36.167	10.905	333.847	382.442	299.80	410.919
Reference F10-15 yr	23	402.449	29.047	6.057	389.888	415.010	350.37	464.223
Reference M10-15 yr	12	420.784	33.174	9.577	399.706	441.862	373.57	479.368
Reference F15- yr	41	442.138	30.217	4.719	432.601	451.676	393.45	517.740
Reference M15- yr	27	487.034	40.996	7.890	470.817	503.252	410.22	568.969
Sling Missiles 7th Mill Late	5	443.273	31.270	13.984	404.447	482.100	402.68	489.577
Sling Missiles Other	4	498.719	33.097	16.548	446.055	551.383	473.15	547.362
Animal Figurines 7th Mill Early	5	450.592	78.043	34.902	353.689	547.495	387.14	586.655
Animal Figurine 6th Mill	2	392.487	24.833	17.560	169.371	615.603	374.93	410.046
Token 7th Mill Late	3	388.761	64.911	37.476	227.513	550.009	333.72	460.340
Token 6th Mill	2	468.173	133.568	94.447	-731.888	1668.234	373.73	562.620
Vessel Frag 6th Mill	13	476.641	55.520	15.399	443.091	510.192	414.81	601.757
Vessel Frag Other	9	443.413	47.868	15.956	406.618	480.208	353.14	524.976
Total	164	433.579	60.980	4.762	424.176	442.981	247.11	601.757

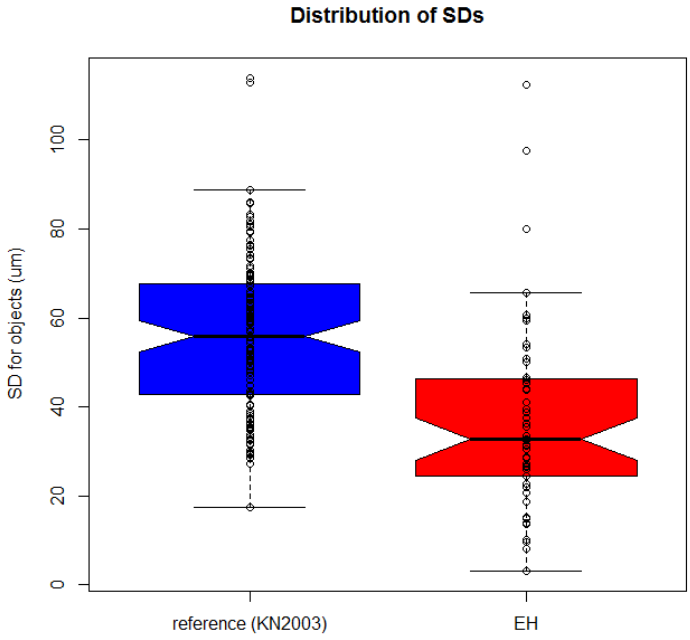


Figure 11.9 Standard deviations of the Ekşi Höyük samples compared to the reference. The results show that the standard deviations of the Mean Ridge Breadths of fingerprints on each clay object from Barcın are even lower than those of the reference. This suggests that each object was probably made by one individual.

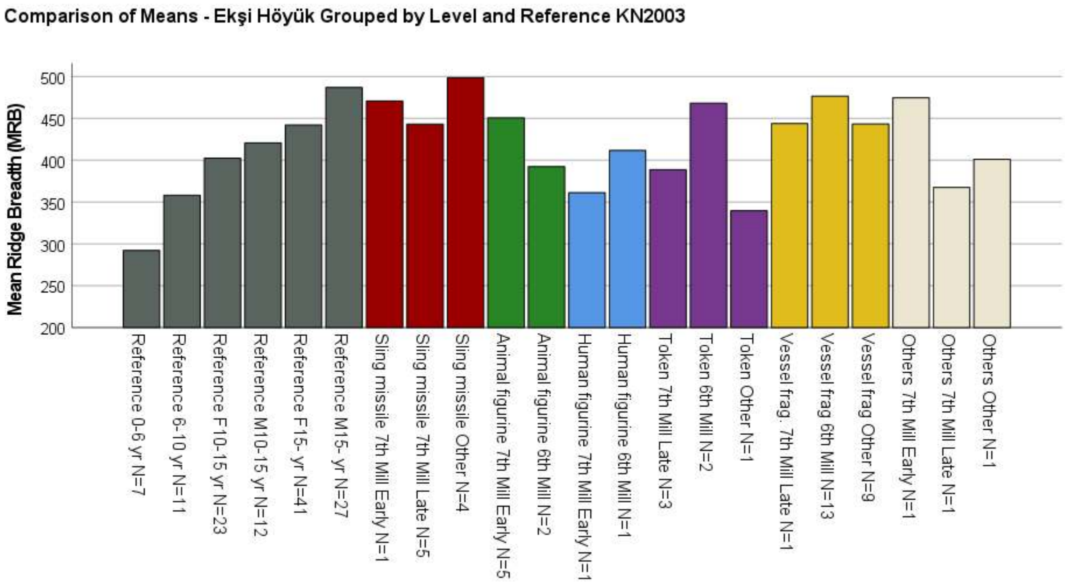


Figure 11.10 Comparison of means - Ekşi Höyük results grouped by level and the reference. The gray boxes are the reference values, and the rest are from the Ekşi Höyük dataset.

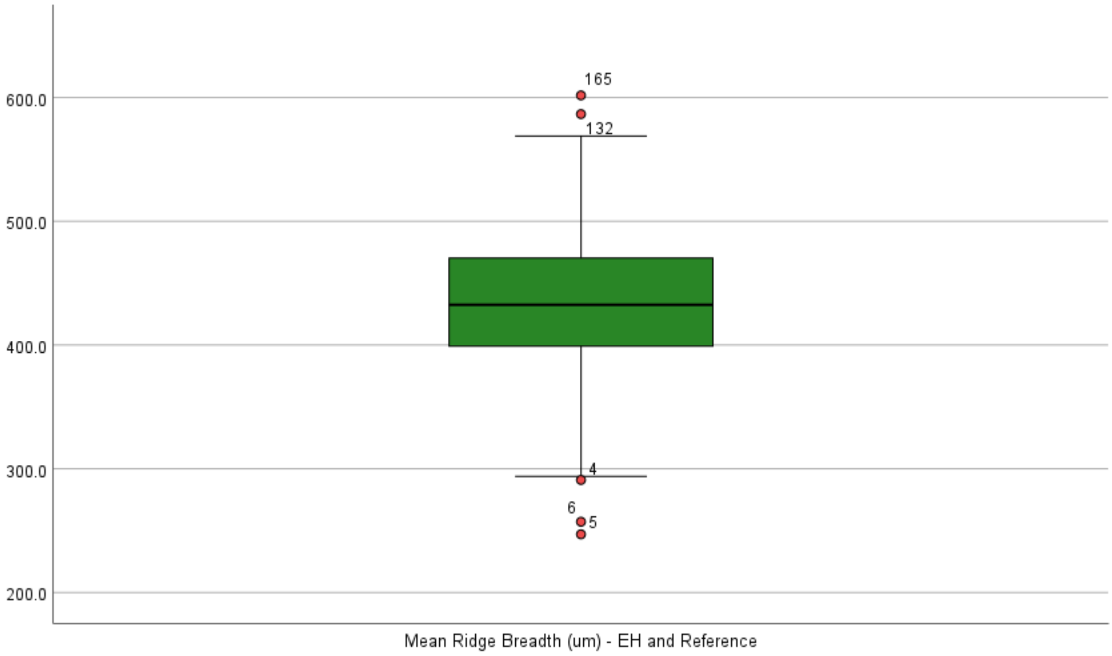


Figure 11.11 Boxplot showing some outliers in Ekşi Höyük and reference data

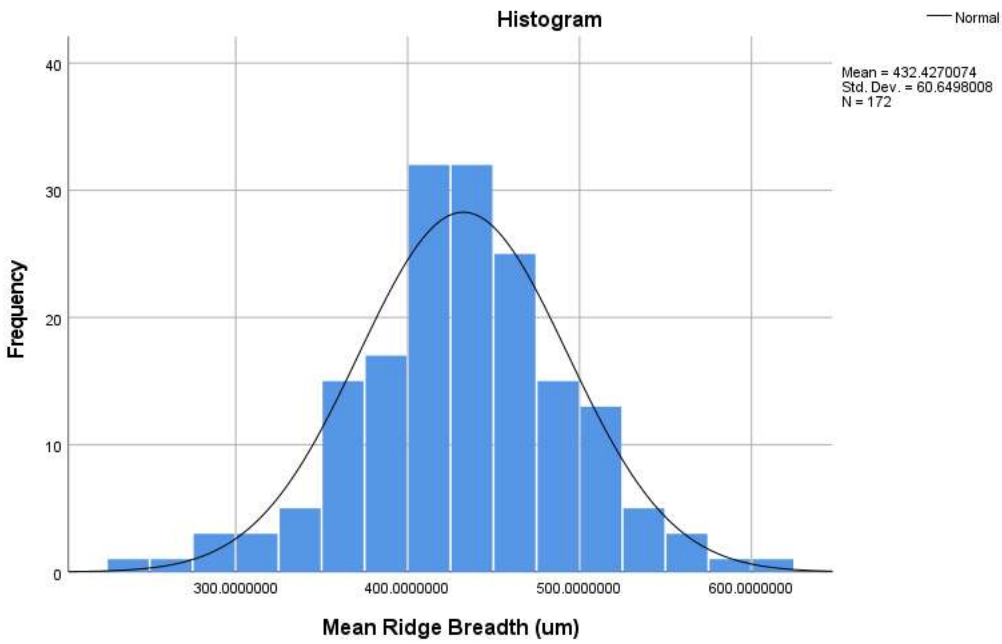


Figure 11.12 Histogram of Ekşi Höyük and reference samples show a normal distribution

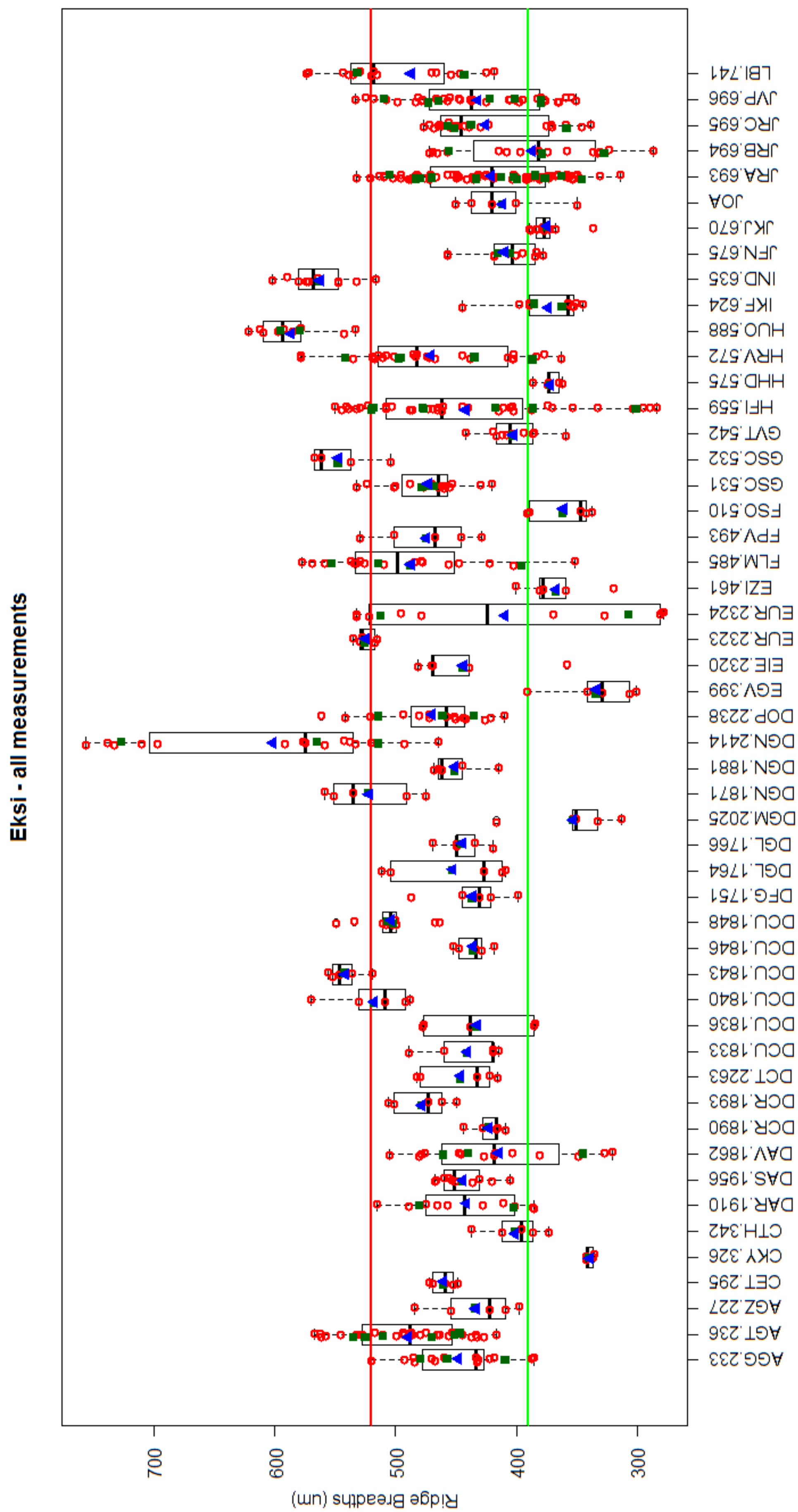

Eksi - all measurements
Ridge Breadths (um)
300
400
500
600
700
AGG.233
AGT.236
AGZ.227
CET.295
CKY.326
CTH.342
DAR.1910
DAS.1956
DAV.1862
DCR.1890
DCR.1893
DCT.2263
DCU.1833
DCU.1836
DCU.1840
DCU.1843
DCU.1846
DCU.1848
DFG.1751
DGL.1764
DGL.1766
DGM.2025
DGN.1871
DGN.1881
DGN.2414
DOP.2238
EGV.399
EIE.2320
EUR.2323
EUR.2324
EZI.461
FLM.485
FPV.493
FSO.510
GSC.531
GSC.532
GVT.542
HFI.559
HHD.575
HRV.572
HUO.588
IKF.624
IND.635
JFN.675
JKJ.670
JOA
JRA.693
JRB.694
JRC.695
JVP.696
LBI.741

Table 11.31 One-way ANOVA results for Ekşi Höyük

ANOVA					
MRBf					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	362651.894	13	27896.300	17.187	<.001
Within Groups	243465.955	150	1623.106		
Total	606117.849	163			

