Community Coalescence and Regional Geospatial Trends of Ceramic Decorative Variation in Late Woodland Northern Iroquoia

A Thesis Submitted to the School of Graduate Studies
in Partial Fulfilment of the Requirements for the Degree of Master of Arts
in the Faculty of Arts and Science

TRENT UNIVERSITY
Peterborough, Ontario, Canada

Anthropology Graduate Program

April 2021

Abstract

This case study focuses on geospatial patterns of decorative variation in pottery assemblages from 234 Northern Iroquoian village communities, occupied between *ca.* 1350–1650 CE. Previous interpretations of these assemblages' ceramic decorative variability have made the assertion that potters from these communities used collar decorative motifs as communicative social signals. However, they did not consider whether these geospatial decorative patterns could simply reflect the outcome of stochastic macroscale social learning processes driven solely by probabilistic information exchange between closer neighboring communities. Cultural transmission, the theoretical framework applied here, is well-suited to address this consideration. Thus, the primary research question of this case study is, "Are the expected outcomes of random copying processes sufficient to explain the range of geospatial ceramic decorative variability observed across Northern Iroquoia?"

Random copying processes are the stochastic, probabilistic social learning mechanisms driving the collective decisions of multiple communities, making up one side of the "random-selective copying spectrum." When the decorative decisions of multiple communities are collectively guided by shared ideas (such as, potentially, symbolic communication structures), they become subsumed under the broad umbrella of "selective copying" processes. The social learning mechanisms involved on both sides have predictable geospatial and structural ranges of ceramic decorative patterning. The goal of this case study was thus to evaluate the range of patterning in Northern Iroquoia, both generally as well as at narrower temporal and spatial scales. Ultimately, region-specific temporal trends in selective copying processes seeming to reflect recently established temporal trajectories of community coalescence were identified.

Acknowledgements

thank u

Contents

List of Figures

List of Tables

Chapter 1

Introduction

In the past 10 years, the approach variously known as "evolutionary archaeology" (Dunnell, 1980), "gene-culture coevolution" (Durham, 1991), or "cultural transmission theory" (Eerkens and Lipo, 2007) has developed considerably, spurred by a diversifying range of theoretical and methodological innovations (Creanza et al., 2017; Eerkens et al., 2014; Groucutt, 2020). By the second decade of the 21st century, cultural transmission theory has grown from a niche topic in evolutionary archaeology to a scientific paradigm with its own full-fledged discipline, distinct from the diverse range of sub-disciplines that inspired it (Mesoudi, 2020; Prentiss, 2021). Cultural transmission theory has earned a reputation for its capacity to adapt methodologies originally designed for diverse types of data (such as genetic diversity in molecular population biology; Prentiss 2019b) and apply them analogously to archaeological datasets of material culture traits (Garvey, 2018). Recent studies have begun to more clearly identify the numerous practical and theoretical considerations that must be made to study transmission processes operating during the descent with modification of intangible "cultural information" that differ from those acting during transmission of tangible traits such as genetic alleles (Mesoudi, 2011; Shennan, 2011; Walsh et al., 2019b).

One of the most useful aspects of cultural transmission theory is its applicability to previously collected archaeological datasets, allowing archaeologists to systematically reassess hypothesized processes of sociocultural interaction using robust quantitative methods (e.g. Jordan, 2015; Rogers and Ehrlich, 2008). By reframing these hypothesized processes in cultural transmission terms, archaeologists can further strengthen (or falsify) their usefulness as explanatory devices in archaeological contexts. For example, Stephen Lycett (2017, 2019, 2020) has published several papers that practically demonstrate the value of reframing archaeological hypotheses with terminology and approaches derived from cultural transmission theory. He used several Great Plains material culture datasets, some collected nearly a century ago (Klimek, 1935; Wissler, 1927), to argue that certain cultural traits were strongly connected to geospatial distance separating Great Plains Tribes, while different traits were more strongly connected to language dialects with less influence from distance. He argued that these different kinds of cultural trait influence reflected the unique cultural transmission processes active among the Great Plains Tribes, potentially showing how these groups differentiated themselves through their decorative decisions.

In 2012, New York archaeologists John P. Hart and William Engelbrecht published the first of what would become a series of papers studying macroscale patterning in the decorative diversity of pottery assemblages from village sites across the region of Northern Iroquoia (Hart and Engelbrecht, 2012, see also Birch and Hart 2018; Dermarkar et al. 2016; Hart et al. 2016, 2017, 2019). These studies collectively resulted in the construction of a database containing modal stylistic attributes of over 70,000 individual ceramic vessels from 234 distinct village assemblages, capturing decorative variation produced over a span of 150 years during one of the most rapid periods of growth in North American pre-contact history (Warrick, 2008). They are thematically underpinned by their shared reliance on a theoretical concept with ties to cultural transmission — social signaling (Bird and Bird, 2018; Bird and Smith, 2005; Conolly, 2017; Quinn, 2019). Derived from human behavioural ecology, signaling theory suggests that individuals (and collectively, communities) actively use cultural traits such as hairstyle, clothing, and material culture to communicate aspects of their social identity and artisanal skills to other members of their own and neighboring communities (Bird and Smith, 2005). These studies assert that the decoration applied to pottery by Northern Iroquoian potters is one such cultural trait, and that Northern Iroquoian potters' complex roles in the domestic and political affairs of their communities would have positioned them to use these decorations to actively signal elements of their personal and collective social identities (Birch and Hart, 2018; Hart and

Engelbrecht, 2012). As active signals of collective social identity, the observed decorative variability among these pottery assemblages is interpreted as a reflection of intercommunity relationships that can potentially be relied upon to reconstruct affiliation between groups of villages at the regional scale. However, social signaling theory is far from axiomatic, and its focus on the behaviour and intentions of individuals has caused its utility for archaeological applications to be questioned (Quinn, 2019).

Cultural transmission theory allows us to reframe the concept of social signaling in explicitly materialist terms by providing a null hypothesis that its predictions can be tested against. This null hypothesis relies on the simple assumption that, in lieu of any other active cultural transmission forces, cultural traits are learned (or transmitted) between individuals and communities through a process of "random copying" among individuals coupled with the introduction of new traits through innovation and the loss of old traits through stochastic processes and sampling error (Mesoudi, 2011, 79). Social signaling, as a process of active manipulation of material culture for use as communicative media, constitutes an additional cultural transmission force that is expected to alter the transmission of certain variants of the cultural trait in question (in this case, the decoration of pottery in Northern Iroquoian village communities), creating patterned variation that is empirically distinguishable from random copying (Kohler et al., 2004; Neiman, 1995; Shennan and Wilkinson, 2001; Steele et al., 2010).

Importantly, the random copying assumption of the neutral model can also be extended in geographic terms to a null hypothesis for the spatial structure of material culture variation known as an "isolation by distance" (IBD) model (Premo and Scholnick, 2011; Scerri et al., 2018; Shennan et al., 2015). The IBD model begins with the assumption that "the frequency of cultural transmission is mostly characterized by a distance decay, where the greater the inter-distance between the donor and the recipient, the less likely is the occurrence of a transmission event. This implies that, other things being equal, the similarity of cultural traits should also decline over distance" (Shennan et al., 2015, 103). Thus, the IBD model assumes that when random copying is the norm, there should be a noticeable degree of spatial autocorrelation between the similarity of material culture assemblages and inter-assemblage distance that simply corresponds to the increased likelihood of two communities interacting and exchanging information. The additional effects of social signaling as an evolutionary process constitute a departure from “other things being equal” and are hypothetically visible against the background “canvas” of the neutral model (Bentley, 2007, 1072). However, in the spatial extension of the neutral model one additional step is necessary to distinguish random copying from external cultural transmission forces related to social signaling.

Spatial autocorrelation of similarity in cultural traits could potentially be caused by the effects of both random copying and social signaling of shared group affiliation in closely grouped communities, but only the latter process will also invoke the effects of homophily (Axelrod, 1997; White, 2013). Homophily in sociological terms is the tendency for individuals to be more likely to share information with those they consider similar to themselves (McPherson et al., 2001; Haun and Over, 2015). In archaeological terms, homophily increases the likelihood of cultural transmission between closely related communities, creating an amplified IBD effect. However, this amplification comes at the cost of an increased level of discontinuity in the *population structure* of the data (Shennan et al., 2015). Discontinuous population structure is also a concept adapted from population genetics and refers to a population of subgroups (i.e. affiliated village communities) displaying increased between-group and decreased within-group variability (Ross et al., 2013). In a random copying IBD model, subgroups are not expected to be distinguished as there are no external processes influencing group preference. Since social signaling of community identity and by extension group affiliation is expected to involve a significant amount of homophily in social learning, the random copying IBD model can be distinguished from social signaling by examining the degree to which the data exhibit a significantly discontinuous population structure.

Thus, the primary research objective of this thesis is to test the null hypothesis that the variability in decorative motifs observed throughout Northern Iroquoia can be sufficiently explained by the expectations of random copying. This objective will be accomplished using a tripartite approach: first, the degree to which the interassemblage similarity of Northern Iroquoian assemblages conform to a model of isolation by distance will be tested. If there is no strong relationship between distance and interassemblage similarity, we must invoke other evolutionary processes for the observed decorative variability which could potentially include signaling of shared social identity. Next, the degree to which the collection of Northern Iroquoian assemblages exhibit a distinct population structure will be assessed to determine the likelihood that homophilic spatial autocorrelation is present. Finally, the robustness of the population structure will be tested independently, since hierarchical population structures can be biased by IBD and vice versa (Meirmans, 2012). If, at the end of this three-step methodology, the null hypothesis cannot be rejected, we must question the validity of the social signaling hypothesis posited by Hart and Engelbrecht (2012) as an explanatory mechanism for the material culture change observed across Northern Iroquoia. In other words, “before we can invoke alternative processes shaping cultural variability, we must first determine the degree to which random copying of neutral traits alone can account for our observations” (Eerkens and Lipo, 2007, 256).

The following chapter lays out the archaeological context of the study area, Northern Iroquoia, and introduces the published archaeological dataset associated with it. Chapter 3 elaborates on cultural transmission theory and the copying spectrum model, situating the archaeological case study and providing a framework to interpret the results of the three scenarios evaluated. Chapter 4 reframes the primary research question as a set of hypotheses and introduces a set of statistical methods to test them. Chapter 5 summarizes the hypotheses’ results in each case to identify the most parsimonious copying processes that explain them. Chapter 6 examines how these copying processes may reflect macroscale geopolitical realignment processes associated with community coalescence over the course of the Late Woodland, and how these processes differed over time and space across Northern Iroquoia. Chapter 7 is a critical evaluation of the effectiveness of both the theoretical framework and methodology of the case study that provides suggestions for future research applying cultural transmission theory to Northern Iroquoian contexts.

Chapter 2

Archaeological Context: Late Woodland Northern Iroquoia

This chapter traces the developmental trajectory of community coalescence in Northern Iroquoia from the onset of semi-sedentary communities through to the formation of distinct regional social institutions such as Nations and confederacies. Geographic and temporal trends in this developmental trajectory are essential for introducing and contextualizing decorative variability among the material culture assemblages that form the basis of the case study. The second half of the chapter is focused on introducing and summarizing this material culture dataset, as well as outlining some of the classification strategies that contributed to its development and elaboration.

2.1 "Northern Iroquoia"

"Northern Iroquoia" is the name conventionally used by archaeologists to refer to a region of Northeastern North America that includes parts of what are now Southern and South-central Ontario, Northern New York State, and portions of Western Quebec along the St. Lawrence River (Figure 2.1). The term draws its etymology from an exonym given to ancestors of the Haudenosaunee people, whom the French called the *Iroquois* (Day, 1968), but its use as a regional place name in the archaeological literature is primarily derived from linguistics. "Northern Iroquoian" refers to a family of language dialects spoken by numerous populations of people dispersed across the lower Great Lakes at the time of sustained European contact (Mithun, 2017). Given the antiquity of the separation of the Northern Iroquoian language family from its surrounding Algonquian neighbors (Martin, 2008; Schillaci et al., 2017), most archaeologists have accepted the term as a referent suitable for such a broad and diverse study area (Williamson and Snow, 2016). Northern Iroquoia contains the traditional territory of many contemporary First Nations groups, including the Wyandot, Haudenosaunee, Huron-Wendat (Sioui, 1999), and Michi Saagiig Nishnaabeg (Gidigaa Migizi [Williams], 2018, 2020). Furthermore, extensive commercial and academic archaeological research in the area has led to the development of a rich archaeological record that is conducive to studying the regional interaction of communities (Williamson and Snow, 2016).

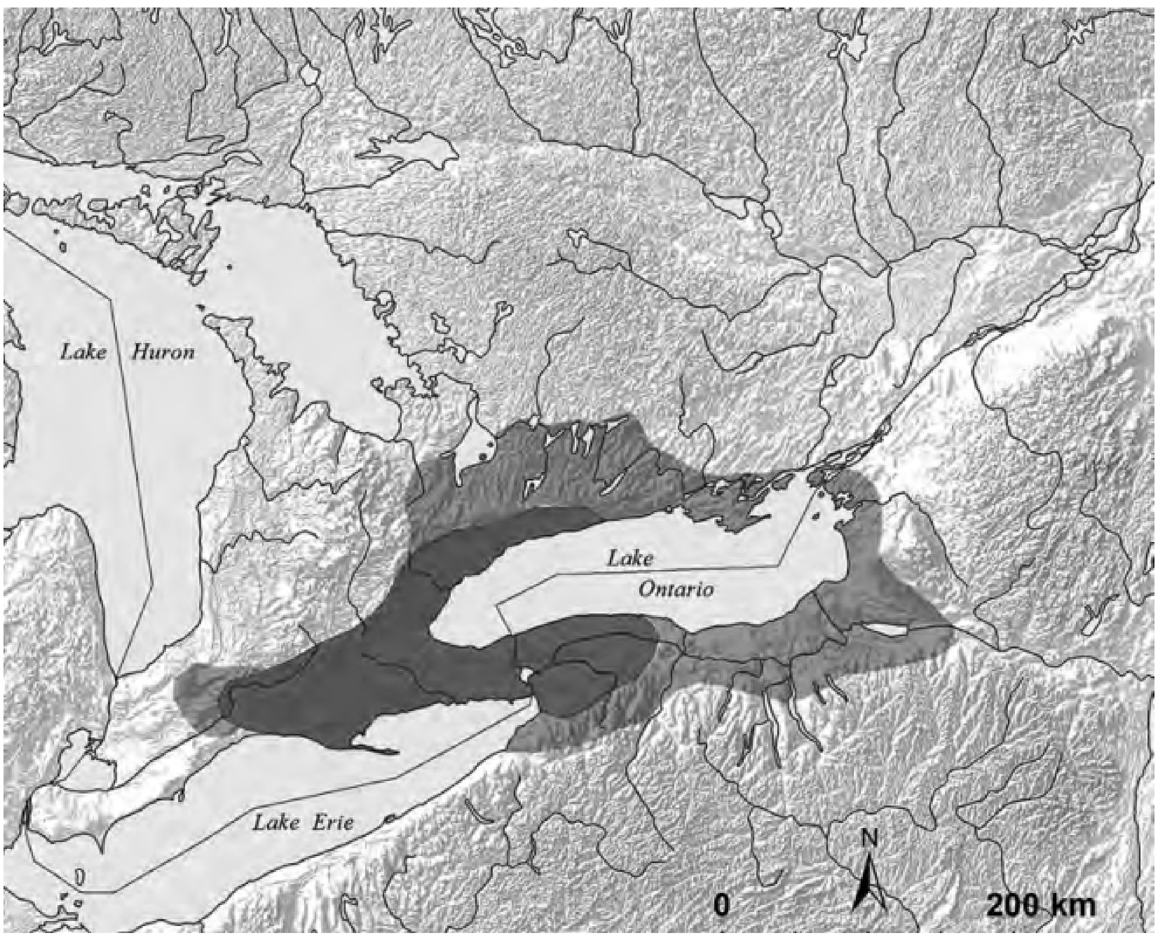


Figure 2.1: Map of “Northern Iroquoia”. The dark grey shaded area represents the theorized extent of occupation by *ca.* 1250 CE, and the light gray area by *ca.* 1300 CE (initial coalescence). Map based on ethnohistoric and archaeological evidence (Fox, 2015, 24).

2.2 Northern Iroquoian Coalescence

The past two decades have witnessed a substantial paradigm shift in the status quo of Northern Iroquoian archaeology. Widely reified monothetic culture-historical phases have given way to a contingent historical processual perspective that emphasizes the diversity of regional sociopolitical systems and institutions (Birch, 2020; Engelbrecht, 1999; Gaudreau and Lesage, 2016; Hart, 2011; Hart and Brumbach, 2003). Burgeoning availability of high-quality databases of regional settlement sequences (e.g. Birch and Williamson, 2013, 2015; Birch et al., 2016; Hart, 2020) and high-fidelity reconstructions of individual communities' organization of domestic space (Birch and Williamson, 2013; Creese, 2016; Dermarkar, 2019) have begun to facilitate an increasingly widespread reappraisal of the developmental trajectories of Northern Iroquoian social institutions attested by the ethnohistoric evidence recorded by 17th century European chroniclers. Central to this broad reappraisal are the efforts of Jennifer Birch and colleagues (Birch, 2020, 2015, 2012, 2010a,b, 2008; Birch and Williamson, 2013, 2018; Birch et al., 2016; Birch and Hart, 2018; Hart et al., 2017, 2016) to reframe the development of these institutions as an ongoing process of community coalescence (Kowalewski, 2006; Kowalewski and Birch, 2020). This theoretical perspective also situates the regional perspective of this case study squarely in the realm of population thinking by recognizing the uniqueness of individual Northern Iroquoian communities while simultaneously appreciating shared trends and patterns in their development.

The roadmap of Northern Iroquoian coalescence has junctions at a few key intersections which delineate the structure of this section. The order of these intersections is closely tied to the population history of the region (Warrick, 2008; Jones, 2010), which played a key role in the forces driving and directing coalescence (Birch, 2010b, 2012). Broadly, Northern Iroquoian communities passed through three stages of population coalescence before European contact: initial coalescence, primary coalescence, and post-coalescence. Each stage of coalescence was accompanied by the introduction or elaboration of new sociopolitical institutions and structures that were likely closely tied to developing collective social identity, real or fictive kinship ties, steadily rising population size, local and interregional social interaction, and the development of pan-Iroquoian belief systems such as the circular society (Birch, 2019, 2020; Sioui, 1999).

