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Author for correspondence:
Anna Marie Prentiss
e-mail: anna.prentiss@umontana.edu

Evolution of the Okvik/Old Bering Sea culture of the Bering Strait as a major transition

Anna Marie Prentiss[1], Cheyenne Laue[1], Erik Gjesfjeld[2], Matthew J. Walsh[3], Megan Denis[1] and Thomas A. Foor[1]

[1]Department of Anthropology, University of Montana, Missoula, MT 59812, USA
[2]McDonald Institute for Archaeological Research, University of Cambridge, Downing Street, Cambridge CB2 3ER, England
[3]Modern History and World Cultures Section, The National Museum of Denmark, Ny Vestergade 10 Prinsens Palæ 1471, Copenhagen, Denmark

AMP, 0000-0002-9393-3170

Great transitions are thought to embody major shifts in locus of selection, labour diversification and communication systems. Such expectations are relevant for biological and cultural systems as decades of research has demonstrated similar dynamics within the evolution of culture. The evolution of the Neo-Inuit cultural tradition in the Bering Strait provides an ideal context for examination of cultural transitions. The Okvik/Old Bering Sea (Okvik/OBS) culture of Bering Strait is the first representative of the Neo-Inuit tradition. Archaeological evidence drawn for settlement and subsistence data, technological traditions and mortuary contexts suggests that Okvik/OBS fits the definition of a major transition given change in the nature of group membership (from families to political groups with social ranking), task organization (emergent labour specialization) and communication (advent of complex art forms conveying social and ideological information). This permits us to develop a number of implications about the evolutionary process recognizing that transitions may occur on three scales: (1) ephemeral variants, as for example, simple technological entities; (2) integrated systems, spanning modular technology to socio-economic strategies; and (3) simultaneous change across all scales with emergent properties.

This article is part of the theme issue 'Human socio-cultural evolution in light of evolutionary transitions'.

1. Introduction

Szathmary & Maynard Smith [1] argue that the major evolutionary transitions are characterized by hierarchical shifts in the locus of replication and selection, dramatic expansion in task specialization and revolutions in communication systems. While subsequent research has identified many nuances to this process, multi-level selection, labour diversity and changing communication strategies remain essential. Put another way, major evolutionary transitions develop from altered relationships between formerly individual parts or what is in effect an evolutionary transition in individuality [2–4]. The emergence of proto-language and new forms of group integration and cooperation in early *Homo* provides a strong example. Arguably, later cultural transitions including the emergence of agricultural polities and state level organizations also reflect aspects of major evolutionary transitions. Szathmary [5] suggests that major evolutionary transitions develop when units that reproduce independently develop 'functional synergies' and novelty in their inheritance systems. The same can be said for social systems, including those of humans (cf. [6], 30). Simulations of cultural evolutionary dynamics suggest that cultural traits may emerge and persist in small populations for long time spans [7]. From

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Figure 1. Map of Bering Strait area showing select major sites representing the cultural phases discussed in this paper. (Arctic Small Tool tradition: Margaret Bay, Cape Krusenstern, Iyatayet; Chukchi Archaic: Chertov Ovrag and Old Whaling/Cape Krusenstern; Choris: Choris sites; Norton: Iyatayet, Difchahak and Qayassiq; Ipiutak: Deering, Ipiutak/Point Hope and Cape Krusenstern; Okvik/Old Bering Sea: Hillside and Uelen).

this standpoint, periods of macroevolutionary stasis could be a productive time for cultural variants emerging in limited transitions. Such traits could periodically recombine in what we might interpret as events resembling major transitions [8].

Laue [7] and Laue & Wright [8] argue that transitions can occur on three scales that we refer to as Types 1–3. Micro-scale changes such as adjustments to simple technologies (Type 1) are easily accumulated in small populations under low selection pressure. Selection and neutral processes can then configure integrated packages ranging from architectural designs to socio-economic strategies (Type 2). Finally, high-level cultural emergence (effectively, cultural speciation) is possible under rare conditions where elements from all scales spanning minute traits to integrated packages of various scales are swept up in a rapid and driven (e.g. [9]) evolutionary process leading to emergent cultural phenomena (Type 3). The latter represent rare great transitions in cultural evolution, as for example, the emergence of agricultural systems and state-like societies with urban centres.

We review data from the middle to late Holocene in the Bering Strait area (figure 1) in three areas: locus of selection, technology and labour diversification and communication systems, to address the nature of the transition from the Paleo-Inuit to the Neo-Inuit cultural pattern as embodied in the Okvik/Old Bering Sea (Okvik/OBS) culture [10]. Current data suggest that during this transition the scale of cultural reproduction and selection shifted from individuals and families to multi-settlement polities; task specialization expanded substantially with the advent of intensive hunting and crafting traditions; and communication systems were revolutionized by the development of complex symbolism coded in dramatic embellishment of every-day objects. These outcomes permit us to postulate an evolutionary model for the rapid development and emergence of the Okvik/OBS pattern. In doing so, we recognize that multiple cultural lineages spanning technologies to seasonal settlement and subsistence strategies converged to create the conditions that made it possible for a macro-cultural entity as complex as Okvik/OBS to emerge. We argue that this result offers new insights into what were likely similar processes operating in other times and places, for example the early Holocene eastern Mediterranean region.

2. The Old Bering Sea culture and the emergence of the Neo-Inuit tradition

North American Arctic archaeologists recognize two major cultural traditions of the past 5000 years (figure 2). The Paleo-Inuit tradition is widely understood to represent an expansion of Middle Neolithic Siberian residentially mobile hunting and gathering populations into eastern Siberia (Chukotka), across the Bering Strait and into Alaska, and eventually colonizing the Eastern Arctic including the coasts of Greenland during the period of ca. 4000–5000 cal. BP [12–14]. Archaeologically, these groups are designated culturally as the Arctic Small Tool (ASTt) [15] and Dorset [16] traditions, characterized by exquisitely manufactured miniscule lithic tools including bi-convex arrow points, triangular harpoon end blades, D-shaped harpoon side blades, hafted burins, hafted concave scrapers, microblade tools and partially ground adzes. The ASTt cultures (Saqqaq and Pre-Dorset) of the Eastern Arctic transitioned into the Dorset tradition by about 2500 years ago and subsequently persisted until the early portion of the last millennium with virtually no evidence for contact with any external populations [11,17,18].