Table 11.32 Tukey's HSD Post hoc test - Ekşi Höyük

Multiple Comparisons – Ekşi Höyük							
Dependent Variable:	MRBf						
			Mean Difference	Std.		95% Confidence Interval	
(I) VAR00001			(I-J)	Error	Sig.	Lower Bound	Upper Bound
Tukey HSD	0-6yr	6-10yr	-65.980	19.479	0.053	-132.395	0.436
		F10-15yr	-110.284*	17.391	0.000	-169.580	-50.988
		M10-15yr	-128.619*	19.161	0.000	-193.949	-63.289
		F15-yr	-149.973*	16.476	0.000	-206.150	-93.797
		M15-yr	-194.869*	17.088	0.000	-253.131	-136.607
		Sling missile Late	-151.108*	23.590	0.000	-231.541	-70.675
		Sling missile Other	-206.554*	25.252	0.000	-292.652	-120.456
		Animal figurine Early	-158.427*	23.590	0.000	-238.860	-77.994
		Animal figurine 6th Mill	-100.322	32.302	0.115	-210.459	9.815
		Token Late	-96.596*	27.801	0.041	-191.387	-1.805
		Token 6th Mill	-176.008*	32.302	0.000	-286.145	-65.871
		Vessel frag 6th Mill	-184.476*	18.887	0.000	-248.874	-120.079
		Vessel frag Other	-151.248*	20.303	0.000	-220.473	-82.022
	6-10yr	0-6yr	65.980	19.479	0.053	-0.436	132.395
		F10-15yr	-44.304	14.769	0.150	-94.661	6.052
		M10-15yr	-62.639*	16.817	0.019	-119.978	-5.300
		F15-yr	-83.994*	13.680	0.000	-130.637	-37.350
		M15-yr	-128.890*	14.411	0.000	-178.025	-79.755
		Sling missile Late	-85.129*	21.730	0.010	-159.218	-11.039
		Sling missile Other	-140.575*	23.523	0.000	-220.778	-60.371
		Animal figurine Early	-92.447*	21.730	0.003	-166.536	-18.358
		Animal figurine 6th Mill	-34.342	30.969	0.998	-139.936	71.251
		Token Late	-30.616	26.241	0.996	-120.087	58.855
		Token 6th Mill	-110.028*	30.969	0.032	-215.622	-4.435
		Vessel frag 6th Mill	-118.497*	16.505	0.000	-174.772	-62.222
		Vessel frag Other	-85.268*	18.108	0.000	-147.009	-23.527
	F10-15yr	0-6yr	110.284*	17.391	0.000	50.988	169.580
		6-10yr	44.304	14.769	0.150	-6.052	94.661
		M10-15yr	-18.335	14.347	0.991	-67.251	30.582
		F15-yr	-39.689*	10.496	0.015	-75.475	-3.903

		M15-yr	-84.585*	11.432	0.000	-123.563	-45.608
		Sling missile Late	-40.824	19.879	0.731	-108.605	26.957
		Sling missile Other	-96.270*	21.825	0.002	-170.686	-21.854
		Animal figurine Early	-48.143	19.879	0.470	-115.924	19.638
		Animal figurine 6th Mill	9.962	29.701	1.000	-91.305	111.229
		Token Late	13.688	24.731	1.000	-70.633	98.010
		Token 6th Mill	-65.724	29.701	0.621	-166.991	35.543
		Vessel frag 6th Mill	-74.192*	13.979	0.000	-121.857	-26.528
		Vessel frag Other	-40.964	15.840	0.358	-94.973	13.045
	M10-15yr	0-6yr	128.619*	19.161	0.000	63.289	193.949
		6-10yr	62.639*	16.817	0.019	5.300	119.978
		F10-15yr	18.335	14.347	0.991	-30.582	67.251
		F15-yr	-21.355	13.223	0.940	-66.440	23.730
		M15-yr	-66.251*	13.978	0.000	-113.909	-18.593
		Sling missile Late	-22.490	21.445	0.999	-95.608	50.629
		Sling missile Other	-77.936	23.260	0.059	-157.243	1.372
		Animal figurine Early	-29.808	21.445	0.982	-102.926	43.310
		Animal figurine 6th Mill	28.297	30.770	1.000	-76.617	133.211
		Token Late	32.023	26.006	0.994	-56.646	120.692
		Token 6th Mill	-47.389	30.770	0.958	-152.304	57.525
		Vessel frag 6th Mill	-55.858*	16.128	0.043	-110.848	-0.868
		Vessel frag Other	-22.629	17.765	0.992	-83.201	37.943
	F15-yr	0-6yr	149.973*	16.476	0.000	93.797	206.150
		6-10yr	83.994*	13.680	0.000	37.350	130.637
		F10-15yr	39.689*	10.496	0.015	3.903	75.475
		M10-15yr	21.355	13.223	0.940	-23.730	66.440
		M15-yr	-44.896*	9.985	0.001	-78.941	-10.851
		Sling missile Late	-1.135	19.084	1.000	-66.205	63.935
		Sling missile Other	-56.581	21.104	0.300	-128.536	15.374
		Animal figurine Early	-8.454	19.084	1.000	-73.523	56.616
		Animal figurine 6th Mill	49.651	29.174	0.912	-49.821	149.124
		Token Late	53.378	24.096	0.619	-28.780	135.536
		Token 6th Mill	-26.035	29.174	1.000	-125.507	73.438
		Vessel frag 6th Mill	-34.503	12.824	0.295	-78.226	9.220
		Vessel frag Other	-1.274	14.830	1.000	-51.839	49.290
	M15-yr	0-6yr	194.869*	17.088	0.000	136.607	253.131

		6-10yr	128.890*	14.411	0.000	79.755	178.025
		F10-15yr	84.585*	11.432	0.000	45.608	123.563
		M10-15yr	66.251*	13.978	0.000	18.593	113.909
		F15-yr	44.896*	9.985	0.001	10.851	78.941
		Sling missile Late	43.761	19.615	0.608	-23.117	110.639
		Sling missile Other	-11.685	21.585	1.000	-85.279	61.910
		Animal figurine Early	36.442	19.615	0.845	-30.436	103.321
		Animal figurine 6th Mill	94.548	29.524	0.090	-6.117	195.212
		Token Late	98.274*	24.518	0.007	14.676	181.871
		Token 6th Mill	18.861	29.524	1.000	-81.804	119.526
		Vessel frag 6th Mill	10.393	13.600	1.000	-35.979	56.765
		Vessel frag Other	43.622	15.507	0.230	-9.250	96.493
	Sling missile Late	0-6yr	151.108*	23.590	0.000	70.675	231.541
		6-10yr	85.129*	21.730	0.010	11.039	159.218
		F10-15yr	40.824	19.879	0.731	-26.957	108.605
		M10-15yr	22.490	21.445	0.999	-50.629	95.608
		F15-yr	1.135	19.084	1.000	-63.935	66.205
		M15-yr	-43.761	19.615	0.608	-110.639	23.117
		Sling missile Other	-55.446	27.026	0.732	-147.593	36.701
		Animal figurine Early	-7.319	25.480	1.000	-94.196	79.559
		Animal figurine 6th Mill	50.786	33.707	0.964	-64.141	165.714
		Token Late	54.513	29.422	0.848	-45.805	154.830
		Token 6th Mill	-24.900	33.707	1.000	-139.828	90.028
		Vessel frag 6th Mill	-33.368	21.201	0.950	-105.655	38.918
		Vessel frag Other	-0.140	22.471	1.000	-76.758	76.479
	Sling missile Other	0-6yr	206.554*	25.252	0.000	120.456	292.652
		6-10yr	140.575*	23.523	0.000	60.371	220.778
		F10-15yr	96.270*	21.825	0.002	21.854	170.686
		M10-15yr	77.936	23.260	0.059	-1.372	157.243
		F15-yr	56.581	21.104	0.300	-15.374	128.536
		M15-yr	11.685	21.585	1.000	-61.910	85.279
		Sling missile Late	55.446	27.026	0.732	-36.701	147.593
		Animal figurine Early	48.127	27.026	0.881	-44.020	140.275
		Animal figurine 6th Mill	106.232	34.890	0.135	-12.729	225.194
		Token Late	109.959*	30.770	0.030	5.044	214.873
		Token 6th Mill	30.546	34.890	1.000	-88.416	149.508

		Vessel frag 6th Mill	22.078	23.035	1.000	-56.464	100.619
		Vessel frag Other	55.306	24.210	0.569	-27.240	137.853
	Animal figurine Early	0-6yr	158.427*	23.590	0.000	77.994	238.860
		6-10yr	92.447*	21.730	0.003	18.358	166.536
		F10-15yr	48.143	19.879	0.470	-19.638	115.924
		M10-15yr	29.808	21.445	0.982	-43.310	102.926
		F15-yr	8.454	19.084	1.000	-56.616	73.523
		M15-yr	-36.442	19.615	0.845	-103.321	30.436
		Sling missile Late	7.319	25.480	1.000	-79.559	94.196
		Sling missile Other	-48.127	27.026	0.881	-140.275	44.020
		Animal figurine 6th Mill	58.105	33.707	0.904	-56.823	173.033
		Token Late	61.831	29.422	0.699	-38.486	162.148
		Token 6th Mill	-17.581	33.707	1.000	-132.509	97.347
		Vessel frag 6th Mill	-26.050	21.201	0.994	-98.336	46.237
		Vessel frag Other	7.179	22.471	1.000	-69.439	83.798
	Animal figurine 6th Mill	0-6yr	100.322	32.302	0.115	-9.815	210.459
		6-10yr	34.342	30.969	0.998	-71.251	139.936
		F10-15yr	-9.962	29.701	1.000	-111.229	91.305
		M10-15yr	-28.297	30.770	1.000	-133.211	76.617
		F15-yr	-49.651	29.174	0.912	-149.124	49.821
		M15-yr	-94.548	29.524	0.090	-195.212	6.117
		Sling missile Late	-50.786	33.707	0.964	-165.714	64.141
		Sling missile Other	-106.232	34.890	0.135	-225.194	12.729
		Animal figurine Early	-58.105	33.707	0.904	-173.033	56.823
		Token Late	3.726	36.778	1.000	-121.670	129.123
		Token 6th Mill	-75.686	40.288	0.835	-213.051	61.679
		Vessel frag 6th Mill	-84.155	30.601	0.262	-188.491	20.182
		Vessel frag Other	-50.926	31.494	0.939	-158.309	56.457
	Token Late	0-6yr	96.596*	27.801	0.041	1.805	191.387
		6-10yr	30.616	26.241	0.996	-58.855	120.087
		F10-15yr	-13.688	24.731	1.000	-98.010	70.633
		M10-15yr	-32.023	26.006	0.994	-120.692	56.646
		F15-yr	-53.378	24.096	0.619	-135.536	28.780
		M15-yr	-98.274*	24.518	0.007	-181.871	-14.676
		Sling missile Late	-54.513	29.422	0.848	-154.830	45.805
		Sling missile Other	-109.959*	30.770	0.030	-214.873	-5.044
		Animal figurine Early	-61.831	29.422	0.699	-162.148	38.486

		Animal figurine 6th Mill	-3.726	36.778	1.000	-129.123	121.670
		Token 6th Mill	-79.413	36.778	0.659	-204.809	45.984
		Vessel frag 6th Mill	-87.881	25.805	0.051	-175.865	0.103
		Vessel frag Other	-54.652	26.859	0.743	-146.229	36.925
	Token 6th Mill	0-6yr	176.008*	32.302	0.000	65.871	286.145
		6-10yr	110.028*	30.969	0.032	4.435	215.622
		F10-15yr	65.724	29.701	0.621	-35.543	166.991
		M10-15yr	47.389	30.770	0.958	-57.525	152.304
		F15-yr	26.035	29.174	1.000	-73.438	125.507
		M15-yr	-18.861	29.524	1.000	-119.526	81.804
		Sling missile Late	24.900	33.707	1.000	-90.028	139.828
		Sling missile Other	-30.546	34.890	1.000	-149.508	88.416
		Animal figurine Early	17.581	33.707	1.000	-97.347	132.509
		Animal figurine 6th Mill	75.686	40.288	0.835	-61.679	213.051
		Token Late	79.413	36.778	0.659	-45.984	204.809
		Vessel frag 6th Mill	-8.468	30.601	1.000	-112.805	95.868
		Vessel frag Other	24.760	31.494	1.000	-82.623	132.144
	Vessel frag 6th Mill	0-6yr	184.476*	18.887	0.000	120.079	248.874
		6-10yr	118.497*	16.505	0.000	62.222	174.772
		F10-15yr	74.192*	13.979	0.000	26.528	121.857
		M10-15yr	55.858*	16.128	0.043	0.868	110.848
		F15-yr	34.503	12.824	0.295	-9.220	78.226
		M15-yr	-10.393	13.600	1.000	-56.765	35.979
		Sling missile Late	33.368	21.201	0.950	-38.918	105.655
		Sling missile Other	-22.078	23.035	1.000	-100.619	56.464
		Animal figurine Early	26.050	21.201	0.994	-46.237	98.336
		Animal figurine 6th Mill	84.155	30.601	0.262	-20.182	188.491
		Token Late	87.881	25.805	0.051	-0.103	175.865
		Token 6th Mill	8.468	30.601	1.000	-95.868	112.805
		Vessel frag Other	33.229	17.470	0.822	-26.337	92.794
	Vessel frag Other	0-6yr	151.248*	20.303	0.000	82.022	220.473
		6-10yr	85.268*	18.108	0.000	23.527	147.009
		F10-15yr	40.964	15.840	0.358	-13.045	94.973
		M10-15yr	22.629	17.765	0.992	-37.943	83.201
		F15-yr	1.274	14.830	1.000	-49.290	51.839
		M15-yr	-43.622	15.507	0.230	-96.493	9.250
		Sling missile Late	0.140	22.471	1.000	-76.479	76.758

		Sling missile Other	-55.306	24.210	0.569	-137.853	27.240
		Animal figurine Early	-7.179	22.471	1.000	-83.798	69.439
		Animal figurine 6th Mill	50.926	31.494	0.939	-56.457	158.309
		Token Late	54.652	26.859	0.743	-36.925	146.229
		Token 6th Mill	-24.760	31.494	1.000	-132.144	82.623
		Vessel frag 6th Mill	-33.229	17.470	0.822	-92.794	26.337
*. The mean difference is significant at the 0.05 level.							

