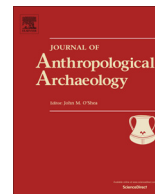




Contents lists available at ScienceDirect

Journal of Anthropological Archaeology

journal homepage: www.elsevier.com/locate/jaa

Modelling capacity of Near Eastern Neolithic non-domestic architecture

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ARTICLE INFO

Article history:

Received 2 December 2013

Revision received 21 January 2015

Available online xxx

Keywords:

Near Eastern Neolithic

Pre-Pottery Neolithic

Architecture

Capacity

Computer modelling

ABSTRACT

Previous estimates of the capacity of archaeological architecture have been based on cross-cultural studies that have determined an average amount of roofed dwelling space occupied by an individual. These studies are problematic when applied to non-dwelling spaces though. In this paper I use scenario modelling to estimate the capacity of any structure using AutoCAD, taking into account the variability of different spaces, as well as different requirements for movement and visibility. This results in more accurate estimates of the size of the group using the space, which can then be compared to estimates of the size of the population to enhance our understanding of the way the groups functioned within the wider community. This methodology is demonstrated using a series of non-domestic structures found at Near Eastern Neolithic sites.

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The anthropological and archaeological study of architecture has tended to focus on the interpretation of function, using artifacts and features to determine what activities were taking place within the space. These interpretations are then used to explore social organisation, family structure, life practices, and other aspects of ancient life. In particular, anthropologists have developed several methods for estimating how many people were living in houses and settlements, but all of these methods ignore non-domestic structures. In this paper I present a method of modelling the capacity of non-domestic structures contextually, taking into account idiosyncratic details of the space to determine the size and nature of the groups participating within these non-domestic structures. This is then applied to a case study of the Neolithic Near East, where there are a series of enigmatic non-domestic spaces, and discussed in relation to a number of ethnographic case study structures.

The methodology demonstrated here builds on previous methods used to estimate capacity of both domestic and non-domestic structures, but unlike previous methods, can be adapted for use in many different time periods and regions. This method models the number of people occupying a space without making assumptions as to the nature of the group using it or the types of activities being performed, as it can be modified based on the available evidence. This means that researchers can move beyond describing the structure and detailing the types of features, and begin to explore how people were actually using the space. Modelling the number of people that could have occupied a given space, regardless of

whether it was domestic or not, also permits discussions of how people were creating and maintaining social groups.

The Neolithic is widely regarded as the period when sedentary villages, agriculture, and herd management practices first emerged in the Near East (Belfer-Cohen and Bar-Yosef, 2000; Asouti and Fuller, 2012). The development of sedentary villages in the Neolithic resulted in larger groups of people living together for longer periods of time, therefore requiring new types of coping mechanisms to diffuse the interpersonal stress of not being able to move away from problems (Bandy, 2004). Many researchers have postulated the existence of these coping mechanisms in reference to a number of different lines of evidence, including changes in mortuary practices, personal adornment, and domestic architecture (Byrd, 2000; Kuijt, 2000a; Wright and Garrard, 2003). All these lines of evidence point to developing complexity in interpersonal relationships, as well as a concern for materializing those relationships, perhaps for mnemonic purposes.

Many Near Eastern Neolithic sites also had large non-domestic structures, which have been interpreted as another coping mechanism (McBride, 2014). These structures have not been very well explored, with most excavators identifying their distinctiveness as compared to the contemporary architecture and then dismissing them as having a ritual function, with little discussion of the types of activities taking place or the groups using the spaces. More recent contextual research is leading to a more nuanced exploration of the structures (McBride, 2012), but much work remains to be done. The emergence of non-domestic structures at Near Eastern Neolithic sites indicates that groups were engaging in regular activities that required dedicated purpose-built space. The institutionalisation of these activities through the construction

E-mail address: alexis.mcbride@gmail.com<http://dx.doi.org/10.1016/j.jaa.2015.01.004>

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of dedicated space suggests the development of new kinds of relationships within communities and a new concern with materializing these relationships, suggesting that the groups using the structures represented larger or more complex social units than existed before. The nature of these social units is unclear, though understanding of the capacity of these structures would help clarify this issue.

In order to understand how groups building and using these structures functioned within Neolithic communities, first, the capacity of the structures needs to be estimated to determine how many people might have been attending events within them using computer scenario modelling, described below. The size of the groups can then be compared to the size of the wider population to calculate the proportion of the community participating. This will elucidate whether stringent selection criteria existed and whether differentiation within the community was materialized through these structures. All of this information can then be used to elucidate the nature of the groups building and using the non-domestic spaces.

