Research Article

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Disruption, Preference Cascades, Contagion, and the Transition to Agriculture in Northern Europe

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Abstract: The transition to agriculture in northern Europe around 4000 BC presents an unresolved question. Explanations have vacillated between the adoption of Neolithic things and practices by indigenous foragers to the displacement of Mesolithic populations by immigrant farmers. The goal of this article is to articulate some thoughts on this process. First, it would have been necessary to introduce food production practices, by acculturation or immigration, to disrupt not only the forager economy but also their values of sharing and social relations. The use of milk for dairy products is a prime candidate for such a disruptive technology. The attraction of Neolithic ways may have been initially concealed from others, and only the realization of their widespread appeal caused fellow foragers to change their preferences. Second, it was necessary for foragers to commit to these changes and for the changed values to spread through mechanisms of social contagion. Immigrant farmers may have been especially influential in this regard, with increased sedentism and interaction being catalysts for completing the transition to agriculture.

Keywords: Baltic sea, transition to agriculture, disruptive technology, preference cascade, social contagion

1 Introduction

The spread of agriculture across Europe from its Near Eastern roots was a complicated interplay between the diaspora of the farming population and uptake by indigenous hunter-gatherers. In central Europe, the dispersal of farming communities took place during the second half of the sixth millennium BC, but then came to a standstill shortly after 5000 BC. Beyond, in the basins of the Baltic and North Seas as well as along the Atlantic Façade, Mesolithic populations continued to live as foragers during much of the fifth millennium BC. Then within a century or two around 4000 BC, there was a rapid transition to agriculture across northern Europe.

For a long time, the prevailing model of the transition to agriculture in northern and western Europe has been one of the delayed adoptions of Neolithic things¹ and practices by indigenous Mesolithic populations (e.g., Price, 2000). Proposed motivations for this change ranged from economic necessity to a desire...

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¹ To quote Cummings and Morris (2018): “Neolithic ‘things’ here relates to domestic animals, domestic plants, pottery, new stone tool technologies and monuments – our preferred terminology as it does not imply simultaneous uptake as the oft-used phrase ‘package’ implies.”
for status and power by emergent elites among complex foraging societies. The uptake of domestic plants and animals was seen as a local transformation of indigenous societies triggered by their availability and eventually their acceptance from the farming societies of interior central Europe. Pottery was also part of the model although it was difficult to see how the pointed-based Ertebølle vessels had much in common with the wares of the central European farmers other than the fact that they were both made from fired clay.

About a decade ago, Rowley-Conwy (2011, pp. 440–442) opened the door to colonization as a factor in the establishment of farming communities across southern Scandinavia. However, it appears that he was proposing that human movement within the region facilitated the rapid spread of Neolithic things and practices rather than a significant influx of colonists from the south, despite the sudden and widespread appearance of exogenous cultural elements. Recently, arguments have been made for northward colonization events by continental agricultural peoples into southern Scandinavia during the late fifth millennium BC (e.g., Sørensen, 2017, 2020; Sørensen & Karg, 2014) on a scale larger than hitherto imagined. These recent proposals would appear to overturn the “inside job” model of the uptake of Neolithic things and practices and even relegate the indigenous hunter-gatherers to bystanders as immigrant farmers introduced a novel way of life.

In 1958, Irving Rouse set forth criteria for evaluating whether population movement is a better explanation for the change in the archaeological record than in situ development:
1. Identify the migrating people as an intrusive unit in the region they have penetrated.
2. Trace this unit back to its homeland.
3. Determine that all occurrences of this unit are contemporaneous.
4. Establish the existence of favorable conditions for migration.
5. Demonstrate that some other hypothesis, such as independent invention or diffusion of traits, does not better fit the facts.
6. Establish that all cultural subsystems are involved and not just an isolated one (such as burial practice).