Table 11.33 Post-hoc results from EH for 0-6 year-olds. Red indicates that they are statistically significantly different from children between 0-6 years old in the reference collection

	Comparison group	Mean Difference	Std. Error	Significance
Child 0-6 years old	Sling missile 7th mill Late	-151.108*	23.590	0.000
	Sling missile Other	-206.554*	25.252	0.000
	Animal Figurine 7th mill Early	-158.427*	23.590	0.000
	Animal Figurine 6th Mill	-100.322	32.302	0.115
	Token 7th mill Late	-96.596*	27.801	0.041
	Token 6th Mill	-176.008*	32.302	0.000
	Vessel frag 6th Mill	-184.476*	18.887	0.000
	Vessel frag Other	-151.248*	20.303	0.000

Table 11.34 Post-hoc results from EH for 6-10 year-olds. Red indicates that these groups are statistically significantly different from adolescents between 6-10 years old from the reference ($p<0.05$). Green represents no statistically significant difference ($p>0.95$)

	Comparison group	Mean Difference	Std. Error	Significance
Child 6-10 years old	Sling missile 7th mill Late	-85.129*	21.730	0.010
	Sling missile Other	-140.575*	23.523	0.000
	Animal Figurine 7th mill Early	-92.447*	21.730	0.003
	Animal Figurine 6th Mill	-34.342	30.969	0.998
	Token 7th mill Late	-30.616	26.241	0.996
	Token 6th Mill	-110.028*	30.969	0.032
	Vessel frag 6th Mill	-118.497*	16.505	0.000
	Vessel frag Other	-85.268*	18.108	0.000

Table 11.35 Post-hoc results from EH for females between 10 and 15 years old. Red indicates that these groups are statistically significantly different from adolescent females between 10-15 years old from the reference (p<0.05). Green represents no statistically significant difference (p>0.95)

	Comparison group	Mean Difference	Std. Error	Significance
10-15-year-old females	Sling missile 7th mill Late	-40.824	19.879	0.731
	Sling missile Other	-96.270*	21.825	0.002
	Animal Figurine 7th mill Early	-48.143	19.879	0.470
	Animal Figurine 6th Mill	9.962	29.701	1.000
	Token 7th mill Late	13.688	24.731	1.000
	Token 6th Mill	-65.724	29.701	0.621
	Vessel frag 6th Mill	-74.192*	13.979	0.000
	Vessel frag Other	-40.964	15.840	0.358

Table 11.36 Post-hoc results from EH for males between 10 and 15 years old. Red indicates that these groups are statistically significantly different from adolescent males between 10-15 years old from the reference (p<0.05). Green represents no statistically significant difference (p>0.95)

	Comparison group	Mean Difference	Std. Error	Significance
10-15-year-old males	Sling missile 7th mill Late	-22.490	21.445	0.999
	Sling missile Other	-77.936	23.260	0.059
	Animal Figurine 7th mill Early	-29.808	21.445	0.982
	Animal Figurine 6th Mill	28.297	30.770	1.000
	Token 7th mill Late	32.023	26.006	0.994
	Token 6th Mill	-47.389	30.770	0.958
	Vessel frag 6th Mill	-55.858*	16.128	0.043
	Vessel frag Other	-22.629	17.765	0.992

Table 11.37 Post-hoc results from EH for adult females. Red indicates that these groups are statistically significantly different from adult females over 15 years old from the reference (p<0.05). Green represents no statistically significant difference (p>0.95)

	Comparison group	Mean Difference	Std. Error	Significance
Adult females above 15 years old	Sling missile 7th mill Late	-1.135	19.084	1.000
	Sling missile Other	-56.581	21.104	0.300
	Animal Figurine 7th mill Early	-8.454	19.084	1.000
	Animal Figurine 6th Mill	49.651	29.174	0.912
	Token 7th mill Late	53.378	24.096	0.619
	Token 6th Mill	-26.035	29.174	1.000
	Vessel frag 6th Mill	-34.503	12.824	0.295
	Vessel frag Other	-1.274	14.830	1.000

Table 11.38 Post-hoc results from EH for adult males. Red indicates that these groups are statistically significantly different from adult males over 15 years old from the reference (p<0.05). Green represents no statistically significant difference (p>0.95)

	Comparison group	Mean Difference	Std. Error	Significance
Adult males above 15 years old	Sling missile 7th mill Late	43.761	19.615	0.608
	Sling missile Other	-11.685	21.585	1.000
	Animal Figurine 7th mill Early	36.442	19.615	0.845
	Animal Figurine 6th Mill	94.548	29.524	0.090
	Token 7th mill Late	98.274*	24.518	0.007
	Token 6th Mill	18.861	29.524	1.000
	Vessel frag 6th Mill	10.393	13.600	1.000
	Vessel frag Other	43.622	15.507	0.230

Table 11.39 Ekşi Höyük Sling Missiles

Ekşi Höyük	**Sling missile 7th mill Early**	**Sling missile 7th mill Late**	**Sling missile 6th mill**	**Sling missile Later Contexts**
Probably made by ($p > 0.95$)		10-15 year-old males Female above 15		Males above 15
Possibly made by (low significance)		10-15 year-old females Males above 15		10-15 year-old males Females above 15
Definitely not made by ($p<0.05$)		0-6 year-olds 6-10 year-olds		0-6 year-olds 6-10 year-olds 10-15 year-old females

Table 11.40 Ekşi Höyük Animal Figurines comparison

Ekşi Höyük	Animal Figurine 7th mill Early	Animal Figurine 7th mill Late	Animal Figurine 6th mill	Animal Figurine Later Contexts
Probably made by (p > 0.95)	10-15 year-old male Females above 15		6-10 year-olds 10-15 year-old female 10-15 year-old male	
Possibly made by (low significance)	10-15 year-old female Males above 15		0-6 year-olds Females above 15 Males above 15	
Definitely not made by (p<0.05)	0-6 year-olds 6-10 year-olds			

Table 11.41 Comparison table for pottery fragments from Ekşi Höyük

Ekşi Höyük	Vessel fragment 6th mill	Vessel fragment Later contexts
Probably made by (p > 0.95)	Male above 15	10-15 year-old male Female above 15
Possibly made by (low significance)	Female above 15	10-15 year-old female Male above 15
Definitely not made by (p<0.05)	0-6 year-olds 6-10 year-olds 10-15 year-old female 10-15 year-old male	0-6 year-olds 6-10 year olds

APPENDIX II:

12 LIST OF OBJECTS STUDIED IN THIS WORK

Table 12.1 List of clay objects with epidermal ridges examined in this work

Site	Object	Object No	Level	Phase (Neolithic)	Object Type	Object Type Code	No of Prints
Barcın Höyük	2218	1	VIb or Vıa	7th Mill Late	Sling Missile	1	1
Barcın Höyük	2220	2	VIb or Vıa	7th Mill Late	Sling Missile	1	1
Barcın Höyük	2265	3	Middle Chalcolithic	Other	Animal Figurine	2	1
Barcın Höyük	2728	4	VIb	7th Mill Late	Animal Figurine	2	1
Barcın Höyük	2753	5	Vıa	7th Mill Late	Token	5	2
Barcın Höyük	2819	6	Late Chalcolithic	Other	Animal Figurine	2	1
Barcın Höyük	2857	7	VIb	7th Mill Late	Sling Missile	1	4
Barcın Höyük	3272	8	VIb or Vıa	7th Mill Late	Sling Missile	1	2
Barcın Höyük	3312	9	VIa	7th Mill Late	Animal Figurine	2	4
Barcın Höyük	3373	10	VIb	7th Mill Late	Sling Missile	1	3
Barcın Höyük	3453	11	VIa	7th Mill Late	Sling Missile	1	1

Barcın Höyük	3493	12	VIa	7th Mill Late	Sling Missile	1	2
Barcın Höyük	4068	13	VIa	7th Mill Late	Animal Figurine	2	2
Barcın Höyük	4116	14	VIb	7th Mill Late	Token	5	2
Barcın Höyük	4366	15	VIb	7th Mill Late	Human Figurine	3	2
Barcın Höyük	5859	16	VIa	7th Mill Late	Animal Figurine	2	4
Barcın Höyük	5887	17	VIb	7th Mill Late	Sling Missile	1	1
Barcın Höyük	6167	18	VIa	7th Mill Late	Animal Figurine	2	4
Barcın Höyük	6193	19	VIa	7th Mill Late	Sling Missile	1	1
Barcın Höyük	6194	20	VIa	7th Mill Late	Sling Missile	1	2
Barcın Höyük	6283	21	VIa	7th Mill Late	Animal Figurine	2	3
Barcın Höyük	6333	22	VIb or VIa	7th Mill Late	Human Figurine	3	1
Barcın Höyük	6561	23	VIa	7th Mill Late	Human Figurine	3	1
Barcın Höyük	6860	24	mixed periods/cleaning	Other	Animal Figurine	2	3
Barcın Höyük	7008	25	VIa	7th Mill Late	Sling Missile	1	3
Barcın Höyük	7056	26	mixed periods/cleaning	Other	Sling Missile	1	2

Barcın Höyük	8004	27	mixed periods/cleaning	Other	Sling Missile	1	2
Barcın Höyük	8107	28	VIa	7th Mill Late	Token	5	1
Barcın Höyük	8579	29	VIa	7th Mill Late	Animal Figurine	2	5
Barcın Höyük	8659	30	VIb or VIa	7th Mill Late	Animal Figurine	2	14
Barcın Höyük	8766	31	VIb	7th Mill Late	Figurine Fragment	4	8
Barcın Höyük	9118	32	Middle Chalcolithic	Other	Human Figurine	3	1
Barcın Höyük	9320	33	mixed periods/cleaning	Other	Sling Missile	1	1
Barcın Höyük	9509	34	VIb	7th Mill Late	Sling Missile	1	5
Barcın Höyük	9523	35	Middle Chalcolithic	Other	Clay Ball	6	2
Barcın Höyük	9697	36	VIc or VIb	7th Mill Late	Sling Missile	1	6
Barcın Höyük	11594	37	mixed periods/cleaning	Other	Token	5	1
Barcın Höyük	11648	38	VId2	7th Mill Early	Sling Missile	1	1
Barcın Höyük	11728	39	VIb	7th Mill Late	Clay Ball	6	1
Barcın Höyük	12316	40	Middle Chalcolithic	Other	Sling Missile	1	2
Barcın Höyük	13097	41	VIb	7th Mill Late	Animal Figurine	2	5

Barcın Höyük	13206	42	mixed periods/cleaning	Other	Sling Missile	1	2
Barcın Höyük	13251	43	Bronze Age	Other	Sling Missile	1	4
Barcın Höyük	13745	44	VId1	7th Mill Early	Sling Missile	1	3
Barcın Höyük	13864	45	VIb	7th Mill Late	Animal Figurine	2	1
Barcın Höyük	14048	46	VIa	7th Mill Late	Token	5	1
Barcın Höyük	14084	47	mixed periods/cleaning	Other	Animal Figurine	2	1
Barcın Höyük	13183	48	VId2	7th Mill Early	Sling Missile	1	2
Barcın Höyük	13630	49	Byzantine	Other	Token	5	2
Barcın Höyük	14002	50	VIa or Middle Chalcolithic	Other	Sling Missile	1	1
Barcın Höyük	14133	51	Early/Middle Bronze Age transitional	Other	Token	5	3
Barcın Höyük	14141	52	VIa	7th Mill Late	Figurine Fragment	4	2
Barcın Höyük	14590	53	VIa	7th Mill Late	Sling Missile	1	1
Barcın Höyük	14614	54	VIb	7th Mill Late	Human Figurine	3	3
Barcın Höyük	14627	55	VIc or VIb	7th Mill Late	Animal Figurine	2	3
Barcın Höyük	15184	56	VIe or VId1	7th Mill Early	Sling Missile	1	1

Barcın Höyük	15449	57	VIb	7th Mill Late	Sling Missile	1	1
Barcın Höyük	15564	58	VIa	7th Mill Late	Token	5	1
Barcın Höyük	15657	59	Early/Middle Bronze Age transitional	Other	Animal Figurine	2	4
Barcın Höyük	16096	60	Late Chalcolithic	Other	Animal Figurine	2	1
Barcın Höyük	16284	61	VIa	7th Mill Late	Animal Figurine	2	1
Barcın Höyük	16285	62	VIa	7th Mill Late	Animal Figurine	2	2
Barcın Höyük	17375	63	VId1	7th Mill Early	Other/Unknown	8	4
Barcın Höyük	17376	64	VId1	7th Mill Early	Vessel Related	7	1
Barcın Höyük	17452	65	Middle Chalcolithic	Other	Token	5	2
Barcın Höyük	17838	66	VIa	7th Mill Late	Animal Figurine	2	4
Barcın Höyük	17856	67	VIa	7th Mill Late	Sling Missile	1	6
Barcın Höyük	17879	68	VIa or Middle Chalcolithic	Other	Animal Figurine	2	5
Barcın Höyük	18382	69	VIb	7th Mill Late	Other/Unknown	8	2
Barcın Höyük	18572	70	VIa or Middle Chalcolithic	Other	Other/Unknown	8	1
Barcın Höyük	19464	71	VIb	7th Mill Late	Animal Figurine	2	3

Barcın Höyük	20233	72	VIa	7th Mill Late	Sling Missile	1	1
Barcın Höyük	20280	73	VIb or VIa	7th Mill Late	Animal Figurine	1	1
Barcın Höyük	20700	74	VIb	7th Mill Late	Human Figurine	3	7
Barcın Höyük	20990	75	mixed periods/cleaning	Other	Sling Missile	1	2
Barcın Höyük	21216	76	VIc	7th Mill Early	Animal Figurine	2	3
Barcın Höyük	22032	77	VIc or VIb	7th Mill Late	Animal Figurine	2	1
Barcın Höyük	22044	78	VIb	7th Mill Late	Sling Missile	1	1
Barcın Höyük	22460	79	VIc	7th Mill Early	Animal Figurine	2	1
Barcın Höyük	25006	80	VIa	7th Mill Late	Animal Figurine	2	3
Barcın Höyük	25048	81	VIa	7th Mill Late	Sling Missile	1	2
Barcın Höyük	26819	82	VIb	7th Mill Late	Animal Figurine	2	8
Barcın Höyük	27678	83	VId3	7th Mill Early	Sling Missile	1	1
Barcın Höyük	27844	84	VIb	7th Mill Late	Animal Figurine	2	10
Barcın Höyük	27934	85	VIb	7th Mill Late	Sling Missile	1	2
Barcın Höyük	28473	86	VIc	7th Mill Early	Sling Missile	1	1

Barcın Höyük	29910	87	VIc	7th Mill Early	Sling Missile	1	1
Barcın Höyük	30746	88	VIc or VIb	7th Mill Late	Sling Missile	1	1
Barcın Höyük	31532	89	VIc	7th Mill Late	Human Figurine	3	1
Barcın Höyük	35535	90	VIc	7th Mill Early	Animal Figurine	2	1
Barcın Höyük	37820	91	VIc	7th Mill Early	Animal Figurine	2	4
Barcın Höyük	38223	92	VIa or Middle Chalcolithic	Other	Sling Missile	1	1
Barcın Höyük	38475	93	VId1	7th Mill Early	Human Figurine	3	1
Barcın Höyük	40545	94	VId1	7th Mill Early	Sling Missile	1	1
Barcın Höyük	41338	95	VId3	7th Mill Early	Sling Missile	1	1
Barcın Höyük	41925	96	VId1	7th Mill Early	Figurine Fragment	4	2
Barcın Höyük	42402	97	VId1	7th Mill Early	Figurine Fragment	4	2
Barcın Höyük	44422	98	VIe or VId1	7th Mill Early	Vessel Related	7	4
Barcın Höyük	45135	99	VId1	7th Mill Early	Human Figurine	3	3
Barcın Höyük	47239	100	Early/Middle Bronze Age transitional	Other	Sling Missile	1	2
Barcın Höyük	47274	101	VIe or VId1	7th Mill Early	Vessel Related	7	1