While there have been many previous approaches to the calculation of settlement population, discussed below, there has been comparatively little analysis of the capacity of individual structures (Adler, 1989). The most influential study was by Naroll (1962), who used cross-cultural comparisons to determine that 10.2 m² of domestic space was required per adult, allowing researchers to calculate household size based on dwelling space (LeBlanc, 1971; Weissner, 1974). It is therefore tempting to simply calculate the capacity of all structures using Naroll's figure; however, there are some problems with this method. Naroll's study only examined roofed space, ignoring other occupied spaces (Kolb, 1985: 583), focussed solely on dwellings, and there are also questions about the validity of his statistical analysis (Brown, 1987). A restudy of Naroll's work, as well as other studies, has shown that a better approximation of the amount of roofed dwelling space per person would be 6 m² (Brown, 1987). This reassessment of the relationship between household size and roofed dwelling space assumes nonetheless that there is a basic human need for roofed shelter, and it is therefore reasonable to study this in a cross-cultural way.

Despite these problems with Naroll's work, some recent examinations of Near Eastern Neolithic non-domestic structures have applied methods similar to Naroll, using a set amount of space per adult, though using different numbers (Verhoeven, 2002: 247). Verhoeven calculated the capacity of several non-domestic structures, but he was not explicit on the criteria he used; however, we can infer that he allowed 2–4 m² per person based on the size of the structures and the size of group he proposes (2002: 247). While 2–4 m² might be a more realistic figure for non-domestic spaces than allowing 10.2 m² per person, as suggested by Naroll, and is closer to the 6 m² suggested by reassessments, there is no justification for Verhoeven's figures.

The cross-cultural anthropological work of Naroll and others only addressed living space and domestic architecture. Public and non-dwelling structures are not discussed, and in fact, are deliberately removed from the studies. This means that their results are not good constants to estimate the number of people occupying public spaces or other structures with more complicated uses. While Naroll and his successors can point to a basic human requirement for shelter in order to determine how many people lived in each structure, the same cannot be said for public spaces. These non-domestic spaces can be used in many different ways at different times. People could have crowded in at physically uncomfortable levels for short periods, or have been widely dispersed. To compound the problem, personal space is culturally constructed, with different levels of public crowding acceptable for different cultures (Batchelor and Goethals, 1972; Bauer, 1973; Draper,

1973; Baldassare and Feller, 1975; Karlin et al., 1976; Kaya and Erkip, 1999). This contrasts with dwellings, which are generally associated with similar numbers of people expecting a culturally appropriate amount of space in which to perform various tasks. Attendees at events in non-domestic structures might require nothing more than the space to breathe. Therefore, it is unlikely that any methodology for calculating capacity based solely on the allocation of a set area per person will accurately describe all non-domestic architecture due to the variability in the activities taking place and the idiosyncrasies of each space.

In this paper, I demonstrate a contextual analysis of non-domestic architecture to calculate capacity. This methodology uses digital scenario modelling to reconstruct the way people might have been occupying the structures, taking into account movement, visibility, acoustics, hearths, storage, and any other activities that might have been taking place. This scenario modelling uses polygons to represent the physical body of an adult, which can then be used to fill the structures in variable ways, demonstrating the way people naturally cluster and occupy space, while also allowing researchers to take into account specific information about the structure. Therefore, occupants can be packed as tightly or spaced as loosely as the individual evidence of a space indicates, rather than relying on a set amount of personal space per person. This means that scenario modelling is a powerful tool for determining potential capacity of structures, without relying on assumptions concerning the type of structure analysed or the amount of space occupied by each individual.

I demonstrate how scenario modelling can be used by estimating the size of the participant group at events within Neolithic non-domestic architecture found at a number of sites. The sites with clear evidence for non-domestic architecture include Jerf el-Ahmar, Göbekli Tepe, Nevali Çori, Jericho, Çayönü Tepesi, Asikli Höyük, and Beidha (Bar-Yosef, 1986; Schirmer, 1990; Esin and Harmankaya, 1999; Hauptmann, 1999; Stordeur et al., 2001; Byrd, 2005; Schmidt, 2007). These sites have architecture that departs from the commonly constructed structures at the site, and these have been interpreted as ritual structures. As the interpretation of how these structures were used is ongoing (see McBride, 2012, 2014), understanding how many people used these structures enhances interpretations of the way these structures were perceived and how they functioned within the wider community.

1. Scenario modelling

Scenario modelling uses representative polygons to populate spaces to create realistic scenarios of occupation. Hemsley (2008) began to develop and implement this methodology, examining the contextual affordances of Pre-Pottery Neolithic A domestic architecture, but I have expanded it to include non-dwelling and public space, as well as incorporating a wider range of physical senses. While I initially modelled these spaces based on people occupying them in a variety of stances, such as lying, sitting cross-legged, and sitting with their knees to the side, I have generally used the stance of people sitting with their knees to the side as it was the largest seated stance (see Fig. 1), encompassing the width required to accommodate hips and shoulders (see Table 1 and Fig. 2). Using AutoCAD, polygons based on modern measurements of people sitting in this way, as well as comparisons of the stature of modern individuals and Near Eastern Neolithic skeletal remains (Hemsley, 2008: 82–86) were created. The representative polygons delineate the amount of space taken up by a person sitting with their knees to the side based purely on their bodies, not the culturally determined space surrounding them. These polygons can then be inserted into the structures to determine the capacity (see Fig. 3).