Using these benchmarks, the great Danubian diaspora in interior central Europe clearly conforms to the model of migration (Bogucki, 2000). If migration is to be accepted as the engine of agricultural dispersal in northern Europe, however, it would be a compelling argument if it can also be shown to fit “Rouse’s Rules.” To some degree, the evidence seems to be headed in that direction, particularly criteria 1–4, but in my view, the case has not yet been made convincingly for criteria 5 and 6 on a broad regional scale.

Some local cases for immigration may be stronger than others. For example, it seems clear that the introduction of agriculture to the island of Bornholm in the middle of the western Baltic basin was not the result of the adoption of Neolithic things and practices by indigenous hunter-gatherers but rather by “off-islanders” (Nielsen & Nielsen, 2020). Evidence from early sites like Vallensgård I shows the abrupt appearance of an intrusive cultural unit on Bornholm with clear ties back to contemporaneous finds on the European mainland. The most parsimonious explanation in this case is the waterborne arrival of a new farming population.

The narrative is further complicated by emerging archeogenetic data from the fourth millennium BC. The study of ancient DNA is continually being refined, and as with any innovative analytical technique, initial results are mixed despite the certainty of each succeeding article. At the moment, they consist primarily of data points rather than broad regional patterns. For example, we can place an individual with Anatolian ancestry at Saxtorp in Scania dated ca. 3800 BC (Mittnik et al., 2018), but how many congener did this person have? The flow also worked in reverse. Nearly a millennium after the period in focus here, ca. 3200–2900 BC, a community in which many individuals carried hunter-gatherer U5 haplogroups and subsisted largely on freshwater fish, yet used Funnel Beaker pottery, buried their dead on an island in Lake Ostorf in northeast Germany (Gehlen, 2016). Were these recalcitrant hunter-gatherers pushed into a refugium? A late Neolithic gallery grave from Niedertiefenbach in western Germany dated ca. 3300–3200 BC contained multiple individuals with some degree of hunter-gatherer ancestry (Immel et al., 2021). The hunter-gatherers of northern Europe did not disappear during the fourth millennium BC, but it seems probable that groups of farmers with Anatolian ancestry worked their way north into southern Scandinavia before 3800 BC.
As of this writing, however, it seems premature to erase the indigenous hunter-gatherers completely from the transition to agriculture in northern Europe during the final centuries of the fifth millennium BC. They must remain part of any discussion of the establishment of farming communities in this area. It required not only the incorporation of novel plants and animals into the indigenous subsistence economy but also a change in hunter-gatherer values and practices to provide the cultural prerequisites for adopting agriculture.

In the previous writing (e.g. Bogucki, 2008), I have drawn a contrast between the “Danubian World” of riverine interior central Europe during the fifth millennium BC, exemplified by societies that descended from the initial diaspora of the Linear Pottery culture, and the “Baltic World” of thriving Mesolithic societies, exemplified by the Ertebølle culture and related communities of the southern Baltic basin (Figure 1). This distinction might be seen as an echo of Childe’s distinction between “Danubian Neolithic” societies and the “Nordic Neolithic” of the Funnel Beaker culture (Childe, 1958), but it is different in that it contrasts two very different sets of cultural values and lifeways at the same time, rather than in sequence. Childe did not have much time for the Mesolithic, so Ertebølle and its congeners are really just a footnote in his narratives. The question here, however, is how the hunter-gatherer communities first resisted and then quickly adopted Neolithic things and practices and to what extent can we need to take into account the agency of indigenous foragers to decide to adopt exogenous cultural elements.

The goal of this study is to attempt to reconcile the traditional view of agricultural origins in northern Europe as having been an “inside job” on the part of indigenous hunter-gatherers around 4000 BC with the impact of novel domesticates, food technology, and even some immigrants from parts of riverine interior Europe that had been colonized by farming communities during the sixth millennium BC. As originally
presented in Barcelona in November 2019, this article focuses on the disruptive effect of novel technologies on Mesolithic economies and social structures. In the intervening year, however, it has been expanded to include concepts derived from models of contagion within social systems. Such models can inform how we might accommodate both indigenous and immigrant populations in the transition to agriculture in northern Europe.