Although there is a rich archaeological history in Northern Iroquoia, the process of coalescence which preceded the development of most Northern Iroquoian social institutions began somewhere in the middle of the "Late Woodland" chronological period (Birch, 2015; Williamson, 2014; Warrick, 2000). The Late Woodland period began around roughly 500 CE and continued through to the period of sustained European contact in the mid-seventeenth century (Creese, 2013; Smith, 1997b), and the earliest evidence of initial coalescence — the appearance of semi-sedentary communities — occurred around the turn of the millennium (Birch and Williamson, 2018, 93). These early "villages" were typically small in size with unstructured spatial organization (Creese, 2016), probably comprising several family groups living together and sharing resources and tasks (Birch and Williamson, 2018, 93). While the aggregation of these early villages was probably driven by numerous objectives, their occupants were likely motivated by the increasing attractiveness of maize horticulture that followed (or spurred) growing populations in the region (Beales, 2014; Birch, 2019). Birch and Williamson (2018, 93) suggest that regional interaction in Northern Iroquoia during pre-coalescence was likely a "locally based social network" without the later hallmarks of cross-cutting regional social institutions such as matrilineal clan affiliation.

While initial coalescence followed the development of the first sedentary communities, it remained a largely localized phenomenon for several centuries. Primary coalescence saw the development of these communities from small groups of families to larger, organized settlements bearing evidence of structured domestic space and regional connections (Birch, 2012, 2019; Creese, 2016). Birch (2019) refers to the period of primary coalescence as a significant "geopolitical realignment" of Northern Iroquoian societies: an overall shift from localized interaction to shared multi-community social interaction.

Although it remained diverse and regionally contingent, primary coalescence was most likely driven by two connected commonalities experienced across Northern Iroquoia: population growth and conflict (Birch, 2010a, 2015). As sedentary agricultural communities became established by the turn of the fourteenth century and maize became a diet staple (Pfeiffer et al., 2016), rapidly rising population sizes quickly followed (Warrick, 2008). Increasing need for food and construction materials occurred as the average size of communities jumped across the region (Creese, 2016). Rapid depletion of local resources shortened average village occupation spans, with most communities relocating every 10–40 years and seldom re-occupying the same site (Birch and Lesage, 2020; Birch and Williamson, 2013, 2015). Site frequency decreased and village size increased as multiple communities moved away from the violence along the North Shore of Lake Ontario and coalesced together (Birch, 2012, 2020; Birch et al., 2020; Birch and Williamson, 2015). Communities in the Trent Valley and around the St. Lawrence relocated and coalesced with others to the West and the South (Birch and Williamson, 2013; Williamson, 2016), while villages in Northern New York continued to develop within their own settlement clusters (Engelbrecht, 2003).

With the rapid increase in regional community size and resource demands came a concomitant spike in violent conflict across the region (Birch, 2010a). Warfare was an important component of Huron-Wendat culture (Sioui, 1999, 165–70) but typically differed in scale from the endemic, community-wide violence that occurred during primary coalescence. Evidence of endemic violence between communities included the construction of robust multi-row palisades, defensive siting of villages on rough terrain, and evidence of violent trauma in human remains (Birch, 2010a, 37–42). Recent radiocarbon modeling by Birch et al. (2020) has established that widespread endemic violence did not occur across Northern Iroquoia in a single unanimous wave; rather, the earliest evidence of endemic violence is found on late 1400s–early 1500s sites from the Finger Lakes region of New York and the Humber River valley in Southern Ontario (Birch et al., 2020, 22), and is not evident on the North shore of Lake Ontario until *ca.* 1525 CE. Given that the advent of endemic violence is a primary force motivating the coalescence of communities (Birch, 2010a), these recent radiocarbon models provide an approximate timeline for primary coalescence in Northern Iroquoia.

Birch (2012, 2019) argued that increasing community sizes during primary coalescence would have eventually necessitated social institutions above the family group if consensus decision-making was to be maintained (e.g. Sioui, 1999, 153–158). These may have initially taken the form of multi-family matrilineages sharing their own longhouses (Birch, 2016). Birch (2016) suggested that the increasing importance of maize agriculture (traditionally part of the domestic realm controlled by women; Sioui 1999, 101–103) during initial coalescence may have helped solidify the role of matrilineages as unifying social institutions later on. Eventually these lineages became integrated in complex kinship structures that cross-cut individual village membership, such as clans (Sioui, 1999).

Further evidence supporting the development of regionally unifying social practices during primary coalescence includes the advent of sweat lodges and the first appearance of ossuaries. Ethnohistoric evidence attests that one of the primary purposes of sweat baths was hosting visitors from other communities (MacDonald, 1988; MacDonald and Williamson, 2001) and they became common in fifteenth century Northern Iroquoian villages (Birch and Williamson, 2013, 20–21). The floruit of these unifying structures implies the increasing importance of external relationships between communities that is further strengthened by the appearance of ossuary burial sites. Huron-Wendat ossuaries were products of a ritual connection between clans, communities, and Nations in which many different ancestors were laid to rest together in the same place in a profound display of unity (Sioui, 1999, 234 n. 194). They first appeared as early as the eleventh century in the Rice Lake area, but most that have been discovered date from the 14th–17th centuries around the time when primary coalescence began to ramp up (Williamson, 2014).

Thus, primary coalescence across Northern Iroquoia led to the development or elaboration of regional interaction and cross-cutting social institutions that would have facilitated connections between both neighbouring and distant communities. From the turn of the sixteenth century to the advent of European contact, these processes rapidly ramped up in both scope and scale as communities grew to massive sizes with populations numbering in the thousands. After the formalization of coalescent communities, carefully organized and reorganized village domestic settings (Birch and Williamson, 2013, 72–77; Creese, 2016), well-established nested social institutions and political structures within which women (and particularly matriarchs) held considerable influence (Birch, 2016, 2020; Trigger, 1978), and well-established regional relationships between Nations of affiliated communities (e.g. Birch and Hart, 2018) became the norm (Birch, 2019). The nascent Wendat-Tionontaté and Haudenosaunee confederacies also probably formed their roots within and between post-coalescent communities as clans organized into phratries and Nations and Nations allied with one another (Birch, 2020).

2.3 Northern Iroquoian Pottery Assemblages Dataset

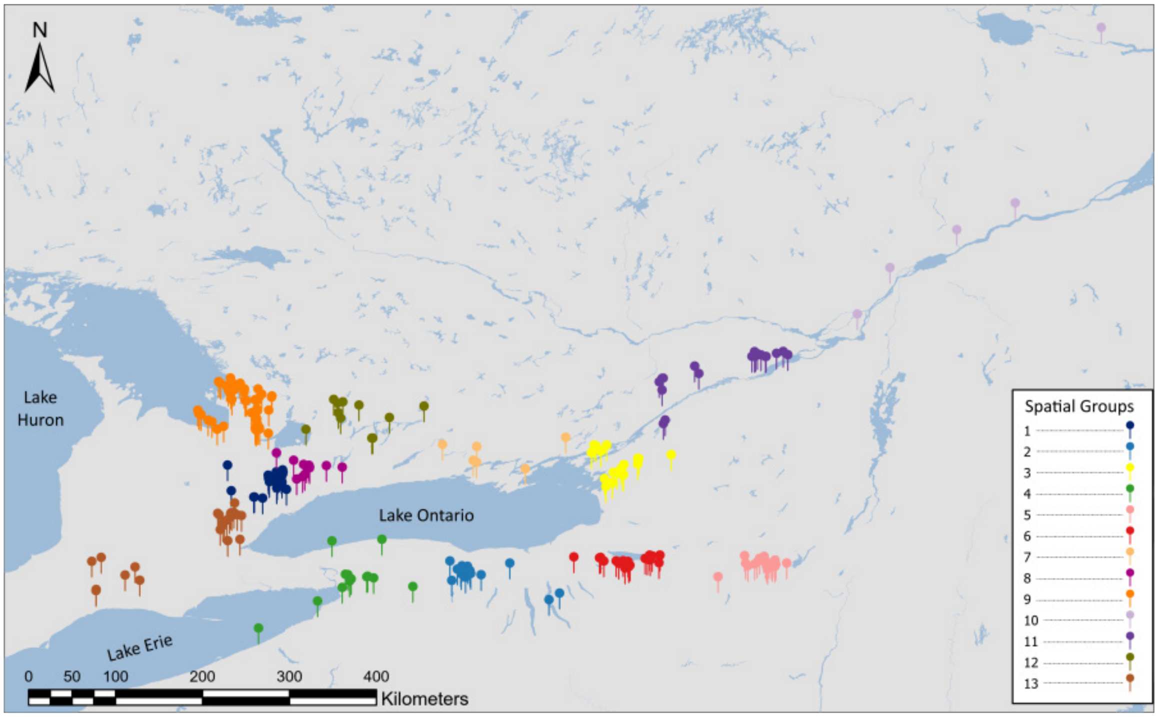


Figure 2.2: Map of spatial groups included in this study. Spatial group codes correspond to Table 2.3. See Table B.1 for a list of all individual sites.

The collection of community assemblages that comprise the materials of this case study are the result of many years' worth of sustained efforts by academic and commercial archaeologists on both sides of the National border. The dataset began as the dissertation research of William Engelbrecht (1971) and has received considerable additions and modifications over the last 50 years, with its proponents adapting Engelbrecht's standardized pottery attribute coding scheme (Engelbrecht, 1996) to include the published and unpublished data and notes of many Northern Iroquoian archaeologists such as Jeffrey A. Bursey, Peter Ramsden, James Tuck, Charles Garrad, and Richard MacNeish (Hart et al., 2016, Table S1). The dataset is curated by the New York State Museum (Susan Winchell–Sweeney, pers. comm. 2020) and in its constantly evolving form has facilitated broad regional studies by John Hart and colleagues (Birch and Hart, 2018; Hart and Engelbrecht, 2012; Hart et al., 2016) as well as case studies of spatial groups from the West Duffins Creek (Hart and Birch, 2021), Finger Lakes (Hart, 2020; Hart and Engelbrecht, 2016) and Northern New York and St. Lawrence areas (Dermarkar et al., 2016; Hart et al., 2017, 2019). In its current state, the dataset contains decorative attribute combinations collected from 70,489 vessels, distributed across 234 assemblages from thirteen spatial groups of communities ranging from *ca.* 1350–1650 CE (Figure 2.2).

2.3.1 Dataset Structure

There are three primary dimensions to the structure of the Northern Iroquoian pottery dataset that have critical implications for its application in a regional study of community interaction: its temporal, spatial, and material data classes. The structure of these classes and the motivation driving their definitions are an important element of the case study that should not be overlooked. All the class definitions applied in this case study were directly adapted from previously published studies (e.g. Hart et al., 2017, 2019).

Temporal Variation: Timeslices and Timeblocks

It is generally well-attested that Northern Iroquoian villages were only occupied for a relatively short period of time (about 10–40 years) due to the collective impact of local resource and soil exhaustion, structural degradation of buildings, and a likely buildup of pests and waste (Birch and Williamson, 2013; Warrick, 1988, 2008). Additionally, after the formal establishment of villages and following coalescence, communities rarely reoccupied sites once they had relocated (Birch and Lesage, 2020; Birch and Williamson, 2015). Together these two assumptions guided the creation of six 50-year timeslices by Hart et al. (2016), dividing the period approximately following the establishment of Northern Iroquoian villages by *ca.* 1350 CE up to the dispersal of the Huron-Wendat from the North shore of Lake Ontario in the mid-seventeenth century (Table 2.1). These timeslices were not intended to be exact temporal phases given the possibility of overlap in community occupation span; to solve that problem, five 100-year sequential overlapping timeblocks were defined (Table 2.2, Figure 2.3). Communities were assigned to a timeslice based on

Table 2.1: Timeslices (after Hart et al., 2017)

Temporal Range CE	Timeslice Code	Number of Sites
1350–1400	I	35
1400–1450	II	41
1450–1500	III	44
1500–1550	IV	41
1550–1600	V	37
1600–1650	VI	36

Table 2.2: Combined Timeblocks

Timeblock Range CE	Number of Sites
1350–1450	76
1400–1500	85
1450–1550	85
1500–1600	78
1550–1650	73

"radiocarbon dates, when available, and relative dating based on ceramic seriation, coefficients of similarity, chronological patterning in other suites of material culture, and the built environment" (Hart et al., 2017, 9).

Until recently, many communities across Northern Iroquoia — especially those closely predating or postdating the first arrival of Europeans — were relatively dated according to either ceramic seriation or the relative amount and types of European trade goods (Wray and Schoff, 1953; Macneish, 1952). The growing existence of programmatic radiocarbon re-dating of sites has long called into question these early relative dates (Smith, 1997b), but recent efforts to systematically redate more recent sites dated only by relative seriation have revealed that many of their estimated occupation dates were up to 100 years too early (Abel et al., 2019; Birch et al., 2020; Manning and Hart, 2019; Manning et al., 2018, 2019, 2020). Assignments of communities to a particular timeslice have been retained from the published dataset, but wherever possible the updated radiocarbon-modelled occupation spans have been accommodated (and all changes denoted in Table B.1).

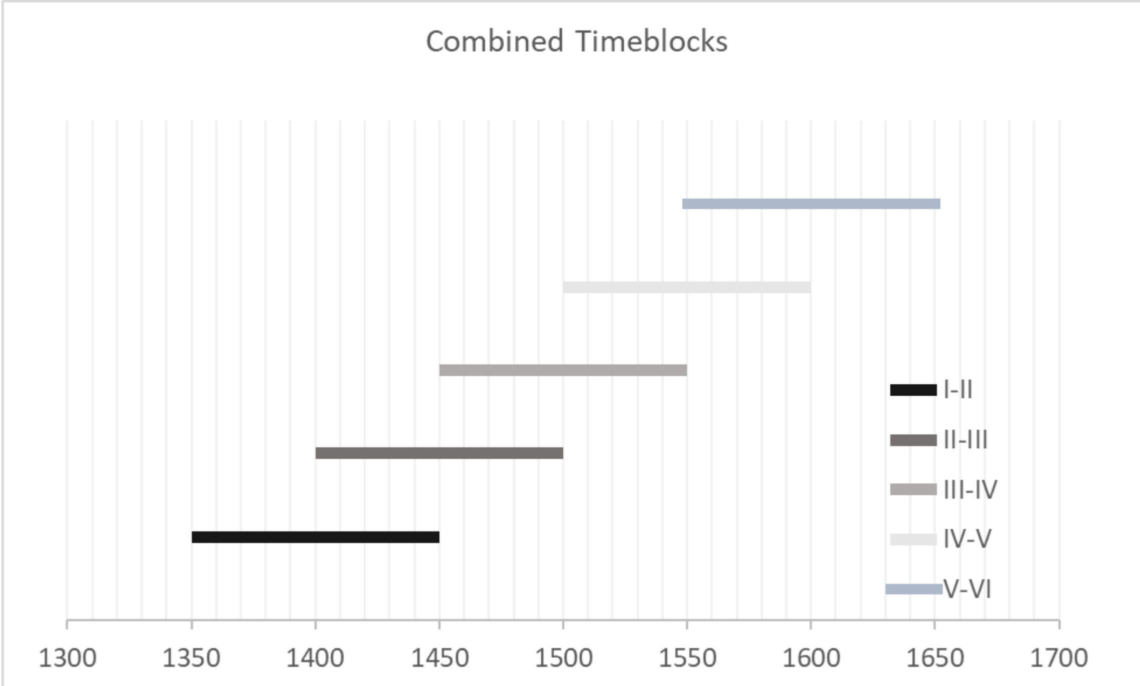


Figure 2.3: Overlapping sequential timeblocks (based on Hart et al., 2017).

Spatial Classes: Spatial and Regional Groups

The spatial structure of the dataset is perhaps the most critical of the three dimensions due to its role in shaping the relationship between interassemblage similarity and distance. As discussed further in Chapter 4, spatial structure can create artificial trends that can easily be misconstrued as the outcome of behavioural processes (Handley et al., 2007, 435). There are two main divisions in the spatial structure of the dataset: regions ("combined groups," Hart et al. 2017, 6; hereafter "regional groups") and geographic clusters (hereafter "spatial groups"). A third potential division, the scale of the community institution itself at the intra-site level (see Holland-Lulewicz et al., 2020, 7), is more difficult to define archaeologically (Birch, 2008; Perreault, 2019) and is outside the scope of this study (but see Birch and Williamson, 2013; Finlayson, 2020).

Spatial Groups The most critical dimension of the Northern Iroquoian dataset is its division into thirteen mutually exclusive spatial groups (Table 2.3). Since the pioneering work of James Tuck (1971), villages across Northern Iroquoia are theorized in terms of site clusters — collections of geographically proximate communities that are assumed to have had

Table 2.3: Number of Sites per Spatial Group in Timeslices I – VI

Spatial Group	Code	I	II	III	IV	V	VI	Total
Credit, Humber, and Don Rivers	1	1	7	7	7			22
Finger Lakes	2		2	3	2	3	5	15
Jefferson County	3		4	7	7			18
Lake Erie Plain / Niagara	4				1	8	4	13
Mohawk Valley	5	2		3	5	9	1	20
Oneida Lowlands	6	2	2	5	2	5	3	19
Prince Edward County	7		3	3				6
Rouge, Duffins, and Durham Rivers	8	5	2	1	2	1	1	12
Simcoe County / Tionontaté	9	7	10	2	4	8	19	50
St. Lawrence Downstream	10	1	1	2	1			5
St. Lawrence Upstream	11	4	3	6	6			19
Trent River	12	3	1	3	3	2		12
West of Credit River	13	10	6	2	1	1	3	23
Total		31	41	44	41	37	36	234

close interactions with one another (Abel, 2001; Hart, 2020; Williamson, 1990; Williamson and Robertson, 1994). In New York, ancestral Haudenosaunee communities were thought to have developed within territorial site clusters (Engelbrecht, 2003) while villages North of Lake Ontario seemed to cluster together in river drainages as they relocated Northwards (Birch and Williamson, 2013, 2015), suggesting to some that these clusters represented distinct populations akin to the Nations of affiliated villages described by ethnohistoric sources (Birch, 2019). Recent evidence derived from the database has raised questions about the veracity of this representation (Hart and Engelbrecht, 2012; Hart et al., 2016), demonstrating cross-cutting ties between distant spatial groups in both New York and Ontario. However, later studies using the same spatial groups state they are "mapped onto archaeologically and historically defined social units" (Hart et al., 2017, 9) and use them as stand-ins for so-called populations such as the St. Lawrence Iroquoians (Dermarkar et al., 2016; Hart et al., 2017) and Northern New York Iroquoians (Hart et al., 2017, 2019). Therefore, it is not objectively clear whether the spatial structure of these spatial groups naturally corresponds to the population structure of the many affiliated communities they contain. To preserve comparability, they have been retained following their most recent definition at the time of writing (Hart et al., 2019).