Fig. 1. Turkish woman sitting with her knees to the side.

Table 1
Average measurements used to model capacity.

Body position	Measurement	Average (cm)
Lying	Width	65
	Length	1.84
Cross-legged	Width	70
	Length	63
Kneeling	Width	43
	Length	65
Knees to side	Width	71
	Length	66

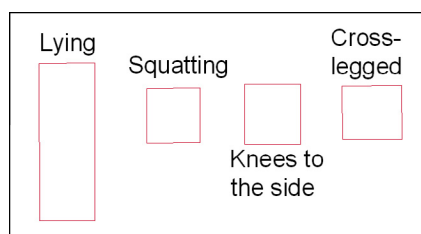


Fig. 2. Representative polygons for modelling capacity.

Once the digital models of the structures and the representative polygons are prepared, the modeller must decide how close to space the polygons. Our modern inclination would be to allow a certain amount of space between individuals; however, personal space is culturally constructed, and it is impossible to determine how much space would have been required for each participant in Near Eastern Neolithic non-domestic structures. This means that

examinations of capacity must start with scenarios that do not make any allowances for personal space. As Hemsley has shown (2008: 86), simply dividing the floor area of a structure by the floor area occupied by a person gives an unrealistic impression of capacity since it ignores the shape of the space they are occupying, as well as any features that affect people, such as posts, furniture, or hearths. Instead, the maximum capacity of the spaces can be modelled by fitting the polygons into the digital reconstruction of the structures in a very regimented way, with all participants facing the same direction in the same position (see Fig. 1). This results in an unrealistically high capacity of the structures, but provides an upper limit for discussions of capacity.

Once the maximum capacity of the structures has been determined, more contextual or contingent capacities can be modelled. Using a more contextual approach means that we can take into account individual requirements for movement, visibility, and distinctive features of each space such as hearths, pillars, storage, and use wear, not simply floor space and area. The variability of available data between sites means that models can be as realistic as possible, incorporating all sources of available evidence, but is also still applicable in poorly preserved examples. Contextual scenario modelling also takes into account the fact that participants would not have occupied the space randomly, instead arriving in the space as individuals and taking their places based on occupants already inside and their intended activity or role in the event. As more people arrived and moved into the space, participants would have clustered and spaced themselves around the structure based on individual interpersonal relationships, though it is also possible that participants had assigned seats and locations.

The first step in modelling these contextual scenarios is leaving allowances for movement. In order to model this, lines representing movement paths from the entrance to various locations within the structure are created to ensure allowances are left for participants to move through the space (Brogan and Johnson, 2003). Then, polygons representing occupants are inserted into the space in semi-random manner, creating small clusters of polygons facing each other but also spacing participants throughout the structures (see Figs. 4 and 5). In spaces with internal furniture and features, as well as buildings that have more evidence for the types of activities that were taking place, polygons can be inserted with greater confidence representing those particular activities. For example, more empty space can be left around hearths, since people would not have stood directly next to a fire, and seating people where there are benches, while also having individuals avoid areas behind pillars or other features that would have blocked visibility. At Jerf el-Ahmar there is wear on the benches around the perimeter of one of the structures, while benches at Nevali Cori also indicate a group was seated around the perimeter (Hauptmann, 1999: 74; Stordeur et al., 2001: 40). If further evidence becomes available, the digital models can be quickly and easily altered, and multiple scenarios can be compared. This gives a more nuanced understanding of the structure than assuming that people would have occupied the space evenly or in the same way as domestic spaces.

Obviously these models are not definitive. It is possible that only one or two people ever occupied the Near Eastern Neolithic non-domestic structures at a time, as was the case in some later examples of non-domestic space. For example, only high priests ever entered the inner sanctum of Ancient Egyptian temples (Kemp, 1989: 188–189); however, without historical records it is only possible to model the affordances of the Neolithic spaces. Additionally, the benefit of digital scenario modelling is the way that the models can be quickly and easily altered, and multiple scenarios can be created in order to demonstrate uncertainty.