The Neo-Inuit tradition emerged in the central and western Bering Strait shortly after 2000 years ago (ca. 1650 cal. BP) as the

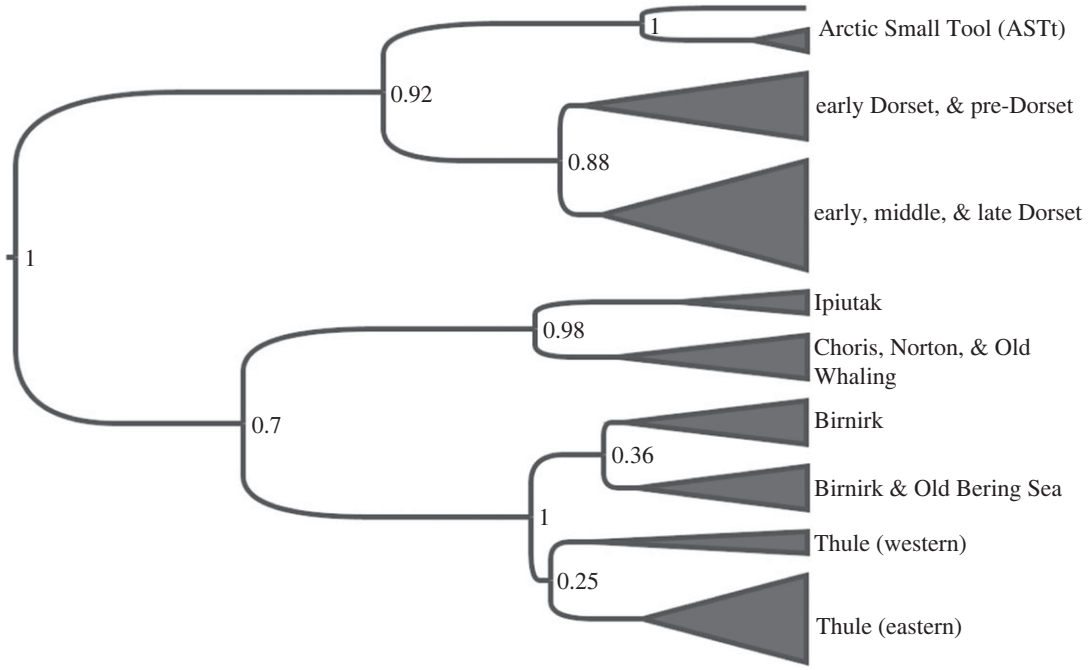

Figure 2. Bayesian phylogenetic tree illustrating evolutionary relationships between major cultural entities in the eastern Siberian and North American Arctic drawing on harpoon head, house architecture, and lithic tool assemblage data (the tree was synthesized from data provided in [11]). This tree demonstrates the major split between Paleo-Inuit (early ASTt, pre-Dorset and Dorset) and Neo-Inuit (Old Bering Sea, Birnirk and Thule lineages). Old Whaling, Choris and Ipiutak are often classified as late Paleo-Inuit and represent intermediate or transitional cultures to the Neo-Inuit group. Old Bering Sea (Okvik/OBS) is the earliest dated fully Neo-Inuit culture.

Okvik/Old Bering Sea culture (OBS), which gave rise to daughter cultures known as Birnirk and Punuk, and in turn the Thule culture [10,19–24]. The Thule culture is sub-divided into western and eastern variants reflecting rapid expansions around the Alaskan coast and across the Eastern Arctic to Greenland where it fully replaced the last of the Dorset culture [11,18,25,26]. Archaeologists agree that Thule populations brought strategies that made them highly adaptable and competitive as compared to the more ancient Dorset cultural pattern. While Dorset groups had persisted in small groups across the Eastern Arctic for millennia on the basis of a flexible adaptation focused on hunting of seal, caribou, muskox and small game, they lacked substantial boats, dog sleds, bows and arrows and bow-drills [27]. By contrast, the incoming Thule groups brought a complex technological repertoire including large open boats (umiaks), dog sled systems, harpoon and float bag systems permitting whaling, compound bows and arrows, and a myriad of other innovations [27]. Critically, they brought with them conceptions of social status hierarchies, territoriality and warfare that had developed across the preceding millennium [21,28].

There remains an intermediate set of cultural entities in western Alaska that are less well understood. These date in the range of about 1000–3000 years ago and are identified as the Choris (ca. 2400–2800 cal. BP), Norton (ca. 1000–2500 cal. BP) and Ipiutak (ca. 900–1600 cal. BP) phases [20,22,29–31]. One other little understood cultural phenomenon also dating to ca. 3000 years ago is represented by the Old Whaling (OW) site, located at Cape Krusenstern, Alaska [24,29]. These entities hold in common stone tool technologies that have resemblances to ASTt patterns including distinctive end and side blades, burins and scrapers. They also have evolved harpoon systems and intensified hunting of sea mammals, especially seals. Finally, each has more substantial driftwood house features as compared to the more ephemeral hide-covered tents of Alaskan ASTt groups. Some significant inter-cultural variation is also present as Choris and Norton feature the use of pottery while Ipiutak does not [22,29]. Ipiutak in turn has a dramatic investment in socio-religious iconography as reflected in burial treatments and imagery incised on to ivory and antler tools that is lacking in Old Whaling, Choris and Norton [31–33].

While the OW, Choris, Norton and Ipiutak cultural entities are considered to be derived Paleo-Inuit and thus generally seen as loosely transitional between the late ASTt of the Western Arctic (known as the Denbigh Flint Complex; DFC) and the earliest Neo-Inuit culture (Okvik/OBS), details are debated. A long-standing scenario suggests that Choris evolved from northwest Alaskan ASTt (DFC) and subsequently gave rise to Norton [34–36]. There is general agreement that Ipiutak arises from Norton [22,31]. Alternatively, Mason & Rasic [24] suggest that OW represents a wider adaptive pattern they call the Chukchi Archaic as represented by sites to the west in Chukotka. Mason & Gerlach [37] argue that Choris, therefore, represents a different population possibly deriving from southwest Alaska (eastern Aleutians and Bristol Bay) and bringing unique cultural traits (including labretifery) and a technology enabling walrus hunting. Darwent & Darwent [29] are loath to attribute Choris to any particular origin, noting that the archaeological record we call Choris may represent groups with a blend of Asian and North American cultural traits. In turn, Okvik/OBS is thought to be a similar composite of traditions with elements of the Chukchi Archaic (notched projectile points), pottery from Chukotka, and artistic practices from East Asia but possibly also Ipiutak [24]. Whatever the pathways, the establishment of Okvik/OBS is widely hailed as a significant transition as it marks the beginning of the Neo-Inuit or Northern Maritime tradition [27,28,38]. Prentiss *et al*. [11] argue that Okvik/OBS emerged as an integrated cultural entity in a cultural transition resembling speciation.

3. Locus of selection

There is extensive discussion in cultural evolution concerning locus of selection. We recognize evolutionary forces acting on scales ranging from ephemeral traits to organizing principles that structure more complex integrated systems [11,39]. While the former can evolve on the basis of inter-personal cultural transmission, the latter code for organization structures and are thus dependent upon cooperation within groups [9]. Transitions in the evolutionary process thus may include shifts in the locus of selection from individuals to groups, which is a hallmark of major transitions [1]. Boyd & Richerson [40] and Soltis *et al*. [41] make the case that group selection can be an essential force in cultural evolution. We measure potential locus of selection in the archaeological record of early Paleo-Inuit (ASTt/DFC), late Paleo-Inuit (Choris, Norton and Ipiutak phases) and early Neo-Inuit (Okvik/OBS) by examining organization of group subsistence, settlement and land tenure. In doing so we recognize three scales of group integration: households, autonomous winter villages and multi-village political groups.