2 The Fifth Millennium Borderland in Northern Continental Europe

From just after 5000 BC to just before 4000 BC, the “Danubian” societies of riverine interior central Europe, descended either directly or indirectly of the great Linear Pottery diaspora, lay separated from the Mesolithic populations of northern Europe by a borderland up to several 100 km across. Broadly speaking, this borderland lies between 52°N and 54°N (see Figure 1 for the situation between the lower Oder and Vistula.) In the Netherlands, settlements of Danubian farmers of Limburg lay about 150 km south of the Mesolithic societies of the Rhine-Maas delta. A similar gap separated Rössen and Michelsberg sites of central Germany from hunter-gatherers living at sites like Timmendorf-Nordmole along the southwest Baltic coast. Near the mouth of the lower Oder, an exclave of Linear Pottery farmers during the late sixth millennium BC performed farming within 100 km of the Baltic, close to where Ertebølle foragers could be found at inland sites like Tanowo. During the first half of the fifth millennium, Stroke-Ornamented Pottery communities along the lower Oder built the recently discovered rondel at Nowe Objezierze about 80 km south of Szczecin (Pospieszny et al., 2018), but Neolithic settlement faded in this area during the second half of the fifth millennium BC. Along the lower Vistula in Poland, major concentrations of Danubian farming communities of the Brześć Kujawski Group as exemplified by sites like Brześć Kujawski, Oslonki, Zelgno, and Kusza Zamkowa lie about 300 km from Baltic coastal foragers (Bogucki, 2019). The discovery of Brześć Kujawski-type trapeziform longhouses at Barłożno and Bielawki closed the distance between the Danubian settlement and the Baltic coast to under 100 km in the second half of the fifth millennium BC (Czerniak, 2007). Areas in between saw human activity, even some settlement, but the regions that were thickly settled by foragers to the north and farmers to the south were some distance apart.

Borderlands are not boundaries. They are meant to be crossed, and it is likely that the hunter-gatherers of the northern coasts were well aware of the interior farming communities during the fifth millennium BC and probably earlier. In addition to Danubian stone tools in Denmark and northern Germany (Fischer, 1982; Klassen, 2004), fragments of Neolithic pottery at Dąbki on the Baltic coast (Czekaj-Zastawny, Kabaciński, Terberger, & Ilkiewicz, 2013), and sites with Stroke-Ornamented Pottery at the edge of the Mazurian Lake-land at Równina Dolna (Rybicka, 2007), archeogenetic studies now document the occasional presence of individuals with hunter-gatherer ancestry among the Brześć Kujawski Group on the lower Vistula (Chyleński et al., 2017; Juras et al., 2017; Lorkiewicz et al., 2015). Archeogenetic evidence indicates that pigs with some domestic ancestry in their genome (although biometrically in the wild range) were hunted by Mesolithic foragers in northern Germany (Krause-Kyora et al., 2013 but see Rowley-Conwy & Zeder, 2014). We can assume that the Mesolithic peoples of coastal northern Europe were familiar with the things and practices of the Neolithic communities of riverine interior Europe for centuries, and the opposite is probably true as well, particularly for those farming communities living along the borderland.

Yet the Mesolithic societies of the Baltic Basin did not immediately embrace Neolithic practices, even if objects, animals, and people did cross the permeable borderland. An explanation for this resistance over nearly a millennium could lie in the fact that sedentary agricultural practices held a scant attraction for very successful hunter-gatherers. In addition, cultural traits ingrained in many foraging societies would have been incompatible with fundamental values necessary for agriculture. These needed to be either overcome or subverted, depending on how one looks at the situation, before the hunter-gatherer groups of the Baltic basin could even contemplate adopting agriculture.
3 Forager Practices and Values