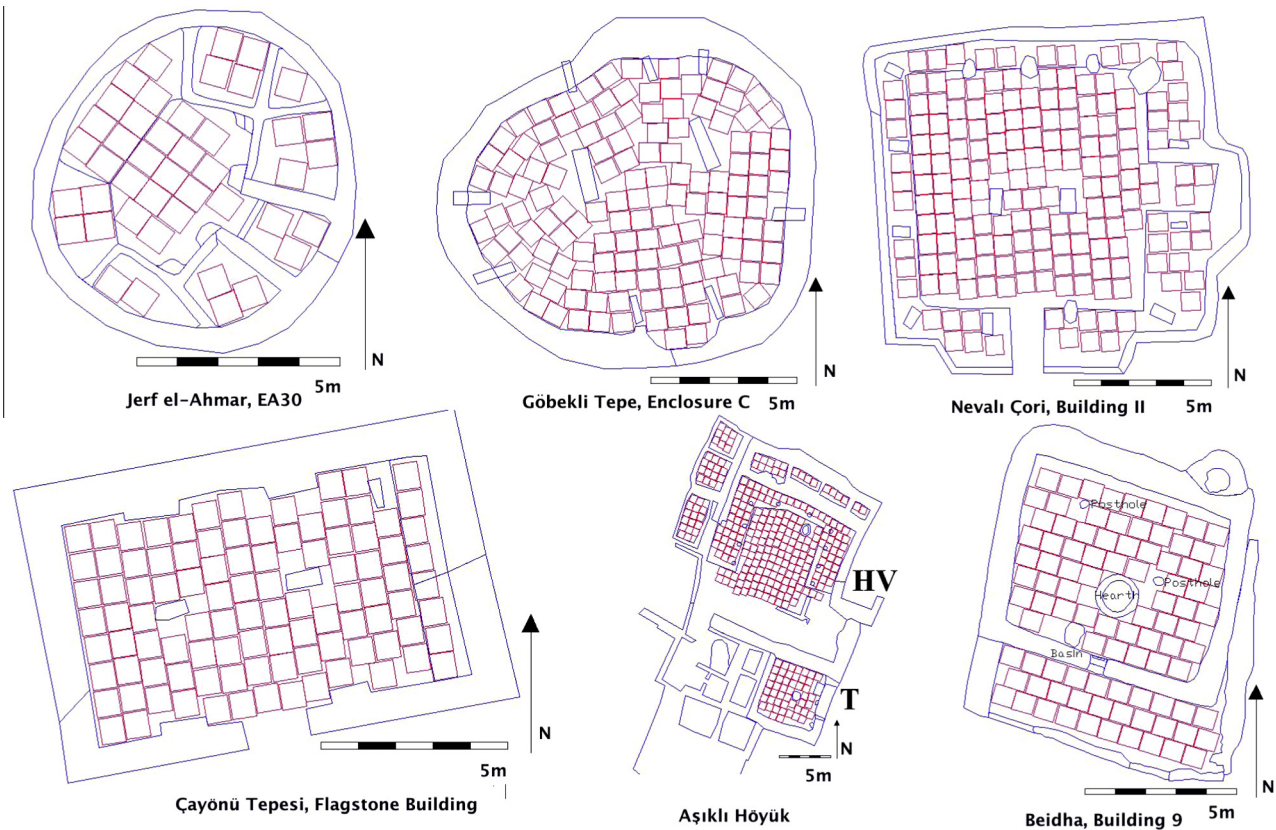


Fig. 3. Maximum capacity of Neolithic non-domestic structures.

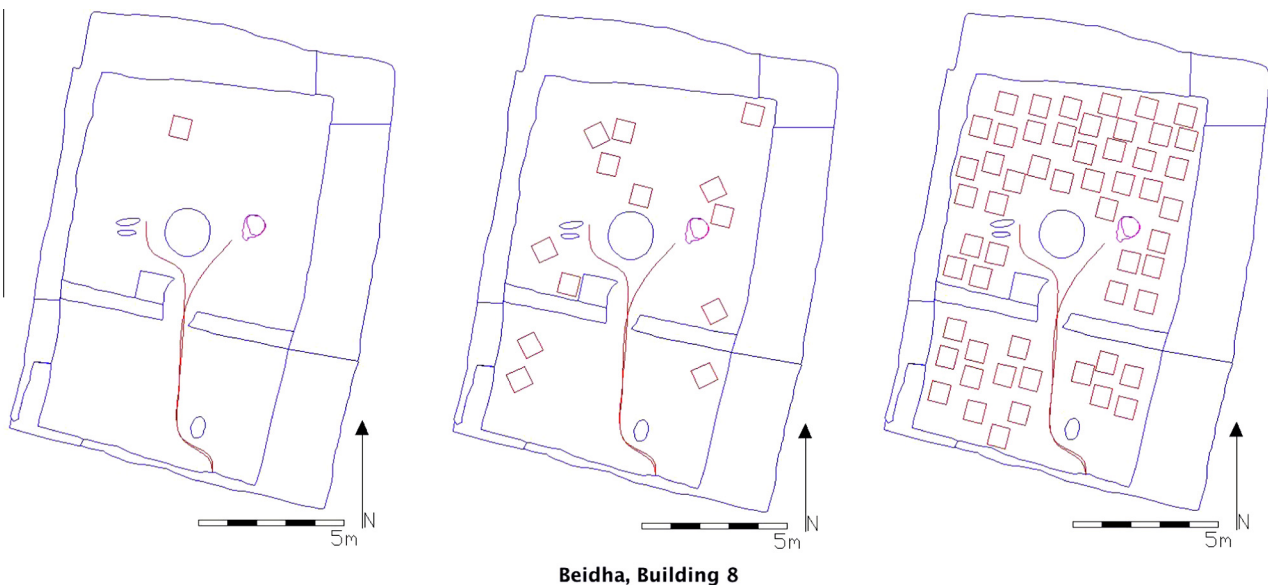


Fig. 4. Model of the way participants might have entered building 8, Beidha.