There is wide agreement that ASTt groups (DFC) were residentially mobile seeking diverse food resources within and between interior and coastal contexts with little to indicate formal villages or territoriality [15,42]. Consequently, we conclude that these populations were never integrated beyond scales of family groups. Choris groups relied upon both terrestrial (especially caribou) and marine (seals) fauna [29]. While Choris occupations are best known from small winter settlements in coastal contexts, interior sites are known, for example, Onion Portage, raising the possibility of seasonal movements and a diverse subsistence base [43]. Dumond [35,44,45] notes that Norton sites are widely distributed along western and southwestern Alaskan coastal contexts but also substantially up major river valleys. Some winter settlements are large with dozens of winter houses and while most have poor archaeological records of subsistence, context and artefacts suggests an economy focused on sea mammals, anadromous fish and caribou (e.g. [46,47]). Ipiutak occupations are widely distributed across northwest coastal and northern interior Alaska where settlements spanning small to large aggregations are well known (e.g. [33,43,48]). Clearly, Ipiutak groups moved between coastal contexts where they pursued sea mammals (especially seals) and interior contexts where they focused on caribou [36,43,49]. Given that Norton and Ipiutak groups maintained regularly visited winter villages (Choris is less well understood), it is likely that social relationships were defined via membership in village-scale social groups with at least some sense of group-controlled hunting, fishing and gathering territories [22].

By contrast, Okvik/OBS groups on St. Lawrence Island and the eastern shores of Chukotka concentrated on seals, walrus and whales [24,50], though as noted by Mason [22], details regarding subsistence priorities remain to be worked out. Deep middens, house mounds and extensive cemeteries (e.g. [51,52]) confirm commitments by Okvik/OBS populations to particular places and thus it appears likely that these groups were residentially sedentary. Further, clusters of major villages with associated cemeteries marked by shared raw materials, tool forms and artistic iconography points to the likelihood of multi-village polities with formal associated territories [20]. Interpersonal social relationships in the Okvik/OBS communities changed dramatically compared to those among earlier groups. Large-scale cemeteries were established in Okvik/OBS contexts on St. Lawrence Island and in eastern Chukotka. Cemeteries at Eulen, Ekven and Chini demonstrate substantial disparity on burial treatment from the standpoints of tomb creation and placement of grave goods [51,53,54]. As summarized by Mason [10], this disparity is especially evident at Eulen and Ekven where human remains were often placed in simple shaft burials with small collections of functional tools (knives, end blades, harpoons, ceramic bowls and various fragmentary items). By contrast, a more limited number of burials include creation of a formal tomb lined by whale bones with interred human remains and grave goods sometimes resting on wooden floors. Grave goods in these contexts often consist of dozens of items that include harpoons, fore-shafts, spears, arrows, adzes, bark containers, ceramic vessels, ornaments, masks, winged objects (harpoon stabilizers) and various raw material items. Some of these tombs include more than one individual raising the possibility that they were crypts reused by social groups [55]. Thus, there are clear indicators that wealth-based inequality existed and that it was often held by elderly individuals and some women. We emphasize that this pattern was new as there is no evidence for either large cemeteries or material wealth-based inequality between burials in any previous archaeological complex in the region.

Overall, these data suggest that explorations of winter sedentary village groupings probably began with the late Paleo-Inuit groups, which, as noted above likely also incorporated spring, summer and fall mobility into annual cycles. Thus approaches to annual sedentism evolved from the highly mobile ASTt (Paleo-Inuit) to the seasonally sedentary Choris/Norton/Ipiutak (possibly OW) group and then to the annually sedentary Okvik/OBS groups. Mason & Rasic [24] argue that intensification of walrus hunting played a critical role in the emergence of the Okvik/OBS pattern on St. Lawrence Island and east Chukotka. They raise the possibility of several proximate factors including climate fluctuations and enhanced marine productivity during the period of ca. 1400–1550 cal. BP. However, they also point to intensified social relationships likely involving exchange and warfare during the centuries preceding the latter date. Social demands could have driven an intensified focus on walrus hunting for hides and tusks thus precipitating establishment of permanent socially networked villages protecting key resource-dense localities such as walrus haul-outs. Thus, we argue that the locus of selection centred on individuals and family groups during early Paleo-Inuit times fluctuated substantially between families and autonomous villages groups in the late Paleo-Inuit phases, and transitioned to permanent village networks during the time of the early Neo-Inuit Okvik/OBS phase [20].

4. Technology and labour diversification

It is highly likely that tasks associated with subsistence became significantly more specialized with the advent of intensified walrus and whale hunting during the emergence of the Okvik/OBS culture [10]. Communities would have likely had multiple walrusing and whaling crews responsible for activities spanning technological production (including boat manufacture and maintenance), spiritual activities, and the actual efforts of hunting, butchering, and distribution of products. Burch ([56]; see also [57]) describes multiple economic, political and spiritual roles that were critical to consistent management

of Iñupiaq walrus and whale hunting operations. Despite the likelihood of such specialized positions, we only have limited understanding of how they were organized given the Okvik/OBS villages evidently did not include *qargüich* or men's houses, central to the organization of such groups in later times [58]. However, data on the evolution of many critical technologies also offer implications regarding the emergence of task specialization. Indeed, nearly all data reflect a trend towards significant specialist Okvik/OBS labour investments in the form of elaborately designed harpoons, complex house forms, groundstone technologies and production of pottery. The Okvik/OBS tradition of dramatic artistic embellishment on ivory and antler objects confirms this conclusion and is discussed further under Communication systems (below). Extreme variability in Okvik/OBS grave goods between individuals at major cemeteries (e.g. Uelen, Ekven and Chini) imply that diversity in individual labour roles were present and essential to functioning of community socio-economic and political strategies [51,53]. Stated differently, it is likely that emergent specialist positions included select artisans (workers in stone, ivory, antler and clay), shamans, harpooners, boat makers and others attached to tasks requiring high degrees of training and skill.

(a) Harpoon heads

Harpoon heads represent an essential Arctic technology, necessary for procurement of sea mammals and generally produced by men [59]. Arctic harpoon heads are constrained to a particular range of forms given necessity for a sharp distal blade and a line hole. Beyond these necessities there are a range of variables that could be manipulated. Some of these include the nature of the distal blade (self-armed or attached end blade), use of side blades, proximal and distal barbs, position and number of line hole(s), fore-shaft attachment system and overall basal and distal morphology. Previous phylogenetic modelling [11] combined with assessment of radiocarbon dating on harpoon head styles [59] suggests a number of conclusions about evolutionary process. First, the Chukchi Archaic (Chertov Ovrag and Old Whaling), Choris and Norton harpoon head designs fall within a large set of designs associated with Paleo-Inuit contexts. Second, and in contrast, the Ipiutak harpoon heads align better with Neo-Inuit (Okvik/OBS and Birnirk) designs. While all likely have a common ancestor in the early Paleo-Inuit (ASTt) groups, it is clear that the major innovation between these and all later designs was the advent of toggling harpoon systems with a single proximal barb and no distal barb. Then, further innovations (multiple proximal barbs and side-blade slots) occurred in Ipiutak and Okvik/OBS contexts. These shared design characteristics may have been at least in part due to political alignments between Okvik/OBS and Ipiutak groups [20]. However, the dramatic Okvik/OBS designs were likely the result of selection for specialized walrus and whale hunting requirements [24] with spiritual powers as marked by artistic embellishment [60,61]. The elaborate Okvik/OBS harpoons were likely manufactured by specialists with access to Asian iron necessary for the finely controlled incisions on each tool [10,31].