Cross-cultural studies of modern hunter-gatherers reveal widespread structural regularities. One is that the sharing of food within the band is an ingrained feature of many hunter-gatherer societies (e.g. Dallos, 2011; Hawkes, O’Connell, & Blerton Jones, 2018; Osaki, 1990), while another is that people disperse from their natal groups such that most individuals who later congregate in residential groups are genetically unrelated (Hill et al., 2011). There is thus little ethos of exclusive property rights within broad interaction networks of mobile unrelated individuals. By contrast, the adoption of agriculture requires a fundamental defection from these strongly held and enforced norms. Farming, particularly that using the suite of plants and animals that dispersed in interior central Europe, required a concept of property and a sense of attachment to space as validated by ancestral ties, that is, by a stricter accounting of kinship relations.

The contrast between the Neolithic societies of riverine interior central Europe and the Mesolithic societies of northern Europe was far deeper than different subsistence practices and material culture. One did not merge seamlessly into the other. The property rights and kinship links substantiated by the Danubian longhouses were a sharp contrast to the mobile Mesolithic groups that probably had fairly loose kinship connections, if at all, within their ephemeral habitations. While the linear pottery culture and its descendants certainly exhibited a level of mobility during their dispersal among the loess basins of central Europe and their exclaves along the lower Vistula and lower Oder on the North European Plain, this was very directional mobility between defined regions, from one long-term settlement location to another. It was not an annual round or a radial pattern from a base camp in search of seasonally available resources.

The relative density of hunter-gatherer populations along the Baltic and North Seas and the Atlantic Façade during the sixth and fifth millennia BC meant that this contrast in values and lifeways could be enforced for centuries. Domestic plants and animals at first glance did not have much to offer them in terms of dietary security, abundance. They had plenty of deer, pigs, fish, and hazelnuts. Why cultivate? Somehow, the hunter-gatherer ethos of sharing and a lack of attention to kinship needed to be subverted for foragers to consider adopting agriculture. It can be hypothesized that there would have been two components to such undermining of the strong hunter-gatherer ethos:

1. One or more technologies or practices that emerged either indigenously or were taken up from the farmers of interior Europe disrupted the hunter-gatherer economy,
2. The willingness to flaunt community norms by some individuals led to the incorporation of elements of these practices into the activities of hunter-gatherer bands, while at the same time, kinship became more important as a connecting principle than friendship or acquaintance.

These changes would not have been trivial to accomplish. Hunter-gatherer economies are embedded in an ideological order that emphasizes interpersonal egalitarianism and resists acquisition. For example, Howell (2011, p. 96) states that the overriding concern of the Chewong in Malaysia lies in “long-term reproduction of social and cosmic order rather than with short-term individual maximization of advantages.” Simply being aware of agriculture does not lead foragers to adopt Neolithic things and practices in the absence of some significant disruptions that undermined these ideological constraints.

4 Disrupting Forager Lifeways

Several technological developments emerged in Mesolithic northern Europe that may have provided some of the motivation for such structural changes. These developments occurred throughout the Mesolithic, and in fact, some have their beginnings in the Palaeolithic, but the argument here is that they became widespread during the fifth millennium BC and had a synergistic relationship that disrupted traditional forager values. The point here is that the first appearance of watercraft, mass-capture facilities with the attendant need for preservation and storage, and attachment to particular locations did not trigger these changes, but
rather the intensification of the interplay among them during the fifth millennium BC sets the conditions for the acceptance and propagation of Neolithic things and practices.