2. Group size

Modelling the capacity of the structures allows us to estimate the size of the group of people participating in events in those spaces, elucidating the changing nature of communal relationships in the Near Eastern Neolithic, as well as contrasting with the modelled capacity of contemporary domestic structures (Hemsley,

2008). Comparison of the previous methods of estimating the capacity of the structures and scenario modelling, it is possible to draw some conclusions concerning the likely size of the groups using them. The anthropological constant of 10.2 m^2 per person calculated by Naroll (1962) clearly gives an unrealistically low estimate of the capacity, as does the more appropriate dwelling constant of 6 m^2 , while the maximum capacity gives an unrealistically

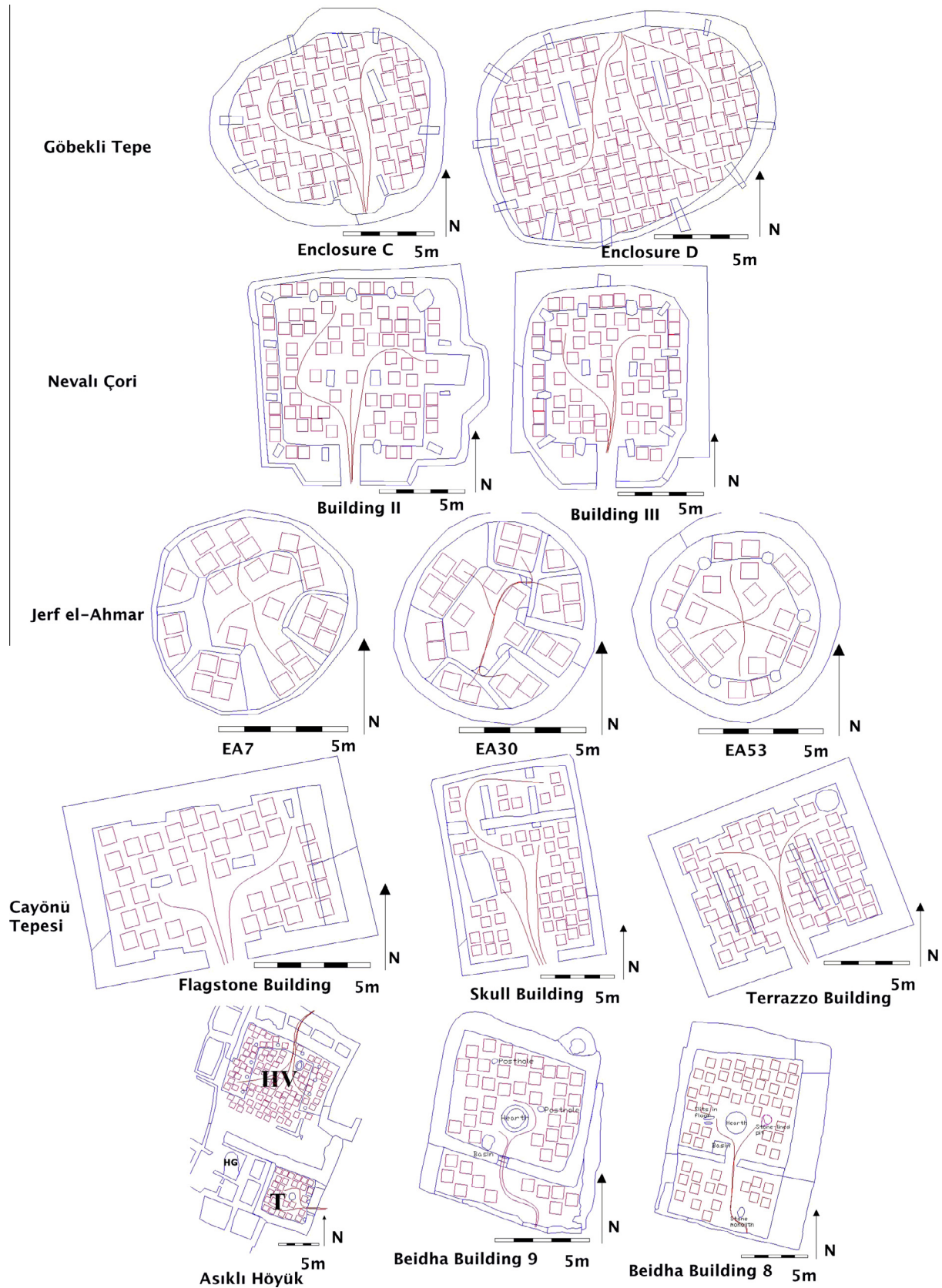


Fig. 5. Contextual capacity of Neolithic non-domestic structures.