(b) House architecture

Arctic houses vary from simple tents as marked archaeologically by rings of stones with interior hearths to more permanent structures constructed using driftwood and sometimes whale bone. The latter structures varied in form from oval to rectangular, often with semi-subterranean entry tunnels and floors, and substantial superstructure insulated with sod [62]. Some designs included additional side rooms for storage, cooking and other activities. Given variation in materials and form there is substantial potential for evolution on short- and long-term scales [11,14,63,64]. Architectural variation does not speak directly to labour specialization. However, investment in substantial permanent housing likely aligned with increasing task specialization (hunting, gathering, goods production, ritual specialization). The Bering Strait chronology of house designs is reasonably well understood [11,27], thus permitting us to draw conclusions on the evolutionary process. The Chukchi Archaic (OW), Choris, Norton and Ipiutak taxa are best aligned with the Neo-Inuit group [11]. This reflects the advent of deeper semi-subterranean floors, benches or platforms within the houses, and the presence of substantial posts for roof support. Thus, while there are differences between OW and Choris houses [29], they have in common technological investment in residential permanence as compared with the ephemeral tents of the Early Paleo-Inuit (ASTt) groups. A major change between the OW, Choris, Norton and Ipiutak group and most later Neo-Inuit houses is the presence of hearths on the floors of the former group. Later groups typically invested in ceramic or groundstone lamps for heating purposes. Additional changes in Okvik/OBS include cold sink entrances, stone floors and side rooms (Choris, Norton and Ipiutak houses lack side rooms, though they were used for a brief time in some OW structures at Cape Krusenstern) for specialized activities particularly associated with food processing. All of these changes implicate a pattern of rapid innovations in housing favouring sedentism (complex structures), comfort (cold sinks, benches and platforms), and task specialization (rooms for specific activities).

(c) Lithic tool assemblages

Lithic tools played essential roles in Arctic adaptations as they were used in killing and processing of game (end blades, side blades, knives), preparing clothing and tent covers (hide scrapers), wood, bone and antler working (burins, scrapers, adzes), and specialized functions such as heating and cooking (stone lamps) (e.g. [65]). Thus, at extremes we recognize the highly formed and specific unifacial and bifacial tools of the ASTt used by residentially mobile groups as compared to the generalized flake-tool and groundstone-dominated assemblages of the much more sedentary Okvik/OBS groups. Phylogenetic analysis classifies lithic tool assemblages on the late Paleo-Inuit group (Chukchi Archaic, Choris, Norton, Ipiutak) more in line with early Paleo-Inuit (ASTt) patterns [11]. The former group includes select tools of similar form to that of ASTt assemblages including chipped triangular end blades, small stemmed end blades/projectile points, and bifacial side blades, while lacking formal hafted burins and microblades. Further, sites from this group also include distinctive perforators, curvilinear flake knives and abraders. By contrast, the late Paleo-Inuit groups lack many of the ground slate tools typical of later Neo-Inuit sites. Finally, the latter group lacks the specialized chipped blades, scrapers, microblades and burins typical of Paleo-Inuit contexts. Thus, it appears that while there were select changes in favoured tool forms between the earlier and later Paleo-Inuit assemblages (including an increase in overall tool size) the major changes came with the advent of Okvik/OBS and the Neo-Inuit tradition. We suggest that this

time marked a radical reorganization of lithic technology from one that favoured a multitude of precisely designed and manufactured chipped stone tools to a system that favoured limited formal chipped stone tools, generalized flake tools and multipurpose ground slate tools. These results agree with scholarship elsewhere that links sedentism with decrease in specialization and formality in lithic technology [66]. It also reflects the emergence of a tool production system requiring substantial investment in tool manufacture during down time. Groundstone tools require significant investments in time given the requirements of abrading and often sawing stone to create final forms (e.g. [67,68]). This pattern is therefore in line with expectations of a sedentary society making investments in tool systems requiring at least part-time craft specialists. Our discussion of artistic embellishment (below) also reflects positively on this conclusion.

(d) Ceramic technology

Ceramic technology can provide another indicator of major change in an annual settlement and subsistence cycle with expanded use of ceramics generally associated with greater degrees of sedentism. For example, the so-called 'container revolution' is associated with increasing sedentism in the late Archaic and early Woodland periods of eastern North America [69]. Ceramic technology spread into the Chukotka region of east Siberia by ca. 3000 BP after a long history to the west in the Yakutia area that began in the early Neolithic Syalakh (ca. 5000–6000 BP) and continued during the middle and late Neolithic Bel'kachinsk (ca. 4000–5000 BP) and Ymyakhtakh (ca. 3000–4000 BP) cultures [29,43,70,71]. Early Chukotkan pottery of the Ust' Bel'skaia culture appears to include linear stamped, cord-marked, dentate and check stamped, and punctated surface designs [70]. Linear-stamped pottery with fibre temper first appears in Choris sites and continues in Norton contexts, eventually spreading around much of southwestern Alaska [35,72,73]. Check-stamped pottery becomes common in early Norton occupations and becomes equally widespread [72]. While ceramic technology does not appear in Ipiutak contexts [22], it is present in Okvik/OBS occupations (e.g. [50,51]). Okvik/OBS pottery is typically linear stamped and slightly thicker than Norton variants with fibre or coarse sand/gravel temper. Given general similarities, Dumond [72] suggests a Norton ancestry for Okvik/OBS ceramics. The absence of pottery along with stone lamps in Ipiutak contexts remains a long-standing question [74]. Mason [22] argues that Ipiutak groups may simply have been so mobile during much of their annual cycles that pottery and lamps were inefficient and replaced, respectively, by birch bark vessels for storage and open hearths for heating. Anderson *et al*. [75] point out that the extensive adoption of pottery among Okvik/OBS groups may reflect a dramatic development in prosocial activities such as exchange, feasting and regulation of social relationships, suggesting that ceramic technology indicates major changes in social customs and interactions across the region circa 1500 BP.

5. Communication systems

We have now made the argument that Okvik/OBS groups were characterized by a new form of cooperation (multi-village political groups) and thus higher locus of selection (cultural group). We followed with evidence that labour became dramatically more specialized as associated with whaling and walrusing crews and craft specialists. A major implication is that communication systems also had to change in order to integrate the new and more complex networks of crafters, hunters, traders and ritual specialists. Lacking centralized leadership, a new logic would have been crucial to provide all with a common ideology and associated language. Such a shared ideology is evident in the florescence of incised images in ivory and antler within Okvik/OBS contexts [61].