Watercraft has been used by people for many millennia in both maritime and interior areas, yet the archeological record in northern Europe is not straightforward (Fischer & Papoulias, 2018). As with many prehistoric innovations, the question is less “the earliest” and more when did they become a ubiquitous item of equipment. Preservation and dating are issues. Archeologists focus on logboats, although skin and bark-covered craft were likely to have been used as well, and perhaps much earlier (Fletcher, 2015), yet not preserved in a way that permits them to be identified as watercraft. Thus, there is a bias toward logboats. Taphonomic factors have prevented the recovery of logboats in maritime contexts before the sixth millennium BC, but the presence of earlier logboats in interior western Europe dating to the seventh and eighth millennia BC (e.g., at Noyen-sur-Seine) suggests that this technology was widespread. Coastal estuarine logboat production has been documented at Bouldnor Cliff on the Solent ca. 6000 BC (Momber, Tomalin, Scaife, Satchell, & Gillespie, 2011; Momber et al., 2021). Wooden paddles complement the evidence for actual watercraft. The availability of thick and tall linden trees in the deciduous Atlantic forests provided material for the consistent and regular production of logboats.

During the fifth millennium BC, watercrafts were routine elements of equipment in coastal, estuarine, and riverine habitats, but they were not suitable for overland movement. Either they had to be left behind, hoping that no one would take them, or they were kept in residential bases that were occupied over an extended period. Some logboats found archeologically were abandoned when they split lengthwise, rendering them no longer fit for purpose. Especially noteworthy are finds of multiple longboats on the same site. For example, at Stralsund-Mischwasserspeicher in northern Germany, three whole logboats and one fragmentary specimen lay within a small excavated area, with boats 2 and 3 lying parallel alongside each other (Fischer, Lübke, & Kloof, 2018; Kloof & Lübke, 2009). They date to the early fifth millennium BC, while a larger boat in a Neolithic layer is from the first centuries of the fourth millennium. The two aligned Mesolithic logboats at Stralsund-Mischwasserspeicher give the impression of a preferred location for waterborne movement.

I suggest a synergy between watercraft use and the increasing attachment to particular locations. Again, the focus is not on the first appearance of long-term residential bases, but on near-sedentism becoming a standard condition of hunter-gatherer groups around the western Baltic. Demonstrating such long-term attachment is not without difficulties, and for the most part, we cannot differentiate between locations that were repeatedly visited for short stays and those for which people lived for extended periods, longer than a season. Presumably, it was a combination of palimpsest occupation and residential stability.

Perhaps the progressive increase in the number of logboats during the fifth millennium BC and beyond reflects a greater attachment to specific localities. Paradoxically, watercraft would have promoted such attachment, by enabling people to exploit larger distances along coastlines, lakeshores, and river systems while returning to specific locations. They could also cross short straits and even some open sea depending on conditions. Farmers in the headwaters of low-energy streams of the North European Plain could become familiar with the coastal foraging societies and vice-versa. Yet they usually came back to the same places after these excursions and focused their attention on the local hinterlands and seashores.

On the basis of comparative isotopic analyses from across Europe, including the Baltic, Schulting (2021, p. 395) makes the intriguing statement: “Perhaps the most striking result is the degree to which Mesolithic groups appear to have been ‘bedded in’ to their respective landscapes at a comparatively constrained spatial scale….The comparatively rich environments offered by some – though importantly not all – coastal and estuarine habitats clearly led to a subsistence and settlement system with the limited group and individual mobility.” In this connection, we can also note the arrival of ceramic technology, most likely from northern Eurasia in the so-called Hyperborean Stream (Gibbs & Jordan, 2013) that provided containers for handling and storing liquids and loose foods. As with watercraft, these were not easily transported overland, they could be used in conjunction with boats for the coastal and riverine movement.

Concurrent with an attachment to particular localities, the widespread appearance of installations for the mass capture of fish take on increased significance. Fish traps and fish weirs enabled small local groups
of people to obtain immense quantities of fish in relation to the amount of effort expended. Again, the focus here is not on identifying the earliest such installations. They are known already from the late eighth/seventh millennia BC at sites like Haväng in southeastern Sweden (Hansson et al., 2018). The archeological visibility issues are similar to those involved with watercraft. Nonetheless, fish traps and weirs were in widespread use across northern Europe by the fifth millennium BC. Like watercraft, they became standard elements of the material landscape.