Table 2.4: Number of Sites per Timeblock in Regional Groups 1–5

Regional Group	1 (1350–1450)	2 (1400–1500)	3 (1450–1550)	4 (1500–1600)	5 (1550–1650)	Total
Jefferson County	4	11	14	7		18
Lake Erie/Niagara			1	9	12	13
New York	8	15	20	26	26	54
Ontario	55	47	35	29	35	125
St. Lawrence	9	12	15	7		24
Total	76	85	85	78	73	234

Regional Groups There are five regional groups in the complete dataset (Table 2.4). These regional groups divide the study area into geographic regions approximating the location of (hypothetically) associated populations (Hart et al., 2017). They are not intended to represent mutually exclusive cultural populations, but rather to facilitate comparisons in regional trends across different parts of Northern Iroquoia. For example, it is well-attested that many communities in the New York regional group are ancestral to contemporary Haudenosaunee peoples (Engelbrecht, 2003), while many communities in the Ontario group are understood to be ancestral to the contemporary Huron-Wendat (Sioui, 1999) and Michi Saagiig Nishnaabeg (Gidigaa Migizi [Williams], 2018, 2020) Nations. The early confederacies historically associated with these contemporary peoples have many similarities, but they cannot be treated as functional equivalents (Birch, 2020; Birch and Hart, 2018). Other regional groups, such as Lake Erie / Niagara, Jefferson County, and St. Lawrence, were also defined on the basis of ethnohistoric evidence, but their relationship to contemporary Indigenous communities is not as well-understood (Abel, 2019; Gaudreau and Lesage, 2016; Williamson, 2016). Additionally, most of the latter "regional groups" only contain a single spatial group (Jefferson County, Lake Erie/Niagara) or two connected spatial groups (St. Lawrence downstream/upstream). Nevertheless, these regional groups serve to divide the study area into geographic regions, serving an important purpose by allowing us to look at Northern Iroquoian communities at the mesoscale.

2.4 Northern Iroquoian Pottery Decoration

Although considerable evidence has shown that variability on Northern Iroquoian pottery is multidimensional (Martelle, 2002; Striker, 2018) in that time-space trends for decorative

Figure 2.4: Photograph of a complete pot from the Charleston Lake site assemblage (photo courtesy of Josh Garrett). The collar is indicated by the bracket.

variability (i.e. pottery collar decoration) can suggest strikingly different behaviour from trends in technical variability (i.e. temper type or wall thickness) in the same vessels, the latter traits are often prohibitively difficult to acquire at the same scale. The present dataset is no exception: many communities were only available because their unpublished collection notes could be reasonably converted to workable data. Nevertheless, treating pottery collar decoration as a cultural trait and studying its spatial and temporal variability still affords considerable value for making conclusions about regional-scale cultural transmission forces in Northern Iroquoia because pottery-making, as a craft skill, would have been strongly guided by norms in social learning (Dorland and Ionico, 2020; Tehrani and Riede, 2008; Watts, 2008).

The collar of a pot is a raised rim of clay around the opening of the vessel (Figure 2.4); they are not unanimously plain or decorated (Brumbach, 2011), and apparently do not significantly improve the effectiveness of pots for cooking, despite the additional labour and skill required to produce and decorate them (Hart and Engelbrecht, 2012, 330). Diachronic inter-assemblage studies of pottery across Northern Iroquoia indicate that the development and use of these collars roughly coincided with the initial coalescence of villages at the end of the Middle Woodland period (Taché and Hart, 2013). While other aspects of pottery can be decorated, Hart and Engelbrecht (2012, 328–332) focused on collars because "[s]itting on the domestic hearth, the collar/wedge would be substantially more visible than either the body or neck" (Hart and Engelbrecht, 2012, 331). This enhanced visibility within the domestic sphere carries important implications for the role of each vessel in cultural transmission, as the chosen decorative motifs would be more likely to be seen by both community members and visitors alike, potentially improving their role as communicative media. The following chapter addresses this point in greater detail.

In this case study, each community assemblage consists of a series of 29 mutually exclusive pottery collar motif combinations (PCMCs) originally developed by William Engelbrecht (1971, 29–32). Attributes were regrouped from a pool of 98 primary geometric "design elements" that formed the base motifs (Figure 2.5). These may range from simple elements like single or multiple oblique lines, combinations of multiple line types, or complex organizations of lines that form geometric patterns. They may be represented on the collar as a single row of elements, or as many as four distinct zones proceeding downward from the lip to the base of the collar. Throughout the development and elaboration of the dataset, the definition of these PCMCs has remained largely consistent with their original formulation, which was deliberately designed to capture "particularistic and often minor stylistic variations" of pottery decoration attribute states (Engelbrecht, 1971, 32). Engelbrecht chose the decorative elements of each PCMC based on his considerable experience with Iroquoian pottery, creating regroupings "on the basis of formal similarity" (ibid., 32–33). In practice this meant grouping different kinds of oblique or intersecting lines, for example, to create a PCMC that could quickly aggregate similarly collared vessels (Engelbrecht pers. comm. 2020).

Appendix A contains a table of each of the 29 PCMCs summarizing the decorative variability of an assemblage of pottery collars. The PCMCs # 2–28 are original and derived directly from Engelbrecht's coding scheme. PCMC # 1 is omitted here because it represents undecorated (plain) collars. The 30th PCMC in the table was first added by Dermarkar et al. (2016); it represents a distinctive collar decoration commonly associated with St. Lawrence

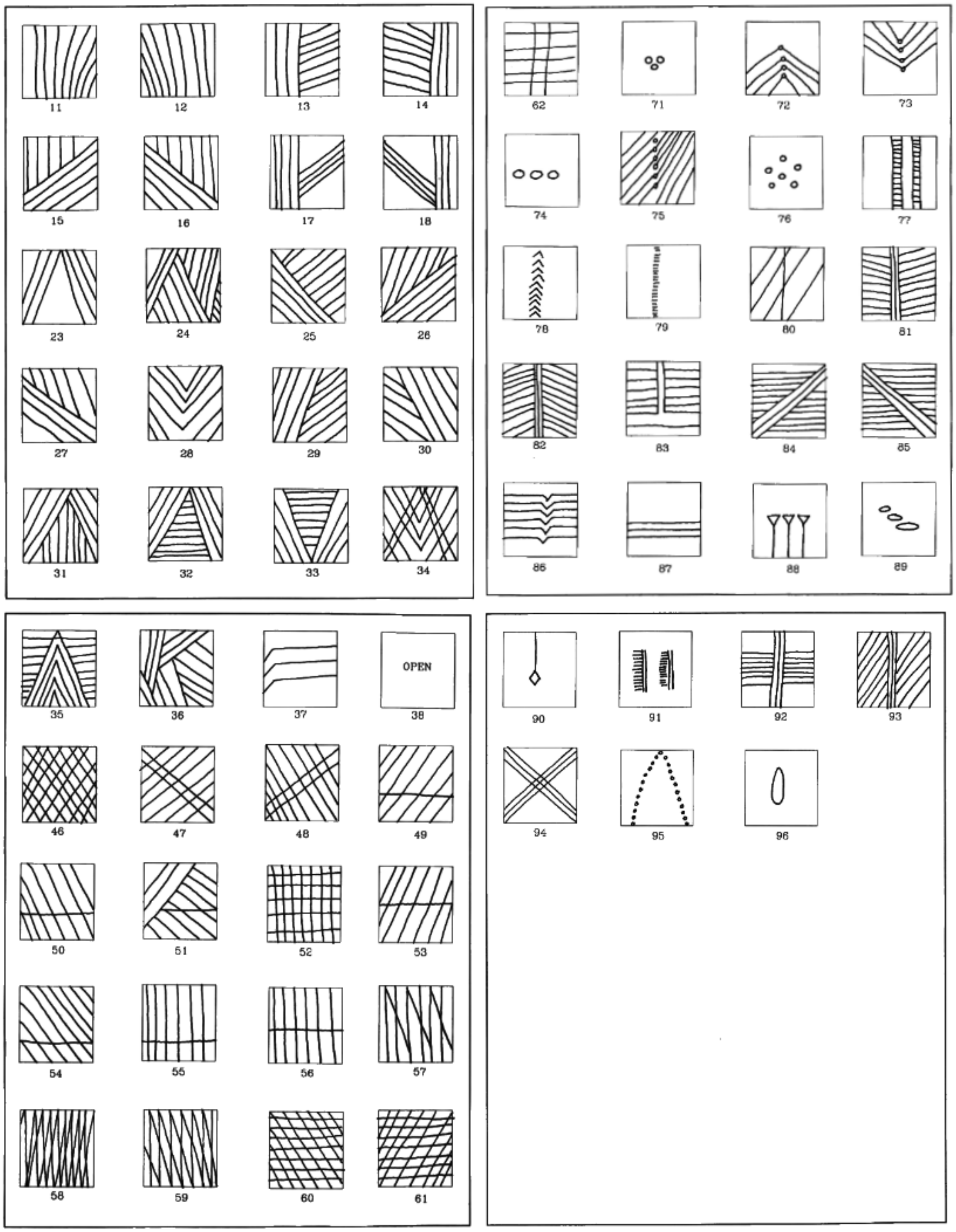


Figure 2.5: Illustrated standardized design elements for attribute regrouping. There are 32 unillustrated simple design elements (e.g. "single horizontal line"; Engelbrecht, 1996, 132–135).

sites (Gates St. Pierre, 2016). When the latter PCMC was added to the dataset, the previous assemblages were rechecked to note its presence (Hart, pers. comm. 2019).

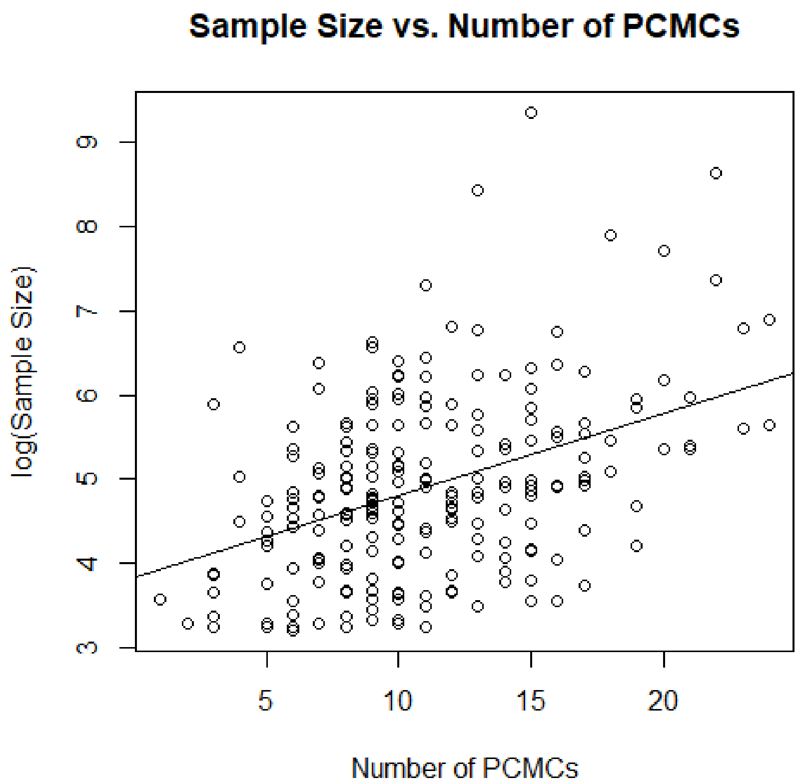


Figure 2.6: Sample size vs. number of PCMCs for all sites.

Counts of each PCMC represent individual vessels, and no assemblages with fewer than 25 vessels were included in the complete database. Sample sizes vary considerably but average in the hundreds (mean = 301 vessels), with large coalescent communities like Parsons and Jean-Baptiste Lainé (Mantle) having thousands of vessels. There is a wide array of PCMC proportions represented in the collection, with the average assemblage having 10 combinations and as little as 1. There was a significant but weak correlation between sample size and the number of PCMCs in an assemblage (Figure 2.6; $adj.R^2 = 0.164$, $F = 47.86, p =< 0.0001$), showing that larger community assemblages were more likely to have a greater range of PCMCs. However, this correlation reflects a natural expectation stemming from increased potential for representation in larger samples and is not strong enough to impact the significance of the case study's results.

2.5 Conclusion

The Late Woodland period of Northern Iroquoia, and Northern Iroquoian archaeology in general, are in a constant state of flux (Holland-Lulewicz et al., 2020; Holland-Lulewicz, 2021; Williamson and Snow, 2016) as new ideas and paradigms replace the old. One of the most welcome of these paradigms is the transition away from monothetic archaeological cultures and culture-historical schemes towards an approach that deliberately seeks commonalities while appreciating diversity. The coalescent history of Northern Iroquoian communities is one such approach, and it has seen considerable support in recent years (Birch, 2015, 2019; Birch et al., 2020; Williamson, 2014). These advances have amiably produced a substantial database of decorative variation in pottery, capturing a regional history of decorative choices spanning a period of considerable change and geopolitical realignment. The following chapter explains how these trends can be reframed and evaluated under the paradigm of cultural transmission theory.

Chapter 3

Theoretical Context: Random and Selective Copying

The goal of this chapter is to introduce the theoretical context of this case study. The central theme of this theoretical perspective is cultural transmission theory. The chapter begins by introducing cultural transmission theory and connecting it to the wider scheme of evolutionary anthropology. From there it moves on to the spectrum of random and selective copying, introducing each before connecting them to the case study at hand. It is argued that random and selective copying are critical for differentiating between meaningful patterning in spatial similarity and trends resulting from the retention of random variability over space. These two alternatives are later connected to the second major theoretical element of the case study, which is the idea of cultural population structure. It is argued that the presence or absence of robust population structure is an essential component of differentiating between spatial similarity generated by random processes and spatial similarity driven by homophily. The chapter concludes by synthesizing the components into a set of primary hypotheses that will be tested in this case study.

3.1 Cultural Transmission Theory

Until recently, cultural evolution as a theoretical paradigm was viewed as an inconsistent and divided range of approaches from several seemingly incompatible subdisciplines

(Gardner and Cochrane, 2011). The disparate theoretical and analytical goals of these subdisciplines led to their unique treatments of human cultural evolution (e.g. O'Brien et al., 1998), often leading to distinct sets of academic jargon and the creation of "balkanized theoretical frameworks" (Perreault, 2019, 144–145). However, the updated Darwinian synthesis of cultural evolution (e.g. Mesoudi, 2011; Mesoudi et al., 2006) unifies the many apparently disparate threads of these competing subdisciplines under the banner of cultural transmission theory, an approach which has gained traction among archaeologists on both sides of the Atlantic (e.g. Garvey, 2018; Prentiss, 2021). Cultural transmission theory unifies many of the competing and contrasting approaches of these subdisciplines into a general approach focused on descent with modification (Shennan, 2011) with a comprehensive, nested framework that begins at the level of observed variability in material culture (Bentley et al., 2011; Creanza et al., 2017; Jordan, 2015; Mesoudi, 2011; O'Brien et al., 2019; Prentiss, 2019a; Richerson and Boyd, 2008; Shennan, 2002).

Early seminal studies in cultural transmission theory were inspired by revolutionary developments in the field of population genetics (Boyd and Richerson, 1985; Cavalli-Sforza and Feldman, 1981). In these pioneering studies, mathematical models originally developed to study the transmission and evolution of genes and alleles within populations were adapted to study the evolution of cultural traits and variants within an archaeological population (i.e. an assemblage of artifacts or collection of assemblages; Cowgill, 1990a; Neff, 1993, 2001). These revolutionary models worked because, despite its distinctiveness from biological evolution, cultural evolution is still Darwinian (Mesoudi 2011, 26; Shennan 2002); in other words, changes in cultural traits over time and space still exhibit Darwin's three original preconditions for evolution: variation, competition, and inheritance. Thus, with sufficient accommodation for the peculiarities of cultural information and its transmission between and within generations, analogous processes pertaining to these three preconditions could be identified and, through theoretical models, used as epistemological tools (Eerkens and Lipo, 2007). As Mesoudi (2011) notes, the existence of these three preconditions gave early modeling studies a goal to strive for — the development of expectations for the empirical outcomes of cultural evolutionary processes on material cultural data, and the demonstration of their existence and influence within empirical datasets.

In cultural evolution, variance is introduced by many different factors, the most important of which include “copying error” (Eerkens and Lipo, 2005), drift (stochastic loss of traits during transmission), innovation, imitation, and individual experimentation (Walsh et al., 2019b). Stochastic or directional change in variance of archaeological traits such as artifact attributes is the key element of cultural descent with modification (Shennan, 2011). Competition in cultural transmission corresponds to differential replication of cultural traits by forces external to random change (Goodale, 2019) characterized as creating “biased” transmission (Boyd and Richerson, 1985), which can be direct (based on traits of the individual being copied) or indirect (based on traits of the population; Table 3.1). Cultural inheritance occurs through cultural transmission, which is simply the conference of cultural information through social learning between learners and teachers (Jordan 2015, 22–24; Walsh et al. 2019a). Propinquity, continuity, and consistency in material culture variation over space and time are thus created by a combination of cultural variance, competition, and inheritance.