The Okvik/OBS culture is probably best known for its intricate incised and carved designs on many types of utilitarian objects including harpoon heads, fore-shafts and sockets, handles, paddles, harpoon stabilizers, counter-weights and snow goggles [10,76,77]. Design styles appear to have evolved through three historical stages termed Okvik/Old Bering Sea I, Old Bering Sea II and Old Bering Sea III. As summarized by Fitzhugh [77], the Okvik/OBS I style emerged abruptly with objects widely distributed in utilitarian and mortuary contexts. Okvik/OBS I style is dominated by 'triangular shapes bordered by form-lines joined at apices by tiny circles or triangles' [78 p. 90], which it turn gives way to OBS II and III circles, dots and tear-drop shapes helping to form stylized images of eyes, eye-lashes and mouths [61]. The meanings of Okvik/OBS artistic embellishment have been widely discussed. Mason [20] suggests social group boundaries were marked by stylistic variability. Arutiunov [79] proposes that carvers expressed information in imagery as related to object ownership by individuals, families and/or clans. Hill [60] and Qu [61] see Okvik/OBS imagery as designed to mediate relations between human and non-human persons, an Inuit tradition well described and understood across the Polar North (e.g. [32,80–83]). Thus, the dramatic new 'art' may have served as a communication system to mark political boundaries, facilitate ownership of property and mediate spiritual relationships between human hunters and their prey.

Scholars have proposed multiple hypotheses as to the cultural origins of Okvik/OBS 'art'. Proposed Asian linkages have included Shang and Zhou civilizations of northern China and Scythian nomads of central Asia, yet dating of Okvik/OBS does not align well with those cultures and definitive material cultural ancestors have not been defined [84]. The relationship with Ipiutak art is much better established [22]. Fitzhugh [77] and Mason [22] note that Ipiutak art combines Okvik/OBS styles (circles, tear-drops and dots) with unique elements associated with images of animals, transformation motifs and poorly understood abstract forms. Some Ipiutak items are clearly associated with shamanic uses including sucking tubes and various open carvings [22]. Current radiocarbon data cannot confidently place Ipiutak before OBS (though Mason & Rasic [24] raise that possibility) and it is thus possible that animistic cosmologies and associated art traditions held by the two co-developed perhaps as facilitated by a political alignment [20].

6. Discussion

Was the evolutionary event associated with the emergence of the Okvik/OBS culture a major transition (per [1,5])? We comment on the three essential elements: multi-level selection, labour diversity and changing communication strategies.

First, probably the most dramatic change associated with the Okvik/OBS culture was emergence of sedentary networked settlements, with social inequality, guarded hunting territories and engagement in long-distance exchange and occasional warfare [10]. Mason [20] refers to these groups as polities and if he is correct, then this marks a dramatic shift from ancestral groups who were likely organized in flexible multi-family groups aggregating and dispersing according to seasonal cycles. This in turn implies that a new higher level of selection above that of the family had emerged in Okvik/OBS settlements. Second, there has not been adequate household archaeology completed in Okvik/OBS villages to make the case for the presence of full-time craft specialists. However, Mason [10] argues on the basis of dramatic diversity in mortuary goods, that craft specialization was likely. We have added that whaling/walrusing crews and complex functional technologies also imply some degree of labour specialization. If so, this suggests that Okvik/OBS labour was more diverse than in earlier times when groups lacked craft specialists or specialized hunting teams. Third, did communication strategies change? Okvik/OBS craftspeople embellished virtually every antler and ivory tool with elaborate ideologically charged geometric, anthropomorphic and zoomorphic designs thought to communicate social boundaries [84], ownership and profound spiritual values [78,79,84]. As there had been no prior archaeologically visible manifestation in any directly ancestral culture, the Okvik/OBS artistic tradition likely also represented an emergent communication system (emergence per Goldstein [85]). Thus, if current interpretations are correct the Okvik/OBS culture appears to embody the expected characteristics of a major transition.

These results also offer implications for the cultural evolutionary process in general. We recognize evolutionary transitions in Bering Strait on each of the three scales discussed in the introduction. First, technological transitions (Type 1) are most common and range from microevolutionary tinkering to macroevolutionary change. Ceramics were first manufactured and used during the Chinese Upper Paleolithic [86], becoming common during the East Asian Neolithic, and eventually spreading into Bering Strait by at least 3000 cal. BP [70,71,74]. During this lengthy period, we recognize multiple refinements in paste, firing and surface marking (e.g. advent of check and dentate stamping). Yet Neolithic pottery is only marginally different from that of the Paleolithic. The deep time antiquity of harpoon technology is not as well understood as with ceramics. However, harpoon technology in Bering Strait clearly underwent a macroevolutionary scale transition with the development of toggle systems, after which we recognize a wide range of more minor changes including the adoption of multiple basal barbs in Ipiutak and Okvik/OBS designs. Similarly, house architecture appears to have undergone a macroevolutionary change with the evolution of substantial wooden superstructures with sod coverings from the much simpler tents of ASTt times. As with harpoons, groups continued to make modifications to house designs including the additions of long semi-subterranean entrance tunnels and attached side-rooms often used as kitchens. The diverse tool forms of the ASTt originated from blade-based technologies of the Siberian Neolithic during the early to middle Holocene [87]. Once in Bering Strait there was continued microevolutionary adjustments to tool forms and sizes. However, the organizational logic to lithic tool production and use was not altered in a significant way until the major transition to Okvik/OBS. Second, socio-economic transitions (Type 2) are far less common than those of technological transitions, though technologies may transition alongside socio-economic strategies. Despite the background of endless technological tinkering in Bering Strait, there are only two significant socio-economic transitions in the past 4000 years. The annually mobile diverse resource-focused ASTt strategy transitioned to the semi-sedentary, seasonally mobile, Choris/Norton/Ipiutak strategy with its engagement with seasonally focused resource harvest. The latter strategy then transitioned to the annually sedentary intensive marine mammal strategy of Okvik/OBS, which evolved further with the addition of intensified whaling during the subsequent Punuk and Thule cultures [10]. At the third scale, we have the rare major transitions where we recognize revolutionary change at all levels, thus combining significant evolution on the scales of technologies, socio-economic strategies, and the emergent phenomena (Type 3) of wealth-based inequality and the associated artistic and ritual tradition in the Okvik/OBS communities.

Was the evolutionary process in Bering Strait entirely unique or can we recognize similar histories in other major cultural transitions? Zeder's ([88,89]; see also [90]) summary of the cultural evolution in the Near East culminating in the Neolithic bears substantial similarity to the Bering Strait scenario. Here, there was clearly a similar series of changes inclusive of altered locus of selection (camps evolving into towns), emergence of craft specialization (refined chipped stone, groundstone, pottery, storage technologies, house architecture) and advent of new communication systems (new artistic conventions and undoubtedly actual language evolution). The evolution of the classic North American Northwest Coast cultures (e.g. [91]) also followed similar trajectories spanning the early to late Holocene with emergent village networks, craft specialization (portable and monumental crafts), and likely communication changes as associated with the development of classic Northwest Coast 'art' traditions [92,93]. Consequently, we recommend that scholars revisit cultural transitions recognizing that while no sequence will be identical, there may be commonalities in their historical trajectories.