Barcın Höyük	47284	102	VId1	7th Mill Early	Vessel Related	7	1
Barcın Höyük	47891	103	Middle Chalcolithic	Other	Other/Unknown	8	2
Ekşi Höyük	AGG.233	104	Layer 4A -6250-6000	7th Mill Late	Sling Missile	1	3
Ekşi Höyük	AGT.236	105	Layer 4A -6250-6000	7th Mill Late	Sling Missile	1	6
Ekşi Höyük	AGZ.227	106	Layer 4A -6250-6000	7th Mill Late	Sling Missile	1	1
Ekşi Höyük	CET.295	107	Layer 4A -6250-6000	7th Mill Late	Token	5	1
Ekşi Höyük	CKY.326	108	Surface	Other	Token	5	1
Ekşi Höyük	CTH.342	109	Layer 1 mixed	Other	Other/Unknown	8	1
Ekşi Höyük	DAR.1910	110	Surface	Other	Vessel Related	7	2
Ekşi Höyük	DAS.1956	111	1 mixed	Other	Vessel Related	7	1
Ekşi Höyük	DAV.1862	112	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	3
Ekşi Höyük	DCR.1890	113	Surface	Other	Vessel Related	7	1
Ekşi Höyük	DCR.1893	114	Surface	Other	Vessel Related	7	1
Ekşi Höyük	DCT.2263	115	mixed	Other	Vessel Related	7	1
Ekşi Höyük	DCU.1833	116	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1
Ekşi Höyük	DCU.1836	117	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1
Ekşi Höyük	DCU.1840	118	Layer 3	6th Mill	Vessel Related	7	1
Ekşi Höyük	DCU.1843	119	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1
Ekşi Höyük	DCU.1846	120	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1
Ekşi Höyük	DCU.1848	121	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1
Ekşi Höyük	DFG.1751	122	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1
Ekşi Höyük	DGL.1764	123	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1
Ekşi Höyük	DGL.1766	124	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1
Ekşi Höyük	DGM.2025	125	mixed	Other	Vessel Related	7	1
Ekşi Höyük	DGN.1871	126	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1

Ekşi Höyük	DGN.1881	127	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	1
Ekşi Höyük	DGN.2414	128	Layer 3 - 5970 5760	6th Mill	Vessel Related	7	3
Ekşi Höyük	DOP.2238	129	Layer 1 mixed	Other	Vessel Related	7	3
Ekşi Höyük	EGV.399	130	Layer 4	7th Mill Late	Token	5	1
Ekşi Höyük	EIE.2320	131	Layer 4A -6250-6000	7th Mill Late	Vessel Related	7	1
Ekşi Höyük	EUR.2323	132	Trench Section	Other	Vessel Related	7	1
Ekşi Höyük	EUR.2324	133	Trench Section	Other	Vessel Related	7	2
Ekşi Höyük	EZI.461	134	Layer 4A	7th Mill Late	Other/Unknow n	8	1
Ekşi Höyük	FLM.485	135	Layer 2	Other	Sling Missile	1	4
Ekşi Höyük	FPV.493	136	Layer 4B	7th Mill Early	Other/Unknow n	8	1
Ekşi Höyük	FSO.510	137	Layer 4B	7th Mill Early	Human Figurine	3	1
Ekşi Höyük	GSC.531	138	mixed Layer 1	Other	Sling Missile	1	3
Ekşi Höyük	GSC.532	139	mixed Layer 1	Other	Sling Missile	1	1
Ekşi Höyük	GVT.542	140	Layer 4A	7th Mill Late	Sling Missile	1	1
Ekşi Höyük	HFI.559	141	Layer 4A	7th Mill Late	Sling Missile	1	7
Ekşi Höyük	HHD.575	142	Layer 4A	7th Mill Late	Token	5	1
Ekşi Höyük	HRV.572	143	Layer 4B	7th Mill Early	Sling Missile	1	5
Ekşi Höyük	HUO.588	144	Layer 4B	7th Mill Early	Animal Figurine	2	2
Ekşi Höyük	IKF.624	145	Layer 3 mixed	6th Mill	Token	5	2
Ekşi Höyük	IND.635	146	Layer 3 mixed	6th Mill	Token	5	1
Ekşi Höyük	JFN.675	147	Layer 3	6th Mill	Animal Figurine	2	2
Ekşi Höyük	JKJ.670	148	Layer 3	6th Mill	Animal Figurine	2	1
Ekşi Höyük	JOA	149	Layer 3	6th Mill	Human Figurine	3	1
Ekşi Höyük	JRA.693	150	Layer 4B	7th Mill Early	Animal Figurine	2	12
Ekşi Höyük	JRB.694	151	Layer 4B	7th Mill Early	Animal Figurine	2	3
Ekşi Höyük	JRC.695	152	Layer 4B	7th Mill Early	Animal Figurine	2	4

Ekşi Höyük	JVP.696	153	Layer 4B	7th Mill Early	Animal Figurine	2	7
Ekşi Höyük	LBI.741	154	Surface	Other	Sling Missile	1	2
Ulucak Höyük	CAL 809 ULU.01.22	155	IVb or III - 5840-5700	6th Mill	Other/Unknown	8	5
Ulucak Höyük	CAN 1305 ULU.01.104	156	IVb - 5840-5700	6th Mill	Animal Figurine	2	1
Ulucak Höyük	COF 1387 ULU.02.07	157	N/A	Other	Human Figurine	3	1
Ulucak Höyük	DIH 2219 ULU.03.199	158	IVb or III - 5700-5500	Other	Sling Missile	1	2
Ulucak Höyük	DSG 1975	159	Va - 6100-6000	7th Mill Late	Animal Figurine	2	6
Ulucak Höyük	DSI 2195 ULU.03.167	160	Va - 6100-6000	7th Mill Late	Sling Missile	1	4
Ulucak Höyük	DSV 1069 ULU.03.145	161	Va - 6100-6000	7th Mill Late	Sling Missile	1	6
Ulucak Höyük	DSY 1698 ULU.03.170	162	Va - 6100-6000	7th Mill Late	Sling Missile	1	4
Ulucak Höyük	DSY 2176 ULU.03.151	163	Va - 6100-6000	7th Mill Late	Sling Missile	1	5
Ulucak Höyük	DSY 2180 ULU.03.155	164	Va - 6100-6000	7th Mill Late	Sling Missile	1	5
Ulucak Höyük	DSY 2182 ULU.05.157	165	Va - 6100-6000	7th Mill Late	Sling Missile	1	4
Ulucak Höyük	DSY 2184 ULU.03.159	166	Va - 6100-6000	7th Mill Late	Sling Missile	1	3
Ulucak Höyük	DSY 2186 ULU.03.161	167	Va - 6100-6000	7th Mill Late	Sling Missile	1	1
Ulucak Höyük	DSY 2187 ULU.03.180	168	Va - 6100-6000	7th Mill Late	Sling Missile	1	3

Ulucak Höyük	DSY 2189 ULU.03.212	169	Va - 6100-6000	7th Mill Late	Sling Missile	1	5
Ulucak Höyük	DSY 2193 ULU.03.165	170	Va - 6100-6000	7th Mill Late	Sling Missile	1	3
Ulucak Höyük	DSY 2196 ULU.03.168	171	Va - 6100-6000	7th Mill Late	Sling Missile	1	1
Ulucak Höyük	DSY 2203 ULU.03.194	172	Va - 6100-6000	7th Mill Late	Sling Missile	1	5
Ulucak Höyük	DVG 2562	173	Vc - 6300-6200	7th Mill Early	Animal Figurine	2	10
Ulucak Höyük	DYY 2391 ULU.04.18	174	Vb - 6200-6100	7th Mill Late	Sling Missile	1	1
Ulucak Höyük	DZF 2632 ULU.04.26	175	Va - 6100-6000	7th Mill Late	Sling Missile	1	1
Ulucak Höyük	EAB 2709 ULU.05.25	176	Va-b - 6200-6100	7th Mill Late	Human Figurine	3	2
Ulucak Höyük	EKH 2914 ULU.06.04	177	Vb - 6200-6100	7th Mill Late	Human Figurine	3	1
Ulucak Höyük	ESA 3004 ULU.06.32	178	Vc - 6300-6200	7th Mill Early	Human Figurine	3	1
Ulucak Höyük	FIR 3469 ULU.07.94	179	Ve - 6500-6300	7th Mill Early	Clay Ball	6	7
Ulucak Höyük	FJH 3476 ULU.07.99	180	Vb-c - 6200-6100	7th Mill Late	Animal Figurine	2	1
Ulucak Höyük	FNL	181	Vb - 6200-6100	7th Mill Late	Sling Missile	1	3
Ulucak Höyük	GHG 3740	182	BA	Other	Human Figurine	3	2
Ulucak Höyük	KTP	183	BA	Other	Sling Missile	1	1

Ulucak Höyük	LBZ 4421	184	IVb or III -?	Other	Animal Figurine	2	5
Ulucak Höyük	LJK 4469 ULU.13.37	185	Va - 6100-6000	7th Mill Late	Human Figurine	9	1
Ulucak Höyük	LLM	186	Vb - 6200-6100	7th Mill Late	Sling Missile	1	1
Ulucak Höyük	LTH	187	IVb - 5840-5700	6th Mill	Sling Missile	1	2
Ulucak Höyük	LUS 4533 ULU.61.13	188	IVb - 5840-5700	6th Mill	Other/Unknow n	8	1
Ulucak Höyük	LYJ 4542	189	IVb - 5840-5700	6th Mill	Animal Figurine	2	5
Ulucak Höyük	LZC	190	Vb - 6200-6100	7th Mill Late	Sling Missile	1	6
Ulucak Höyük	MAB 4548 ULU.51.13	191	IVb - 5840-5700	6th Mill	Other/Unknow n	8	2
Ulucak Höyük	MCJ	192	Vb - 6200-6100	7th Mill Late	Sling Missile	1	1
Ulucak Höyük	MCL	193	Vb - 6200-6100	7th Mill Late	Sling Missile	1	1
Ulucak Höyük	MCM	194	Vb - 6200-6100	7th Mill Late	Sling Missile	1	2
Ulucak Höyük	MCO	195	Vb - 6200-6100	7th Mill Late	Sling Missile	1	1
Ulucak Höyük	MMY	196	Vb - 6200-6100	7th Mill Late	Sling Missile	1	1
Ulucak Höyük	RUK O10 B7	197	IVb - 5840-5700	6th Mill	Other/Unknow n	8	1
Ulucak Höyük	SRI O10 B41	198	IVb - 5840-5700	6th Mill	Clay Lump	11	5

Ulucak Höyük	SRJ O10 B41	199	IVb - 5840-5700	6th Mill	Clay Lump	11	2
Ulucak Höyük	SRH O10 B41	200	IVb - 5840-5700	6th Mill	Clay Lump	11	2
Ulucak Höyük	TFK O9 B160	201	IVa - 5700-5760	6th Mill	Human Figurine	3	1
Ulucak Höyük	TJZ O9 B180	202	IV - ?	6th Mill	Human Figurine	3	1
Ulucak Höyük	ULU.18.49 SGB	203	IV - ?	6th Mill	Animal Figurine	2	2
Ulucak Höyük	ULU.18.58 SCV	204	IV - ?	6th Mill	Animal Figurine	2	5
Ulucak Höyük	ULU.18.62 SET	205	IV - ?	6th Mill	Animal Figurine	2	2
Ulucak Höyük	ULU.18.77 RSC	206	?	6th Mill	Human Figurine	3	1
Ulucak Höyük	OGI M13b B21. OGI 27300	207	IVc - 6005-5840	6th Mill	Vessel Related	7	1
Ulucak Höyük	OTZ M12 B15. OTZ 27810	208	IVc - 6005-5840	6th Mill	Vessel Related	7	1
Ulucak Höyük	OUT M12 B10.OUT 27711	209	IVc - 6005-5840	6th Mill	Vessel Related	7	1
Ulucak Höyük	OZS M12 B39. DZS 27740	210	IVb-c - 6000-5700	6th Mill	Vessel Related	7	2
Ulucak Höyük	PEY M12D B55	211	IVc - 6005-5840	6th Mill	Vessel Related	7	1
Ulucak Höyük	PEZ M12 B+D B56	212	IVc - 6005-5840	6th Mill	Vessel Related	7	4
Ulucak Höyük	MPM	213	IVb - 5840-5700	6th Mill	Hematite Ball	10	2

Ulucak Höyük	MTI 4649 ULU.14.49	214	IVc - 6005-5840	6th Mill	Clay Ball	6	8
Ulucak Höyük	NMN	215	IVb - 5840-5700	6th Mill	Hematite Ball	10	4
Ulucak Höyük	ODJ	216	IVc - 6005-5840	6th Mill	Hematite Ball	10	2
Ulucak Höyük	OEU	217	IVc - 6005-5840	6th Mill	Vessel Related	7	6
Ulucak Höyük	OMJ	218	IVc - 6005-5840	6th Mill	Hematite Ball	10	1
Ulucak Höyük	OMO	219	IVc - 6005-5840	6th Mill	Hematite Ball	10	1
Ulucak Höyük	OMP	220	IVc - 6005-5840	6th Mill	Hematite Ball	10	1
Ulucak Höyük	PDZ	221	IVc - 6005-5840	6th Mill	Hematite Ball	10	2
Ulucak Höyük	PEB	222	IVc - 6005-5840	6th Mill	Clay Lump	11	8
Ulucak Höyük	PEF	223	IVc - 6005-5840	6th Mill	Hematite Ball	10	1
Ulucak Höyük	PEI	224	IVc - 6005-5840	6th Mill	Hematite Ball	10	2
Ulucak Höyük	PEJ	225	IVc - 6005-5840	6th Mill	Vessel Related	7	10
Ulucak Höyük	PJK	226	IVc - 6005-5840	6th Mill	Hematite Ball	10	2
Ulucak Höyük	PLT	227	IVc - 6005-5840	6th Mill	Hematite Ball	10	23
Ulucak Höyük	PPY	228	IVb - 5840-5700	6th Mill	Clay Lump	11	4