The challenge with catching a lot of fish all at once is that you need to preserve and store it. This has two implications. The first is that you will not be going very far if you have a supply of dried, smoked, or salted fish at your home base. The second is that you have to assert ownership over the produce from your mass-capture facility, and in fact of the weirs and traps themselves. These are fixed in the landscape, and you are not going to readily abandon them to be taken over by others. Thus, the notion of ownership can be considered to have become an aspect of hunter-gatherer social interactions. Tolerated theft and enforced sharing must have been undermined once such mass-capture facilities became widespread, and people would have stayed in fixed locations longer.

Thus, I propose that the widespread adoption of watercraft, the widespread establishment of mass-capture facilities, storage and preservation, and their promotion of an attachment to specific locations on a constrained spatial scale converged to have a disruptive effect on the stable hunter-gatherer economy that eventually helped overturn the egalitarian sharing values. This disruption opened the door to attractive practices that could be adopted from farmers on the other side of the north European borderland.

The farmers of the south offered two attractive practices to the Baltic hunter-gatherers. These were not tangible objects but rather processes. Grain could be fermented into something like beer, thus yielding a storable source of nutrition and perhaps a pleasant buzz as well. This is much harder to do this with hazelnuts. Second, and far more significant in my view, would have been the attraction of milk and its derivatives such as cheese. The grain and the livestock could only come from the Danubian World. The acquisition of ceramic technology either from Danubian farmers or from the so-called Hyperborean Stream originating in Asia (Gibbs & Jordan, 2013) provided containers that could be used in these bio-processes. It seems no coincidence that the first domestic animals that appear just before 4000 BC throughout northern Europe are domestic cattle, and accumulating residue data shows rapid adoption of dairy products in many regions of northern and western Europe, including the western Baltic basin (Cubas et al., 2020, Isaksson & Hallgren, 2012).

Thus, it is probable that process technologies rather than specific innovations in material culture drove the disruption of the forager economy. Evidence for dairy production among the first markers of Neolithic things and practices along the Atlantic Façade and in southern Scandinavia is compelling. A key correlate of the appearance of dairying in the western Baltic ca. 4000 BC, however, is that the exploitation of wild terrestrial game and fishing continued to be important after the transition to agriculture. For example, the practice of building weirs for catching large numbers of fish that began in the Mesolithic appears to have intensified during the Neolithic at sites like Nekselø (Fischer, 2007; Pedersen, Fischer, & Bartholin, 2018). As Cubas et al. (2020) note, “indigenous and well-established culinary practices seemed to have persisted well into the Neolithic.” Is it really possible to say that all of Rouse’s criteria for migration have been satisfied?

5 Preference Falsification and Preference Cascades

Hunter-gatherer customs and values that had developed over millennia of the human experience would have been difficult to shake off, particularly the social norms that enforced sharing. There may have been strong social pressures to stick to old ways of hunting, gathering, and fishing and to decline to adopt new things and practices. Even if the technological processes had clear advantages for dietary security, food preservations, and storage, ideological constraints that inhibited their uptake still needed to be overcome.

Perhaps we can hypothesize that there were two coupled social processes in play. These can be termed “preference falsification” and “preference cascades,” concepts attributed to the economist Kuran (1995) and
popularized by law professor and blogger Glenn Reynolds. Although these are derived from observations of modern Western societies, perhaps they can be sufficiently generalized to make it possible to apply them to human interactions in northern Europe 6,000 years ago. Maintaining social standing under communal pressures and the self-interested desire for social acceptance seems to be some of the most fundamental human concerns.

Preference falsification is the misrepresentation of one’s wants or beliefs under perceived social pressures. This can happen in very small-scale situations, such as agreeing with a group about how tasty the food is when you find it unappetizing, or in very large-scale collective contexts, such as when voters tell pollsters that they will vote for a candidate whom they perceive to be more acceptable in their social circles when privately they prefer the other. People behave the way they think they ought to, not the way they want to. Preference falsification can be a powerful force in maintaining the status quo by preserving existing structures and suppressing the exploration of novel possibilities when social pressures are overwhelming. Such pressures may have been powerful in the Mesolithic world.

