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Communities on the Edge of Civilization

Fiona Coward and R.I.M. Dunbar

INTRODUCTION

The Neolithic 'Revolution' has long been seen as a dramatic step-change in human lives. The abandonment by some groups of mobile hunting and gathering lifeways to become settled agricultural villagers has long been considered to set the scene for many subsequent developments which ultimately led to the establishment of modern Western lifeways (e.g. Runciman 2005: 130, Cauvin 2000: 72, Childe 1936). However, in recent years several distinct trajectories of social, material, economic, political, and cognitive change have been identified over this period. In particular, sedentary life and the development of more or less permanent settlements at much larger group sizes than those known among hunter-gatherers is now known to precede cultivation or domestication (e.g. Watkins 2005). As a result, in recent years the issue of how and why groups chose to pursue what ultimately become sedentary village lives has been at least partially decoupled from debates surrounding the 'invention' of agriculture. The spotlight has fallen instead on consideration of the changes in social life, cognition, and ideology that accompanied these changes in settlement practice, and that subsequently underpinned economic change (Coward 2010a, 2010b, 2013, forthcoming, Watkins 2008, 2004a, Kuijt and Goring-Morris 2002, Cauvin 2000, Kuijt 2000a, 2000b, Byrd 1994, Hodder 1990).

Of course, questions remain as to how far even the larger sites from this period can be considered aggregated 'village' communities of permanently co-resident inhabitants of the kind known later in prehistory and indeed today (Asouti and Fairbairn 2010: 164, Goring-Morris and Belfer-Cohen 2010: 16, Perlès 1990: 305). Nevertheless, it does seem clear that some settlements became increasingly large, housed many more inhabitants, and were occupied at least semi-permanently for much longer periods of time than known among earlier populations (Kuijt 2000b).

Forager groups are typically characterized by a pattern of mobility and social structure known as 'fission-fusion'. Such groups aggregate only on a temporary, ad hoc basis for short periods of time, and frequently disaggregate to re-disperse across the landscape at very low densities, with group memberships remaining highly flexible but generally low in numbers (Lehmann et al. this volume, chapter 11; Grove et al. 2012, Aureli et al. 2008). Human foragers share this mode of social

organization with a number of other primate species, including our closest living relatives, the chimpanzees (see e.g. Grove et al. 2012 for references): fission-fusion systems represent a very effective means of balancing the significant stresses imposed by increased group size with the benefits of living with large numbers of conspecifics, particularly in the face of the low population densities and high mobility required by modern humans' highly carnivorous diets (Grove 2010a, Layton and O'Hara 2010, Lehmann et al. 2007, Binford 2001). The adoption of stable, (semi-)permanent settlement patterns during the early Neolithic, and the establishment of large communities of, in some cases, thousands of long-term co-residents, therefore represents a significant break with settlement practices that had been established for millennia. Such developments required novel solutions to some very old problems.

The question of *why* sedentism (and indeed cultivation, domestication, and fully fledged agricultural lifeways) should have become adaptive when and where it did has been the subject of considerable debate, and will not be reviewed here (see e.g. Barker 2006 for an up-to-date review). We now know that sedentism and agriculture both arose—separately and in combination—on a number of independent occasions in different regions across the globe, following a distinct trajectory in each according to local particularities of history and ecology (Bellwood 2005). These developments represent the outcome of long histories of close relationships developed over millennia between human groups, their animal prey and plant resources, and more generally with the environments in which they lived (Harris 1989, Rindos 1984, Jarman et al. 1982, Binford 1968). The direction of causality among such interrelated aspects of 'Neolithization' as sedentism, population increase, and population pressure and intensification of subsistence practices remains the subject of fierce debate.

However, much less attention has been paid to the *social* problems that early Holocene groups faced in establishing permanent settlements and that resulted from their subsequent expansion (though see Byrd 1994, Kuijt 2000b). The abandonment of fission-fusion mobility in favour of habitual co-residence in large aggregations imposes significant stress, and it is clear that these developments occurred alongside, or even preceded, economic change. Indeed, it could be argued that they represent adaptations which were at least as significant as the domestication of livestock and cereals to the establishment of Neolithic, and ultimately modern Western, lifeways.

THE NATURE OF THE PROBLEM: WHY IS IT SO DIFFICULT TO FORM LARGE, PERMANENT GROUPS?

Group living brings with it a number of significant benefits (Lehmann et al., this volume, chapter 11; see also Layton and O'Hara 2010). However, the size and longevity of social groups, and the mobility and settlement strategies they pursue, are also subject to a variety of constraints. Perhaps the most obvious constraints are imposed by ecological pressures, such as the productivity, carrying capacity, and the temporal and geographic structuring of different habitats (e.g. Layton and O'Hara 2010, Binford 2001). Not only do larger groups require more resources,

but increasing group size also increases the distance groups must travel to access sufficient resources, putting strain on time-budgets (Dunbar 1996, Dunbar et al. 2009 [this volume, chapter 10]).

In addition to these direct ecological constraints, the *indirect* consequences of aggregation may perhaps be more serious still. Among primates, increased levels of social stress and harassment within the group as a result of crowding during long-term aggregation may be a very significant factor, particularly for females, whose menstrual cycles and thus fertility are negatively affected (Dunbar 2012 [this volume, chapter 13], Hill et al. 2000, Abbott 1987, Abbott et al. 1986). Among primates, these stresses appear to be as significant as ecological conditions in determining whether aggregations persist or whether they fragment and disperse (Dunbar et al. 2009 [this volume, chapter 10]).

However, increases in group size also incur a number of other costs. As the number of individuals in a group increases in a linear fashion, the potential combinations of relationships between those individuals increases geometrically. The demands of maintaining and servicing these relationships strains time and energy budgets (Roberts 2010). Furthermore, simply navigating the immediate social fabric of one's group, remembering the outcomes of past interactions with others and tracking your relationships with them, and theirs with others, places increasing demands on memory and social cognition. Among primates generally, the very strong relationship between brain size and immediate social group size suggests that larger groups require more—metabolically expensive—brain power to cope with these cognitive demands (Dunbar 1992, 2011a).