Ulucak Höyük	PYM	229	IVb - 5840-5700	6th Mill	Hematite Ball	10	1
Ulucak Höyük	RBS	230	IV - ?	6th Mill	Clay Lump	11	7
Ulucak Höyük	RDH	231	IVb - 5840-5700	6th Mill	Clay Lump	11	1
Ulucak Höyük	REF	232	IVb - 5840-5700	6th Mill	Clay Lump	11	1
Ulucak Höyük	RPG	233	IVb - 5840-5700	6th Mill	Clay Lump	11	2
Ulucak Höyük	NOU 4733	234	Vb - 6200-6100	7th Mill Late	Sling Missile	1	13
Ulucak Höyük	NZR	235	III - ?	Other	Sling Missile	1	2
Ulucak Höyük	OCH	236	Vd - 6400-6300	7th Mill Early	Human Figurine	3	1
Ulucak Höyük	OJR M13a B32	237	IVc - 6005-5840	6th Mill	Figurine Fragment	4	1
Ulucak Höyük	PSC 5007 ULU.17.43	238	IVb - 5840-5700	6th Mill	Animal Figurine	2	3
Ulucak Höyük	PZF 5004 ULU.17.40	239	IVb - 5840-5700	6th Mill	Animal Figurine	2	3
Ulucak Höyük	RHE 5047 ULU.17.80	240	IVb-c - 6000-5700	6th Mill	Animal Figurine	2	3
Ulucak Höyük	RSC S12 B0	241	??	Other	Human Figurine	9	2
Ulucak Höyük	RTV O10b B6	242	IVb - 5840-5700	6th Mill	Human Figurine	3	1

APPENDIX III:

13 SAMPLE MEAN RIDGE BREADTH MEASUREMENTS

Table 13.1 Mean Ridge Breadth (MRB) measurements - sample

Site	Object	Phase	Object type	Object no	Total FP No	FP No	Repeat	Angle	Length	No of Ridges	Ridge Breadth	RB maximum	RB minimum
BH	2218	7th Mill Late	1	1	1	1	1	178.831	1324.57	3	441.5233333	448.8012	412.5344
BH	2218	7th Mill Late	1	1	1	1	2	180	1087.813	3	362.6043333	368.5813	338.797
BH	2218	7th Mill Late	1	1	1	1	3	-177.376	1083.691	3	361.2303333	367.1847	337.5132
BH	2218	7th Mill Late	1	1	1	1	4	179.53	1099.14	3	366.38	372.4192	342.3247
BH	2218	7th Mill Late	1	1	1	1	5	179.154	1219.325	3	406.4416667	413.1413	379.7561
BH	2220	7th Mill Late	1	2	2	1	1	167.289	1151.091	3	383.697	390.0217	358.5048
BH	2220	7th Mill Late	1	2	2	1	2	158.051	1219.73	3	406.5766667	413.2785	379.8822
BH	2220	7th Mill Late	1	2	2	1	3	153.642	1045.874	3	348.6246667	354.3712	325.7352
BH	2220	7th Mill Late	1	2	2	1	4	156.626	1085.307	3	361.769	367.7322	338.0165
BH	2220	7th Mill Late	1	2	2	1	5	157.834	1230.726	3	410.242	417.0042	383.3069
BH	2265	Other	2	3	3	1	1	174.833	1749.732	3	583.244	592.8579	544.9502
BH	2265	Other	2	3	3	1	2	171.06	1670.217	3	556.739	565.916	520.1854
BH	2265	Other	2	3	3	1	3	163.018	1618.542	3	539.514	548.4071	504.0914
BH	2265	Other	2	3	3	1	4	175.914	1951.505	3	650.5016667	661.2242	607.792
BH	2265	Other	2	3	3	1	5	178.877	1418.47	3	472.8233333	480.6171	441.7794
BH	2728	7th Mill Late	2	4	4	1	1	-154.35	1067.097	3	355.699	361.5622	332.345
BH	2728	7th Mill Late	2	4	4	1	2	-153.638	1200.736	3	400.2453333	406.8428	373.9666
BH	2728	7th Mill Late	2	4	4	1	3	-152.289	1064.4	3	354.8	360.6484	331.5051
BH	2728	7th Mill Late	2	4	4	1	4	-155.521	1292.689	3	430.8963333	437.999	402.6052
BH	2728	7th Mill Late	2	4	4	1	5	-150.969	1142.005	3	380.6683333	386.9431	355.675
BH	2753	7th Mill Late	5	5	5	1	1	170.455	1031.558	3	343.8526667	349.5206	321.2765
BH	2753	7th Mill Late	5	5	5	1	2	167.645	967.671	3	322.557	327.8739	301.379

BH	2753	7th Mill Late	5	5	5	1	3	-177	1032.196	3	344.0653333	349.7367	321.4752
BH	2753	7th Mill Late	5	5	5	1	4	164.745	1026.439	3	342.1463333	347.7861	319.6822
BH	2753	7th Mill Late	5	5	5	1	5	175.295	1096.002	3	365.334	371.356	341.3474
BH	2753	7th Mill Late	5	5	6	2	1	168.067	1787.991	3	595.997	605.8211	556.8659
BH	2753	7th Mill Late	5	5	6	2	2	171.128	1870.926	3	623.642	633.9218	582.6958
BH	2753	7th Mill Late	5	5	6	2	3	167.471	1579.567	3	526.5223333	535.2013	491.9527
BH	2753	7th Mill Late	5	5	6	2	4	164.014	1735.303	3	578.4343333	587.969	540.4563
BH	2753	7th Mill Late	5	5	6	2	5	172.425	1710.17	3	570.0566667	579.4532	532.6287
BH	2819	Other	2	6	7	1	1	-20.154	1033.631	3	344.5436667	350.223	321.9221
BH	2819	Other	2	6	7	1	2	-23.268	1122.631	3	374.2103333	380.3786	349.641
BH	2819	Other	2	6	7	1	3	-17.475	1166.309	3	388.7696667	395.178	363.2444
BH	2819	Other	2	6	7	1	4	-26.065	1054.961	3	351.6536667	357.4502	328.5653
BH	2819	Other	2	6	7	1	5	-25.829	1075.74	3	358.58	364.4907	335.0369
BH	2857	7th Mill Late	1	7	8	1	1	176.186	1318.235	3	439.4116667	446.6547	410.5614
BH	2857	7th Mill Late	1	7	8	1	2	159.254	1304.595	3	434.865	442.0331	406.3133
BH	2857	7th Mill Late	1	7	8	1	3	-175.749	1371.888	3	457.296	464.8338	427.2715
BH	2857	7th Mill Late	1	7	8	1	4	-179.805	1361.736	3	453.912	461.3941	424.1097
BH	2857	7th Mill Late	1	7	8	1	5	-157.532	1475.001	3	491.667	499.7714	459.3858
BH	2857	7th Mill Late	1	7	8	1	6	-2.42	1339.087	3	446.3623333	453.72	417.0557
BH	2857	7th Mill Late	1	7	8	1	7	-3.391	1274.172	3	424.724	431.7249	396.8381
BH	2857	7th Mill Late	1	7	8	1	8	-2.075	1301.059	3	433.6863333	440.835	405.212
BH	2857	7th Mill Late	1	7	8	1	9	-1.332	1215.739	3	405.2463333	411.9262	378.6393
BH	2857	7th Mill Late	1	7	8	1	10	-2.09	1291.644	3	430.548	437.6449	402.2797
BH	2857	7th Mill Late	1	7	9	2	1	-162.435	1393.077	3	464.359	472.0133	433.8708
BH	2857	7th Mill Late	1	7	9	2	2	-158.066	1534.767	3	511.589	520.0218	477.9998
BH	2857	7th Mill Late	1	7	9	2	3	174.661	1541.03	3	513.6766667	522.1439	479.9504
BH	2857	7th Mill Late	1	7	9	2	4	177.355	1447.37	3	482.4566667	490.4092	450.7802
BH	2857	7th Mill Late	1	7	9	2	5	180	1388.639	3	462.8796667	470.5096	432.4886

BH	2857	7th Mill Late	1	7	10	3	1	145.418	1486.381	3	495.4603333	503.6273	462.9301
BH	2857	7th Mill Late	1	7	10	3	2	140.723	1477.675	3	492.5583333	500.6774	460.2186
BH	2857	7th Mill Late	1	7	10	3	3	145.698	1326.721	3	442.2403333	449.53	413.2044
BH	2857	7th Mill Late	1	7	10	3	4	145.636	1424.559	3	474.853	482.6802	443.6758
BH	2857	7th Mill Late	1	7	10	3	5	141.9	1556.922	3	518.974	527.5285	484.8999
BH	2857	7th Mill Late	1	7	11	4	1	137.3	1624.833	3	541.611	550.5387	506.0507
BH	2857	7th Mill Late	1	7	11	4	2	132.239	1558.115	3	519.3716667	527.9327	485.2715
BH	2857	7th Mill Late	1	7	11	4	3	131.009	1407.567	3	469.189	476.9229	438.3837
BH	2857	7th Mill Late	1	7	11	4	4	150.007	1586.347	3	528.7823333	537.4985	494.0643
BH	2857	7th Mill Late	1	7	11	4	5	144.612	1640.029	3	546.6763333	555.6875	510.7834
BH	3272	7th Mill Late	1	8	12	1	1	171.301	1623.355	3	541.1183333	550.0379	505.5904
BH	3272	7th Mill Late	1	8	12	1	2	162.749	1744.539	3	581.513	591.0984	543.3329
BH	3272	7th Mill Late	1	8	12	1	3	160.737	1727.709	3	575.903	585.3959	538.0912
BH	3272	7th Mill Late	1	8	12	1	4	158.829	1626.785	3	542.2616667	551.2	506.6586
BH	3272	7th Mill Late	1	8	12	1	5	166.19	1616.329	3	538.7763333	547.6573	503.4021
BH	3272	7th Mill Late	1	8	13	2	1	166.971	1619.72	3	539.9066667	548.8062	504.4582
BH	3272	7th Mill Late	1	8	13	2	2	170.853	1558.717	3	519.5723333	528.1367	485.459
BH	3272	7th Mill Late	1	8	13	2	3	162.621	1790.156	3	596.7186667	606.5547	557.5402
BH	3272	7th Mill Late	1	8	13	2	4	176.07	1712.463	3	570.821	580.2301	533.3429
BH	3272	7th Mill Late	1	8	13	2	5	171.051	1676.682	3	558.894	568.1065	522.1989
BH	3272	7th Mill Late	1	8	13	2	6	171.912	1648.751	3	549.5836667	558.6427	513.4999
BH	3272	7th Mill Late	1	8	13	2	7	173.606	1504.248	3	501.416	509.6811	468.4947
BH	3272	7th Mill Late	1	8	13	2	8	168.598	1564.429	3	521.4763333	530.0721	487.238
BH	3272	7th Mill Late	1	8	13	2	9	179.514	1520.719	3	506.9063333	515.2619	473.6246
BH	3272	7th Mill Late	1	8	13	2	10	171.937	1561.879	3	520.6263333	529.2081	486.4438
BH	3312	7th Mill Late	2	9	14	1	1	147.403	804.366	3	268.122	272.5416	250.518
BH	3312	7th Mill Late	2	9	14	1	2	154.28	839.86	3	279.9533333	284.5679	261.5726
BH	3312	7th Mill Late	2	9	14	1	3	148.134	804.643	3	268.2143333	272.6354	250.6043

BH	3312	7th Mill Late	2	9	14	1	4	149.146	830.945	3	276.9816667	281.5473	258.796
BH	3312	7th Mill Late	2	9	14	1	5	150.915	846.132	3	282.044	286.6931	263.526
BH	3312	7th Mill Late	2	9	15	2	1	-12.931	922.7	3	307.5666667	312.6364	287.3729
BH	3312	7th Mill Late	2	9	15	2	2	-25.422	820.585	3	273.5283333	278.037	255.5694
BH	3312	7th Mill Late	2	9	15	2	3	-16.409	777.886	3	259.2953333	263.5694	242.2709
BH	3312	7th Mill Late	2	9	15	2	4	-26.97	872.473	3	290.8243333	295.6181	271.7298
BH	3312	7th Mill Late	2	9	15	2	5	-30.769	923.997	3	307.999	313.0759	287.7768
BH	3312	7th Mill Late	2	9	16	3	1	138.601	936.627	3	312.209	317.3553	291.7104
BH	3312	7th Mill Late	2	9	16	3	2	137.526	889.884	3	296.628	301.5175	277.1524
BH	3312	7th Mill Late	2	9	16	3	3	141.159	913.906	3	304.6353333	309.6568	284.634
BH	3312	7th Mill Late	2	9	16	3	4	144.211	980.1	3	326.7	332.0852	305.25
BH	3312	7th Mill Late	2	9	16	3	5	139.728	872.377	3	290.7923333	295.5856	271.6999
BH	3312	7th Mill Late	2	9	17	4	1	0.774	1057.166	3	352.3886667	358.1973	329.252
BH	3312	7th Mill Late	2	9	17	4	2	0	1057.069	3	352.3563333	358.1644	329.2218
BH	3312	7th Mill Late	2	9	17	4	3	-5.511	1090.681	3	363.5603333	369.5531	339.6902
BH	3312	7th Mill Late	2	9	17	4	4	-1.534	1066.975	3	355.6583333	361.5208	332.307
BH	3312	7th Mill Late	2	9	17	4	5	-2.579	1058.141	3	352.7136667	358.5276	329.5557
BH	3373	7th Mill Late	1	10	18	1	1	142.496	1439.258	3	479.7526667	487.6607	448.2538
BH	3373	7th Mill Late	1	10	18	1	2	147.68	1539.614	3	513.2046667	521.6641	479.5094
BH	3373	7th Mill Late	1	10	18	1	3	144.126	1578.369	3	526.123	534.7954	491.5796
BH	3373	7th Mill Late	1	10	18	1	4	147.657	1513.816	3	504.6053333	512.923	471.4747
BH	3373	7th Mill Late	1	10	18	1	5	140.407	1527.635	3	509.2116667	517.6053	475.7786
BH	3373	7th Mill Late	1	10	19	2	1	167.876	1203.33	3	401.11	407.7217	374.7745
BH	3373	7th Mill Late	1	10	19	2	2	131.112	1272.354	3	424.118	431.109	396.2719
BH	3373	7th Mill Late	1	10	19	2	3	165.793	1420.371	3	473.457	481.2612	442.3714
BH	3373	7th Mill Late	1	10	19	2	4	162.44	1444.232	3	481.4106667	489.346	449.8029
BH	3373	7th Mill Late	1	10	19	2	5	167.242	1420.719	3	473.573	481.3791	442.4798
BH	3373	7th Mill Late	1	10	20	3	1	-12.14	1572.293	3	524.0976667	532.7366	489.6872