Table 3.1: Forces and Processes in Cultural Evolution (after Walsh et al., 2019b, Table 3.1)

Random Forces	Cultural mutation	Variation introduced by random individual-level processes such as innovation and invention.
	Cultural drift	Random changes in cultural trait frequencies due to cultural mutation, random copying, and sampling error (Mesoudi, 2011, 57).
	Cultural inertia	A feedback loop that influences the frequency of new or existing traits conservatively; maintenance of the status quo as a result of conservative modes of transmission that tend to reject change such as the propensity for conformist transmission. While not technically "random," cultural inertia is subject to any number of stochastic forces interacting in such complex ways as to make it probabilistically random.
Decision-Making Forces	Guided variation	Transmission of individual modifications to a previously learned cultural trait, leading to the guided improvement of that trait.
	Content-Biased transmission	A form of direct bias where the preferable content of a cultural variant directly influences its likelihood to be transmitted.
	Frequency-Biased transmission	A form of indirect bias where the most common (e.g. conformity) or rarest (e.g. anticonformity) cultural traits are more likely to be transmitted.

	Model-Biased transmission	A type of indirect bias where the perception of the individual exhibiting a cultural trait (e.g. their prestigiousness) influences its likelihood of transmission.
Selection Forces	Natural selection	Cultural traits spread due to their effect on biological survival and reproduction (Mesoudi, 2011, 57).
	Cultural selection	“Individuals with certain cultural traits are more likely to be taken as models for imitation than others, by virtue of those traits, and these in turn become successful models as a result” (Shennan, 2011, 1070).
Social Learning Processes	Cultural inheritance	Descent with modification of cultural traits through the direct or indirect transmission of information between individuals.
	Cultural transmission	“The movement of cultural traits from one place to another; at the microscale, from one individual to another. Describes ways in which information passes from one entity to another leading to descent with modification of cultural traits. The different ways in which cultural traits get passed between individuals and diffuse through and between populations.”
	Pedagogy	“The capacity to learn and transfer information through guidance in a tutor-to-pupil format, as well as the act of doing so.”
	Propagation	Microscale evolution of material culture traits within defined populations.

Experimental and empirical research within cultural transmission theory has revealed numerous forces and processes associated with one or more of the three preconditions mentioned above (see chapters in Prentiss 2019a; Lycett 2015a). Matthew J. Walsh and colleagues (2019b, Table 3.1) tabulated the common forces and processes that operate during cultural transmission (Table 3.1), sorting them into "random forces," "decision-making forces," "selection forces" (both cultural and natural), and "social learning processes." These diverse sets of forces and processes can be subdivided into those that exclusively operate through systematic mechanisms at the population level (such as random forces and selection forces) and those that are the cumulative result of many individuals' decisions (such as decision-making forces and social learning processes). In historical archaeological case studies, the influence of specific microscalar decision-making forces that operate at the scale of interactions between individuals (such as forms of content- and model-biased transmission) is typically opaque (Neff, 2001). For example, ethnographers studying the decorative decisions of Conambo potters producing vessels for their own domestic use found that the choices of each potter were deeply connected to her self-ascribed identity and role in a set of overlapping social institutions within the community (Bowser, 2000, 2002; Bowser and Patton, 2008). However, the decorative variation of the complete vessel assemblage did not reflect the choices of any one potter (Bowser and Patton, 2008). The same reductive effect characterizes all pottery assemblages, including those of Northern Iroquoian communities. In these contexts, the contextual idiosyncrasies of individual decisions are lost to the aggregative, diachronic nature of the archaeological record, leaving only assemblage-scale patterns to be identified and understood archaeologically (Neff, 1993). Population thinking, explored below, is essential to this identification process.

Studies building on the original work of Cavali-Sforza and Feldman and Boyd and Richerson have furnished methodological simulations and empirical examples of many of these cultural evolution processes at work in populations of cultural traits, both in contemporary datasets such as lists of dog breeds and baby names (e.g. Bentley et al., 2011); early archaeological case studies of pottery assemblages, textiles, and lithic assemblages (e.g. Bettinger and Eerkens, 1999; Eerkens and Lipo, 2005; Jordan and Shennan, 2003; Kohler et al., 2004; Neiman, 1995; Shennan and Wilkinson, 2001; Steele et al., 2010); and recently in comprehensive, computationally-intensive simulation and modeling studies (e.g. Bentley and Shennan, 2003; Bentley et al., 2004, 2007; Crema et al., 2014, 2016; Kandler and Crema, 2019; Kandler and Powell, 2018; Kandler and Shennan, 2015; Premo, 2014, 2016; Porčić, 2015; Porčić and Nešić, 2014; Shennan and Bentley, 2008; Shennan et al., 2015; White, 2013). Notably, mechanisms and mathematical approaches of contemporary cultural transmission theory were recently incorporated for the first time into a comprehensive multi-scalar ethnoarchaeological study of human technological traditions (Jordan, 2015), demonstrating their capacity for generating useful inferences of real social change. Thus, the theory of cultural transmission has rapidly become an important component in the archaeologist's analytical toolbox (Garvey, 2018). The usefulness of this approach comes from its ability to generate models of expected cultural change under assumed forces of cultural transmission that can be compared to observed changes in datasets, providing an empirical approach to (cautiously; see Richerson and Boyd, 2007) test and falsify hypotheses causally explaining observed changes in material culture.

3.2 The Copying Spectrum

A theoretical concept that will be familiar to many archaeologists is the notion of "style" in material culture. Like cultural transmission (Lyman, 2008), style has a long history in archaeological thought (Carr and Neitzel, 1995; Conkey and Hastorf, 1990; Hegmon, 1992; O'Brien and Leonard, 2001). A turning point of this diverse history was the "fundamental dichotomy" between the concepts of "style" and "function" first theorized by Robert C. Dunnell (1978, 1980). The trajectories of both concepts have reached a point of intersection within contemporary cultural transmission theory (Bentley, 2007, 2011; Shennan, 2011, 2020). As evolutionary processes driven by different cultural transmission forces (Dunnell, 2001), the material implications of these distinct yet complementary concepts form an important spectrum along which this case study is aligned.

In particular, Dunnell's original definiton of style as the stochastic replication of "adaptively neutral" traits (1978, 199) was a lightningrod for the development of neutral theory (Kandler and Crema, 2019; Neiman, 1995; Shennan and Wilkinson, 2001), which is a crucial component of cultural transmission models adopted from contemporary population genetics. In contrast, the evolutionary role of function is driven by selection forces which do not act stochastically, but rather lead to differential replication of "adaptive" cultural traits with higher "fitness" (their "intrinsic probability of being copied and transmitted"; Bentley 2011, 103).

It is important to clarify that Dunnell's (1978) original definition of neutral traits can oversimplify the reality of what constitutes an "adaptive" trait in archaeological terms. Early treatments were concerned with demonstrating the relationship between cultural traits and reproductive fitness in the biological sense (Braun, 1995; Kirch, 1980), in contrast to the idea that neutral traits were unrelated to selective forces at all. This early stance led to criticism of the style-function spectrum as being artificial (Bettinger et al., 1996), focusing on the fact that "stylistic" traits like pottery decoration can be driven by selection forces if they become attached to biases in transmission (Meltzer, 1981). Indeed, as Shennan (2020, 292) recently wrote,

> Even decorative attributes on ceramic vessels, the stylistic attribute par excellence, can potentially be under selection for social reasons; for example, pressure to conform to group norms that might have a bearing on people's chances of marriage and reproductive success. In contrast, if we take the definition of style as 'a way of doing', all functions are carried out in locally specific ways that have a transmission history, including adaptive ones, although the extent to which the history of the attributes relevant to the function has been subject to random drift and innovation patterns, as opposed to selection, will vary.

The importance of this point lies in the idea that "style" and "function" *are* artificial — rather than objectively discoverable entities, they are ways of looking at material culture variation that generate expectations of the patterns it should contain (O'Brien and Bentley, 2020, 264–265).

Bentley (2011) has argued that the ends of this spectrum of "style" and "function," when reframed in explicitly population-focused materialist terms, can be viewed as an opposition between *random copying* and *selective copying*, both of which have predictable material consequences that can be empirically modelled and compared to real world data (e.g. Blythe, 2012; Grove, 2019; Steele et al., 2010). Accordingly, rather than labelling traits as stylistic or functional in an *a priori* manner, the population thinking of cultural transmission theory emphasizes characterizing variability first, and then determining whether it fits the expectations of random or selective copying. This promotes a bottom-up perspective which is better suited to the patchy and coarse resolution of the chronically underdetermined archaeological record (Perreault, 2019, 1–2). Thus, the remainder of this section dives into the opposing ends of the random-selective copying spectrum and their relevance for understanding social signaling theory and cultural drift in Northern Iroquoia.

3.2.1 Random Copying and Cultural Drift

The core of the random copying approach is "population thinking" (Riede, 2011, 247). Population thinking was a paradigm shift that accompanied the species debates of the modern evolutionary synthesis of biology in the mid-20th century (Chung, 2003; Mayr, 1959). It challenged essentialist typological strategies that treated biological species as objective groups by emphasizing the ubiquitous variability inherent to nature, and highlighting the importance of using quantitative techniques to describe and empirically classify this variability (Grene, 1990). Population thinking is essential to cultural transmission because the patterned variation left behind in the archaeological record is the only tangible signature of the behaviours of past populations, and to identify, partition, and interpret this variability requires quantitative techniques that are appropriate to its scale and resolution (Eerkens and Lipo, 2005, 2007; Neiman, 1995; Perreault, 2019; Riede, 2011; Riede et al., 2019). Thus, a population-thinking approach to understanding the behavioural signatures apparent in the variability of Northern Iroquoian decorative diversity must not attempt to fit it with essentialist definitions of style or function; instead, it should focus on the scale, scope, and structure of variation across populations and whether it is consistent with random or selective copying.

The random copying spectrum draws part of its inspiration from Dunnell's original definitions of style and function, but its application in this case study bears more resemblance to Shennan's unification of these terms quoted above. The most important caveat of this model is that the transmission of a *neutral* trait is the product of numerous intentional decisions at the scale of individuals learning from and copying one another, but at the population level the patterns of these decisions statistically resemble random copying (Bentley, 2011; Bentley et al., 2011; O'Brien et al., 2019). If there are other cultural transmission forces influencing the distribution of the trait that direct its population-level patterning (i.e. if its likelihood of transmission is driven by being applied as a signal) then it is no longer a neutral trait. As Bentley (2007) has pointed out, the dynamics of a neutral trait at the population level are not much different from the dynamics of contemporary fashion trends — among a set of equivalent fashions (such as face mask designs, recently) it is difficult to empirically predict which design in particular will be the most popular, but it is inevitable that there will be varieties that reach their floruit before waning in popularity (Bentley et al., 2007). Since the likelihood of any of these variants of becoming the most common is probabilistically equivalent, they can be described as neutral. Despite the unique dynamics of each individual's motivation for choosing a specific variant, their intentions are opaque to the scale of the population.

Under conditions of random copying, material culture variability within the population is controlled by the random forces of drift or mutation (Table 3.1). These forces are stochastic in nature and are not indicative of any overarching signals of collective behaviour; rather, they are simply the product of cultural descent with modification (Shennan, 2011). As explored below, these processes also have important spatial implications. In an archaeological context, the random copying model does not disregard the importance of material culture as an active component of social behaviour (e.g. Hodder, 1982); rather, it simply shifts the focus away from the intentions of each potter (which are, like those of the decisions of every individual customer, opaque to the population) and pushes it towards a perspective that more thoughtfully considers how these collective decisions might produce macroscale patterns. It is important not to let the connotations of the term "random copying" or the analogy of popular fashion imply that the intentions of each potter were trivial or irrelevant in their lived experience. Ethnographic studies have consistently revealed that these individuals' decisions are wonderfully complex and worthy of study (Bowser and Patton, 2008; David and Kramer, 2001). The only implication of this null hypothesis is that there is no detectable signal of selective copying at the population level.

3.2.2 Selective Copying and Social Signaling

Selective copying implies that the collective decisions of the population are influenced strongly enough by the common direction of individual-level decision-making forces (like the many forms of biased transmission; Table 3.1) that they retain a detectable signature that cannot be explained by stochastic variation (Boyd and Richerson, 1985; Maxwell, 2001; Walsh et al., 2019a). Previous studies have shown that precisely identifying which cultural transmission forces are most prominently contributing to this signal can be challenging (Crema et al., 2014; Madsen, 2020; Kandler and Shennan, 2013, 2015), but it is important to note that treating selective copying as a general alternative hypothesis to random copying is a necessary first step in the understanding of cultural transmission. In other words, if the null hypothesis of random copying is rejected, there may be evidence of a retained signal of collective decorative decisions in the data, the root cause of which remains unknown but can be speculated about. In this case study, previous approaches to theorizing Northern Iroquoian pottery decoration are adapted to develop one potential selective copying alternative hypothesis, based on the use of pottery as a social signal (Birch and Hart, 2018; Hart and Engelbrecht, 2012; Hart et al., 2016, 2017, 2019).

Drawing their root inspiration from Wobst (1977), Chilton (1996), and Carr (1995), Hart and Engelbrecht (2012) argued that pottery collars were a strong candidate for material evidence of social signaling by Northern Iroquoian potters. Social signaling is a form of nonverbal communication that originated in theories of human behavioural ecology (Bird and Bird, 2018; Bird and Smith, 2005; Quinn, 2019). Ethnographic studies have shown that decorative choices on pots can be used as a salient signal of the personal skills and identities of the potter (Bowser, 2000; Bowser and Patton, 2004), especially when pottery was crafted in workgroups (as it probably was in Northern Iroquoian communities; Perelli 2009). Wobst (1977) and Carr (1995) further developed the idea that objects with greater visibility are more likely to be used in active signaling, leading Hart and Engelbrecht (2012) to theorize that pottery collars — which would have been centrally visible over the hearth in the communal longhouse (Chilton, 1996) — may have been used as signals, especially since they require additional effort, raw materials, and skill to craft. The key connection these visible signals may have had in regional networks of interaction lies in the increasingly important role of women in community affairs as community coalescence progressed across Northern Iroquoia (Birch and Hart, 2018; Hart et al., 2016).

Women gained increasing amounts of political power through their control of the domestic sphere and role in the decisive councils associated with it (Birch, 2015, 2020; Brown, 1970), while communities simultaneously began to develop stronger regional ties as coalescence progressed (Birch, 2019). Birch and Hart (2018) have argued that women — as the manufacturers of pottery — were thus well-situated to signal their community's membership in regional alliance networks through their decorative decisions on the pottery they crafted for their longhouse hearths. They go on to suggest that pottery collar decoration was a "symbolically generalized communication media that facilitated communication within large, regional networks . . . an archaeologically visible medium in which women signaled their membership in political and other networks, forming and strengthening alliances within and between communities" (Birch and Hart, 2018, 19–20).

A critical intercept between social signaling networks and selective copying is the concept of homophily in human social interaction. Homophily is the tendency for individuals or collective groups to preferentially interact with those whom they perceive to share similar traits (Drost and Vander Linden, 2018; Fu et al., 2012; Haun and Over, 2015; Centola et al., 2007; McPherson et al., 2001). This perceived similarity can exist in many forms, including collective identity, social status, gender, religion or worldview, and kinship ties. The pervasive ubiquity of homophily in human social behaviour has been repeatedly demonstrated in psychology and sociology (McPherson et al., 2001). Some of the strongest homophilic ties exist among family and extended kinship groups (Apicella et al. 2012, McPherson et al. 2001, 431). Wendat historian Georges Sioui (1999) has written about the profound importance of close-knit family lineages and extended clan kinship structures in the lives of Huron-Wendat people prior to and following the arrival of Europeans in Northern Iroquoia. These networks could have also been bolstered by additional trading agreements, military alliances, and a broadly shared mythos and belief system emphasizing cooperation and mutual respect (Engelbrecht, 2003; Sioui, 1999; Gidigaa Migizi [Williams], 2018). If Northern Iroquoian pottery collars were used as active signals of these regional connections, then their decorative variability would likely show strong evidence of homophily. In contrast, the same far-reaching ties and connections would not be present if random copying was the sole process responsible for generating material variability between communities.

Thus, a key element in the theoretical framework of this case study is the spectrum of random and selective copying processes and its implications for interpreting material culture patterning across Northern Iroquoia over the trajectory of regional community coalescence. The heart of this framework lies in the cultural transmission processes operating during the creation and elaboration of pottery decoration by communities of Northern Iroquoian potters. The null hypothesis relies on the underlying assumption that, while individual potters certainly had their own reasons for choosing and applying the suite of decorative combinations that they did, at the *population level* these intentions are opaque to the detective capacity that the macroscalar regional archaeological record offers (cf. Perreault, 2019, 21–39). Collectively, they would resemble stochastic material variability that is structurally equivalent to random copying. The alternative hypothesis at the opposing end of the spectrum is selective copying, and simply reflects the contribution of additional selective forces — cultural transmission biases — to the decorative variability of the collection of community assemblages.

If potters in Northern Iroquoian communities were actively representing and maintaining social signaling networks through their collective decorative decisions, we might expect the decorative variability of their pottery assemblages to be characterized by selective copying forces. Hart and Engelbrecht (2012, 344) argued that relative similarity between pottery assemblages is a key indicator of signaled community membership in this homophilic interaction network. However, interassemblage similarity is also a basic expectation of the random copying model. Differentiating the two outcomes is only possible with an explicitly spatial perspective.

3.3 Space and Population Structure

Cultural transmission processes do not occur independently of geographic space. While the random–selective copying spectrum carries a set of expectations for material culture patterning, without consideration of the spatial dimension of these processes it is difficult to surpass equifinality. Some of the most useful analogies for understanding the spatial context of these processes come from population genetics, which has long endeavoured to understand broad clinal patterns of molecular genetic diversity (Handley et al., 2007; Manel et al., 2003; Scerri et al., 2018). The following section introduces some of the models and methods adapted from population genetics by archaeologists interested in studying the transmission of cultural information over space and explains how they can be applied to distinguish random and selective copying processes. The concept of "isolation by distance," a well-known model of population genetics, has been adapted for cultural transmission theory in many productive contexts (Conolly, 2018; de Groot, 2019, 2020; Jordan, 2015; Jordan and Shennan, 2003; Lycett, 2014, 2015b, 2017, 2019, 2020; Shennan and Bentley, 2008; Shennan et al., 2015). Models invoking isolation by distance in population genetics are typically interested in developing deeper understandings of population structure, which is the structuring of genetic variability between subgroups of individuals within a meta-population (Waples and Gaggiotti, 2006). Population structure is also closely associated with the concept of homophily (Shennan et al., 2015), which has important implications for the relationships of subgroups within human populations (Haun and Over, 2015). All in all, each of these related concepts play their own important roles in characterizing the formation and constraint of decorative variability in Northern Iroquoian pottery.