In short, trade-offs between the benefits and costs of group living should result in group sizes being constrained below a particular maximum determined by both ecology and cognition. In this light, fission-fusion patterns of aggregation and disaggregation can be seen as a highly flexible and efficient means of tuning the size of daily foraging groups to be optimal for local environmental conditions. Regression equations based on primate models suggest a cognitive upper limit to group size among *Homo sapiens* at around 150 (Dunbar 2003, 2011a). Thus while aggregations of around this level could theoretically occur where immediate environmental conditions allow, increasing group size should result in progressively marginal advantages as numbers approach 150, resulting in fragmentation and dispersal as costs eventually outweigh benefits.

The ~150 figure ('Dunbar's number') does indeed appear to be a significant building-block not only for traditional societies but even for modern industrial social systems (Dunbar 1993, Zhou et al. 2005, Hamilton et al. 2007), and among foragers, the size of the group within which day-to-day life occurs is usually well below this (Layton and O'Hara 2010). However, contemporary human groups regularly number considerably more than 150 individuals, and often do so for considerable lengths of time. Indeed, *Homo sapiens* is perhaps now better considered as *Homo urbanus*, a city-dwelling species living in aggregations of millions. Of course, much of this dramatic growth of aggregations has occurred in very recent times, but settlements of 8–10 ha date to as early as 7000 BCE during the later pre-pottery phases of the Neolithic (PPNB) of the Fertile Crescent at sites such as 'Ain Ghazal, Beisamoun, Es-Siffiya, Basta and Wadi Shu'eib (Kuijt 2000b: Table 1).

Table 17.1. Estimates of population size for Neolithic villages in the Levant.

Period	Maximum site size in hectares	Average estimated population level of the largest sites from each period
Late Natufian (~10.5–10k BCE)	0.2	18–59
PPNA (~10–8.5k BCE)	2.5	101.8–332
MPPNB (~8.1–7.2k BCE)	4.5	234–764
LPPNB (~7.2–6.7k BCE)	10	915–3293
PPNC/Final PPNB (~6.7–6.2k BCE)	12–14	1170–3822

Lower and upper estimates are based on two differing estimates of population density for agricultural groups from two ethnographies, one estimating ~90 people per 1,000m^2 village, and the other ~294 people per hectare (references in Kuijt 2000b, Table 1 p. 81, date ranges calibrated and changed to BCE). Note the EPPNB is a short and poorly known period and many researchers would in fact indicate there is insufficient evidence to support it as a separate temporal/cultural phase (e.g. Kuijt 1997).

Estimating the potential number of inhabitants of an archaeological site based solely on its size is of course fraught with difficulty. Even simply determining the extent of contemporaneously occupied areas of a site is problematic, especially as larger sites are rarely excavated in full. In addition, numerous factors influence the extent of survival and excavation of archaeological sites of different sizes. Thus, while ethnographic examples provide a range of baseline figures for typical population densities of the settlements of foragers and agriculturalists which can be used as the basis for extrapolation to archaeological sites (see Grove 2010b, Byrd 2000, Kuijt 2000b), such estimates remain highly problematic. Nevertheless, a review by Kuijt (2000b) provides tentative estimates of population levels for the largest known settlements of the Epipalaeolithic and early Neolithic (see Table 17.1).

Despite the inevitably broad ranges of these estimates, there is clearly a dramatic increase in the maximum size of settlements at this time. Although it is important to recognize that smaller settlements remained numerous (and indeed the norm) in the region throughout this period, even using the conservative lower estimated figure it seems clear that at least some sites in the Near East housed populations well above the ~150 threshold by the MPPNB, perhaps as early as 8000 BCE. Nor are these ephemeral, short-lived aggregations; these sites demonstrate considerable investment in architecture and material culture, with cultural deposits of up to 4m and even 8m in depth attesting to the longevity of occupation at some sites (Basta and PPNA Jericho respectively; references in Kuijt 2000b: Table 1).

Given that plant cultivation is established for many PPNA sites, and that the classic 'Neolithic package' of crops and livestock was widespread by the Middle and Late PPNB (Zeder 2011), increasing intensification of subsistence practices is likely to have alleviated the need to divide the broader community into smaller functional parties as among fission-fusion hunter-gatherers. However, it is important to note that intensification does not necessarily imply agriculture. Intensive subsistence practices focused on locally and seasonally abundant, readily 'harvested' and stored *r*-selected resources such as cereals, but also including fish, shellfish, and nuts (Price and Brown 1985) sustained many early Holocene groups. 'Complex' hunter-gatherers such as Mesolithic groups in Atlantic and

central Europe (e.g. Bailey and Spikins 2008), groups in Thailand such as those represented at Khok Phanom Di (Higham and Thosarat 1993), Jomōn groups in Japan (Akazawa 1986), Peruvian coastal groups such as the Chinchorro (Richardson 1999, Wise 1999) and many other historically (and indeed contemporary) communities such as those of the northwest coast of North America (see references in Hayden 1996) are also characterized by larger and more permanent settlements, but remained foragers for long periods of time, often despite coexisting and even trading with agriculturalists. It seems clear, therefore, that these societies—often independently of agriculture per se—developed mechanisms which allowed them to offset the cognitive, physiological, and psychological costs associated with larger aggregations. Three potential candidates for such mechanisms are discussed below: the elaboration of material environments, the establishment of formalized 'top-down' social institutions, and the development of group ideologies and religious beliefs. These are not mutually exclusive or independent solutions; rather, some or all seem to have been used by groups at this time to allow them to breach a series of thresholds constraining group size to limits imposed not by local ecological conditions but by the social and cognitive skills of modern humans, and by the structural dynamics of social networks. First, however, we review recent analyses of changes in social network structure that occurred in the Levant over the early Neolithic.