BH	3373	7th Mill Late	1	10	20	3	2	-27.281	1598.789	3	532.9296667	541.7142	497.9393
BH	3373	7th Mill Late	1	10	20	3	3	0.686	1492.553	3	497.5176667	505.7185	464.8524
BH	3373	7th Mill Late	1	10	20	3	4	4.514	1703.276	3	567.7586667	577.1173	530.4816
BH	3373	7th Mill Late	1	10	20	3	5	-7.125	1585.118	3	528.3726667	537.0821	493.6815
EH	AGG.233	7th Mill Late	1	104	251	1	1	-56.725	1289.068	3	429.6893333	433.9112	398.6586
EH	AGG.233	7th Mill Late	1	104	251	1	2	-49.399	1397.266	3	465.7553333	470.3315	432.12
EH	AGG.233	7th Mill Late	1	104	251	1	3	-60.588	1440.164	3	480.0546667	484.7714	445.3867
EH	AGG.233	7th Mill Late	1	104	251	1	4	-70.577	1544.506	3	514.8353333	519.8938	477.6557
EH	AGG.233	7th Mill Late	1	104	251	1	5	-47.839	1442.55	3	480.85	485.5745	446.1246
EH	AGG.233	7th Mill Late	1	104	252	2	1	-103.465	1284.372	3	428.124	432.3305	397.2063
EH	AGG.233	7th Mill Late	1	104	252	2	2	-89.215	1284.372	3	428.124	432.3305	397.2063
EH	AGG.233	7th Mill Late	1	104	252	2	3	-48.652	1464.647	3	488.2156667	493.0125	452.9584
EH	AGG.233	7th Mill Late	1	104	252	2	4	-60.301	1367.073	3	455.691	460.1683	422.7825
EH	AGG.233	7th Mill Late	1	104	252	2	5	-71.91	1388.052	3	462.684	467.23	429.2705
EH	AGG.233	7th Mill Late	1	104	253	3	1	-60.555	1254.766	3	418.2553333	422.3648	388.0503
EH	AGG.233	7th Mill Late	1	104	253	3	2	-54.233	1281.494	3	427.1646667	431.3617	396.3163
EH	AGG.233	7th Mill Late	1	104	253	3	3	-58.339	1242.327	3	414.109	418.1778	384.2034
EH	AGG.233	7th Mill Late	1	104	253	3	4	-64.612	1150.962	3	383.654	387.4235	355.9478
EH	AGG.233	7th Mill Late	1	104	253	3	5	-73.934	1146.264	3	382.088	385.8421	354.4949
EH	AGT.236	7th Mill Late	1	105	254	1	1	141.677	1285.583	3	428.5276667	432.7381	397.5808
EH	AGT.236	7th Mill Late	1	105	254	1	2	145.327	1424.512	3	474.8373333	479.5028	440.5462
EH	AGT.236	7th Mill Late	1	105	254	1	3	154.779	1343.675	3	447.8916667	452.2923	415.5464
EH	AGT.236	7th Mill Late	1	105	254	1	4	154.57	1288.436	3	429.4786667	433.6984	398.4632
EH	AGT.236	7th Mill Late	1	105	254	1	5	163.212	1356.126	3	452.042	456.4835	419.397
EH	AGT.236	7th Mill Late	1	105	255	2	1	143.326	1536.058	3	512.0193333	517.0501	475.043
EH	AGT.236	7th Mill Late	1	105	255	2	2	144.184	1567.769	3	522.5896667	527.7243	484.85
EH	AGT.236	7th Mill Late	1	105	255	2	3	148.158	1465.671	3	488.557	493.3572	453.2751
EH	AGT.236	7th Mill Late	1	105	255	2	4	145.733	1443.173	3	481.0576667	485.7842	446.3173

EH	AGT.236	7th Mill Late	1	105	255	2	5	153.221	1570.834	3	523.6113333	528.756	485.7979
EH	AGT.236	7th Mill Late	1	105	256	3	1	-84.753	1672.127	3	557.3756667	562.8521	517.1239
EH	AGT.236	7th Mill Late	1	105	256	3	2	-87.295	1620.199	3	540.0663333	545.3727	501.0646
EH	AGT.236	7th Mill Late	1	105	256	3	3	-93.504	1668.237	3	556.079	561.5427	515.9208
EH	AGT.236	7th Mill Late	1	105	256	3	4	-89.502	1465.53	3	488.51	493.3098	453.2314
EH	AGT.236	7th Mill Late	1	105	256	3	5	-90	1516.448	3	505.4826667	510.4492	468.9784
EH	AGT.236	7th Mill Late	1	105	257	4	1	-25.346	1300.231	3	433.4103333	437.6687	402.1109
EH	AGT.236	7th Mill Late	1	105	257	4	2	-38.66	1267.218	3	422.406	426.5563	391.9013
EH	AGT.236	7th Mill Late	1	105	257	4	3	-57.771	1345.226	3	448.4086667	452.8144	416.0261
EH	AGT.236	7th Mill Late	1	105	257	4	4	-59.167	1238.837	3	412.9456667	417.003	383.1241
EH	AGT.236	7th Mill Late	1	105	257	4	5	-53.13	1484.297	3	494.7656667	499.6269	459.0353
EH	AGT.236	7th Mill Late	1	105	258	5	1	-34.321	1463.266	3	487.7553333	492.5477	452.5313
EH	AGT.236	7th Mill Late	1	105	258	5	2	-39.987	1410.452	3	470.1506667	474.7701	436.198
EH	AGT.236	7th Mill Late	1	105	258	5	3	-34.136	1656.598	3	552.1993333	557.6249	512.3213
EH	AGT.236	7th Mill Late	1	105	258	5	4	-34.129	1684.529	3	561.5096667	567.0267	520.9593
EH	AGT.236	7th Mill Late	1	105	258	5	5	-34.624	1581.558	3	527.186	532.3658	489.1144
EH	AGT.236	7th Mill Late	1	105	259	6	1	-114.444	1382.419	3	460.8063333	465.3339	427.5284
EH	AGT.236	7th Mill Late	1	105	259	6	2	-116.565	1449.692	3	483.2306667	487.9786	448.3334
EH	AGT.236	7th Mill Late	1	105	259	6	3	-115.145	1376.209	3	458.7363333	463.2436	425.6079
EH	AGT.236	7th Mill Late	1	105	259	6	4	-119.197	1320.329	3	440.1096667	444.4339	408.3264
EH	AGT.236	7th Mill Late	1	105	259	6	5	-115.665	1447.976	3	482.6586667	487.4009	447.8027
EH	AGZ.227	7th Mill Late	1	106	260	1	1	-89.574	1182.161	3	394.0536667	397.9254	365.5964
EH	AGZ.227	7th Mill Late	1	106	260	1	2	-91.051	1439.947	3	479.9823333	484.6983	445.3196
EH	AGZ.227	7th Mill Late	1	106	260	1	3	-89.377	1215.235	3	405.0783333	409.0584	375.8249
EH	AGZ.227	7th Mill Late	1	106	260	1	4	-93.366	1349.575	3	449.8583333	454.2783	417.3711
EH	AGZ.227	7th Mill Late	1	106	260	1	5	-90	1254.788	3	418.2626667	422.3722	388.0571
EH	CET.295	7th Mill Late	5	107	261	1	1	-82.171	1344.406	3	448.1353333	452.5384	415.7725
EH	CET.295	7th Mill Late	5	107	261	1	2	-82.451	1393.903	3	464.6343333	469.1995	431.08

EH	CET.295	7th Mill Late	5	107	261	1	3	-84.394	1363.369	3	454.4563333	458.9215	421.637
EH	CET.295	7th Mill Late	5	107	261	1	4	-82.158	1403.267	3	467.7556667	472.3515	433.9759
EH	CET.295	7th Mill Late	5	107	261	1	5	-83.186	1332.967	3	444.3223333	448.6879	412.2349
EH	CKY.326	Other	5	108	262	1	1	-145.008	1014.174	3	338.058	341.3795	313.6446
EH	CKY.326	Other	5	108	262	1	2	-145.516	997.877	3	332.6256667	335.8938	308.6046
EH	CKY.326	Other	5	108	262	1	3	-143.973	1017.063	3	339.021	342.352	314.538
EH	CKY.326	Other	5	108	262	1	4	-146.178	1000.089	3	333.363	336.6384	309.2886
EH	CKY.326	Other	5	108	262	1	5	-145.66	1016.282	3	338.7606667	342.0891	314.2965
EH	CTH.342	Other	8	109	263	1	1	-158.199	1298.816	3	432.9386667	437.1924	401.6733
EH	CTH.342	Other	8	109	263	1	2	-151.579	1110.008	3	370.0026667	373.6381	343.2823
EH	CTH.342	Other	8	109	263	1	3	-149.331	1148.323	3	382.7743333	386.5352	355.1317
EH	CTH.342	Other	8	109	263	1	4	-148.173	1176.017	3	392.0056667	395.8573	363.6963
EH	CTH.342	Other	8	109	263	1	5	-143.775	1224.374	3	408.1246667	412.1346	378.6513
EH	DAR.1910	Other	7	110	264	1	1	-179.045	1359.133	3	453.0443333	457.4956	420.327
EH	DAR.1910	Other	7	110	264	1	2	-177.879	1529.86	3	509.9533333	514.9638	473.1262
EH	DAR.1910	Other	7	110	264	1	3	-178.591	1382.011	3	460.6703333	465.1966	427.4023
EH	DAR.1910	Other	7	110	264	1	4	177.93	1410.825	3	470.275	474.8956	436.3133
EH	DAR.1910	Other	7	110	264	1	5	175.533	1453.957	3	484.6523333	489.4142	449.6524
EH	DAR.1910	Other	7	110	265	2	1	-158.904	1145.939	3	381.9796667	385.7327	354.3944
EH	DAR.1910	Other	7	110	265	2	2	-160.71	1147.481	3	382.4936667	386.2518	354.8713
EH	DAR.1910	Other	7	110	265	2	3	-171.798	1219.457	3	406.4856667	410.4795	377.1306
EH	DAR.1910	Other	7	110	265	2	4	-171.904	1270.565	3	423.5216667	427.6829	392.9364
EH	DAR.1910	Other	7	110	265	2	5	-169.252	1192.162	3	397.3873333	401.2918	368.6894
EH	DAS.1956	Other	7	111	266	1	1	-169.439	1345.713	3	448.571	452.9784	416.1767
EH	DAS.1956	Other	7	111	266	1	2	-169.778	1389.823	3	463.2743333	467.8262	429.8182
EH	DAS.1956	Other	7	111	266	1	3	-167.065	1203.889	3	401.2963333	405.2392	372.3161
EH	DAS.1956	Other	7	111	266	1	4	-165.735	1365.002	3	455.0006667	459.4712	422.142
EH	DAS.1956	Other	7	111	266	1	5	-164.641	1353.982	3	451.3273333	455.7618	418.734

EH	DAS.1956	Other	7	111	266	1	6	-21.848	1278.284	3	426.0946667	430.2812	395.3235
EH	DAS.1956	Other	7	111	266	1	7	-16.086	1248.79	3	416.2633333	420.3533	386.2022
EH	DAS.1956	Other	7	111	266	1	8	-17.85	1386.831	3	462.277	466.819	428.8929
EH	DAS.1956	Other	7	111	266	1	9	-18.357	1297.138	3	432.3793333	436.6276	401.1543
EH	DAS.1956	Other	7	111	266	1	10	-21.846	1337.833	3	445.9443333	450.3259	413.7397
EH	DAV.1862	6th Mill	7	112	267	1	1	-86.791	1199.578	3	399.8593333	403.7881	370.9828
EH	DAV.1862	6th Mill	7	112	267	1	2	-54.162	1242.671	3	414.2236667	418.2935	384.3098
EH	DAV.1862	6th Mill	7	112	267	1	3	-73.993	1420.683	3	473.561	478.2139	439.362
EH	DAV.1862	6th Mill	7	112	267	1	4	-56.185	1428.072	3	476.024	480.7011	441.6471
EH	DAV.1862	6th Mill	7	112	267	1	5	-83.26	1239.845	3	413.2816667	417.3423	383.4358
EH	DAV.1862	6th Mill	7	112	268	2	1	-56.174	1329.09	3	443.03	447.3829	411.0359
EH	DAV.1862	6th Mill	7	112	268	2	2	-53.032	1324.94	3	441.6466667	445.986	409.7524
EH	DAV.1862	6th Mill	7	112	268	2	3	-57.45	1269.355	3	423.1183333	427.2756	392.5621
EH	DAV.1862	6th Mill	7	112	268	2	4	-66.744	1499.098	3	499.6993333	504.609	463.6127
EH	DAV.1862	6th Mill	7	112	268	2	5	-66.741	1412.41	3	470.8033333	475.4291	436.8035
EH	DAV.1862	6th Mill	7	112	269	3	1	-157.51	971.167	3	323.7223333	326.903	300.3442
EH	DAV.1862	6th Mill	7	112	269	3	2	-147.456	1028.938	3	342.9793333	346.3492	318.2105
EH	DAV.1862	6th Mill	7	112	269	3	3	-157.38	1037.528	3	345.8426667	349.2407	320.8671
EH	DAV.1862	6th Mill	7	112	269	3	4	-149.036	1130.178	3	376.726	380.4275	349.5201
EH	DAV.1862	6th Mill	7	112	269	3	5	-134.029	951.454	3	317.1513333	320.2674	294.2477
EH	DCR.1890	Other	7	113	270	1	1	-12.693	1236.494	3	412.1646667	416.2143	382.3995
EH	DCR.1890	Other	7	113	270	1	2	-19.983	1271.993	3	423.9976667	428.1636	393.378
EH	DCR.1890	Other	7	113	270	1	3	-27.711	1215.252	3	405.084	409.0641	375.8302
EH	DCR.1890	Other	7	113	270	1	4	-19.552	1233.961	3	411.3203333	415.3617	381.6162
EH	DCR.1890	Other	7	113	270	1	5	-18.733	1319.658	3	439.886	444.208	408.1189
EH	DCR.1893	Other	7	114	271	1	1	9.599	1504.352	3	501.4506667	506.3776	465.2376
EH	DCR.1893	Other	7	114	271	1	2	9.828	1405.76	3	468.5866667	473.1907	434.7469
EH	DCR.1893	Other	7	114	271	1	3	4.624	1488.134	3	496.0446667	500.9185	460.222