As argued by Prentiss *et al*. [11] this research demonstrates that cultural evolution unfolds simultaneously across multiple scales. Our conclusions are in line with scholarship in cultural microevolution and macroevolution. Cultural transmission plays a basal role in the evolutionary process giving rise to lower scale cultural variants (e.g. [40,94]). Cultural evolutionary dynamics clearly also act on scales of more complex cultural entities held by populations of various sizes. Eldredge [95] suggests that we could view cultural evolution in a hierarchical framework similar to that of biological systems such that we might recognize evolutionary process accumulating and sorting variation on scales spanning individual to local groups, to the entire universe of artefact makers. Sukhoverkhov & Gontier [96] argue that cultural evolution should include community-level traits held by groups. Lenton *et al*. [97] propose the idea of persistence-based selection operating on systems-level scales. Future research is required to explore these arguments in greater detail as they offer potentially significant implications for how we understand the great cultural transitions.

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References

1. Szathmary E, Maynard Smith J. 1995 The major evolutionary transitions. *Nature* **374**, 227–232. (doi:10.1038/374227a0)
2. Carmel Y. 2022 Human societal development: is it an evolutionary transition in individuality?. *Phil. Trans. R. Soc. B* **378**, 20210409. (doi:10.1098/rstb.2021.0409)
3. Godfrey-Smith P. 2011 Darwinian populations and transitions in individuality. In *The major transitions in evolution revisited* (eds B Calcott, K Sterelny), pp. 65–81. Cambridge, MA: MIT Press.
4. Simpson C. 2011 How many levels are there? How insights from evolutionary transitions in individuality help measure the hierarchical complexity of life. In *The major transitions in evolution revisited* (eds B Calcott, K Sterelny), pp. 199–225. Cambridge, MA: MIT Press.
5. Szathmary E. 2015 Toward major evolutionary transitions theory 2.0. *Proc. Natl Acad. Sci. USA* **112**, 10 104–10 111. (doi:10.1073/pnas.1421398112)
6. McShea DW, Simpson C. 2011 The miscellaneous transitions in evolution. In *The major transitions in evolution revisited* (eds B Calcott, K Sterelny), pp. 15–33. Cambridge, MA: MIT Press.
7. Laue CL. 2018 Social, cultural, and environmental influences on the process of technological innovation. PhD dissertation, Department of Anthropology, University of Montana.
8. Laue CL, Wright AH. 2019 Landscape revolutions for cultural evolution: integrating advanced fitness landscapes into the study of cultural change. In *Handbook of evolutionary research in archaeology* (ed. AM Prentiss), pp. 127–148. New York, NY: Springer.
9. Spencer CS, Redmond EM. 2001 Multilevel selection and political evolution in the valley of Oaxaca 500–100 B.C. *J. Anthropol. Archaeol.* **20**, 195–229. (doi:10.1006/jaar.2000.0371)
10. Mason OK. 2016 The Old Bering Sea florescence about Bering Strait. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 417–442. Oxford, UK: Oxford University Press.
11. Prentiss AM, Walsh MJ, Gjesfjeld E, Denis M, Foor TA. 2022 Cultural macroevolution in the middle to late Holocene Arctic of East Siberia and North America. *J. Anthropol. Archaeol.* **65**, 101388. (doi:10.1016/j.jaa.2021.101388)
12. Grønnow B. 2016 Independence I and Saqqaq: the first Greenlanders. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 713–736. Oxford, UK: Oxford University Press.
13. Powers WR, Jordan RH. 1990 Human biogeography and climate change in Siberia and Arctic North America in the fourth and fifth millennia BP. *Phil. Trans. R. Soc. Lond. A* **330**, 665–670. (doi:10.1098/rsta.1990.0047)
14. Prentiss AM, Walsh MJ, Foor TA, Barnett KD. 2015 Cultural macroevolution among high latitude hunter-gatherers: a phylogenetic study of the Arctic small tool tradition. *J. Archaeol. Sci.* **59**, 64–79. (doi:10.1016/j.jas.2015.04.009)
15. Tremayne AH, Rasic JT. 2016 The Denbigh Flint Complex of Northern Alaska. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 349–370. Oxford, UK: Oxford University Press.
16. Ryan K. 2016 The 'Dorset Problem' revisited: the transitional and early and middle Dorset periods in the eastern Arctic. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 761–782. Oxford, UK: Oxford University Press.
17. Milne SB, Park RW. 2016 Pre-Dorset culture. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 693–712. Oxford, UK: Oxford University Press.
18. Park RW. 2016 The Dorset-Thule transition. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 807–826. Oxford, UK: Oxford University Press.
19. Friesen TM. 2016 Pan-Arctic population movements: the early Paleo-Inuit and Thule Inuit migrations. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 673–692. Oxford, UK: Oxford University Press.
20. Mason OK. 1998 The contest between Ipiutak, Old Bering Sea, and Birnirk Polities and the origin of whaling during the first millennium A.D. along Bering Strait. *J. Anthropol. Archaeol.* **17**, 240–325. (doi:10.1006/jaar.1998.0324)
21. Mason OK. 2009 Flight from the Bering Strait: did Siberian Punuk/Thule military cadres conquer northwest Alaska. In *The northern world AD 900–1400* (ed. HD Maschner), pp. 76–130. Salt Lake City, Utah: University of Utah Press.
22. Mason OK. 2016 From the Norton culture to the Ipiutak cult in northwest Alaska. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 443–468. Oxford, UK: Oxford University Press.
23. Mason OK. 2016 Thule origins in the Old Bering Sea culture: the Interrelationship of Punuk and Birnirk cultures. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 489–512. Oxford, UK: Oxford University Press.
24. Mason OK, Rasic JT. 2019 Walrusing, whaling, and the origins of the Old Bering Sea culture. *World Archaeol.* **51**, 454–483. (doi:10.1080/00438243.2019.1723681)
25. Park RW. 1993 The Dorset-Thule succession in Arctic North America: assessing claims for culture contact. *Am. Antiq.* **58**, 203–234. (doi:10.2307/281966)
26. Raghavan M *et al.* 2014 The genetic prehistory of the New World Arctic. *Science* **345**, 1020–1029. (doi:10.1126/science.1255832)
27. Mason OK, Friesen TM. 2017 *Out of the cold: archaeology on the Arctic rim of North America*. Washington, DC: The SAA Press.
28. Mason OK. 2020 The Thule migrations as an analog for the early peopling of the Americas: evaluating scenarios of overkill, trade, climate forcing, and scalar stress. *PaleoAmerica* **6**, 308–356.
29. Darwent CM, Darwent J. 2016 The enigmatic Choris and Old Whaling cultures of the western Arctic. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 371–394. Oxford, UK: Oxford University Press.
30. Gerlach C, Mason OK. 1992 Calibrated radiocarbon dates and cultural interaction in the western Arctic. *Arctic Anthropol.* **29**, 54–81.
31. Mason OK. 2014 The Ipiutak cult of shamans and its warrior protectors: an archaeological context. In *The foragers of Point Hope: the biology and archaeology of humans on the edge of the Alaskan Arctic* (eds CE Hilton, BM Auerbach, LW Cowgill), pp. 35–70. Cambridge, UK: Cambridge University Press.
32. Fitzhugh WW. 2014 The Ipiutak spirit-scape: an archaeological phenomenon. In *The foragers of Point Hope: the biology and archaeology of humans on the edge of the Alaskan Arctic* (eds CE Hilton, BM Auerbach, LWCowgill), pp. 266–290. Cambridge, UK: Cambridge University Press.
33. Larsen H, Rainey F. 1948 *Ipiutak and the Arctic whale hunting culture*. Anthropological Papers of the American Museum of Natural History 42. New York, NY: American Museum of Natural History.
34. Anderson DD. 1984 Prehistory of Northern Alaska. In *Handbook of North American Indians, volume 5, Arctic* (ed. D Damas), pp. 80–93. Washington, DC: Smithsonian Institution.
35. Dumond DE. 2016 Norton hunters and fisherfolk. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 395–416. Oxford, UK: Oxford University Press.