An effect of preference falsification, however, is to render disliked or unstable structures vulnerable to sudden massive and unanticipated changes. Small-scale events or disruptions can trigger the realization that others share similar wants, beliefs, or practices. When enough people discover that they are not alone in these aspirations, a practice – whether it involves voting for a particular candidate or adopting a new set of beliefs or technology – spreads like wildfire through a community and beyond. Traditional values and practices are upended quickly. For example, a radical publication or a dramatic public act may lead people to discover that there are many others who share their wants and aspirations. The person-to-person communication of rejection of earlier beliefs and values can be termed a “preference cascade.”

I propose that powerful hunter-gatherer social norms, including enforced sharing, could be up-ended by both developments internal to the forager world and external effects of proximity to farmers. Internally, the increasing attachment to places, paradoxically promoted by the mobility afforded by watercraft, and the development of mass-capture fishing facilities may have subverted traditional social arrangements. Externally derived bio-processes such as the fermentation of grain and milk practiced by central European farmers may have attracted the interest of Mesolithic groups and served as the eventual instrument of disruption of the forager economy. After centuries of being held in check by Mesolithic social norms despite knowledge of Neolithic things and practices, perhaps these factors triggered many local preference cascades during the final centuries of the fifth millennium BC that resulted in the rapid and widespread uptake of domestic plants and animals.

6 Contagious Agriculture

The concept of preference cascades provides a hypothetical mechanism for the initial local transformation of hunter-gatherer economies as a result of disruptive technologies and practices. In general, however, it describes short-term situational effects of individual decisions. Once individuals and their campmates defected from the Mesolithic social norms that inhibited the uptake of Neolithic things and practices, then what? How were their choices to adopt farming and its consequences propagated on a regional scale, maintained, and reinforced? Social contagion is a two-stage process, beginning with the “activation” of individual actors and then the propagation and reinforcement of such activations through interactions with peers throughout social networks (Piedrahita, Borge-Holthoefer, Moreno, & González-Bailón, 2018). The proposition has been advanced that human social networks share structural similarities across cultures and levels of social complexity such that they are shaped by fundamental evolutionary forces (Isakov, Fowler, Airoldi, & Christakis, 2019). These regularities in the human network structure have been shown to occur in Hadza hunter-gatherers (Apicella, Marlowe, Fowler, & Christakis, 2012), for example, suggesting that it is a fruitful line of inquiry to consider them here in connection with Mesolithic foragers.

After they have decided to indicate a preference for novel things and practices, social actors must decide whether they want to continue with the new regime or to revert to the earlier conditions. What
happens then requires coordination and communication among the actors to exchange information and reinforce their decisions. Communication and coordination among the activated are where true social contagion takes place.

Actors have to be in touch with each other, and communication technologies are key for such information exchange. A clear recent example is how the Internet has led to intensified social contagion since 1990 and especially since 2010. At the dawn of the fourth millennium BC around the Baltic, advances in watercraft may have played a similar role by enabling activated individuals to connect more easily than over land. Moreover, sedentism itself promoted communication, not only because a group of people interacted continuously but also because it provided fixed nodes in networks that connected other such communities. People knew where to find each other.

Increased sedentism would have promoted a phenomenon of networks known as “transitivity.” A simple definition of transitivity is that your friends are friends with each other (McDermott, Fowler, & Christakis, 2013). Since people tend to associate with people who share their values, in many cases, high transitivity can introduce conformity. Conversely, if someone breaks out of the conformity and is in a node with high transitivity, then dramatic changes can take place. In some cases, the network effects of transitivity can be bad, such as clusters of teen suicides. In other cases, high transitivity can promote widespread and contagious positive social changes.