NETWORKS IN THE NEOLITHIC

Coward (2010a, 2010b, 2013, forthcoming) has used a database of material culture from well-dated Epipalaeolithic and early Neolithic sites in the region to establish measures of similarity in material culture inventories between nodes in social networks at both intra- and inter-site levels. Because the distribution of material culture is underpinned by interpersonal performances such as trade, exchange and gifting, or the dissemination of knowledge, skills, and cultural practices, these matrices of material culture similarity can be considered to reflect the strength of social relationships between nodes. This makes it possible to use social network analysis techniques to analyse temporal trends in formal network properties such as the average strength of relationships between sites (degree), network density, and measures of the interconnectedness of the network (distance) for successive networks throughout the Epipalaeolithic and early Neolithic in this region.

At the intra-site level, analyses suggested that an increase in the average strength of relationships in early Neolithic networks was accompanied by a decreasing density of those networks as the mounting costs of individuals' social networks in the larger groups implied by increasingly large settlement size impacted on the number and extent of relationships they could maintain. However, measures of fragmentation remained relatively low throughout the period, indicating that these groups remained strongly interconnected internally and did not fractionate into smaller clusters over time. The implication is that mechanisms were found to offset these problems and keep communities bonded together.

The increases in relationship strength were almost entirely accounted for by the fact that later repertoires of material culture are more elaborate than earlier ones,

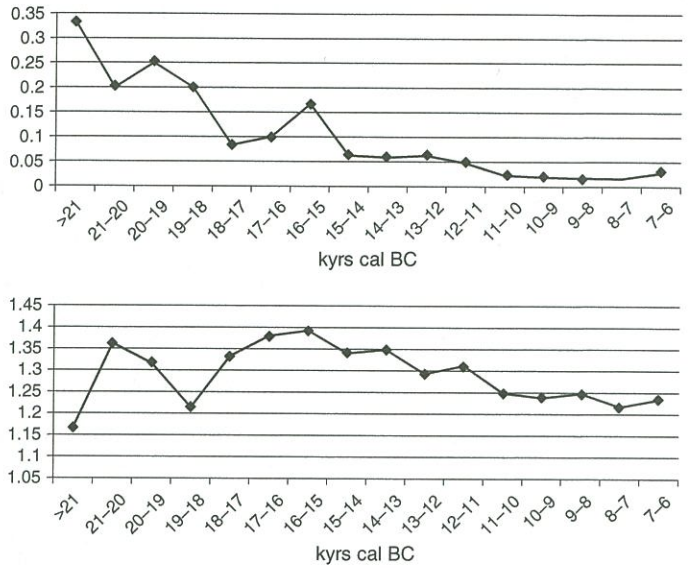

Fig. 17.1. Decrease over time in average strength of relationships between sites (top) and average density of networks (bottom) (once corrected for the number of material culture types contributing) for Neolithic sites in the Levant.

as new forms of material culture—for example, new kinds of artistic representation and new varieties of ground stone and personal ornamentation—were added to early Neolithic assemblages. Correcting networks for the number of different types of material culture contributing to them reveals a *decrease* in the average strength of relationships and in the overall density of social networks over time, both within and between sites (Fig. 17.1). This suggests that the increasing use of material culture long noted for the period was not simply an accidental by-product of sedentism but was in fact an integral part of the process of scaling up Epipalaeolithic and early Neolithic communities.

Several different categories of material culture may provide corroborative evidence for this argument. A series of studies of the developments in architecture over the period have highlighted the increasing investment in construction, but have also drawn attention to the way in which houses appear to become internally more compartmentalized and less readily accessible by others (Kuijt 2000, Banning and Byrd 1989). Coupled with elaboration of doorways with lintels, hearthstones etc., these developments are interpreted as reflecting an increasing emphasis on control of access and others' surveillance, and a more marked distinction between public and private (Byrd 1994). Activities that seem to be communal—or were at least performed in the open—in earlier settlements are now conducted inside the house, in private (Wright 2000, Byrd 1994). In

particular, while communal storage is attested to earlier in the period, for example, at PPNA sites such as Jerf al Ahmar, Tell 'Abr, Dhra, Tel Qaramel and Dja'de, in later PPNB sites storage appears to have been organized within households, as processing and preparation and foodstuffs is throughout the period (e.g. at Çatalhöyük [Willcox et al. 2008, Fairbairn et al. 2005, Finlayson and Kuijt 2005, Willcox 2002, Byrd 2000]; Bouqras [Hole 2000]; and Beidha [Byrd 1994]).

It seems that these developments in architectural style increasingly allowed individuals to choose which aspects of their life were available for social surveillance and which were 'private' (Wilson 1988: 101). As individuals' social networks became dominated by others at more inclusive social layers, with little or no personal knowledge involved, people may have been more motivated to seek privacy while at the same time having increasing freedom to determine how they should present themselves to people who did not know them. Indeed, if the wheels of social interaction are not to grind to a halt as group size increases, people may *need* to adopt increasing numbers of identities and roles (Coser 1975) and to signal these in more complex ways.

It is certainly clear that social roles were becoming more defined and fixed at this time. Population size and number of occupational specializations are strongly correlated (Naroll 1956), and while some specialization of roles does occur in small-scale groups, the scale of pre-pottery Neolithic production of items such as stone rings and beads during the middle and late PPNB in particular (e.g. at 'Ain el-Jammam [Rollefson 2005], Bağa 1 [Gebel and Kinzel 2007], Es-Siffiya [Mahasneh 1997] and at several separate sites at Wadi Jilat and Azraq [Wright and Garrard 2003: 272]) suggests that these systems had become much more formalized well before large settlements developed. In addition, osteological research suggests that gender-based division of labour was becoming more prevalent at many sites, with the daily chore of grinding grain falling predominantly to women (Molleson 2007, Moore and Molleson 2000). There is also skeletal evidence to suggest that some individuals specialized in other activities, such as the preparation of string or cord, or the making of baskets (Molleson 2007: 193, Moore and Molleson 2000: 503).