Table 2

Calculation of the capacity using different criteria.

Site	Building	10.2 m ² /person	6 m ² /person	Maximum	50%	Contextual	Bench
Jerf el-Ahmar	EA7	4.27	7	46	23	27	9
	EA30	3.47	7	44	22	25	6
	EA53	2.87	6	48	24	22	14
Göbekli Tepe	A	4.41	7	69	34.5	34	
	B	5.63	9	87	43.5	40	
	C	8.62	14	136	68	72	
	D	11.54	22	208	104	127	
Nevalı Çori	II	12.09	21	175	87.5	93	25
	III	10.63	15	126	63	61	24
Çayönü	Flagstone	5.9	10	99	49.5	39	
	Skull 1	5.8	10	99	49.5	44	
	Skull 2a	10.2	13	148	74	51	
	Terrazzo	7.7	13	128	64	64	
Aşıklı Höyük	HV	16.8	23	255	127.5	91–92	24
	T	3.0	5	48	24	27	17
Beidha	Building 9	5.6	9	89	44.5	44	
	Building 8	10	17	183	91.5	63	

high estimate (see Table 2). The reality is somewhere between these two estimates, perhaps around 50% of the maximum capacity.

Comparison of the 50% capacity estimate and the contextual capacity shows that these estimates are similar in most cases. In a few cases, such as Göbekli Tepe enclosure D, Çayönü Skull building 2a, and the Aşıklı Höyük structures, the contextual capacity is lower than the 50% capacity. These structures had more complex movement requirements and more space was left to allow for movement between the various parts of the structures. These idiosyncrasies demonstrate how the flexibility of a contextual approach to capacity can take further detail concerning a space into account and demonstrate why it is important to examine each structure contextually. In other cases, such as at Jerf el-Ahmar and Nevalı Çori, the benches around the perimeter might indicate that the majority of participants were seated on these benches, with only a small number of people in the central space. This scenario has been modelled as the bench contextual capacity in Table 2. This is an example of how contextual modelling can present different scenarios to demonstrate uncertainty, as well as allow researchers to compare different models to determine which scenario was most likely.

Estimating the size of the group that could have occupied the non-domestic structures emphasizes the fact that these spaces were dramatically different from the contemporary domestic spaces. Hemsley has modelled a variety of PPN domestic structures and modelled that the likely co-resident group was under 10 people, while a few of the spaces could have held gatherings of up to 20 people (2008). This contrasts with the modelled occupancy of the non-domestic structures shown in Table 2, where even the smallest structures from Jerf el-Ahmar would have held gatherings for more than 20 people.

3. Groups and communities

Once we have an estimate of the size of the group participating in events at non-domestic structures, it is possible to calculate the scale of the group as well. This allows for more complex discussions of how these groups functioned in the wider community, such as what percentage of the settlement population these groups represented. In order to accomplish this, we need to calculate the population of settlements, which is fraught with difficulties. As most sites are not entirely excavated, population estimates are by necessity based on assumptions concerning the number of people per unit of area living on a site, as well as assumptions about the size of the site and the density of occupation (Kuijt, 2000b: 81). This methodology has all of the same problems associated with Naroll's conclusions concerning the capacity of domestic structures, as well as problems with assuming a standard density of occupation across the site (Naroll, 1962; Kolb, 1985: 583). However, as this is the standard methodology for estimating population, it provides a starting point for the examination of the relationship between participants and the wider community. Estimates of the range of the population of the case study sites are listed below in Table 3, calculated based on the published size of the settlement and the ranges of population per hectare from Kuijt (2000b): 81. This can then be compared to the estimated group size calculated above to determine the percentage of the site that could have been participating in events within the structures. Obviously, these figures can be refined as better information is available.

Comparisons of the capacity estimates indicate that there were a wide variety of group sizes using the different structures. However, these groups represented a much narrower range of the percentage of the population. The percentage of the settlement

Table 3

Comparison of the estimated population and non-domestic group size at the case study sites.