3.3.1 Random Copying and Isolation by Distance

The pioneering formulations of the random copying model in cultural transmission assumed that all individuals in the landscape had an equal probability of interacting with each other (e.g. Neiman, 1995; Shennan and Wilkinson, 2001). This was a simplifying assumption intended to isolate the effects of drift and innovation on the transmission of "neutral" traits, but it also had the consequence of allowing communities separated by great distances to have just as likely a chance of exchanging cultural traits as those comparably closer to one another. Assuming that all individuals (or communities, in the Northern Iroquoian case) have an equally probable likelihood of interacting with one another ignores the effect of spatial distance friction on intercommunity interaction. This effect is important because studies have shown that the social learning of craft skills such as pottery-making or flintknapping requires considerable amounts of pedagogy and guided variation between learner and teacher (Jordan, 2015; Shennan and Steele, 1999; Roux, 2019; Tehrani and Riede, 2008; Tostevin, 2012), heightening the frictional effects of distance on social learning (Jordan and Shennan, 2003, 69). Thus, in order to explicitly apply the null hypothesis of the neutral model to macroscale, regional contexts, it was quickly realized that accomodations would necessarily have to be made for the effects of spatial distance (Lipo et al., 1997). Fortunately, the field of population genetics has long dealt with the effect of geographic distance on intercommunity genetic similarity (Malécot, 1948; Wright, 1943).

Exploring the relationship between gene flow and space, Sewall Wright (1943; 1946) first proposed the concept of "isolation by distance" (IBD) as a mechanism that limits gene flow between more distant populations due to the decreasing probability that individuals within them have the ability to interact and reproduce. As a direct consequence of this limited dispersal, the IBD model proposed that genetic similarity of populations should be inversely correlated to the amount of geographic distance between them. Once the general utility of the random copying model was established, the importance of considering IBD in cultural transmission terms followed shortly after (Lipo et al., 1997). Evolutionary archaeologists were interested in developing theoretical explaNations for some of the long-held common-sense truisms in anthropological and archaeological thought (e.g. Dunnell, 1978, 1980, 1982; Neff, 1993), and the most pervasive of these was the notion that "the degree of stylistic similarity between two components or assemblages is a measure of the intensity of social interaction between them" (e.g. David and Kramer, 2001, 168). This assertion is a fundamental component of the theory of social signaling (Hart and Engelbrecht, 2012, 328).

However, while the connection between distance and the probability of interaction between communities is a logical assumption, the relationship between distance and material culture similarity was largely an assumption stemming from the culture-historical roots of archaeological thought (Lyman, 2008; Lyman et al., 1997). The random copying model is a generalized, population-level mechanism for understanding *how* and *why* this patterned similarity might arise, and more importantly provides a quantitative approach for determining *when* that mechanism might be relevant in historical situations. Under random copying, the probability of interaction between communities is a key factor in the likelihood that they will exchange information — in this case, about ideas for combining motif design elements of pottery collar decoration. As Shennan and Bentley (2008, 165) suggested, the random copying model "assumes that no particular forces encourage the preferential copying of certain individuals or trait variants — individuals have their own unique reasons for copying one variant or another — other than the probability of encountering that individual or trait, which in a spatial context is likely to depend on the distance between them." Thus, to reiterate the words of Shennan et al. (2015, 103), "other things being equal, the similarity of cultural traits should also decline over distance and that some degree of spatial autocorrelation is expected."

If pottery collar decoration — as a cultural trait — was not part of a wider regional constellation of interaction as an active social signal of collective community affiliation, then it should follow the expectations of the random copying model, which predict that populations of social learners (i.e. village communities) "copying" one another would be more likely to learn from communities closer to them (with which they were more likely to interact) than from distant ones — creating IBD in assemblage similarity. However, if pottery collar decoration was not a "neutral" trait, but was instead imbued with a set of meaningful symbolic signals reflecting collective identity networks, then these similarity patterns would no longer be solely defined by the probability of interaction and thus would not be limited by physical distance between communities. As the previous section alluded to, relative interassemblage similarity between communities can be a symptom of both random and selective copying — either the passive outcome of more frequent interaction and information exchange, or the active result of intentional reproduction of symbolically meaningful decorative norms. However, only the former outcome is also expected to consistently display strong evidence of isolation by distance because the salient cultural transmission forces responsible for generating the observed similarity are probabilistic and based on the relative intensity of interaction (and subsequent social learning) between populations. In contrast, for the latter outcome similarity between assemblages would have been engendered by active homophilic social ties which could have been, but were not required to be, correlated with physical distance between communities. In other words, while the existence of IBD does not necessarily invalidate the existence of selective copying, the non-existence of IBD is incompatible with random copying, leading to the rejection of the null hypothesis.

IBD is an essential component of the random–selective copying spectrum and a critical step in the interpretation of similarity between Northern Iroquoian communities. However, like many elements of cultural transmission theory it can at times be beset by equifinality because selective copying can also generate IBD under the right circumstances — especially when signaling networks of communities are also situated in close proximity to one another, as may have been the case during the earliest pre-coalescent periods of village life (Birch, 2012; Birch and Williamson, 2015, 2018). The key to clarifying this equifinality lies in the relationship between homophily and population structure, which is the focus of the next section.

3.3.2 Population Structure and Homophily

Before proceeding it is important to define "population structure" when referring to cultural transmission and material culture instead of molecular genetics (Shennan, 2000; Shennan et al., 2015). Cultural transmission considers populations at different scales. Microscale studies typically focus on the interactions of members within individual communities (Birch, 2016; Striker, 2018; Walsh et al., 2019a), while macroscale studies look at the interaction between groups of communities (Jordan, 2015; Lycett, 2020; Prentiss and Laue, 2019; Rogers and Ehrlich, 2008). Oftentimes the resolution of the archaeological record complicates microscale investigations of cultural transmission (Perreault 2019; Madsen 2020, Chapter 1). This macroscale case study treats the collection of Northern Iroquoian communities as a metapopulation (*sensu* Crema et al., 2014) — a group of subpopulations associated by a common language type (Mithun, 2017). In population genetics, these subpopulations are designated by field sampling processes (Waples and Gaggiotti, 2006). Previous applications of population structure in cultural transmission have defined subpopulations based on the geographic range of ethnolinguistic groups (Bell et al., 2009; Ross et al., 2013; Rzeszutek et al., 2012) and archaeological cultures (Rigaud et al., 2015; Shennan et al., 2015). In the latter case, the existence of structured variation among the subgroups of the global metapopulation becomes a hypothesis rather than an assertion (Boyd et al., 1997; Furholt, 2008), and a battery of tests exist for determining the proportion of between-group versus within-group variation that the structure constrains (Chapter 4; Excoffier et al., 1992; Excoffier, 2007; Wright, 1969).

In this case study, the sampled communities are drawn from the same broad ethnolinguistic group — the Northern Iroquoian language family (Mithun, 2017). Without independent evidence of shared dialects spoken by individual Northern Iroquoian communities, linguistic evidence does not provide any clues to the possible population structure of the region. Faced with this caveat, this study follows the approach of previous regional studies by dividing the global metapopulation (i.e. all 234 Northern Iroquoian sites) into a series of subpopulations defined by their geographic positions in the landscape. Despite previous studies' suggestions that these geographically defined spatial groups may not truly constitute mutually exclusive populations (Hart and Engelbrecht, 2012; Hart et al., 2016) they continue to be used to represent collective Northern Iroquoian social groups in macroscale analyses of pottery collar decoration (Hart et al., 2017, 2019). Therefore, these spatial groups are treated as hypothesized populations in lieu of direct evidence for alternative population structures. In fact, recent aDNA evidence has shown evidence of considerable genetic drift among Northern Iroquoian communities (Pfeiffer et al., 2014), and recent studies have also begun to cast doubt on the security of assumptions that villages in the same sequence are related (Hart, 2020; Hart and Birch, 2021); therefore, confirming whether these spatial groups correspond with robust structured variation is an important outcome of this study.

The propagation of regional networks in which potters signaled the importance of intercommunity alliances materially through their collective decorative decisions does have the potential to create distinctive material culture patterning that could correspond to the geographic distribution of spatial groups, if the signal preserved is strong enough. There is a chance that selective copying driven by social signaling with the collective goal of demonstrating alliances matching this distribution could create structured decorative variability, which could potentially be manifest as an increased proportion of between-group differentiation. In contrast, if the structure is artificial and derived entirely from an unfounded connection between social groups and geographic clusters, then there should not be a detectable between-group signature in the global population. The key to this distinction lies in the notion of *homophily*, a property of social systems that has important implications for population structure.

Cultural transmission models studying the effects of homophily on spatial interaction have discovered that it can magnify the minute stochastic fluctuations in material cultural variability that are created by the effects of random copying (Centola et al., 2007; Drost and Vander Linden, 2018) and environmental gradients on the transmission of traits (Manel et al., 2003). These can create regional patterns which can closely resemble the effects of random copying and IBD, especially in diverse landscapes (Axelrod, 1997; White, 2013). These equifinalities are the reason IBD alone cannot rule out random copying. However, population-level homophily also leads to the creation of marked discontinuities and clustering in the variation of cultural trait transmission that should be visible as constrained variability in the global population structure (Axelrod, 1997; Centola et al., 2007; Lipo et al., 1997; Shennan et al., 2015). In Northern Iroquoia, robust population structure among spatial groups would reflect the homophilic ties of relational signaling networks if the size of these networks was affected by spatial group membership. Such constraint should not naturally occur under random copying, where there are no overarching structures acting on variability above the friction of distance on interaction. Thus, robust evidence of population structure is the final piece of the puzzle for differentiating between random and selective copying because it allows for the identification of homophilic ties between communities. In the final section, the primary hypotheses of this study will be outlined in the context of similarity, isolation by distance, and population structure.

3.4 Primary Hypotheses and Conclusion

Many studies in the past decade have taken a closer look at trends in the regional variation of Northern Iroquoian pottery decoration (Birch and Hart, 2018; Hart and Engelbrecht, 2012; Hart, 2020; Hart and Birch, 2021; Hart et al., 2016, 2019; Holland-Lulewicz, 2021). These studies have advanced the hypothesis that pottery was used as an active signal communicating the potter's membership in a broad network of intercommunity interactions that flourished and changed after the coalescence of Northern Iroquoian villages. However, these studies have advanced this assertion without first confirming whether the suite of decorative variability among Northern Iroquoian communities over the course of the last few centuries of the Late Woodland period can be sufficiently explained by the cumulative effects of individual communities' decorative decisions.

In this chapter, I have advanced an alternative framework — the random–selective copying spectrum — for theorizing the generation of this material variability. This framework is in accordance with recent studies emphasizing the unique developmental trajectories of Northern Iroquoian communities during coalescence (Birch et al., 2020) in that it emphasizes a population-thinking approach for theorizing decorative variability. Random copying is the collective result of a constellation of individual decisions, whereas selective copying emphasizes the collective directionality of these decisions and the retainance of structured variability. Accordingly, the primary research question of this thesis is to ask whether the variability of Northern Iroquoian pottery collar decoration over the course of the Late Woodland can be sufficiently explained by the expectations of random copying processes. Furthermore, can random copying adequately explain the changes in decorative variability over time and space as Northern Iroquoian coalescence progresses? To answer these questions, two primary hypotheses were designed and tested for each case scenario described in the next chapter:

- H_1: Spatial patterns of similarity in pottery decoration in Northern Iroquoia can be explained by the effects of isolation by distance alone.

- H_2: There is no robust evidence of cultural population structure corresponding to spatial group membership.

Figure 3.1 summarizes the interpretation of these hypotheses' results under the theoretical framework of the case study. If robust evidence for population structure following spatial groups is obtained, it would be the strongest evidence in support of active selective copying processes. Based on the results of previous studies (Hart, 2012; Hart et al., 2016, 2019), I predict that there will not be a consistent isolation by distance trend across the study area, although this case study includes more sites than the previous examples. Based on the expectation that community coalescence increases the importance of regional interaction between populations (Birch, 2016, 2020), I predict that more robust support for IBD will be found during earlier timeblocks. Also based on the results of previous studies (Hart and Engelbrecht, 2012; Hart et al., 2016), I predict that there will be little to no robust evidence of population structure corresponding to spatial groups, given the amount of cross-cutting social ties these studies have identified. If there is robust population structure, it is more likely to be found in later timeblocks as post-coalescence regional networks became crystallized. Ultimately I predict that random copying will not be sufficient to explain most observed geospatial patterns of decorative variability in Northern Iroquoia.

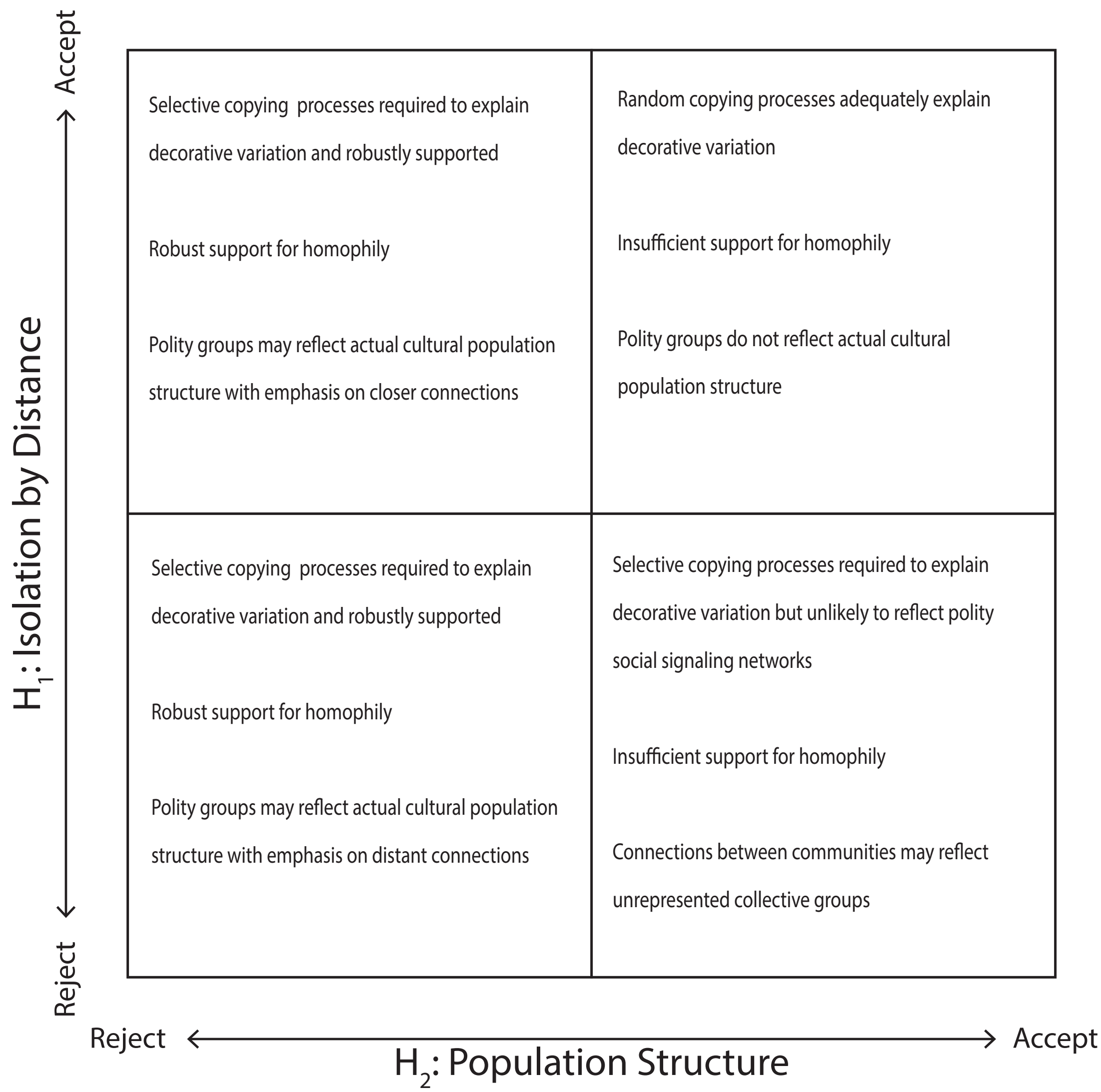


Figure 3.1: Potential outcomes of primary hypotheses.

Chapter 4

Methods

The goal of this chapter is to develop a series of steps to test both of the hypotheses laid out in the previous chapter. The first section develops an approach to empirically estimate the level of similarity between individual assemblages of pottery collar motif combinations (PCMCs) in a manner that allows it to be correlated with the geographic distance between them. The next section builds on this index of inter-assemblage similarity by introducing an approach that was originally designed to identify correlations between genetic distance matrices (Mantel, 1967), but which has been successfully adapted for understanding the effects of spatial distance on cultural transmission between communities (e.g. Jordan and Shennan, 2003; Jordan, 2015; Lycett, 2020). This test has been extended to explicitly identify changing patterns of spatial autocorrelation between distance matrices (Borcard and Legendre, 2012; Smouse et al., 1986), and thus is well-suited to the identification of isolation by distance (IBD) at the regional scale. In addition to introducing and developing these testing methods, these first sections will lay out how IBD in the complete metapopulation (i.e. all assemblages independent of time period) breaks down over the course of the Late Woodland period across Northern Iroquoia.

The following section introduces methods of testing for the existence and strength of cultural population structure within the Northern Iroquoian metapopulation that were also originally developed for studying population differentiation in molecular genetics (Excoffier et al., 1992). Following Shennan et al. (2015), these approaches can be adapted to cultural data to empirically identify the amount of differentiation between "populations," which here consist of hypothesized Northern Iroquoian spatial groups. The final section is concerned with developing a set of steps to quantify the strength of potential biases resulting from the confounding effects of spatial autocorrelation and population structure. As Meirmans (2012) has shown, tests of IBD and population structure can both be biased by the spatial structure of geographically clustered metapopulations. This bias evaluation is crucial for differentiating between population structure potentially reflecting selective copying from artificial structure introduced by geographic clustering due to the spatial definition of spatial groups. It is essential for clarifying any true signal or pattern in the variation. The following chapter presents the results of each of the approaches described here.