A new concern with identity and role could also inform on the burgeoning interest in representing the human form during this period. While human figurines are of course known earlier in the archaeological record, the human representations of the early Neolithic seem to develop a new theme: that of *display*. The large plaster statues recovered from often carefully buried caches at MPPNB sites such as 'Ain Ghazal (Rollefson 2005, Rollefson 2000, Schmandt-Besserat 1998), Jericho (Kuijt 2000), and Nahal Hemar (Schmandt-Besserat 1998) are strikingly well made and boast carefully modelled and painted facial features. However, they are also very thin (~5–10 cm thick) with plain, unadorned backs—they are indeed literally all about the front. Similarly, skulls themselves are displayed: plastered and/or painted with detailed facial features at many sites, and perhaps even adorned with wigs or headgear (Kuijt and Goring-Morris 2002, Goring-Morris 2000, Schmandt-Besserat 1998), displayed on pedestals or plinths elsewhere (Akkermans and Schwartz 2003, Nierlé 1982, Cauvin 1978). All of these practices would seem to indicate a new concern with how people presented themselves and how they were perceived. This would seem to support a model in which increasing

elaboration of material environments scaffolded social performance and interaction in the face of decreasing social integration, thus allowing the expansion of settlements.

MECHANISMS FOR BREACHING THE ~150 THRESHOLD

Weak ties, categorization, and material culture

One clue to how this scaling-up of social groups may have been achieved lies in a consideration of the *structure*, rather than simply the size, of human and indeed primate social groups. Small-scale societies are dominated by individuals who are connected to one another by 'strong ties'—usually, though not always, kin. Interactions are frequent, and the individuals concerned invest a lot of time, energy, and emotion into those relationships. In small-scale societies, almost all aspects of daily life occur communally, in full view (Whitelaw 1991: 182, Rapoport 1969: 66, Wilson 1988: 188); the individuals concerned generally know a great deal about all aspects of one another's lives. The ties between them are thus typically multiplex and biographical.

However, the time and energy costs of maintaining such intensive relationships mean that, as group size increases, time and energy must be increasingly targeted and some relationships prioritized at the expense of others (Roberts 2010). Social networks do not therefore simply expand with group size (see Lehmann and Dunbar 2009). Instead, more and more inclusive 'layers' are added to individuals' social networks, each containing successively larger numbers of individuals who are encountered less and less frequently (Dunbar 2011b: 10, Sutcliffe et al. 2012 [this volume, chapter 7]; Hillier and Hanson 1984: 27) and whom ego knows (and who know ego) less and less well. Below the ~150-person threshold individuals are likely to know (at least in some sense) many, if not all, of the other members. However, as numbers increase individuals can afford to have strong ties only with small proportions of the overall group and there is a commensurate reduction in the effort expended on relationships with others. As a result, individuals' social networks are strongly hierarchized, and the absolute numbers encompassed within each 'layer' of the social network are remarkably robust cross-culturally. Within the ~150-strong 'active network' any individual is likely to be able to maintain only around 3–5 very close relationships, or 'strong ties', and ~15 in one's wider but still tightly bonded 'sympathy' network (see Roberts 2010, Sutcliffe et al. 2012 [this volume, chapter 7]). Larger groups, therefore, are less highly interconnected than smaller groups (Lehmann and Dunbar 2009, Kudo and Dunbar 2001:10). The existence of such 'clusters', coalitions or cliques within larger groups is also highly adaptive in that they help individuals balance the costs and benefits of group life by allowing individuals to retain the support of their fellow clique-members in situations of adversarial social interactions (Dunbar 2009a, 2012 [this volume, chapter 13).

Group size can, therefore, only increase if individuals are able to cope not just with increasingly large social networks but also with the decreased familiarity of a disproportionate number of other group members. Relationships with the

increased proportion of other members of the expanding group with whom one has only 'weak' links are therefore typically based mainly on *categorical* or role-based knowledge of others (see Read 2010, Coward 2010a, Dunbar 1993, Granovetter 1983, 1973, Milgram 1977: 25, 177, Lofland 1973). This ability to categorize and to form 'weak' ties represents an important adaptation to life in larger social groups which offsets the cognitive, temporal, and energetic costs of navigating large amounts of social information and large numbers of social relationships. This capacity is crucial for linking together the dense, intimate clusters of individuals who share 'strong ties' into larger aggregations. It is the *combination* of 'strong' and 'weak' ties that allows social groups to grow, rather than to fission (Lehmann et al. 2008, Postmes et al. 2005: 10, Kudo and Dunbar 2001, Hillier and Hanson 1984, Lofland 1973: 236).

The growth of groups and social networks attested to by the larger and increasingly permanently co-residential settlements of the late Epipalaeolithic and early Neolithic is not associated with any increase in brain size. Indeed, it has been argued that the size of the modern human brain is at or near its functional limit (Hofman 2001) and that the brains of post-Pleistocene *Homo sapiens* have if anything *reduced* slightly in size (Miguel and Henneberg 2001). Therefore, some other mechanism must have been employed to allow early Neolithic groups to expand their social networks.

A series of multi-scalar studies by Coward (2010a, 2010b, 2013, forthcoming) have recently suggested one possible mechanism by which this might have been achieved—the elaboration of material culture environments (see also Watkins 2004a, 2004b). Coward argues that the increasing use of material culture 'scaffolded' an increase in the proportion of 'weak ties' in individuals' social networks, thus allowing the establishment of larger permanent aggregations.

Small-scale groups, being composed of individuals with proportionally stronger relationships with one another, are able to function well with minimal communicative codes (Coser 1975: 78), often largely restricted to the 'incorporated' cues of bodily *hexis* and appearance and a minimum of external paraphernalia (Rapoport 1981, 1990, Lofland 1973, Goffman 1959). Cross-cultural studies have demonstrated that larger and more complex societies tend to be those which use more (and more complex) forms of material culture (Whitelaw 1991: 165, Kent 1990a, 1990b, Rapoport 1990: 17, 1969: 9, Donley-Reid 1990: 115, Altman and Lett 1970). These, Coward argues, are societies where many—indeed, most—relationships are 'weak ties' based on categorical social roles. In these societies, 'elaborated' forms of social communication, often relying on specialized forms of material culture in the form of 'settings' and personal 'fronts', become increasingly necessary to regulate social interaction between individuals who are virtual strangers. Elaborating the 'settings' for social interaction simplifies social interactions and performance by off-loading the social information necessary for effective interactions from human memory into the material environment. Rather than having to remember detailed biographical information about the others involved, individuals need only establish the 'category' of interaction and relative roles within that (a lecture, a trip to the supermarket, having a haircut, etc.) and then rely on prior experience to ascertain the outlines of the social performances required. In this way, individual interactions become simpler even as the social fabric in which they are embedded becomes ever-more intricate (Gamble 1998, Strum and Latour 1987: Figure 1, Rapoport 1981: 30, see also Watkins 2004a, 2004b for further discussion of the symbolic aspects of this process).