36. Giddings JL, Anderson DD. 1986 *Beach ridge archaeology of Cape Krusenstern: Eskimo and pre-Eskimo settlements around Kotzebue Sound, Alaska*. Washington, DC: Publications in Archeology 20, National Park Service.
37. Mason OK, Gerlach SG. 1995 The archaeological imagination, zooarchaeological data, the origins of whaling in the Western Arctic, and 'Old Whaling' and Choris cultures. In *Hunting the largest animals: native whaling in the western Arctic and subarctic* (ed. AP McCartney), pp. 1–32. Edmonton, Canada: The Canadian Circumpolar Institute, University of Alberta.
38. Collins H. 1964 The Arctic and Subarctic. In *Prehistoric man in the New World* (eds JD Jennings, E Norbeck), pp. 85–114. Chicago, IL: University of Chicago Press.
39. Boyd R, Borgerhoff Mulder M, Durham WH, Richerson PJ. 1997 Are cultural phylogenies possible? In *Human by nature: between biology and the social sciences* (eds P Weingart, SD Mitchell, PJ Richerson, S Maasen), pp. 355–384. Mahwah, NJ: Lawrence Erlbaum Associates.
40. Boyd R, Richerson PJ. 1985 *Culture and the evolutionary process*. Chicago, IL: University of Chicago Press.
41. Soltis J, Boyd R, Richerson PJ. 1995 Can group functional behaviors evolve by cultural group selection? An empirical test. *Curr. Anthropol.* **36**, 473–494. (doi:10.1086/204381)
42. Tremayne AH, Winterhalder B. 2017 Large mammal biomass predicts the changing distribution of hunter-gatherer settlements in mid-late Holocene Alaska. *J. Anthropol. Archaeol.* **45**, 81–97. (doi:10.1016/j.jaa.2016.11.006)
43. Anderson DD. 1988 Onion Portage: the archaeology of a stratified site from the Kobuk River, northwest Alaska. *Anthropol. Pap. Univ. Alsk.* **22**, 1–163.
44. Dumond DE. 1981 *Archaeology on the Alaska peninsula: the Naknek region, 1960–1975*. University of Oregon Anthropological Papers no. 21. Eugene, Oregon: University of Oregon.
45. Dumond DE. 1982 Trends and traditions in Alaskan prehistory: the place of the Norton culture. *Arctic Anthropol.* **19**, 39–51.
46. Giddings JL. 1964 *The archaeology of Cape Denbigh*. Providence, RI: Brown University Press.
47. Henn W. 1978 *Archaeology on the Alaska peninsula: the Ugashik drainage, 1973–1975*. University of Oregon Anthropological Papers no. 14. Eugene, Oregon: Museum of Natural and Cultural History and Department of Anthropology, University of Oregon.
48. Gerlach SG, Hall Jr ES. 1988 The later prehistory of northern Alaska: the view from Tukuto Lake. In *The late prehistoric development of Alaska's native people*. Aurora Monograph Series no. 4 (eds RD Shaw, RK Harritt, DE Dumond), pp. 107–136. Anchorage, Alaska: Alaska Anthropological Association.
49. Gerlach C. 1986 Models of caribou exploitation, butchery, and processing at the Croxton site, Tukuto Lake, Alaska. PhD dissertation, Department of Anthropology, Brown University.
50. Collins H. 1937 *Archaeology of St. Lawrence Island, Alaska*. *Smithsonian Miscellaneous Collections* **96**, 1–431.
51. Arutiunov SA, Sergeev DA. 2006 (1969) *Ancient cultures of the Asiatic Eskimos: the Uelen cemetery*. Translated and edited by RL Bland. Anchorage, Alaska: US Department of the Interior, National Park Service, Shared Beringian Heritage Program.
52. Gusev S, Zogoroulko AV, Porotov AV. 1999 Sea mammal hunters of Chukotka, Bering Strait: recent archaeological results and problems. *World Archaeol.* **30**, 354–369. (doi:10.1080/00438243.1999.9980417)
53. Arutiunov SA, Sergeev DA. 2006 (1975) *Problems of ethnic history in the Bering Sea: the Ekven cemetery*. Translated and edited by RL Bland. Anchorage, Alaska: US Department of the Interior, National Park Service, Shared Beringian Heritage Program.
54. Dikov ND. 2002 (1974) *The Chini cemetery (A history of sea mammal hunters in Bering Strait)*. Translated by RL Bland. Anchorage, Alaska: US Department of the Interior, National Park Service, Shared Beringian Heritage Program.
55. Broshtein M, Plumet P. 1995 Ekven: l'art préhistorique béringien et l'approche russe de l'origine de la traditionan culturelle esquimaude. *Etudes/Inuit Studies* **19**, 5–59.
56. Burch Jr ES. 2006 *Social life in northwest Alaska: the structure of Iñupiaq eskimo nations*. Fairbanks, Alaska: University of Alaska Press.
57. Spencer RF. 1959 *The North Alaskan Eskimo: a study in ecology and society*. Bureau of American Ethnology paper 171. Washington, DC: Bureau of American Ethnology.
58. Jensen AM, Sheehan GW. 2016 Contact and postcontact Iñupiat ethnohistory. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason), pp. 631–652. Oxford, UK: Oxford University Press.
59. Mason OK. 2009 'The multiplication of forms': Bering Strait harpoon heads as a demic and macroevolutionary proxy. In *Macroevolution in human prehistory: evolutionary theory and processual archaeology* (eds AM Prentiss, I Kuijt, C Chatters), pp. 73–110. New York, NY: Springer.
60. Hill E. 2011 Animals as agents: hunting ritual and relational ontologies in prehistoric Alaska and Chukotka. *Camb. Archaeol. J.* **21**, 407–426. (doi:10.1017/S0959774311000448)
61. Qu F. 2020 Body metamorphosis and interspecies relations: an exploration of relational ontologies in Bering Strait prehistory. *Arctic Anthropol.* **57**, 131–148. (doi:10.3368/aa.57.2.131)
62. Lee M, Reinhardt GA. 2003 *Eskimo architecture: dwelling and structure in the early historic period*. Fairbanks, Alaska: University of Alaska Press.
63. Jordan P. 2015 *Technology as human social tradition*. Berkeley, CA: University of California Press.
64. Prentiss AM, Walsh MJ, Foor TA. 2017 Evolution of Early Thule material culture: cultural transmission and terrestrial ecology. *Hum. Ecol.* **46**, 633–650. (doi:10.1007/s10745-017-9963-9)
65. DesRosiers PM, Sørensen M. 2016 Paleoeskimo lithic technology. In *The Oxford handbook of the prehistoric Arctic* (eds TM Friesen, OK Mason). Oxford, UK: Oxford University Press.
66. Parry WA, Kelly RL. 1987 Expedient core technology and sedentism. In *The organization of core technology* (eds JK Johnson, CA Morrow), pp. 285–304. Boulder, CO: Westview Press.
67. Darwent J. 1998 *The prehistoric use of nephrite on the British Columbia plateau*. Burnaby, Canada: Archaeology Press, Simon Fraser University.
68. Graesch AP. 2007 Modeling ground slate knife production and implications for the study of household labor contributions to salmon fishing on the Pacific Northwest Coast. *J. Anthropol. Archaeol.* **26**, 576–606. (doi:10.1016/j.jaa.2007.07.001)
69. Fagan BM. 2005 *Ancient North America*, 5th Edn. London, UK: Thames and Hudson.
70. Ackerman RE. 1982 The Neolithic-Bronze Age cultures of Asia and the Norton phase of Alaskan prehistory. *Arctic Anthropol.* **19**, 11–38.
71. Dikov ND. 2004 *Early cultures of northeastern Asia*. Translated by RL Bland. Anchorage, Alaska: US Department of the Interior, National Park Service, Shared Beringian Heritage Program.
72. Dumond DE. 1969 The prehistoric pottery of southwestern Alaska. *Anthropol. Pap. Univ. Alsk.* **14**, 19–42.
73. Oswalt W. 1955 Alaskan pottery: a classification and historical reconstruction. *Am. Antiq.* **21**, 32–43. (doi:10.2307/276106)
74. Anderson SL. 2019 Ethnographic and archaeological perspectives on the use life of northwest Alaskan pottery. In *Technology, lifeways, and cuisine* (eds P Jordan, K Gibbs), pp. 128–150. Cambridge, UK: Cambridge University Press.
75. Anderson S, Tushingham S, Buonasera TY. 2017 Aquatic adaptations and the adoption of Arctic pottery technology: results of residue analysis. *Am. Antiq.* **82**, 1–28. (doi:10.1017/aaq.2017.8)
76. Collins HB. 1929 *Prehistoric art of the Alaskan Eskimo*. Smithsonian Miscellaneous Collections 81, part 14. Washington, DC: Smithsonian Institution.
77. Fitzhugh WW. 2009 Notes on art styles, cultures, and chronology. In *Gifts from the ancestors: ancient ivories of Bering Strait* (eds WW Fitzhugh, J Hollowell, AL Crowell), pp. 88–93. New Haven, CT: Princeton University Art Museum and Yale University Press.
78. Fienup-Riordan A. 2009 *Cat Tamarmeng Ellanqqertut*/All things have awareness. In *Gifts from the ancestors: ancient ivories of Bering Strait* (eds WW Fitzhugh, J Hollowell, AL Crowell), pp. 226–239. New Haven, CT: Princeton University Art Museum and Yale University Press.
79. Arutiunov SA. 2009 The enigma of ancient Bering Strait art. In *Gifts from the ancestors: ancient ivories of Bering Strait* (eds WW Fitzhugh, J Hollowell, AL Crowell), pp. 126–138. New Haven, CT: Princeton University Art Museum and Yale University Press.