4.1 Measuring Interassemblage Similarity

The classification scheme developed for describing the range of observed decorative variability within each Northern Iroquoian community assemblage relies on the definition of a series of 29 Pottery Collar Motif combinations (PCMCs; Appendix A). These modal attribute groups represent combinations of decorative motifs drawn from a pool of shared design elements, and previous Northern Iroquoian studies have relied on these combinations to collect their data. As a result, the structure of the dataset's material culture classes is characterized by a set of absolute frequencies representing abundances of individual PCMC variants. As previously mentioned, any assemblages with a cumulative frequency of less than 25 were not included to improve statistical robustness; however, some assemblages in the collection have thousands of vessels in contrast to others with tens or hundreds (mean $\bar{n} = 301$ vessels). Since there are a wide variety of sample sizes represented in the database, it is critical to apply an approach for interassemblage similarity that is both capable of taking advantage of categorical, frequency-based data and independent of biases resulting from sample size effects.

One index of similarity between assemblages common to archaeological applications is the Brainerd-Robinson (BR) coefficient of agreement (Brainerd, 1951; Robinson, 1951). This similarity index was developed as part of a quantitative approach to archaeological seriation (Shennan, 1988, 191, 208), but at its core it is a pairwise measurement of the agreement among proportions of shared categories between assemblages (Cowgill, 1990b). These shared categories are typically ceramic types (e.g. Dermarkar, 2019), but they are represented by proportions of PCMCs in this case study. The BR coefficient is a type of city-block metric (Shennan, 1988, 201) formally represented by Equation (4.1),

$$BR(A, B) = 200 - \sum_{i=1}^{N} |p_{iA} - p_{iB}| \tag{4.1}$$

where A and B are a pair of assemblages, N is the total number of PCMCs and p_{iA} and p_{iB} are the proportions of the ith PCMC in each assemblage. As a city-block metric, the BR coefficient is a sum of the difference in proportion between each set of categorical variables, and since it relies on proportional difference it is fairly robust to comparisons between assemblages of different sample sizes (Robinson and Brainerd, 1952). The summed difference between categorical proportions is subtracted from 200 to calculate an index of the similarity between a pair of assemblages, where a BR of 0 represents perfect dissimilarity and 200 perfect agreement. In the following sections, a pairwise matrix of BR similarity coefficients was calculated using the `BRsim` function within the `GmAMisc` package in R (Alberti, 2020; R Core Team, 2020). The `BRsim` function performs an additional step of "penalizing" BR coefficients for pairs of assemblages that have unshared categories (i.e. a PCMC is represented in one assemblage but not another) by dividing them by the number of unshared categories plus 0.5 (the latter addition applies to pairs with only a single unshared category). This additional correction step does not apply to shared absences, and acts as a control in comparisons between assemblages with larger differences in richness. The function was also applied to rescale the BR similarity coefficients to a range of 0–1.

The BR coefficient is a measure of similarity rather than a distance metric; the two have different implications for the correlation of matrices (Legendre et al., 2015, 1240). However, it can be changed to a distance metric using the `BRsim` package; to do so, the value of the rescaled BR coefficient was subtracted from the maximum possible value (i.e. the maximum rescaled value is 1, so the distance conversion follows the simple formula $BR_{dist} = 1 - BR$). This converts the BR coefficient to a measurement of *dissimilarity* because subtracting the BR coefficient from the maximum value allows sites with larger differences in BR similarity to have correspondingly larger "distances" separating them. The correlation between differences in these distances and differences between spatial distance is assessed through the Mantel tests described below.

4.2 Hypothesis 1: Isolation by Distance

At the heart of the problem of identifying pairwise correlations between distance and similarity within populations of archaeological assemblages are the necessary restrictions of the approach used to do so. Previous studies have approached the identification of such a correlation by developing multiple linear regression models between BR similarity and inter-community distance (e.g. Birch and Hart, 2018; Hart, 2012; Hart and Engelbrecht, 2012; Hart et al., 2019). However, distance matrices violate the standard assumptions of linear regression because their components are not independent — removing a site changes the ordering of the entire distance matrix (Shennan et al., 2015, 105).

An alternative approach to comparing correlation of distance matrices was first developed by Nathan Mantel (1967), an epidemiologist who was interested in comparing spatial and temporal distance matrices between paired cases of disease outbreaks in epidemics. The objective of the Mantel test is to explore correlations between the *magnitudes* of paired distances between two distance matrices (Mantel, 1967); the null hypothesis of the test is that the sizes of paired distances between the two distance matrices are unrelated. The standardized Mantel statistic r_M is calculated by Equation (4.2)

$$r_M = \frac{1}{d-1} \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \left(\frac{x_{ij}-\bar{x}}{s_x}\right) \left(\frac{y_{ij}-\bar{y}}{s_y}\right) \tag{4.2}$$

where x_{ij} and y_{ij} are the values of the ith row and jth column of distance matrices $\mathbf{X}$ and $\mathbf{Y}$, $\bar{x}$ and $\bar{y}$ are the mean distances in each matrix with s_x and s_y being their standard deviations, and $d = [n(n-1)/2]$ equaling the number of distances in each matrix (Borcard and Legendre, 2012, 1474). The degree of correlation (expressed as the strength of a *monotonic* relationship between the magnitude of paired distances) between the matrices was assessed by the Spearman correlation coefficient (Legendre and Legendre, 2012, 205–209). Spearman's *rho* was used instead of the traditional Pearson correlation because the former is non-parametric and thus relaxes the assumption that the data are normally distributed (Dietz, 1983), making it especially useful for archaeological data.

A significant monotonic correlation between magnitudes in the two matrices indicates that large differences in spatial distance between sites correlate with large differences in BR distance (corresponding to increased dissimilarity) between the same sites, and vice versa for small differences. The significance level of the Mantel test statistic r_M was calculated by comparing it to a range obtained by randomly permuting the rows and columns in the matrix of the predicted variable to obtain a null distribution against which the observed test statistic is compared (Legendre, 2000; Smouse et al., 1986). Since the Mantel test evaluates correlations between the sizes of distances rather than directly from the raw data, the r_M coefficient is different than the R^2 coefficient of determiNation used in multiple linear regression, but the former is still useful for identifying correlations among distance matrices and especially spatial autocorrelation (given certain modifications; see below) because it sidesteps the issue of spatial dependence among communities.

An important extension to the Mantel test was developed by Smouse et al. (1986), who modified its approach to control for the confounding effects of a third distance matrix on the response variable (Legendre and Legendre, 2012, 604). This approach, known as a partial Mantel test, is vital for identifying an independent signature of population structure by testing for the correlation between interassemblage dissimilarity and spatial group membership (represented as a binary distance matrix) while controlling for the confounding effects of spatial distance. However, it is important to note that the power of the partial Mantel test as a tool for de-trending the confounding influence of spatial distance on correlations between pairwise dissimilarity has recently been questioned (Legendre et al., 2015). Thus, it should be used in combination with other approaches and interpreted cautiously.

Legendre et al. (2015) note that Mantel tests alone are not very strong in their ability to identify the extent of the structure of spatial autocorrelation (e.g. Meirmans, 2012). Therefore, to identify the existence of spatial structure in BR dissimilarity using the Mantel test, it can be extended to measure the correlation between distance matrices across a series of distance classes using a *Mantel correlogram* (Borcard and Legendre 2012; Legendre and Legendre 2012, 819–821). Mantel correlograms compute a series of Mantel tests on sets of sites from the complete distance matrix based on their distances from one another. Starting with the closest neighboring sites, the Mantel correlogram converts the distance matrix to a model matrix differentiating sites falling within a specified distance range (denoted as 0) and sites separated by distances outside that range (denoted as 1 in the first class) and calculates a standardized Mantel statistic of the correlation between this model matrix and the pairwise BR distance matrix. The model matrix changes to denote each set of progressively more distant sites (or *distance class*) — changing 0's to reflect sites in each class and increasing the 1's to 2's to reflect the increased distance (and so on for k distance classes) — and a series of standardized Mantel statistics are calculated for each distance class until there are no longer enough distant sites. The significance of every standardized Mantel test statistic is tested by permutation in the same manner as the single Mantel test (and the effects of multiple testing are corrected for; Borcard and Legendre 2012).

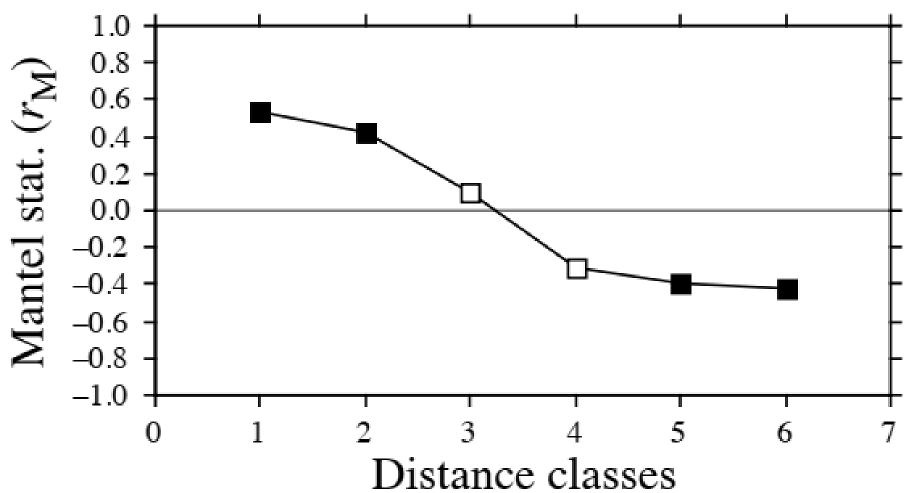


Figure 4.1: Example of a Mantel correlogram (after Legendre and Legendre, 2012, 820).

Figure 4.1 is an example of a Mantel correlogram calculated for ecological data (Legendre and Legendre, 2012, 819–820). In the Mantel correlogram, the magnitude of the r_M statistic is less important than the shape of the trend between significant distance classes. The shape of the example trend depicted in Figure 4.1 is typical of a gradation in dissimilarity over increasing distance. In the first few distance classes, correlation between the dissimilarity of sites and their distance is positive, but this trend gradually shifts negatively until it crosses the zero axis, remaining negative or eventually shifting back towards randomness at farther distance classes. The shape of the trend in the example is typical of a pattern of isolation by distance because it reflects a situation in which the size of differences in dissimilarity coefficients are smaller at closer distance classes, before gradually shifting towards being significantly different at larger intersite distances. As discussed above, the r_M statistic does not measure the correlation of the exact values of the dissimilarity index, but rather the correlation between the magnitude of differences between it and geographic distance for the same pair of sites. Thus, if Figure 4.1 represented the BR dissimilarity of the study area, it would reflect that the magnitude of differences between BR_{dist} coefficients and relative differences in geographic distance separating pairs of sites was smaller for closer distance classes, unrelated at medium distances, and significantly larger at farther distances — consequently reflecting significantly greater interassemblage similarity at closer distances and significantly greater interassemblage dissimilarity at farther distances.

In short, the trend in the example represents the expectation under the effects of IBD — departures from the general trend could thus indicate departures from the null hypothesis. Importantly, under the expectations of random copying, communities in the closest distance class should exhibit significant positive autocorrelation because they have the highest likelihood of interaction and thus the greatest chance of "copying" PCMCs from one another, ultimately producing a higher degree of interassemblage similarity. Insignificant or negative autocorrelation in the first distance class is thus a possible symptom of additional selective copying processes.

4.2.1 Mantel Tests: Matrix Creation

For the majority of Mantel tests and correlograms conducted in this study, two distance matrices were created: a BR distance matrix and a geodesic distance matrix. In the following cases, all of the BR distance matrices were generated using the `BRsim` function as described above. A corrected and rescaled BR similarity coefficient was calculated for each pair of sites, then converted to a distance metric of dissimilarity. BR distance matrices were created for the complete metapopulation, each of the five timeblocks, each of the five regional groups, and for each timeblock in each of the regional groups (see Appendix D). A geographic distance matrix was also generated for all the sites in each of the aforementioned cases using an R function written by Enrico Crema called `distMat` (Shennan et al., 2015, Supplementary Code 1). The function calculates a geodesic (Great Circle) distance matrix from a vector of site coordinates in decimal degrees; the matrix records the pairwise distance between sites in kilometers.

4.2.2 Mantel Tests: Case Scenarios

To fully explore the range of spatial and temporal variability in IBD across Northern Iroquoia, Mantel tests and correlograms were conducted in several case scenarios at varying scales. For each scenario, a single Mantel test measuring the monotonic correlation between BR distance and spatial distance was first conducted using the `mantel` function of the `vegan` package in R (Oksanen et al., 2019; R Core Team, 2020), followed by the generation of a Mantel correlogram with uniform 10 km distance classes with the `mantel.correlog` function from the same package. Tests were conducted with 10,000 permutations each. Correlation between BR distance and geographic distance was evaluated for each of the following case scenarios:

1. Complete metapopulation: All sites across all timeblocks and spatial groups.
2. Timeblocks: All sites across all spatial groups in each of the five sequential overlapping timeblocks.
3. Regional groups: All sites classified to each of the five regional groups (Jefferson County, Erie/Niagara, New York, Ontario, and St. Lawrence), both across all timeblocks and within each one.

The representation of spatial groups across each of these case scenarios is highly variable. In most case scenarios, all thirteen groups are not represented concomitantly, and in many there are highly uneven sample distributions (with some spatial groups having only a single community). Future research would benefit from the addition of new data from collections to bolster the representation of these spatial groups (with a promising avenue being the inclusion of data from legacy collections; Glencross et al. 2015; LaPierre 2019).

4.3 Hypothesis 2: Population Structure

The goal of this section is to introduce and contextualize the approach that will be used to identify and evaluate the strength of apparent population structure captured by the partitioning of archaeological sites into spatial groups across the region of Northern Iroquoia. Like the previous section, the first part introduces the tests designed to identify a potential signal of this structure and the following parts describe the application of this approach to a set of case scenarios.

As discussed in the previous chapter, population structure is not strictly limited to genetic data; cultural data have proven amenable to studies of population structure in many different contexts (Ross et al., 2013; Rzeszutek et al., 2012; Shennan et al., 2015) because these data can potentially contain signals of subpopulation differentiation corresponding to the effects of cultural transmission forces. Approaches in population genetics have developed quantitative methods of identifying structured variation in genetic diversity (Excoffier, 2007), and approaches have been developed using distance matrices that are flexible to the analysis of non-genetic data amenable to presentation in distance matrix form. One such approach that has seen application in these studies is the Analysis of Molecular Variance (AMOVA) framework (Excoffier et al., 1992; Meirmans, 2006; Mengoni and Bazzicalupo, 2002). The goal of the AMOVA framework is to partition the observed variability of a distance matrix quantitatively into sets of different hierarchical components defined *a priori* by the researcher based on the scenario being tested. The definition of these components is based on the scale of the analysis, and in studies of cultural population structure they often correspond to ethnolinguistic groups (Ross et al., 2013; Rzeszutek et al., 2012). However, Shennan et al. (2015) identified the value of the AMOVA framework as a hypothesis-testing approach for studying the empirical validity of archaeological cultures, given that these collections of polythetic material culture assemblages are often implicitly treated as distinct populations (Furholt, 2008; Riede, 2011; Riede et al., 2019; Roberts and Vander Linden, 2011).

As a hypothesis-testing approach for the objective empirical value of extensionally defined spatial groups, the AMOVA framework proves useful for studying the relationship of structured variability within and between Northern Iroquoian spatial groups. As discussed above, the expectations of the random copying model suggest that a distinct population structure (that is, within the *material culture* population — here represented by PCMC variants) should not be present under such conditions; rather, subpopulations defined by spatial group membership might be more aptly described as an "arbitrarily imposed discretization of a continuum determined exclusively by isolation by distance" (Shennan et al., 2015, 103). The AMOVA framework can identify the proportion of between-group variability explained by the partitioning of the metapopulation into spatial groups, providing some important insight on this question.

The version of the AMOVA framework applied in this case study follows Shennan et al. (2015) in using the Φ_{ST} test statistic as a proxy of apparent population structure. Φ_{ST} is derived from a measure of population differentiation developed for genetic allele frequencies by Sewall Wright (1965), which Excoffier et al. (1992) adapted for use with distance matrices (see Excoffier, 2007, for a review of other population differentiation statistics). They developed a range of test statistics for studying various forms of population differentiation, from which Φ_{ST} is the most useful for studying straightforward differentiation among a group of populations (i.e. spatial groups). The test statistic is computed as a ratio of variance components obtained from a pairwise matrix of squared distances (Excoffier et al., 1992, 481). It is calculated by dividing the variance in BR dissimilarity between populations by the sum of the variance between populations and within populations (Shennan et al., 2015, 105), and is formally represented by Equation (4.3)

$$\Phi_{ST} = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_b^2} \tag{4.3}$$

where σ_a^2 represents the variance component between populations and σ_b^2 represents the variance component within populations (Meirmans, 2006, 2399).

The significance of Φ_{ST} was calculated by randomly permuting the distance matrix in the same manner as the r_M statistic above. The value of this statistic measures the variation between pairwise distances drawn from defined subpopulations relative to the variation between pairwise distances drawn from the complete metapopulation (Excoffier et al., 1992, 482). Thus, the larger the value of Φ_{ST}, the greater the proportion of variability in BR dissimilarity that is constrained between spatial groups.

In other words, for $\Phi_{ST} = 0$, the range of dissimilarity between assemblages attributed to the same spatial group is not differentiable from the range of dissimilarity between assemblages attributed to different spatial groups — reflecting a complete lack of structuring related to spatial group membership. In contrast, for $\Phi_{ST} = 1$ the range of BR dissimilarity is completely different for each spatial group with no variation within — reflecting a situation in which all assemblages attributed to the same spatial group have an identical combination of PCMC proportions that is also unique to the combination of all other spatial groups. Negative Φ_{ST} statistics have no meaning and are converted to zero (Ross et al., 2013, 4), and insignificant Φ_{ST} statistics also reflect a lack of meaningful differentiation between populations. Global Φ_{ST} statistics calculated for cultural datasets have ranged from 0.021 (Rzeszutek et al., 2012) to 0.134 (Shennan et al., 2015) depending strongly on context and the type of data under consideration.