Formalized social structure, ideology, and religion

While material culture may be an important means of facilitating interaction between strangers, it does not in and of itself explain how large groups are maintained over greater timescales. Indeed, the simplification of individual performances and interactions through the use of material culture, combined with the increasing salience of materially signified roles and statuses, arguably *exacerbates* one perennial problem facing social aggregations—the need to insure against freeloaders and cheats who claim all of the benefits of group living while contributing nothing to the group themselves (Dunbar 1999, 2008 [this volume, chapter 1]).

In small-scale groups, where most members are connected to one another by strong links, it is relatively easy to maintain 'social surveillance' over others to ensure that they continue to pull their weight in the group (see, for example, Curry and Dunbar 2011). However, the increasing fragmentation of larger social groups makes it more difficult to monitor others' behaviour, and reliance on elaborated material environments may make it easier for freeriders to avoid detection by simply adopting the relevant social signals.

A decrease in one's perceived ability to detect freeriders, coupled with the impossibility of sharing with everyone in larger groups, may be part of the explanation for why the egalitarian social norms obliging foragers to share with others are ultimately exchanged for the delayed-return systems (Woodburn 1980, 1982) typically seen among agriculturalists, which involve individualized household economies and the accumulation and storage of surpluses (Benz 2010: 80). Furthermore, a decline in the importance of generalized reciprocity may also result in a feedback loop as it negatively impacts on insurance against resource stress in the event of environmental perturbations which must be compensated for by investing in further delayed-return systems. As more is invested in group- or household-level storage, or individuals and/or groups specialize and establish trading networks with other individuals or groups with access to different kinds of resources, thereby becoming increasingly interdependent, the need to insure against freeloaders and cheats becomes ever more pressing (Watkins 2004a: 16).

This increasing vulnerability to freeriders as egalitarian norms and systems of social surveillance begin to fail at higher group sizes is likely to be one reason why larger and longer-lived aggregations generally demonstrate a shift in social organization (Naroll 1956, Johnson and Earle 2000). The style of social organization typical of mobile hunter-gatherer groups is 'bottom-up', based primarily (if not solely) on kinship and structured around extended family and local bands (Whitelaw 1991: 153). While highly effective at integrating small, dense groups of people tightly interconnected by 'strong' social ties, such informal organizational structures are insufficient to constrain social conflict even in relatively small-scale aggregations (Benz 2010: 80), as demonstrated by studies of the (often artificial) imposition of large, sedentary settlement systems on traditional communities (Whitelaw 1991: 181). Aggregations of larger numbers of people

over longer timescales are generally associated with more formal institutions of social organization (Whitelaw 1991: Table 2).

In part, this is likely to be because the cooperation, altruism, and concern that are marked in the more exclusive inner layers of individuals' social networks (and especially relatives) rarely extend beyond the layer encompassing ~150. Thus levels of trust in others' willingness to cooperate are likely to drop dramatically beyond this level of an individual's social network, and the need for social surveillance to ensure that others are not freeriding on one's investment in the group will increase. Economic games suggest that people are willing to bear a cost to punish freeriders or to reward cooperators (Rand et al. 2009, Gintis et al. 2003, Fehr and Gachter 2002), and the costs of such 'policing' of sociality are likely to increase significantly where increasing group size impairs social surveillance—thus explaining why larger groups need explicit, formalized mechanisms for monitoring others and ensuring cooperation. Indeed, the Hutterites (a religious group who live in communes, mainly in North America) deliberately maintain communities at or below the level of ~150 members explicitly in order to be able to maintain an egalitarian social organization *without* such formal mechanisms for imposing order (Dunbar 2008 [this volume, chapter 1]).

Larger and more fragmented groups will also face problems in disseminating and integrating information. Although higher rates of information flow and access to novel ideas and skills are often cited as positive effects of increasing group size, Dunbar's (2011b) analyses of information flow within groups of different size found that the progressive drop-off in rate of contact between individuals at more inclusive distant layers of the social network means that the benefits of larger social networks begin to decline when communities exceed only around ~50 individuals, and become increasingly marginal at around ~150 (Fig. 17.2). Due to the fracturing effect of the cognitive constraints on hierarchical social structure, no further gains in efficiency of information flow are made at all beyond a community size of around ~1,500 members.

Communities above ~150 members, then, are likely to need some form of specialized system of organization, surveillance, and/or information dissemination to monitor group members and ensure they fully 'buy into' the concept of a wider 'community', and to punish non-cooperators. One solution is the establishment of group ideology and ritual—in particular, *religious* beliefs and practices. Another important mechanism seems to have been the introduction of social hierarchies into community structure. Dávid-Barrett and Dunbar (2012) used agent-based modelling to explore the requirements for cultural coordination (one example would be to agree on a common cultural icon or rule of behaviour), and found that the presence of an elite significantly increases the speed of coordination, resulting in greater economic benefits to the advantage of all members.