Site	Site size	Population	Group size	Percentage (%)
Jerf el-Ahmar	>1 ha Stordeur (2000): 1	>90–294	5–15	1–16
Göbekli Tepe	>1 ha Schmidt (2000): 45	>90–294	30–130	10–144
Çayönü	2–3 ha Hole (2000): 199	180–882	40–60	4–33
Nevalı Çori	0.7 ha Hole (2000): 201	63–206	25	12–39
Aşıklı Höyük	3.5–4 ha Esin and Harmankaya (1999): 118	315–1176	90	7–29
Beidha	0.3 ha Banning (1998): 194	27–89	40–60	45–222

participating in events tends to fall between 5% and 30% of the estimated population of the community. This means that there were likely some selection criteria for who could participate in events within the case study structures, as the entire population could not have been accommodated, but participants were likely not travelling from outside the community. We can then begin to discuss how these groups might have been composed and whether there is any evidence for the selection criteria. In a few cases, the estimated settlement population is so small that the size of the non-domestic structures would seem to indicate that participants were travelling to events from outside the community, such as at Göbekli Tepe and Beidha. However, closer examination demonstrates that these are due to problems estimating the population of the settlement. In the case of Göbekli Tepe, population estimates are based on the suggestion that there was no contemporary domestic community at the site. However, the excavators have discovered architecture that resembles Near Eastern Neolithic domestic architecture found at other sites, it is likely that the population of the settlement was much greater than is estimated here (Schmidt, 2000: 46; Schmidt, 2005: 13; McBride, 2012: 180–181). At Beidha, it is likely that the site was originally larger than was excavated, as much of it was eroded by the seasonal stream than ran alongside the site (Kirkbride, 1968: 263). This means that in both of these cases, the population of the settlements has been underestimated, and therefore, the percentage of the population that could have participated in events in the non-domestic structures would have been much lower, perhaps closer to 30% and it is unnecessary to conclude that participants travelled to the site from elsewhere. If, for example, Beidha was originally 1 ha, then the percentage of the population that could have participated would have been 14–67%, and more similar to the range represented by the other sites.

4. Anthropological implications

The emergence of non-dwelling structures at sites in the Neolithic Near East indicates that groups of people were engaging in regular activities that required dedicated purpose-built space. The construction of dedicated space represents the institutionalisation of these activities and as well as the development of new kinds of relationships within communities. Construction of buildings to house and materialize these relationships suggests that the groups using the structures represented larger or more complex social units than existed before, requiring more complex paraphernalia to manage. While the existence of new types of relationships and new group dynamics is interesting, the real question is how these groups functioned and what their purpose was within Near Eastern Neolithic society. Examination of the ethnographic record can suggest ways larger social units might have functioned and give clues for evidence that should be sought in the future.

Anthropologically, various types of institutions had dedicated space, such as age groups, decision making groups like councils, and initiatory religious groups (Strathern, 1970; Richards and Kuper, 1971; Stewart, 1977; Bernardi, 1985; Flannery and Marcus, 2012: 110). All of these groups have selection criteria, as

well as structured space requirements that might have resulted in the construction of non-domestic structures similar to those found at Near Eastern Neolithic sites. The central focus of many of the structures demonstrated by peripheral benches and focussing pillars that are found in many of the structures might suggest a central speaker or performer (McBride, 2012), which might indicate a decision-making body or council as well as an initiatory group, where central speakers or performers are common.

Ethnographic literature concerning the capacity of dedicated non-dwelling spaces is surprisingly limited. Occasionally, there are mentions of either numbers of people or the size of the structure, but rarely is there both available to discuss how people were occupying space. This is one of the reasons anthropologists have been overlooking how people occupy non-dwelling spaces in institutions and community gatherings. As mentioned previously, discussions of capacity address dwelling and domestic spaces, while dismissing ritual and institutional community spaces as they are often idiosyncratic and variable. The advent of digital modelling tools allows us to quickly and easily overcome this variability while also incorporating data concerning the body size of the community and specific details about the events if they are known.

I applied my contextual modelling technique to several ethnographic examples of ritual structures from small-scale societies, and compared the estimated modelled capacity to the size of the use group reported in the literature (see Table 4). Due to the lack of discussion of the size of the groups using non-domestic structures in the ethnographic literature, I have estimated rough numbers based on ethnographic accounts. For example the Baktaman cult house (Barth, 1975: 49) and Yurok sweathouse (Kroeber, 1976: 82) have estimates of the number of people using the structures, mainly based on ethnographic population estimates, and discussions of what segment of the population used the structures. Estimating the capacity of the Pomo dance house was more difficult though, as the only discussions of who used the structures mention visiting neighbouring village's dance houses for events. Therefore, I used estimates of village populations, and suggest that the dance houses must have accommodated at least three villages worth of people (Kroeber, 1976: 16–17). Similarly, estimates of the capacity of the Maidu earthlodge were difficult to find, with some estimates as suggesting that the largest gathering ever in an earthlodge comprised 250 people (Nabokov and Easton, 1989: 286), setting an upper limit on the capacity of the largest structures.