The outcome of the AMOVA framework consists of a single set of variance components, which is useful for providing a glance summary of structure but does not provide much more information on the relative differentiation between individual groups. Following Shennan et al. (2015), it can be extended to a pairwise AMOVA framework by considering the constraint of variation between all sites of a single group against all sites in the other groups of the metapopulation. When applied in this way, the Φ_{ST} is a measurement of the pairwise differentiation of that particular group against all others: when the pairwise Φ_{ST} of two groups is zero or insignificant, it indicates that their communities have little to no differentiation in their decorative variation. If the mean pairwise Φ_{ST} of a spatial group is zero or insignificant, there is no evidence to suggest it is distinct from the rest of the groups in the metapopulation. Additionally, these pairwise Φ_{ST} matrices can be tested against the spatial distance between spatial groups to ascertain how strongly the apparent differentiation is influenced by geographic position.

4.3.1 AMOVA: Case Scenarios

Since the AMOVA framework is designed to distinguish between-group and within-group variance components, it can only be applied to case scenarios with two or more groups (100 percent of variability in a single group is within-group). This limits the range of case scenarios for which population structure can be tested, but not substantially. In each of the following case scenarios, a single AMOVA test was conducted on the corresponding BR distance matrix using the spatial groups represented by that case scenario as the population components. For the meso-scale scenarios, regional group affiliation was used as the grouping factor. Both single and pairwise AMOVA tests were conducted using the `pegas` package in R (Paradis, 2010) with 10,000 permutations. Apparent population structure was evaluated in each of the following case scenarios:

1. Complete metapopulation: All spatial groups aggregated across all timeblocks.
2. Timeblocks: All spatial groups represented across each of the five timeblocks.
3. Regional groups: when possible (i.e. when more than two groups were present), internal differentiation between spatial groups within each of the regional groups was assessed across all timeblocks and within each one; cultural population structure was also evaluated collectively among entire regional groups (e.g. St. Lawrence, New York, and Ontario) for the same timescales when possible.

The same sparse spatial group representation was also a factor in the population structure evaluations. It is possible that un-published data from communities that were deeply involved in possible interaction networks could substantially change the outcome of the results, especially in cases where spatial groups were represented by a single site.

4.4 Quantifying and Evaluating Biases

In the previous sections of this chapter, two complimentary approaches have been laid out for evaluating population-level patterns in BR dissimilarity between communities across Northern Iroquoia. The first approach focused on the relationship between interassemblage similarity and intersite distance with the goal of identifying potential departures from isolation by distance, and the second approach looked at the apparent population structure in order to quantify the amount of differentiation between and within spatial groups. Both approaches consider separate but complimentary trends which can potentially be combined to address the random copying null hypothesis; however, a critical first step must be taken before this combination can proceed.

Studies have shown that statistical tests of both IBD and population structure can be biased by the presence of geographically clustered metapopulations (Bradburd et al., 2013; Drummond and Hamilton, 2007; Guillot et al., 2009; Meirmans, 2012; Meirmans et al., 2011). For example, Meirmans (2012, 2840) has demonstrated using simulated data that Mantel tests can return false positives in the presence of geographically clustered metapopulations, even when there is no simulated IBD present. Conversely, he showed that AMOVA frameworks conducted for unstructured populations with strong IBD showed consistent spurious statistical significance. In other words, the Mantel test can be biased by spatially structured metapopulations even in the absence of IBD, and the AMOVA can be biased by IBD even in the absence of population differentiation. Fortunately, Meirmans (2012) laid out a series of additional tests that can be conducted for both approaches that allow for the impact of these potential biases to be identified. Therefore, the goal of this section is to introduce these additional tests, beginning with the identification of structuring biases in the Mantel tests and moving on to potential IBD biases on the tests of population structure.

4.4.1 Potential Biases in Mantel Tests

As Meirmans (2012, Table 1) demonstrated with simulated data, single Mantel tests conducted on geographically clustered metapopulations can identify significant correlation even under a complete absence of simulated IBD. He further showed that this spurious result is broadly similar to non-clustered populations when evaluated by a Mantel correlogram (Meirmans, 2012, Figure 1). Meirmans argued that a strong approach to identifying biases to the Mantel test of IBD caused by geographic clustering is to perform a *stratified* Mantel test.

In a stratified Mantel test the distance matrices are still randomly permuted, but instead of permuting all communities randomly across the metapopulation each time, shuffling of locations is stratified by their particular population (i.e. spatial group). Thus, conducting a stratified Mantel test is roughly equivalent to running a separate test for each spatial group simultaneously. Crucially, stratified Mantel tests can still identify IBD in metapopulations without distinct geographic clustering (Meirmans, 2012, Table 1). By comparing the magnitude and significance of the normal and stratified single Mantel tests, the potential effects of biases caused by geographic clustering can be identified. Importantly, these biases may be limited to specific regions or temporal periods, so by comparing the stratified and unstratified Mantel tests a clearer picture of the relationship between spatial distance and BR dissimilarity over time and space can be obtained.

Stratified Mantel tests were conducted for each of the above case scenarios except for the Erie/Niagara and Jefferson County regional groups, which only have a single spatial group and therefore cannot be stratified. The significance of each stratified Mantel test was confirmed via 10,000 permutations using the `vegan` package in R (Oksanen et al., 2019), with the spatial group affiliations of the assemblages defined as their associated strata.

4.4.2 Potential Biases in AMOVA

Meirmans (2012) showed that AMOVA frameworks conducted on unstructured metapopulations can cause gradated dissimilarity to also be partitioned, creating spurious differentiation. In other words, variance components divided by the AMOVA can accidentally appear to be selectively differentiated if they happen to partition ceramic decorative variability characterized solely by IBD ultimately generated by random copying processes alone, producing an artificially significant Φ_{ST} falsely supporting selective copying. He argued that it is therefore essential to identify and, if possible, control for the biasing effects of IBD on population differentiation.

First, the extent of spatial distance between communities as a biasing factor on population differentiation can be evaluated by treating the pairwise Φ_{ST} matrices described above as distance matrices and conducting a Mantel test between them and an inter-polity distance matrix. Second, a spatially independent evaluation of population structure can be conducted; first by creating a binary distance matrix of spatial group membership and checking the correlation of this matrix against the BR dissimilarity matrices (independent of spatial and temporal distance) using partial Mantel tests, and second by testing for significant differences in mean BR dissimilarity among the spatial groups using the Analysis of Similarities (ANOSIM) test (Clarke, 1993).

As we have seen, distance between populations plays an important role in the probability that they will interact and exchange information; indeed, Shennan et al. (2015, 106) hypothesized that the proportion of between-group differentiation among archaeological cultures would likely be positively correlated with their relative distance in space and time. As we have also seen, IBD can create spurious differentiation within unstructured metapopulations by causing gradated dissimilarity to resemble structuring. The correlation of differences in inter-polity Φ_{ST} and spatial distance (and thereby the extent that inter-polity differentiation is biased by IBD) can thus be investigated by adding an explicit spatial dimension to the pairwise Φ_{ST} matrices created for the complete metapopulation and sequential overlapping timeblocks above.

In order to approximate the geographic location of each spatial group as represented by the pairwise Φ_{ST} matrix, its centroid was calculated by taking the mean longitude and latitude of all communities attributed to it (Figure 4.2), following the approach taken by Shennan et al. (2015). A pairwise interpolity distance matrix was created based on these mean centroid positions for all spatial groups in each of the case scenarios, again using the `distMat` function. Single Mantel tests were conducted on these matrices, again using the `vegan` package with 10,000 permutations each, to determine the extent that differentiation between spatial groups was biased by spatial distance.

As Meirmans (2012, 2841) demonstrated for simulated data, one potential option for identifying spatially independent population structure is to develop a “model matrix of

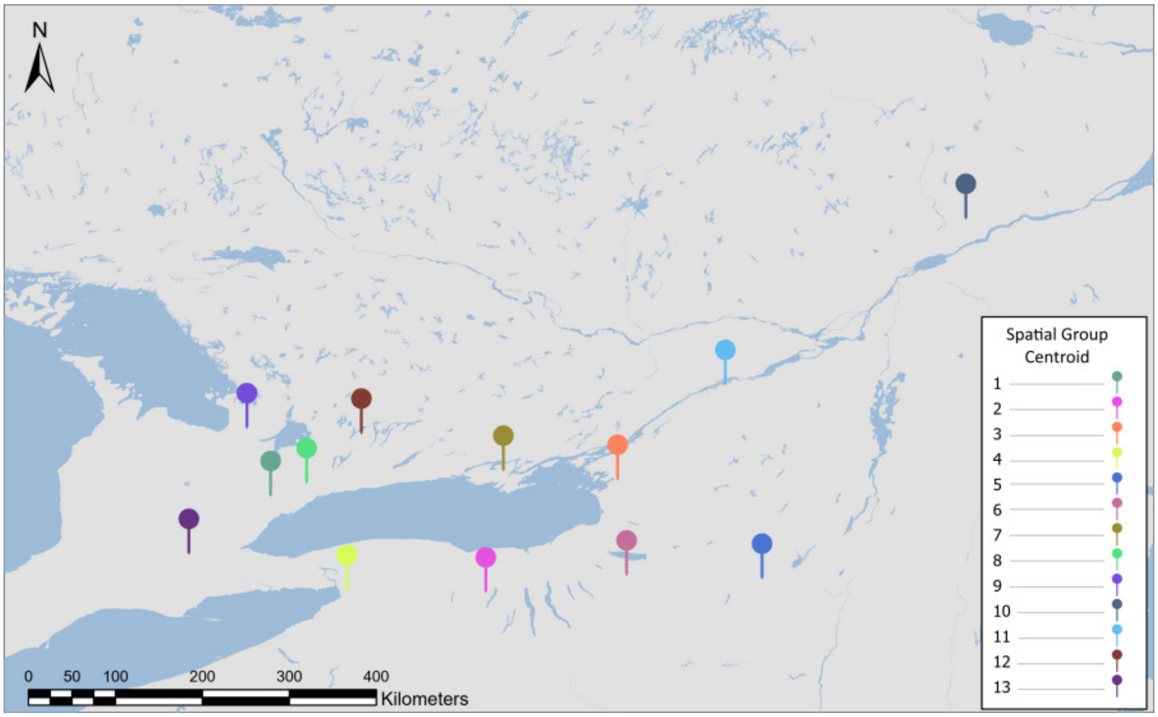


Figure 4.2: Geographic centroids calculated for each of the thirteen spatial groups.

cluster membership." This is a character matrix that describes relationships between communities that are affiliated with the same population within a metapopulation (e.g. Drummond and Hamilton, 2007); Shennan et al. (2015, 106) also refer to it as a "binary distance matrix representing cultural affiliation." Communities attributed to the same spatial group are scored as 1, and those from different spatial groups are scored as 0. In fact, the binary distance matrices are identical in form to the distance class model matrices created during the calculation of Mantel correlograms (Legendre and Legendre, 2012, 819–821). The binary matrix can be converted into a Euclidean distance matrix, allowing it to be correlated with the BR dissimilarity matrix via a series of partial Mantel tests which allow the confounding effects of spatial distance between sites to be controlled for (e.g. Smouse et al., 1986). By checking for a significant correlation between interassemblage BR dissimilarity and shared spatial group membership while holding for the effects of spatial distance, these partial Mantel tests allow for an independent assessment of population differentiation at the complete metapopulation scale — which is expected to be insignificant under random copying.

A binary distance matrix of spatial group membership was constructed for each case scenario using the `BinaryCulture` function, also written by Enrico Crema (Shennan et al., 2015, Supplementary Code 1). The correlation between BR dissimilarity and these binary distance matrices independent of spatial distance was evaluated by partial Mantel tests conducted using the `vegan` package (Oksanen et al., 2019) with 10,000 permutations each.

To further support the results of the partial Mantel tests described above as well as furnish an additional independent assessment of the apparent constraint of between-group variability by spatial group membership, the Analysis of Similarities (ANOSIM) test was also applied for each case scenario. The ANOSIM test is a nonparametric approach used in ecology (Clarke, 1993) and occasionally archaeology (Rigaud et al., 2015). It is a permutation-based test designed for dissimilarity matrices that tests the null hypothesis that there are no significant differences in the *ranked* means of dissimilarity coefficients across a set of *a priori* defined groups (Clarke, 1993). In archaeology, the approach has been used to test for significant group differentiation among metapopulations of archaeological cultures represented by dissimilarity matrices of ornament data (Rigaud et al., 2015).

The ANOSIM test statistic R_{ANOSIM} is a ratio of the mean ranked dissimilarity between groups to the mean of ranked dissimilarity of sites within groups (Clarke, 1993); in archaeological contexts, "pairwise groups with R-values >0.75 are well separated; groups with R>0.5 are partially overlapping but noticeably different and groups with R<0.25 are scarcely separable" (Rigaud et al., 2015, 11). The significance of the R_{ANOSIM} statistic is calculated by permuting the dissimilarity matrix and recalculating the mean between-group and within-group ranked dissimilarity — thus, it is conceptually similar to a stratified Mantel test. ANOSIM tests were conducted on the BR dissimilarity matrices using the `anosim` function of the `vegan` package in R (Oksanen et al., 2019), treating spatial group membership as the sampling unit. The significance of the statistic was evaluated after 10,000 permutations.

4.5 Conclusion

The previous chapter defined the two primary research questions of this regional case study and reframed them as hypotheses. In this chapter, a methodology was developed for evaluating each of these hypotheses. The strategy of this approach relied on combining the results of multiple deterministic tests which each reveal aspects of regional decorative patterning observed over multiple scales.

Table 4.1 summarizes the testing methods used to evaluate the first hypothesis. It focused on regional trends in interassemblage similarity consistent with the effects of isolation by distance; the primary method for recognizing these trends relied on the Mantel test: a permutation-based correlation test that identifies instances when pairs of communities separated by smaller spatial distances were more likely to also have smaller Brainerd-Robinson distances between their decorative assemblages — indicative of smaller differences among the proportions of their shared pottery collar motif combinations. Pairs of communities were shuffled (i.e. permuted) randomly across all spatial groups and within individual spatial groups (i.e. stratified), the latter serving to test for the potentially biasing effects of spatial structure described above. As Table 4.1 shows, the relative magnitude and significance of the Mantel r_M test statistic was used as the main proxy for isolation by distance effects, both independently in single and stratified Mantel tests and for sets of distance classes in Mantel correlograms. The absence of these effects, either caused by a lack of relationship or by more prominent similarity over larger distances compared to closer ones, is an expected outcome of selective copying processes.

Table 4.2 summarizes the testing methods used to evaluate the second hypothesis. It focused on group-level trends in cultural population structure; the primary approach for identifying apparent cultural population structure corresponding to spatial group membership was the Analysis of Molecular Variance (AMOVA): a permutation-based method that calculates the proportion of variability among site-level BR_{Dist} coefficients that is constrained *between* a set of pre-defined populations (here groups of communities defined by spatial group membership) against the proportion distributed among populations, producing a test statistic (Φ_{ST}) as a ratio of these components. The existence and magnitude of variability in relative interassemblage similarity constrained between spatial groups reflects a higher likelihood of the existence of homophilic ties among communities correlating with regional signaling networks and driven by selective copying processes. The absence of these ties is expected under random copying, leading to the rejection of the second hypothesis whenever evidence for *robust* population structure is supported.

Since proportioning of similarity among communities can also be created arbitrarily by geographic clustering, Φ_{ST} alone was not enough to reject H_2. Spatially independent evidence of cultural population structure was also required. Partial Mantel tests were used to compare site-level similarity against character matrices representing shared spatial group membership while controlling for the impact of geographic distance. The magnitude and significance of r_M calculated by these tests was the primary factor supporting the acceptance of Φ_{ST} as robust; larger and strongly significant r_M coefficients reflect scenarios where communities within separate spatial groups have different levels of similarity even when the effects of distance friction between them were removed, potentially signifying the existence of selective copying processes. Additional supporting evidence included the relative influence of distance between spatial group centroids on pairwise Φ_{ST} (calculated as Mantel r_M) and the relative overlap in mean ranking of BR_{Dist} coefficients between spatial groups (reflected by the magnitude of R_{ANOSIM}). The former captures the strength of possible bias in overall Φ_{ST} due to spatial structure, and the size of the latter characterizes the relative separation of spatial groups based on the central tendencies of their communities' similarity coefficients. In summary, evidence of spatially independent structuring corresponding to spatial group membership strongly supports the robustness of the apparent cultural population structure reflected by single and pairwise Φ_{ST} for each case scenario, leading to the rejection of H_2 and demonstration of potential homophilic ties within spatial groups. When Φ_{ST} could not be supported as robust due to the impact of geographic clustering H_2 was accepted, acknowledging that homophilic ties could still exist but that they cannot be distinguished from stochastic pattering — random copying processes.

Hypothesis 1: Spatial patterns of similarity in pottery decoration in Northern Iroquoia can be sufficiently explained by the effects of isolation by distance						
Test	Independent Variable	Response Variable	Test Statistic	Result	Interpretation of Result	Evaluation
Single Mantel	Geographic Distance Between Communities	BR_{Dist} Between Communities	r_M	$p > 0.05$	Relative interassemblage similarity unaffected by spatial distance; random copying cannot sufficiently explain.	Reject H_1
				$p \leq 0.05$	Relative overlap in proportions of shared pottery collar decorative motif combinations larger for communities separated by shorter spatial distances; random copying can sufficiently explain.	Accept H_1 only if spatial bias ruled out by stratification
Stratified Mantel	Geographic Distance Between Communities within Spatial Groups	BR_{Dist} Between Communities within Spatial Groups	r_M	$p > 0.05$	Apparent significance of correlation between relative interassemblage similarity and spatial distance driven by effects of spatial biases due to geographic clustering.	Reject H_1
				$p \leq 0.05$	Robust relationship between relative interassemblage similarity and intercommunity distance independent of spatial biases; random copying can sufficiently explain.	Accept H_1
Mantel Correlogram	BR_{Dist} among Communities within Distance Class	BR_{Dist} among Communities outside of Distance Class	r_M	$p > 0.05$	No significant autocorrelation; BR_{Dist} of pairs of communities separated by distances within the distance class are not significantly different from communities separated by larger or smaller distances; random copying inadequate to explain.	Reject H_1
			$+r_M$	**$p \leq 0.05$**	Positive autocorrelation; assemblages from pairs of communities separated by distances within the distance class are significantly more similar than assemblages from pairs of connunities separated by smaller or larger distances; random copying sufficiently explains only in first/closest distance classes.	Accept H_1 if present in closest distance classes; Reject H_1 if present at farthest distance classes
			$-r_M$	**$p \leq 0.05$**	Negative autocorrelation; assemblages from pairs of communities separated by distances within the distance class are significantly more different than assemblages from pairs of communities separated by smaller or larger distances; random copying sufficiently explains only in farther distance classes.	Reject H_1 if present in closest distance classes; Accept H_1 if present at farthest distance classes

Table 4.1: Summary of the methods introduced in this chapter for evaluating the first hypothesis.