Religion, and in particular organized religion, seems to have played a particularly important role in effecting social cohesion after the appearance of settlements. There is a long-standing body of work on the topic of religion as a means of promoting group solidarity (for references, see Sosis and Bressler 2003: 212). Much of this has focused on the suggestion that religious beliefs and practices developed specifically to combat the threat posed to larger communities by freeriders (Dunbar 1999, 2008 [this volume, chapter 1]). Non-cooperators are often adept at sending out the right signals, paying lip-service to the beliefs of others,

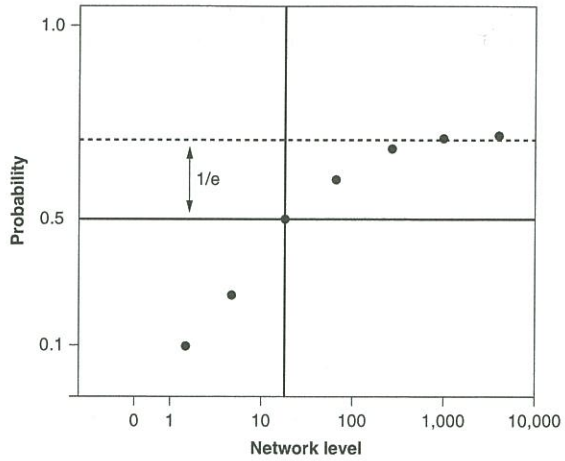

Fig. 17.2. Cumulative probability of acquiring an item of knowledge through face-to-face interaction with an individual who has that knowledge in communities of different size (5, 15, 50, 150, 500, 1,500, and 5,000), based on the contact rates given by Dunbar (2011b: figure 5). The model assumes that 1 per cent of all community members are knowledgeable. For logistic relationships, the inflexion point (the point at which the rate of gain on the y-axis starts to decline) is defined as the value on the x-axis corresponding to e^{-1} proportion down from the asymptotic value. This marks the point at which the gains start to level off. Reproduced with permission from Dunbar (2011b).

whether that is a 'belief' in the community from which they derive benefits or a formal 'religious' belief. Perhaps because of this, many groups and religions have established *costly* signals which are hard to fake as markers of membership (Sosis and Alcorta 2003).

Such groups may require adherents to invest time or money, or to engage in various forms of self-denial (such as the renouncing of alcohol, tobacco, or meat, foregoing sex, or engaging in isolation or fasting). These costs must be balanced by individual gains, and there is a large literature on the purported benefits of religion, and in particular of religious *practice*. These include physiological and psychological benefits such as improved health, fertility, and psychological well-being (Reynolds and Tanner 1995). In contrast, the evidence for significant individual fitness advantages from religiousness is mixed (Boyer and Bergstrom 2008: 115). This may be because the substantive benefits from religion probably derive from its capacity to generate social cohesion rather than immediate benefits at the individual level (Sosis and Alcorta 2003, Dunbar 2008 [this volume, chapter 1], 2013).

Costly signals have been extensively studied in animals (Zahavi and Zahavi 1997). In the context of human religion, costly signals serve as transparent signals of one's commitment to the group cause (Sosis and Bressler 2003, Irons 2001), thereby promoting mutual trust and enabling groups to avoid the costs of establishing formal systems of monitoring and punishment (Sosis and Bressler

2003: 72). This suggestion is supported by a burgeoning corpus of empirical evidence. Sosis and Bressler (2003) suggest that the major causes of group collapse and dissolution are internal disputes and economic failure (taken to indicate a low level of willingness to contribute to the group), highlighting the divisive effects of within-group tensions in large aggregations. However, it is noteworthy that religious communities are much less likely to dissolve than secular ones and, on average, persist for longer (Sosis and Bressler 2003, Sosis and Alcorta 2003).

The costs of group membership and the frequency of group ritual have been invoked as potential explanations for this observation, as both are more frequent among religious groups. There is some evidence to suggest that the more costly the commitment demanded of members of religious communes, the more successful (or at least long-lived) those groups are (Sosis and Bressler 2003: figure 1, Sosis and Alcorta 2003, Kanter 1972), suggesting that requiring conspicuous sacrifices of individuals does indeed enhance group cohesion. However, the costs of group membership did not seem to relate to the longevity of secular groups, suggesting that there is something specific to *religious* belief and commitment that enhances group bonding and cohesion among religious groups compared to secular ones. Might this relate to the increased frequency of religious group ritual?

It is well-established that group activities such as rhythmic dancing, chanting, and laughter trigger the release of endorphins which enhance group bonding (Dunbar 2009b, 2013, Dunbar et al. 2011, 2012). In traditional small scale forager societies, religion is experiential in form, typically lacking a coherent theology, any formal rituals, places of worship, or priests; instead, trance dancing is commonly used to enter trance states in which the adept engages in travels in the spirit world (Eliade 1964, 1978). In southern African San communities, trance dances are typically held at times when it is felt that community cohesion is deteriorating (Marshall 1999, Alan Barnard, personal communication). Similar observations have been reported for the Aranta in Australia (Spencer and Gillen 1904). The effect of holding a trance dance seems to be to restore social equilibrium. With time, the stresses and strains of social living inexorably lead once more to a decline in cohesion, triggering the need for another trance dance. The cycle length is commonly in the order of a month or more.

We know little about the physiological processes involved, although Lewis-Williams (2002) has discussed the hallucinogenic-like aspects of trance states. While these effects are undoubtedly real and important, the substantive effect probably arises from the endorphin activation triggered by the physical exertion of the dancing. In effect, it produces the same kind of psychopharmacological state that grooming produces among non-human primates at the dyadic level and laughter and music at the group level in humans (Dunbar et al. 2011, 2012), but does this on a larger scale that can involve many more individuals. As a result, it has the effect of generating in many individuals at the same time an enhanced sense of bondedness and commitment to the larger community. This is something of a crude psychopharmacological fix and it seems to rely heavily on the physicality of dancing and musical performance to produce the trance effect (Rouget 1985). Cohen and colleagues have shown that synchronized activity (in this case, sweep oar rowing) ramps up the endorphin effect generated naturally by physical exercise (Cohen et al. 2010), and it seems that there is something about synchrony

that ramps up endorphin activation, producing the sense of uplift and social engagement that Durkheim (1915) referred to as *effervescence* and Turner (1966) as *communitas* (see also Ehrenreich 2006)—though we have no idea why this happens. The consequence seems to be to be enhanced pro-sociality and altruism (Wiltermuth and Heath 2009), and there is indeed some evidence to suggest that higher levels of cooperation are more common among those who are not only religious but also engage more regularly in collective rituals (Ruffle and Sosis 2007, Sosis and Bressler 2003).