Central to this process are individual actors with outsized personal impact. In the world of COVID, we might call them “superspreaders.” On Instagram, they are “influencers” who promote products and have thousands of followers. In northern Europe around 4000 BC, individuals with personal appeal, status, and influence who successfully adopted Neolithic things and practices would have become known beyond their immediate home areas as a result of the presumed transitivity of Stone Age networks. These may have been indigenous personalities, or they might have been newcomers.

Here is where a role for immigrants from north-central Europe to the Baltic World might be found. Rather than arriving through mass migration and rapid population replacement, we can envision them as evangelists for Neolithic things and practices. If farming immigrants insinuated themselves into the existing Mesolithic networks and by virtue of their “otherness” were seen as highly influential and popular, then hunter-gatherers, whose world had already been changed though the disruptions described earlier, could have become motivated to take up farming and stockherding. The incoming migrating farmers would have imparted a high level of agronomic knowledge to receptive students. This knowledge went beyond sowing the first seeds. For example, soil enrichment through manuring and cattle management for dairying were practiced from the earliest appearance of domestic plants and animals across much of southern Scandinavia (Gron et al., 2021; Gron, Montgomery, & Rowley-Conwy, 2015) and could not have been independent inventions. If the immigrant farmers connected with networks with a high level of transitivity, then the rapid expansion of farming throughout southern Scandinavia would have been a result.

7 Conclusion

Figure 2 provides a graphical summary of the processes proposed in this essay. The basic time frame is what might be called the “long fifth millennium BC,” recognizing that long-term developments began in the preceding millennia and continued past 4000 BC. At the upper left within the dotted box are the three key technological innovations that were amplified and mutually reinforced: regular use of watercraft in daily life; the elaboration of mass-capture facilities for fishing; and the use of storage and preservation techniques to store perishable that could not be consumed immediately. These all contributed to an increasing attachment to specific locations, bordering on sedentism, and eventually to the weakening of traditional hunter-gatherer values such as enforced sharing. Meanwhile on the right, the effects of contact with farming groups in interior central Europe are depicted: exchanges, feral livestock, genetic transfer, and eventually the possibility of immigrants north of the borderland that existed during the sixth and early fifth millennia BC. A key innovation that contributed to the eventual disruption of the hunter-gatherer economy
as the old sharing norms were unraveling was the attraction of bioprocess technologies, such as the use of milk for cheese production and the fermentation of grain. We can point to 4000 ± 100 BC as a reference date for many local preference cascades in which the traditional norms were shed and the adoption of domestic plants and animals occurred. Finally, the result was the very rapid uptake of agricultural things and practices during the first centuries of the fourth millennium BC throughout northern continental Europe and southern Scandinavia.

The transformation of late hunter-gatherer society described here, coupled with the poorly-understood role of immigrant farmers, can be seen to have set the stage for the emergent inequality in Early Neolithic society observed during the fourth millennium BC in southern Scandinavia (Nielsen & Sørensen, 2018; Price & Gebauer, 2017). Evangelists for the adoption of Neolithic things and practices, as well as individuals perceived as successful in navigating the new arrangements, may have emerged as leaders. Eventually, the same process of local preference cascades could have resulted in the acknowledgment of differences in social status. Farming societies south of the borderland, such as the Brześć Kujawski Group of northern Poland, exhibited markers in inequality in the previous millennium (Budd et al., 2020), so social differentiation was already on the (southern) horizon.

This essay has been a speculative exploration of possible explanations for the sudden transition to agriculture in southwestern Baltic and southern Scandinavia. After rejecting the Danubian model of
agriculture and household organization, the Mesolithic groups in northern Germany, Denmark, and southern Sweden were changing in the direction of sedentism and ownership rights, which upset traditional hunter-gatherer values of mobility and sharing. The appearance of disruptive technologies, such as dairying, from the Danubian World and eventually the arrival of farmers from northern central Europe “infected” the hunter-gatherers with an appetite for Neolithic things and practices, first gradually and then suddenly, as the contagion effects took hold in their networks. Within a few centuries, their world had changed completely.

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