Comparisons in Table 4 show that the contextual capacity effectively estimates the size of the use group of the ethnographic structures in the low level integrative structures as determined by Adler (1989). These structures, as defined by Adler, would have been meant to be used by a portion or segment of society, as opposed to the high level integrative structures, which were intended to be used by entire communities (1989: 38). However, in the case of the high level integrative structures, such as the Pomo and Maidu dance houses, the contextual modelling does not match the ethnographic literature closely. This means that further exploration of the space and the ethnographic account is warranted. For example, the contextual capacity of the Maidu earthlodge was 101 people, as compared to the ethnographic literature, which suggests

Table 4
Ethnographic integrative structures with estimates of capacity.

Structure	Floor area (m ²)	Use group size Adler (1989)	Ethnographic estimate	Contextual capacity
Pomo Sweat – Low	30	25	23	36
Dogon – Low	36	30		29
Yurok – Low	40	22	23	28
Baktaman – Low	46	30	63	49
Maidu Earthlodge – High	90	350	250	101
Pomo Dance – High	170	300	135	158

250–350 people. In a building 90 m², then each person would only have had 0.26–0.36 m² each. This would be a very different type of event than other structures, but more likely the number of participants represents attendance over a period of time rather than at any one time. However, the ethnographic estimates are also less reliable for the high-level structures. In fact, the difficulty I had finding information concerning both the size and capacity of ethnographic non-dwelling structures in the ethnographic literature indicates a gap in the way we discuss non-dwelling architecture. This means that contextual modelling is an effective method for calculating the use group, and will enhance our understanding of structures discussed in the ethnographic literature.

5. Discussion

In the Near Eastern Neolithic, researchers accept the idea of institutional groups associated with the non-domestic structures, but have not begun to explore what these groups did or how they functioned within the wider community. Using scenario modelling it is possible to examine the user group size and begin to explore how these groups functioned within the community. The percentage of the population that could have participated in events suggests some selection criteria, as the entire population could not have been accommodated within the structures at once. There is little evidence from within the structures to indicate the composition of the groups using them, and whether there was any differentiation between those who could participate in events within the structures and those that were excluded. The stated prevalence of male iconography in the Göbekli Tepe enclosures has been used to argue that the groups were composed predominantly of men (Hodder and Meskell, 2011: 237–241), but the iconography is not as male dominated as has been suggested (Sutcliffe, 2012: 125). Additionally, Flannery and Marcus have interpreted these structures as men's houses (2012: 121–138), either as bachelor residences or as spaces for initiated men. However, evidence from Çayönü suggests that the groups using the structures in the Near Eastern Neolithic were composed of both males and females (Ozdoğan, 1999: 51; Croucher, 2005: 614–615), meaning that the generalised interpretation as men's houses is too simplistic. Other evidence for group composition comes from Çayönü, where there are indications that the people deposited in the non-domestic Skull building had a different diet from those deposited elsewhere in the settlement (pers. comm. J Pearson). Assuming that the remains deposited in the Skull building represented the people participating in events, these inhabitants would have been distinguished in their lifestyle as well as their participation in non-domestic events. This would also indicate that group members were not selected based on age and sex, as the remains found in the Skull building were from both males and females, and from children and adults (Schirmer, 1990: 381–382; Croucher, 2005: 614–616). These small hints at the composition of the groups participating in events in the non-domestic structures refines our understanding of how they functioned within the wider community, and suggests wider significance to participation in events in the non-domestic structures.

Using scenario modelling to contextually examine each individual space allows for a realistic estimate of the number of people occupying prehistoric architecture. Small amounts of evidence for the detailed use and participant group can then be used in conjunction with contextual scenario modelling to provide a more nuanced understanding of prehistoric architecture and social interaction. This then permits a discussion of the way these events and spaces functioned within the wider community, through analysis of the percentage of the settlement that could have been accommodated, as well as any evidence for the selection criteria used

to determine participation. Understanding how many people might have been occupying any particular space in comparison to the wider population then allows researchers to discuss how social groups might have been created and maintained.

This analysis has greatly enhanced our understanding of the way non-domestic structures were perceived and used in the Near Eastern Neolithic, but this technique is applicable in any space. In fact, using scenario modelling might provide insight into how non-dwelling spaces were used in ethnographic societies, as a survey of the literature demonstrates that there is little understanding of how many people were actually using these spaces. Additionally, as the calculation of capacity through scenario modelling takes into account any details that are relevant to a space, it can be used anywhere, including exterior spaces, such as stone circles from Prehistoric Europe, or Andean plazas, as well as domestic structures.

Acknowledgments

I would like to thank Dr. Douglas Baird and Dr. Matthew Fitzjohn for their comments and advice during my PhD research. I would also like to thank Dr. Samantha Hemsley for her guidance on AutoCAD and scenario modelling. Several anonymous reviewers made thorough and helpful comments which greatly improved this discussion. Support for this research was generously provided by the University of Liverpool, the Overseas Research Students Award Scheme, the British Institute at Ankara, and the Council for British Research in the Levant.

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