80. Fienup-Riordan A. 1996 *The living tradition of Yup'ik masks: Agayuliyararput*. Seattle, WA: University of Washington Press.
81. Fitzhugh WW, Kaplan SA. 1982 *Inua: spirit world of the Bering Sea eskimo*. Washington, DC: Smithsonian Institution Press.
82. Hill E. 2018 Humans, birds, and burial practices at Ipiutak. Alaska: perspectivism in the Western Arctic. *Environ. Archaeol.* **24**, 434–448. (doi:10.1080/14614103.2018.1460031)
83. Willerslev R. 2004 Not animal, not not animal: hunting, imitation and empathetic knowledge among the Siberian Yukaghirs. *J. R. Anthropol. Inst.* **10**, 629–652. (doi:10.1111/j.1467-9655.2004.00205.x)
84. Mason OK. 2009 Art, power, and cosmos in Bering Strait prehistory. In *Gifts from the ancestors: ancient ivories of Bering Strait* (eds WW Fitzhugh, J Hollowell, AL Crowell), pp. 112–125. New Haven, CT: Princeton University Art Museum and Yale University Press.
85. Goldstein J. 1999 Emergence as a construct: history and ideas. *Emergence* **1**, 49–72. (doi:10.1207/s15327000em0101_4)
86. Wu X, Zhang C, Goldberg P, Cohen D, Pan Y, Arpin T, Bar-Yosef O. 2012 Early pottery at 20,000 years ago in Xianrendong Cave, China. *Science* **336**, 1696–1700. (doi:10.1126/science.1218643)
87. Coutouly YAG. 2016 Migrations and interactions in prehistoric Beringia: the evolution of Yakutian lithic technology. *Antiquity* **90**, 9–31. (doi:10.15184/aqy.2015.176)
88. Zeder MA. 2009 Evolutionary biology and the emergence of agriculture: the value of co-opted models of evolution in the study of culture change. In *Macroevolution in human prehistory: evolutionary theory and processual archaeology* (eds AM Prentiss, I Kuijt, JC Chatters), pp. 157–212. New York, NY: Springer.
89. Zeder MA. 2009 The neolithic macro-(r)evolution: macroevolutionary theory and the study of culture change. *J. Archaeol. Res.* **17**, 1–63. (doi:10.1007/s10814-008-9025-3)
90. Kuijt I, Prentiss AM. 2009 Niche construction, macroevolution and the late Epipaleolithic of the Near East. In *Macroevolution in human prehistory: evolutionary theory and processual archaeology* (eds AM Prentiss, I Kuijt, JC Chatters), pp. 253–274. New York, NY: Springer.
91. Drucker P. 1955 *Indians of the northwest coast*. New York, NY: McGraw Hill.
92. Lyons N, Hoffman T, Miller D, Martindale A, Ames KM, Blake M. 2021 Were the Ancient Coast Salish farmers? A story of origins. *Am. Antiq.* **86**, 504–525. (doi:10.1017/aaq.2020.115)
93. Matson RG, Coupland G. 1995 *The prehistory of the northwest coast*. San Diego, CA: Academic Press.
94. Walsh MJ, Prentiss AM, Reide F. 2019 Introduction to cultural microevolutionary research in anthropology and archaeology. In *Handbook of evolutionary research in archaeology* (ed. AM Prentiss), pp. 49–70. New York, NY: Springer.
95. Eldredge N. 2009 Material cultural macroevolution. In *Macroevolution in human prehistory: evolutionary theory and processual archaeology* (eds AM Prentiss, I Kuijt, JC Chatters), pp. 297–316. New York, NY: Springer.
96. Sukhoverkhov AV, Gontier N. 2021 Non-genetic inheritance: evolution above the organismal level. *Biosystems* **200**, 104325. (doi:10.1016/j.biosystems.2020.104325)
97. Lenton TM, Kohler TA, Marquet PA, Boyle RA, Crucifix M, Wilkinson DM, Scheffer M. 2020 Survival of the systems. *Trends Ecol. Evol.* **36**, 333–344. (doi:10.1016/j.tree.2020.12.003)