The switch from the dispersed communities of foragers to the larger co-resident communities of Neolithic villages seems to have sparked a major shift in the style of religion. From this point on, we see the progressive rise of doctrinal religions—religions that have theologies, priests, hierarchies, formalized rituals, places of worship, and more frequent and more regular religious events (Eliade 1978). However, more regular ritual practice demands discipline from the individuals involved to ensure that they turn up regularly. In other words, some mechanism is needed to persuade people to keep turning up. This is precisely the function of a formal theology: it provides a reason why individuals should believe what they do and why they should take part in the regular cycle of worship and ritual as laid down by these beliefs.

This phase shift into doctrinal religions is associated with the appearance of high (or moralizing) gods. Roes and Raymond (2003) linked these to social complexity, notably the appearance of larger chiefdoms, and were able to demonstrate a correlation between the frequency of internal conflict and social complexity. Moralizing gods thus play a role in controlling freeriding through the threat of future punishment, either in this life or the next. Known as the 'fear of supernatural punishment hypothesis' (Johnson 2005), this suggestion has received considerable support (Johnson 2005, Atkinson and Bourrat 2010, Bourrat et al. 2011). However, without being cognitively capable of fifth-order intentionality (the typical limit for most adult humans: Kinderman et al. 1998, Stiller and Dunbar 2007, Powell et al. 2010, Lewis et al. 2011), we would not be able to conceive of a high god capable of making such demands on us (Dunbar 2008 [this volume, chapter 1]). Belief in supernatural beings may thus act to enforce group norms in larger groups where social surveillance becomes impossible, allowing religious groups to reduce the costs of monitoring and/or punishment systems designed to minimize the impact of freeriders on the group.

ARCHAEOLOGICAL EVIDENCE FOR CHANGES IN SOCIAL ORGANIZATION, RELIGION, AND IDEOLOGY

The organizational principles characteristic of early Neolithic societies in the Near East remain a topic of considerable debate, but a number of recent reviews have found support for the possibility of 'household' or 'lineage' systems of organization cross-cutting basic family structure in pre-pottery Neolithic sites (see Kuijt 2000c for review and discussion). Lévi-Strauss's concept of the 'House Society' has been invoked here (Watkins 2004a: 11, Kuijt 2000c: 318), with researchers pointing to the increasing elaboration of household architecture and the apparent

shift of activities formerly conducted communally and in the open *into* individual houses, as evidence for the increasing importance of the 'household' as a social and political organizational principle. Others have suggested that the examples of remodelled and publicly or privately displayed skulls represent evidence for the veneration of 'ancestors' or heads of lineages, perhaps pointing to a lineage-based system of social structure involving groups of related families headed by elders as the major structuring principle (e.g. Kuijt 2000c, Bar-Yosef 1995: 198). However, such conclusions may be somewhat undermined by work which has concluded that there was little evidence to suggest any expansion of households per se beyond the nuclear family (Byrd 2000).

It does seem clear, however, that later Epipalaeolithic and early Neolithic groups were increasingly capable of mounting group-level endeavours that must have required, if not necessarily *hierarchical* organization, then certainly some level of group cohesion. Many sites, while clearly those of semi-mobile hunter-gatherer groups, seem to demonstrate considerable investment by potentially large numbers of individuals. For example, many sites boast evidence of large-scale earthworks; sites are often 'dug in' to the sides of terraces (e.g. 'Ain Ghazal [Rollefson 1986]; Basta [Vries 1992]; Nahal Oren [Noy et al. 1973]) and/or boast large walls (perhaps retaining walls for terracing; e.g. Beidha [Bar-Yosef 1995]; Halula [Molast 1998]; Magzaliya [Bader et al. 1981]; Wadi Faynan 16 [Finlayson and Mithen 2007]; 'Ain Ghazal [Kuijt and Goring-Morris 2002]). Other examples of group endeavours include the tower and wall at PPNA Jericho (Kenyon 1981), or the 'communal' structures found at a number of pre-pottery sites (e.g., 'Ain Ghazal [Rollefson 1997, 1984]; Beidha [Byrd 1994]; Çayönü [Özdogan and Özdogan 1989]; Göbekli Tepe [Bischoff 2007, Schmidt 2001, 2003]; Gurçu Tepe [Hauptmann 1999]; Hallan Çemi Tepesi [Rosenberg and Redding 2000]; Jerf al Ahmar [Stordeur 2000]; Nevali Çori [Voigt 2000]; Qermez Dere [Watkins 1995] and Tell al Abr' [Yartah 2005].

Traditionally, 'communal' or 'non-domestic' buildings have been related to the growing importance of ideological and religious rituals in daily life. However, the extent to which the buildings reflect specifically *religious* ideology, rather than simply evidence of group endeavours, remains unclear. The tower and wall at Jericho, for example, long held to be religious or ritual in nature, is now more usually considered a flood defence system (Bar-Yosef 1986), although it may have been appropriated for religious purposes later on. However, it is undeniable that many late Epipalaeolithic and early Neolithic sites show considerable evidence for organized communal ritual and/or religious activity. As noted above, communal buildings are known from a number of sites; such 'special purpose' buildings or 'sacred precincts' are typically significantly larger than obviously domestic structures, often boast particular effort in internal fittings (benches; lime plaster, flagged or terrazzo floors, fittings such as basins), yield higher-than-average levels of 'exotic' materials such as obsidian, and lack domestic refuse.

In addition, many of these buildings also demonstrate 'a great concern with imagery, symbolism and symbolic representation' (Watkins 2004a: 8), sometimes on stone monoliths and friezes engraved or sculpted in relief (e.g. at Göbekli Tepe, Nevali Çori and Jerf al Ahmar; see Hole [2000] for further discussion of some of these sites). At some sites, these 'communal' spaces are also associated with

human remains—often large numbers of disarticulated bones and especially skulls mingled in charnel rooms (e.g. Abu Hureyra [Moore and Molleson 2000]; Çayönü [Özdogan 1999]) and/or collective burials of large numbers of individuals (e.g. Kfar HaHoresh [Goring-Morris et al. 1995, Goring-Morris et al. 1994–5], Beisamoun [Lechevallier 1978], Dja'de [Coqueugniot 2000]). The frequent findings of figurines, often of women and wild animals (especially bulls), and of representations in other formats such as sculpted monoliths, has prompted suggestions that these may be depictions of gods and goddesses, and/or of sacred animals. Indeed, Cauvin (2000) has identified the Neolithic as the 'birth of the Gods'.