EH	DCR.1893	Other	7	114	271	1	4	5.152	1335.996	3	445.332	449.7075	413.1716
EH	DCR.1893	Other	7	114	271	1	5	6.39	1371.842	3	457.2806667	461.7736	424.2574
UH	CAL 809 ULU.01.22	6th Mill	7	155	359	1	1	106.169	963.257	3	321.0856667	330.7397	298.197
UH	CAL 809 ULU.01.22	6th Mill	7	155	359	1	2	110.298	849.595	3	283.1983333	291.7132	263.0105
UH	CAL 809 ULU.01.22	6th Mill	7	155	359	1	3	114.193	828.193	3	276.0643333	284.3647	256.385
UH	CAL 809 ULU.01.22	6th Mill	7	155	359	1	4	107.585	1050.906	3	350.302	360.8345	325.3307
UH	CAL 809 ULU.01.22	6th Mill	7	155	359	1	5	125.146	838.343	3	279.4476667	287.8498	259.5272
UH	CAL 809 ULU.01.22	6th Mill	7	155	360	2	1	-84.987	1258.955	3	419.6516667	432.2693	389.7367
UH	CAL 809 ULU.01.22	6th Mill	7	155	360	2	2	93.846	1312.101	3	437.367	450.5172	406.1892
UH	CAL 809 ULU.01.22	6th Mill	7	155	360	2	3	80.698	1293.147	3	431.049	444.0093	400.3216
UH	CAL 809 ULU.01.22	6th Mill	7	155	360	2	4	81.802	1311.547	3	437.1823333	450.327	406.0177
UH	CAL 809 ULU.01.22	6th Mill	7	155	360	2	5	91.893	1331.875	3	443.9583333	457.3067	412.3107
UH	CAL 809 ULU.01.22	6th Mill	7	155	361	3	1	67.59	1151.913	3	383.971	395.5158	356.5996
UH	CAL 809 ULU.01.22	6th Mill	7	155	361	3	2	65.973	997.662	3	332.554	342.5528	308.8478
UH	CAL 809 ULU.01.22	6th Mill	7	155	361	3	3	62.978	1232.391	3	410.797	423.1484	381.5133
UH	CAL 809 ULU.01.22	6th Mill	7	155	361	3	4	73.698	1212.474	3	404.158	416.3097	375.3475
UH	CAL 809 ULU.01.22	6th Mill	7	155	361	3	5	67.681	1127.43	3	375.81	387.1094	349.0203
UH	CAL 809 ULU.01.22	6th Mill	7	155	362	4	1	-61.991	1149.499	3	383.1663333	394.6869	355.8523
UH	CAL 809 ULU.01.22	6th Mill	7	155	362	4	2	-65.26	1212.517	3	404.1723333	416.3245	375.3609
UH	CAL 809 ULU.01.22	6th Mill	7	155	362	4	3	-65.854	1029.344	3	343.1146667	353.431	318.6557
UH	CAL 809 ULU.01.22	6th Mill	7	155	362	4	4	113.54	1189.418	3	396.4726667	408.3933	368.2101
UH	CAL 809 ULU.01.22	6th Mill	7	155	362	4	5	116.796	1197.427	3	399.1423333	411.1433	370.6894
UH	CAL 809 ULU.01.22	6th Mill	7	155	363	5	1	61.39	967.594	3	322.5313333	332.2288	299.5396
UH	CAL 809 ULU.01.22	6th Mill	7	155	363	5	2	62.571	981.89	3	327.2966667	337.1374	303.9653
UH	CAL 809 ULU.01.22	6th Mill	7	155	363	5	3	70.128	973.612	3	324.5373333	334.2951	301.4026
UH	CAL 809 ULU.01.22	6th Mill	7	155	363	5	4	61.39	829.366	3	276.4553333	284.7675	256.7482
UH	CAL 809 ULU.01.22	6th Mill	7	155	363	5	5	62.21	922.786	3	307.5953333	316.8437	285.6684
UH	CAN 1305 ULU.01.104	6th Mill	2	156	364	1	1	64.455	819.558	3	273.186	281.3998	253.7119

UH	CAN 1305 ULU.01.104	6th Mill	2	156	364	1	2	66.584	749.383	3	249.7943333	257.3049	231.9877
UH	CAN 1305 ULU.01.104	6th Mill	2	156	364	1	3	68.276	747.771	3	249.257	256.7514	231.4887
UH	CAN 1305 ULU.01.104	6th Mill	2	156	364	1	4	66.371	758.912	3	252.9706667	260.5767	234.9376
UH	CAN 1305 ULU.01.104	6th Mill	2	156	364	1	5	66.038	800.815	3	266.9383333	274.9643	247.9096
UH	COF 1387 ULU.02.07	Other	3	157	365	1	1	-60.616	1231.814	3	410.6046667	422.9502	381.3347
UH	COF 1387 ULU.02.07	Other	3	157	365	1	2	-61.928	1240.073	3	413.3576667	425.786	383.8914
UH	COF 1387 ULU.02.07	Other	3	157	365	1	3	-63.794	1486.67	3	495.5566667	510.4565	460.2308
UH	COF 1387 ULU.02.07	Other	3	157	365	1	4	-61.085	1250.016	3	416.672	429.2	386.9695
UH	COF 1387 ULU.02.07	Other	3	157	365	1	5	-68.033	1337.153	3	445.7176667	459.119	413.9446
UH	DIH 2219 ULU.03.199	Other	1	158	366	1	1	112.671	1193.963	3	397.9876667	409.9539	369.6171
UH	DIH 2219 ULU.03.199	Other	1	158	366	1	2	102.68	1143.544	3	381.1813333	392.6422	354.0088
UH	DIH 2219 ULU.03.199	Other	1	158	366	1	3	101.712	1167.86	3	389.2866667	400.9913	361.5363
UH	DIH 2219 ULU.03.199	Other	1	158	366	1	4	143.276	1096.132	3	365.3773333	376.3631	339.3314
UH	DIH 2219 ULU.03.199	Other	1	158	366	1	5	140.194	1089.191	3	363.0636667	373.9798	337.1826
UH	DIH 2219 ULU.03.199	Other	1	158	367	2	1	-74.358	1455.015	3	485.005	499.5876	450.4314
UH	DIH 2219 ULU.03.199	Other	1	158	367	2	2	-73.088	1444.936	3	481.6453333	496.1269	447.3112
UH	DIH 2219 ULU.03.199	Other	1	158	367	2	3	-83.752	1287.344	3	429.1146667	442.0168	398.5252
UH	DIH 2219 ULU.03.199	Other	1	158	367	2	4	-86.399	1338.384	3	446.128	459.5416	414.3257
UH	DIH 2219 ULU.03.199	Other	1	158	367	2	5	-82.924	1364.819	3	454.9396667	468.6183	422.5092
UH	DSG 1975	7th Mill Late	2	159	368	1	1	54.433	1266.257	3	422.0856667	434.7764	391.9972
UH	DSG 1975	7th Mill Late	2	159	368	1	2	59.621	1301.091	3	433.697	446.7369	402.7808
UH	DSG 1975	7th Mill Late	2	159	368	1	3	55.665	1225.386	3	408.462	420.7432	379.3447
UH	DSG 1975	7th Mill Late	2	159	368	1	4	59.162	1294.388	3	431.4626667	444.4354	400.7058
UH	DSG 1975	7th Mill Late	2	159	368	1	5	59.942	1379.901	3	459.967	473.7967	427.1782
UH	DSG 1975	7th Mill Late	2	159	369	2	1	103.815	1387.545	3	462.515	476.4214	429.5446
UH	DSG 1975	7th Mill Late	2	159	369	2	2	96.71	1415.607	3	471.869	486.0566	438.2318
UH	DSG 1975	7th Mill Late	2	159	369	2	3	105.399	1352.246	3	450.7486667	464.3012	418.617
UH	DSG 1975	7th Mill Late	2	159	369	2	4	96.364	1496.911	3	498.9703333	513.9728	463.4012

UH	DSG 1975	7th Mill Late	2	159	369	2	5	100.647	1408.004	3	469.3346667	483.4461	435.8781
UH	DSG 1975	7th Mill Late	2	159	370	3	1	-59.271	1159.273	3	386.4243333	398.0429	358.878
UH	DSG 1975	7th Mill Late	2	159	370	3	2	-61.105	1157.389	3	385.7963333	397.396	358.2948
UH	DSG 1975	7th Mill Late	2	159	370	3	3	-57.482	1049.338	3	349.7793333	360.2961	324.8453
UH	DSG 1975	7th Mill Late	2	159	370	3	4	-59.645	1165.635	3	388.545	400.2273	360.8475
UH	DSG 1975	7th Mill Late	2	159	370	3	5	-60.255	1164.628	3	388.2093333	399.8816	360.5358
UH	DSG 1975	7th Mill Late	2	159	371	4	1	-63.93	1146.603	3	382.201	393.6926	354.9557
UH	DSG 1975	7th Mill Late	2	159	371	4	2	-68.199	1136.568	3	378.856	390.247	351.8492
UH	DSG 1975	7th Mill Late	2	159	371	4	3	-66.129	1057.746	3	352.582	363.183	327.4481
UH	DSG 1975	7th Mill Late	2	159	371	4	4	-70.53	1167.607	3	389.2023333	400.9044	361.458
UH	DSG 1975	7th Mill Late	2	159	371	4	5	-69.31	1112.133	3	370.711	381.8571	344.2848
UH	DSG 1975	7th Mill Late	2	159	372	5	1	93.719	1115.593	3	371.8643333	383.0451	345.3559
UH	DSG 1975	7th Mill Late	2	159	372	5	2	94.177	989.754	3	329.918	339.8376	306.3997
UH	DSG 1975	7th Mill Late	2	159	372	5	3	92.726	1055.035	3	351.6783333	362.2522	326.6089
UH	DSG 1975	7th Mill Late	2	159	372	5	4	93.102	1129.524	3	376.508	387.8284	349.6686
UH	DSG 1975	7th Mill Late	2	159	372	5	5	91.163	1098.506	3	366.1686667	377.1782	340.0663
UH	DSG 1975	7th Mill Late	2	159	373	6	1	-92.672	857.693	3	285.8976667	294.4937	265.5174
UH	DSG 1975	7th Mill Late	2	159	373	6	2	-88.839	845.641	3	281.8803333	290.3556	261.7865
UH	DSG 1975	7th Mill Late	2	159	373	6	3	-88.483	861.041	3	287.0136667	295.6433	266.5539
UH	DSG 1975	7th Mill Late	2	159	373	6	4	-88.441	838.198	3	279.3993333	287.8	259.4823
UH	DSG 1975	7th Mill Late	2	159	373	6	5	-89.246	868.488	3	289.496	298.2002	268.8592
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	374	1	1	124.477	1334.053	3	444.6843333	458.0546	412.9849
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	374	1	2	119.099	1193.213	3	397.7376667	409.6964	369.3849
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	374	1	3	127.304	1244.87	3	414.9566667	427.4331	385.3764
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	374	1	4	122.949	1213.724	3	404.5746667	416.7389	375.7345
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	374	1	5	124.787	1297.559	3	432.5196667	445.5242	401.6874
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	375	2	1	-100.985	1606.501	3	535.5003333	551.6011	497.3271
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	375	2	2	-118.037	1776.243	3	592.081	609.883	549.8744

UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	375	2	3	-72.165	1681.042	3	560.3473333	577.1952	520.4029
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	375	2	4	-75.851	1707.726	3	569.242	586.3573	528.6635
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	375	2	5	-76.787	1643.769	3	547.923	564.3973	508.8642
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	376	3	1	-96.52	1259.933	3	419.9776667	432.6051	390.0395
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	376	3	2	-84.726	1167.313	3	389.1043333	400.8035	361.367
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	376	3	3	-83.853	1169.092	3	389.6973333	401.4143	361.9177
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	376	3	4	-91.169	1314.648	3	438.216	451.3918	406.9777
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	376	3	5	-104.882	1322.983	3	440.9943333	454.2536	409.558
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	377	4	1	113.806	1311.716	3	437.2386667	450.385	406.07
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	377	4	2	114.411	1259.783	3	419.9276667	432.5536	389.9931
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	377	4	3	117.613	1294.626	3	431.542	444.5171	400.7795
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	377	4	4	115.327	1278.923	3	426.3076667	439.1254	395.9183
UH	DSI 2195 ULU.03.167	7th Mill Late	1	160	377	4	5	114.316	1307.256	3	435.752	448.8537	404.6894
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	378	1	1	113.938	1163.209	3	387.7363333	399.3943	360.0965
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	378	1	2	110.391	1007.582	3	335.8606667	345.9589	311.9188
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	378	1	3	119.002	1042.464	3	347.488	357.9359	322.7173
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	378	1	4	117.084	979.514	3	326.5046667	336.3216	303.2297
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	378	1	5	113.54	1091.795	3	363.9316667	374.8739	337.9887
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	379	2	1	146.01	1596.218	3	532.0726667	548.0704	494.1438
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	379	2	2	147.075	1457.285	3	485.7616667	500.367	451.1341
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	379	2	3	150.903	1319.57	3	439.8566667	453.0818	408.5014
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	379	2	4	148.496	1640.493	3	546.831	563.2725	507.8501
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	379	2	5	144.233	1458.112	3	486.0373333	500.6509	451.3901
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	380	3	1	93.429	1342.415	3	447.4716667	460.9257	415.5736
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	380	3	2	94.054	1277.964	3	425.988	438.7961	395.6214
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	380	3	3	92.49	1155.407	3	385.1356667	396.7155	357.6812
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	380	3	4	97.787	1185.322	3	395.1073333	406.987	366.9421
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	380	3	5	95.625	1331.365	3	443.7883333	457.1316	412.1528

UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	381	4	1	128.598	1426.04	3	475.3466667	489.6388	441.4615
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	381	4	2	132.776	1425.135	3	475.045	489.3281	441.1814
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	381	4	3	133.379	1466.126	3	488.7086667	503.4026	453.871
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	381	4	4	129.168	1462.74	3	487.58	502.24	452.8228
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	381	4	5	129.019	1459.658	3	486.5526667	501.1818	451.8687
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	382	5	1	128.367	1152.428	3	384.1426667	395.6926	356.759
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	382	5	2	120.033	1042.022	3	347.3406667	357.7841	322.5804
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	382	5	3	124.136	1006.799	3	335.5996667	345.6901	311.6764
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	382	5	4	124.695	1189.534	3	396.5113333	408.4332	368.246
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	382	5	5	119.745	1061.455	3	353.8183333	364.4565	328.5963
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	383	6	1	135.255	1476.18	3	492.06	506.8547	456.9834
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	383	6	2	134.433	1325.334	3	441.778	455.0609	410.2858
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	383	6	3	135	1381.035	3	460.345	474.1861	427.5292
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	383	6	4	134.715	1318.724	3	439.5746667	452.7913	408.2395
UH	DSV 1069 ULU.03.145	7th Mill Late	1	161	383	6	5	136.882	1398.191	3	466.0636667	480.0767	432.8403
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	384	1	1	124.934	1084.462	3	361.4873333	372.3561	335.7187
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	384	1	2	127.648	791.46	3	263.82	271.7522	245.0136
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	384	1	3	115.32	921.048	3	307.016	316.247	285.1303
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	384	1	4	121.95	981.212	3	327.0706667	336.9046	303.7554
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	384	1	5	125.261	860.66	3	286.8866667	295.5124	266.4359
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	385	2	1	63.357	1510.304	3	503.4346667	518.5713	467.5473
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	385	2	2	73.009	1387.458	3	462.486	476.3915	429.5176
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	385	2	3	77.546	1538.17	3	512.7233333	528.1393	476.1738
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	385	2	4	68.398	1476.69	3	492.23	507.0298	457.1413
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	385	2	5	68.565	1336.398	3	445.466	458.8597	413.7109
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	386	3	1	70.233	1322.147	3	440.7156667	453.9666	409.2992
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	386	3	2	68.124	1382.687	3	460.8956667	474.7533	428.0407
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	386	3	3	67.964	1321.324	3	440.4413333	453.684	409.0444

UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	386	3	4	69.634	1368.675	3	456.225	469.9422	423.7029
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	386	3	5	63.252	1360.678	3	453.5593333	467.1964	421.2273
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	387	4	1	76.917	1383.787	3	461.2623333	475.131	428.3812
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	387	4	2	81.87	1409.495	3	469.8316667	483.958	436.3397
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	387	4	3	99.176	1249.96	3	416.6533333	429.1808	386.9521
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	387	4	4	94.151	1180.108	3	393.3693333	405.1967	365.3279
UH	DSY 1698 ULU.03.170	7th Mill Late	1	162	387	4	5	97.177	1291.544	3	430.5146667	443.4589	399.8254
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	388	1	1	-60.922	1043.204	3	347.7346667	358.1899	322.9464
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	388	1	2	-71.053	945.187	3	315.0623333	324.5353	292.6031
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	388	1	3	-65.501	1157.424	3	385.808	397.408	358.3056
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	388	1	4	-66.772	1126.832	3	375.6106667	386.9041	348.8352
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	388	1	5	-66.705	1044.461	3	348.1536667	358.6215	323.3355
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	389	2	1	83.326	1329.899	3	443.2996667	456.6283	411.699
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	389	2	2	85.236	1466.471	3	488.8236667	503.521	453.9778
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	389	2	3	87.524	1734.697	3	578.2323333	595.6179	537.013
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	389	2	4	94.538	1478.665	3	492.8883333	507.7079	457.7527
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	389	2	5	113.562	1359.262	3	453.0873333	466.7102	420.7889
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	390	3	1	80.482	1548.607	3	516.2023333	531.7229	479.4048
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	390	3	2	81.085	1416.362	3	472.1206667	486.3158	438.4655
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	390	3	3	84.19	1580.983	3	526.9943333	542.8394	489.4275
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	390	3	4	78.163	1560.47	3	520.1566667	535.7961	483.0772
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	390	3	5	85.4	1593.533	3	531.1776667	547.1485	493.3126
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	391	4	1	-75.713	1532.426	3	510.8086667	526.1671	474.3956
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	391	4	2	-86.698	1441.303	3	480.4343333	494.8795	446.1865
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	391	4	3	-70.986	1443.898	3	481.2993333	495.7705	446.9898
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	391	4	4	-75.256	1449.749	3	483.2496667	497.7794	448.8011
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	391	4	5	-78.536	1345.851	3	448.617	462.1055	416.6373
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	392	5	1	-80.056	1416.13	3	472.0433333	486.2362	438.3937

UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	392	5	2	-79.875	1545.73	3	515.2433333	530.7351	478.5141
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	392	5	3	-73.202	1504.335	3	501.445	516.5219	465.6994
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	392	5	4	-80.119	1425.052	3	475.0173333	489.2996	441.1557
UH	DSY 2176 ULU.03.151	7th Mill Late	1	163	392	5	5	-79.851	1490.639	3	496.8796667	511.8193	461.4595
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	393	1	1	41.074	1305.916	3	435.3053333	448.3936	404.2745
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	393	1	2	46.909	1533.617	3	511.2056667	526.576	474.7643
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	393	1	3	69.677	1300.25	3	433.4166667	446.4481	402.5205
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	393	1	4	57.628	1197.708	3	399.236	411.2398	370.7764
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	393	1	5	45.725	1513.728	3	504.576	519.747	468.6072
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	394	2	1	62.622	1131.763	3	377.2543333	388.5972	350.3617
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	394	2	2	61.39	1011.906	3	337.302	347.4436	313.2574
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	394	2	3	62.978	1007.28	3	335.76	345.8552	311.8253
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	394	2	4	67.457	1029.849	3	343.283	353.6044	318.812
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	394	2	5	69.167	1084.905	3	361.635	372.5082	335.8558
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	395	3	1	98.18	1444.316	3	481.4386667	495.914	447.1192
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	395	3	2	93.294	1244.039	3	414.6796667	427.1478	385.1192
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	395	3	3	91.922	1332.084	3	444.028	457.3785	412.3754
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	395	3	4	97.172	1359.844	3	453.2813333	466.9101	420.9691
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	395	3	5	97.674	1271.24	3	423.7466667	436.4874	393.5398
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	396	4	1	89.045	1099.239	3	366.413	377.4299	340.2932
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	396	4	2	88.264	907.163	3	302.3876667	311.4795	280.8319
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	396	4	3	88.438	1007.871	3	335.957	346.0582	312.0083
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	396	4	4	88.409	989.559	3	329.853	339.7706	306.3394
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	396	4	5	89.012	1062.608	3	354.2026667	364.8524	328.9533
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	397	5	1	67.539	918.453	3	306.151	315.356	284.327
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	397	5	2	72.759	866.215	3	288.7383333	297.4198	268.1556
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	397	5	3	68.38	837.315	3	279.105	287.4968	259.209
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	397	5	4	81.469	767.381	3	255.7936667	263.4846	237.5594

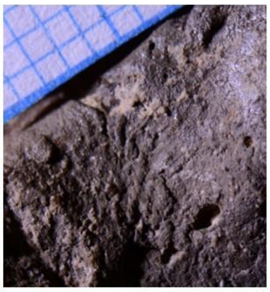
UH	DSY 2180 ULU.03.155	7th Mill Late	1	164	397	5	5	69.963	854.22	3	284.74	293.3012	264.4423

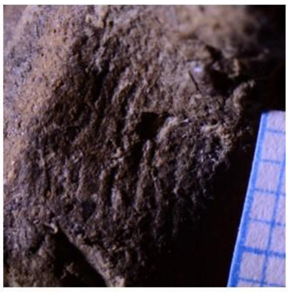
APPENDIX IV:

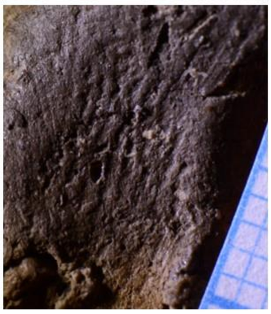
14 SAMPLE CATALOGUE OF OBJECTS AND THEIR FINGERPRINTS

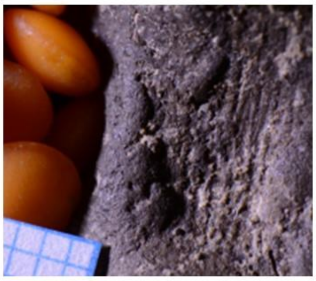
The complete fingerprint dataset including the measurements and the images are stored in Koç University Research Data Repository (KU-RDR).

BH6167 – Animal Figurine

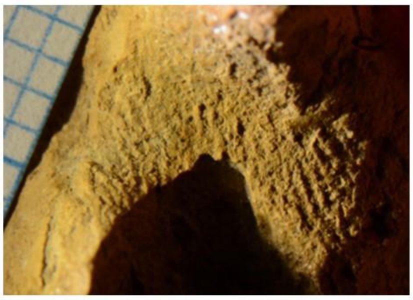


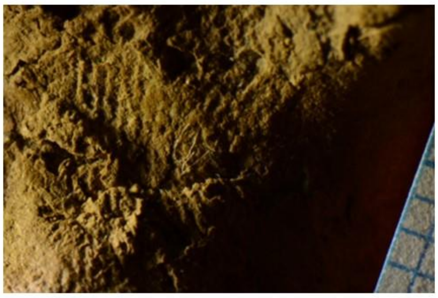


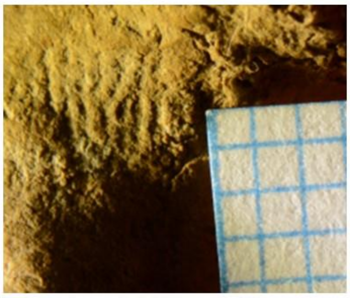


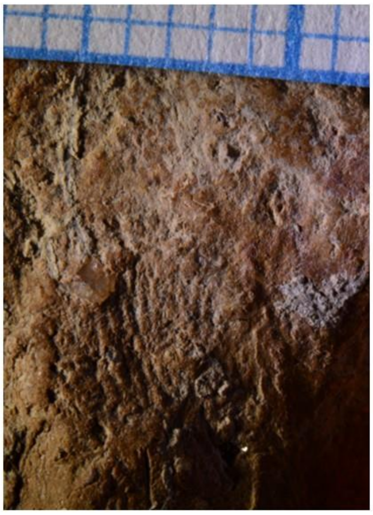


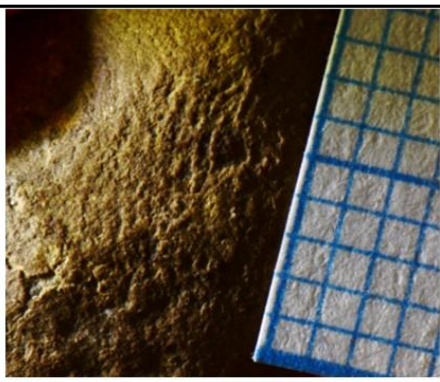
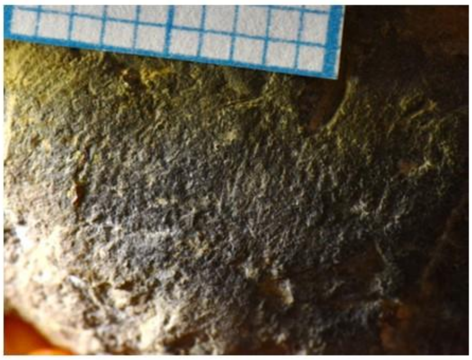
BH6283 – Animal Figurine



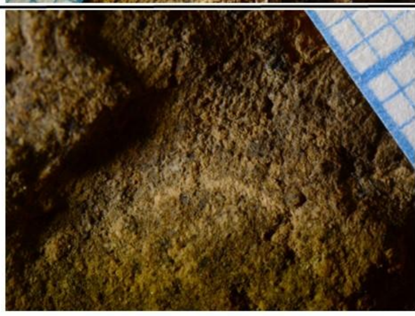




BH6561 – Human Figurine		

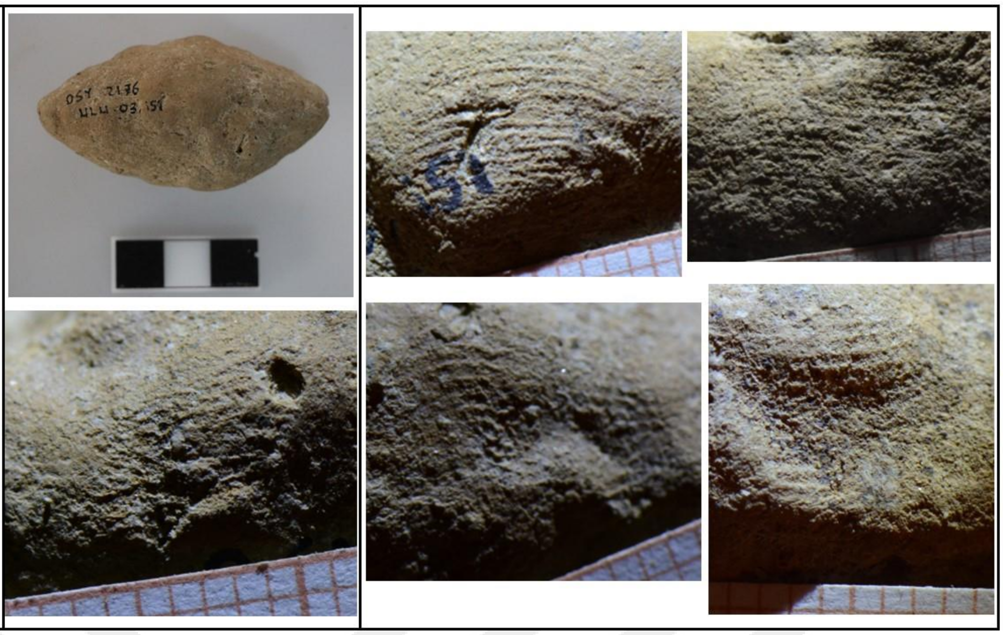
BH8004 – Sling Missile	 	 

BH9523 – Clay Ball



ULU – TFK.5204 – Human Figurine

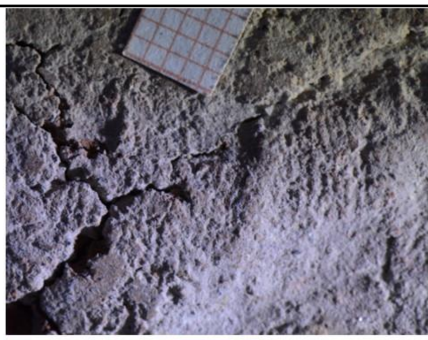
ULU – DSY.2176 – Sling Missile

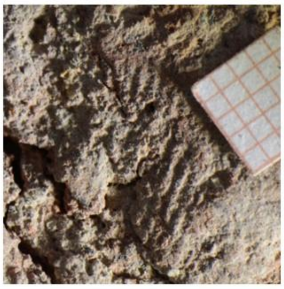


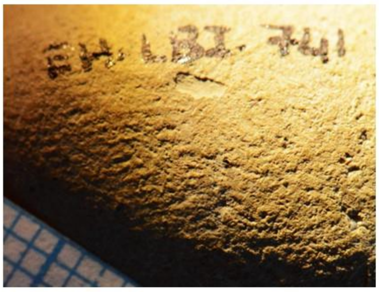
ULU – DSY.2196 – Sling Missile

ULU – RHE.5047 – Animal Figurine

ULU – ODJ – Hematite Lump



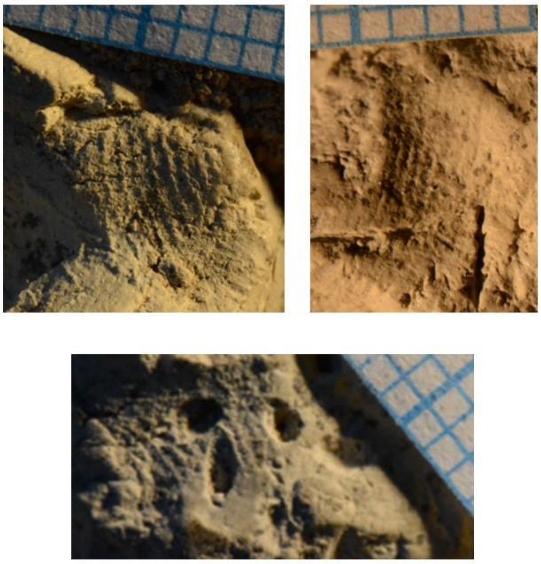


EH – LBI.741 – Sling Missile		

EH – JKJ.670 – Animal Figurine		

EH – IND.635 – Token

EH – JRB.694 – Animal Figurine



EH – DCU.1833 – Vessel Fragment