Speculation as to the specific religious meaning of these representations and the practices that surrounded them is beyond the scope of this chapter. It is, however, notable that few of these structures seem large enough to house the full population of any site (Hole 2000: 205), suggesting that participation was limited to a certain sector of society—perhaps to 'elders' or heads of lineages, or to ritual specialists. On some sites, more than one 'special structure' may have served different elements of the group contemporaneously (e.g. Hallan Çemi Tepesi [Rosenberg and Redding 2000]). Indeed, a number of sites seem to demonstrate evidence of being composed of several more or less distinct groups (Rollefson 2000: 185–6, Coqueugniot 1998, 2000). These observations might support a model of limited hierarchicalization, with social differentiation mainly horizontal rather than vertical, and probably most archaeologists would agree that early Neolithic communities were not at this time fully hierarchical in the sense of having a ruling elite. The striking similarity of layout and equipment between houses and apparently collective burial rites have been hailed as signalling a basically egalitarian society, and many scholars posit forms of elaborated kinship or 'tribal' systems for the period, although others have cautioned that we should be in no rush to categorize other societies in this way (e.g. Asouti 2006: 105).

However, others have argued that this egalitarianism may have been coming under increasing strain at this time, and that the ideological emphasis on egalitarianism in burial, and the focus on representation of wild animals as symbolic of shared resources, might in fact be a response to an increasing fractionalization of society. Burials may remain largely undifferentiated in terms of status, but only a small percentage of inhabitants' bones are represented on sites, and while some are accorded special treatment, others are found apparently disposed of as waste (Goring-Morris and Belfer-Cohen 2010, Goring-Morris and Horwitz 2007, Rollefson 1984, 2000: 170, 184, Rollefson et al. 1992). An increasing codification of funerary practices (e.g. Coward, forthcoming) might indicate not only incipient social differentiation (for discussion, see Goring-Morris 2000, Kuijt 2000c) but also an increasing role for ritual specialists, perhaps foreshadowing the emergence of ritual, civic, and economic 'elites' (Asouti 2006: 98–99). In short, ideological appeals to traditional values such as egalitarianism and the sharing of wild food resources may mask a breakdown in the fundamental social norms of foragers (Benz 2010: 83, see also Bogaard and Isaakidou 2010) as group sizes expanded rapidly, but without the changes in social structure and organization necessary for large aggregations to persist in the long term—a dramatic but short-lived experiment that was to end with the PPNB 'collapse'.

CONCLUSION

The Neolithic 'Revolution' has long been mooted as a significant turning point in human prehistory. However, such accounts have more usually focused on the economic and ecological ramifications of Neolithization, with social changes such as the adoption of sedentary village life often seen as inevitable secondary consequences. Consideration of the broader context of social aggregation, however, demonstrates that the dramatic scaling-up of social lives apparent among these early Neolithic groups must have presented significant problems of its own. Not only ecological but cognitive constraints needed to be overcome before long-term aggregations could be established. Some of the innovative practices that may have made this possible have been discussed in this chapter. They include an increasing elaboration of material culture environments to simplify social interactions with the increasing proportion of the population that individuals do not know very well, and the establishment of additional new types of formalized, 'top-down' social organization and group and religious beliefs to minimize the costs of 'policing' communities and identifying freeriders.

While it has long been noted that the early Neolithic is associated with an 'explosion' of material culture, despite some impressive work such as that by Watkins examining the role of material culture in embodying symbolic codes (e.g. Watkins 2004a, 2004b), the reasons for this have remained largely unexplored. Further research in this area is likely to prove highly fruitful. First, more detailed analysis of settlement sizes is clearly needed to clarify the pattern of expansion, coupled with analysis of individual houses to establish better parameters for estimating the numbers of inhabitants. One possibility might be the use of proxemics (Sanders 1990, Hall 1966) and/or formal spatial analysis techniques (Hillier and Hanson 1984); analyses using these and similar techniques are also likely to provide valuable information on the kinds of social interaction these buildings were designed for, and which could inform greatly on our understanding of the kinds of social relationships inhabitants engaged in (see e.g. Banning and Byrd 1989 for an early example of such analysis).

There is also considerable potential for work on the role that houses may have played in Neolithic social networks. The burial of some individuals and/or the caching of skulls inside houses, below (and indeed in some cases, e.g. at Wadi Faynan 16, deliberately *poking through* [Finlayson and Mithen 2007]) floors, or displayed in niches in walls or on pedestals (e.g. at Tell Ramad [de Contenson 2000]; Tell Mureybet [Cauvin 1978]; see also Kuijt 2000: 149–50 and Table 1) suggests an apparent connection between bodies and burned houses as part of a mooted 'death rite' for individual houses. In some cases, structures seem to have been deliberately destroyed and abandoned (e.g. Nemrik House 2A [Kozlowski 2002]; Çayönü [Rollefson 2000, Özdogan 1999]; Jerf el Ahmar [Stordeur 2000]). In conjunction with the repeated reconstruction and re-working of houses on the same footprints elsewhere (e.g. Abu Hureyra [Moore et al. 2000]) and the multiple episodes of re-plastering of floors and walls common on some sites (e.g. Nemrik [Kozlowski 2002]; Es-Siffiya [Mahasneh 1997]; Beidha [Byrd 1994]; El-Kowm II [Stordeur 1989]; Dja'de [Coqueugniot 2000]) these observations suggest that houses were thoroughly caught up in and fundamental to social networks within these communities. If individual structures were associated with individuals, families, or lineages (Rollefson 1997), analysis of site layout (where excavations have involved sufficiently large exposures) and the temporal and spatial relationships between structures might be a promising avenue of research into the topic.

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