Hypothesis 2: There is no robust evidence of cultural population structure corresponding to spatial group affiliation

Test	Independent Variable	Response Variable	Test Statistic	Result	Interpretation of Result	Evaluation
Single AMOVA	Average Proportion of Variation in BR_{Dist} Across All Groups	Average Proportion of Variation in BR_{Dist} Constrained Between Groups	Φ_{ST}	$p > 0.05$	Amount of variation in community-level interassemblage similarity among sites within the (Spatial/Regional) group is not significantly different than the amount of variation across all communities; random copying can adequately explain.	Accept H_2
				$p \leq 0.05$	A significant percentage (represented by Φ_{ST}) of average variation in relative assemblage similarity is apportioned to communities within (Spatial/Regional) groups; random copying can only adequately explain when no supporting evidence exists for robust group differentiation.	Reject H_2 only with robust supporting evidence
Pairwise AMOVA	Proportion of Variation in BR_{Dist} of First Group	Proportion of Variation in BR_{Dist} of Second Group	Φ_{ST}	$p > 0.05$	Variability of relative similarity in First and Second (Spatial/Regional) groups is not significantly different—no robust cultural population structure between groups; random copying can adequately explain.	Accept H_2
				$p \leq 0.05$	A significant percentage (represented by Φ_{ST}) of variability in relative assemblage similarity is constrained by the separation of communities into the First and Second (Spatial/Regional) groups; random copying can only adequately explain if no supporting evidence for robust cultural population structure exists.	Reject H_2 only with robust supporting evidence
Single Mantel — Pairwise Φ_{ST}	Geographic Distance between Spatial Group Centroids	Spatial Group Pairwise Φ_{ST}	r_M	$p > 0.05$	Apparent cultural population structure is not affected by geographic distance between groups—supporting evidence that spatial biases are not driving pairwise Φ_{ST}; random copying cannot adequately explain.	Reject H_2
				$p \leq 0.05$	Geographic distance separating groups explains a proportion (equal to size of r_M) of the apparent cultural population structure—evidence of spatial biases; random copying can adequately explain.	Accept H_2
Partial Mantel — Group Affiliation Character Matrix	Binary Distance Matrix of Spatial/Regional Group Affiliation — Confounding Influence of Spatial Distance Removed	BR_{Dist} Between Communities	r_M	$p > 0.05$	Relative similarity of assemblages in the same spatial group does not exist beyond the confounding influence of spatial distance between them; refutive evidence of robust cultural population structure identified by AMOVA Φ_{ST}; random copying can adequately explain.	Accept H_2
				$p \leq 0.05$	Communities in the same group are significantly likely to be more similar independent of the confounding influence of spatial distance between them; strongest supporting evidence of robust cultural population structure; random copying cannot adequately explain.	Reject H_2
ANOSIM	Average Ranked Community BR_{Dist} Across All Groups	Average Ranked Community BR_{Dist} Within Group	R_{ANOSIM}	$p > 0.05$	Average similarity of community assemblages across all groups are not significantly different; random copying can adequately explain.	Accept H_2
			$0 > R_{ANOSIM} \geq 0.25$	$p \leq 0.05$	Average similarity among assemblages within (Spatial/Regional) groups greatly overlaps; random copying can adequately explain.	Accept H_2
			$0.25 > R_{ANOSIM} \geq 0.50$	$p \leq 0.05$	Average similarity among assemblages within (Spatial/Regional) groups overlaps overlaps slightly less but remains scarcely separable; random copying can adequately explain.	Accept H_2
			$0.5 > R_{ANOSIM} \geq 0.75$	$p \leq 0.05$	Average similarity among assemblages within (Spatial/Regional) groups is noticably different but some overlap remains; random copying no longer adequately explains.	Reject H_2
			$R_{ANOSIM} > 0.75$	$p \leq 0.05$	Average similarity among assemblages within (Spatial/Regional) groups is very well separated and hardly overlaps; random copying does not adequately explain.	Reject H_2

Table 4.2: Summary of the methods introduced in this chapter for evaluating the second hypothesis.

Chapter 5

Results for the Complete and Regional Samples of Northern Iroquoian Spatial Groups

This chapter presents the results of the hypotheses tested for each of the three observational scales described in the previous chapter.[1] To reiterate, two primary hypotheses were evaluated in each case: H_1: Geospatial similarity among assemblages of pottery collar motifs can be *sufficiently* explained by the expectations of random copying processes (creating pronounced isolation by distance [IBD] between the closest neighboring sites); and H_2: There is no *robust* supporting evidence for cultural population structure corresponding to spatial group membership — also a predicted outcome of random copying alone.

Figure 5.1 is an illustrated synthesis of the results obtained in this case study. As the chart shows, the first hypothesis was mostly rejected at all scales, while the opposite was overwhelmingly true for the second hypothesis. As expected, scant robust supporting evidence for population structure was observed, highlighting a near-complete lack of support for homophilic ties matching the scale of spatial groups. In contrast, supporting evidence for IBD was noted in six distinct contexts, reaching its greatest state of clarity at the finest-grained observational scale. The three main sections of this chapter focus on progressively finer observational scales, beginning with the complete sample of sites from all regions and

[1] All raw data and R code used to generate them are available at github.com/daniellapierre/copying

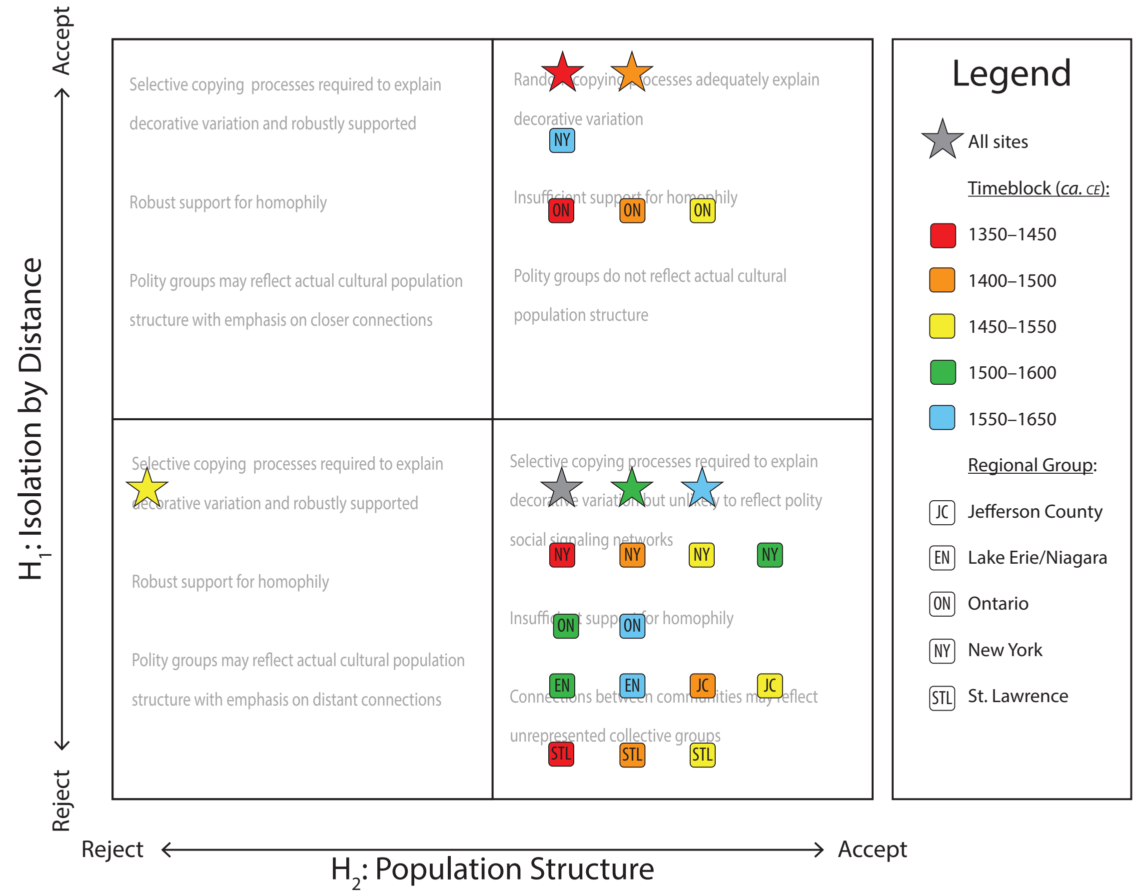


Figure 5.1: Synthesis of the outcomes of Hypothesis 1 and 2.

time periods.

5.1 Result 1: Among All Sites, Random and Selective Copying Cannot be Distinguished

The sample with the broadest observational scale was the complete collection of 234 community assemblages. This viewpoint sacrifices geographic and temporal nuances for a broader overview (Bevan and Conolly, 2006). Previous studies (e.g. Shennan et al., 2015) have applied this scale to provide a concise — although terse — abstract of patterns of IBD and apparent cultural population structure across entire samples of sites. However, as will become clearer in later case scenarios, aggregating populations to this degree can have unfortunate side effects related to the amount of information that is lost.

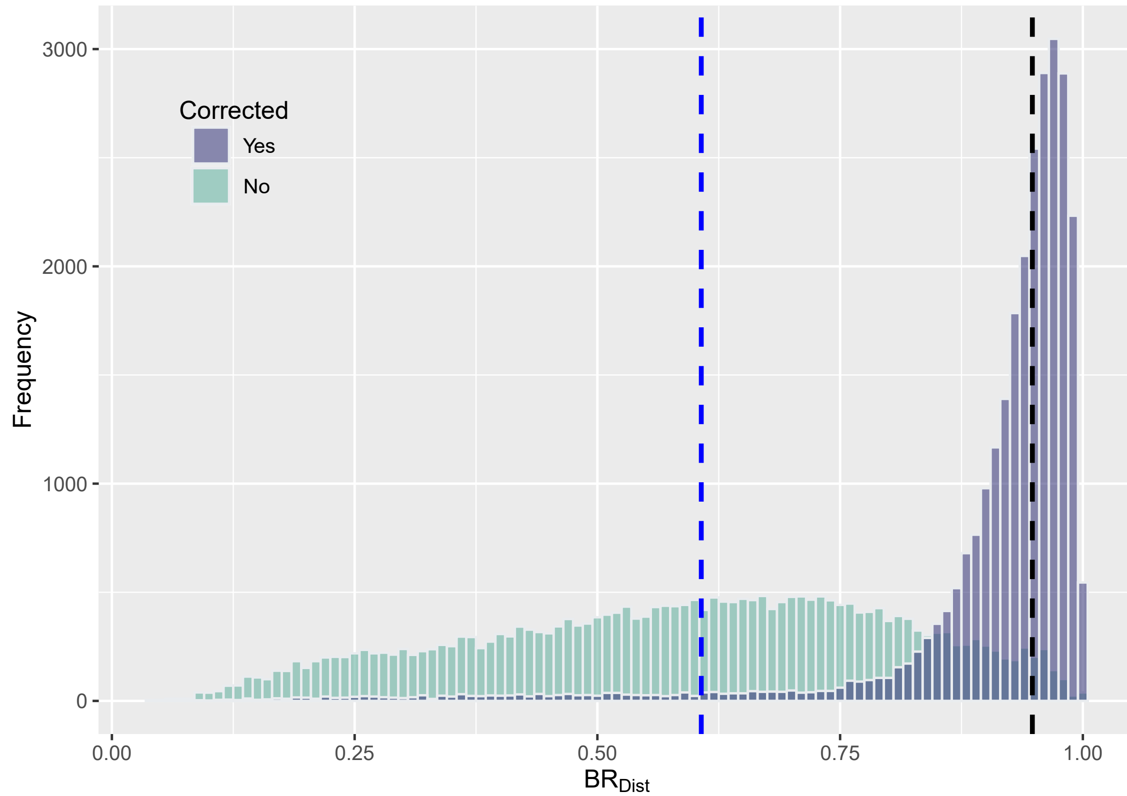


Figure 5.2: Histogram of corrected (purple) and uncorrected (cyan) BR_{Dist} coefficients across all sites. Values on the left tail represent assemblage pairs with greater similarity. Blue dashed line = uncorrected median ($BR_{Dist} = 0.607$); black dashed line = corrected median ($BR_{Dist} = 0.908$).

Overall, corrected Brainerd-Robinson (BR) distances across all sites were severely left-skewed indicating a generally low level of proportional overlap between pottery collar motif combination (PCMC) assemblages (Figure 5.2; see also Figure D.1–Figure D.4). When spatial autocorrelation in assemblage similarity among all sites was assessed, the side effects of aggregation were clearly visible in the Mantel correlogram (Figure D.5). In sharp contrast with the correlograms of the individual timeblocks in the following case scenario (Figure D.6), combining the complete collection of assemblages resulted in almost every distance class up to 700 km showing weak but significant autocorrelation — seemingly implying strong evidence of IBD due to random copying processes. However, on further inspection and in combination with the results of case studies at finer spatial and temporal scales, it became clear that much of this apparent relationship was attributable to Type-I error introduced by the spatial structure of the spatial groups themselves. When the impact of this potential clustering bias was controlled with a stratified Mantel test, the robustness of the apparent correlation evaporated (Table D.1).

At first glance, robust population structure corresponding to spatial group membership (a side effect of homophilic ties not expected to occur under random copying alone) was indicated by a significant single Analysis of Molecular Variance (AMOVA) test ($\Phi_{ST} = 0.056$ $p < 0.0001$), which showed that 5.6 percent of the variation in similarity among assemblages was constrained *between* spatial groups (Table D.4). As described above, PCMC variation under random copying would not be constrained by additional cultural structures, which in the Northern Iroquoian case could be introduced by signaling networks between communities of shared polity affiliation. However, further evaluation showed that almost 64 percent of variability in pairwise Φ_{ST} was biased by distance between polity centroids ($r_M = 0.639, p \leq 0.0001$; Table D.6). Additionally, one spatially independent assessment of the correlation between average similarity among assemblages and a binary character matrix representing their shared spatial group membership showed a nearly nonexistent relationship (Table D.7), while another of the relative separation between spatial groups (based on their average ranked BR coefficients) showed they overlapped too much to be distinct ($R_{ANOSIM} = 0.426$; Table D.8). In other words, spatial group membership alone was scarcely contributing to any of the apparent differentiation in decorative similarity between groups of assemblages at this observational scale, which was more strongly affected by the spatial structure of the groups themselves.

In summary, given the complexity of macroscale cultural transmission, it is likely that processes of both random and selective copying contributed to the spatial and material patterning of decorative variability among sites in the complete Northern Iroquoian sample, but potentially identifying them requires context that does not and cannot exist at this scale (cf. Perreault, 2019). Accordingly, summative test statistics like the single Mantel r_M or the AMOVA Φ_{ST} are not likely to accurately capture the full scope of complexity in these contexts. The second case scenario seriated the complete sample into timeblocks but left the geographical scale intact to evaluate possible general temporal trends.

5.2 Result 2: Across All Regions, Random Copying Sufficiently Explains Decorative Variability Until 1500 CE

The complete sample was separated into 100-year timeblocks (Table 2.4; see Chapter 2). Based on the most recent radiocarbon models (Birch et al., 2020), the first three timeblocks (1350–1450, 1400–1500, 1450–1550; all dates *ca.* CE) roughly reached the peak of community coalescence across Northern Iroquoia. The final two timeblocks (1500–1600, 1550–1650) approximately encompassed the formalization of Northern Iroquoian confederacies as well as the crystallization of substantial regional interaction networks between Nations most likely to correlate with spatial group scales (Birch, 2015; Birch and Hart, 2018; Williamson, 2014). On average, site-level ceramic decorative similarity significantly differed between all but the first two timeblocks (Figure D.1). As shown by Figure 5.1, H_1 was accepted for the first two timeblocks and rejected for the final three, while H_2 was accepted for all but the third timeblock — at the peak of coalescence. Thus, seriating the temporal scale revealed some nuanced additional patterning that could pertain to random and selective copying; however, it remained difficult to determine whether these patterns were shared by all regional groups at this observational scale.

The first and second timeblocks seemed to have similar spatial and structural patterns. In contrast to both the complete sample of sites and the preceding three timeblocks, decorative similarity of community pottery assemblages across Northern Iroquoia occupied during the years 1350–1450 and 1400–1500 was robustly correlated with geographic distance between them, even when site clustering was taken into account (stratified Mantel r_M = 0.442 and 0.502, both $p = 0.03$; Table D.1). Mantel correlograms of the first and second timeblocks provided further supporting evidence for IBD, showing robust positive autocorrelation among the closest distance classes (Figure D.6 b, c). In the earliest timeblock, almost all significant autocorrelation occurred between the closest pairs of sites (Table D.2). Thus, H_1 was accepted for the first and second timeblocks.

Both the first and second timeblocks were also characterized by a lack of robust cultural population structure correlating with spatial group membership. While the single Φ_{ST} was significant for both timeblocks, neither had supporting evidence that this apparent differentiation existed independently of the confounding effects of geographic distance between sites (Table D.7). Furthermore, differentiation between spatial groups in both timeblocks was significantly influenced by the geographic distance separating them, which explained more than two thirds of variation in pairwise Φ_{ST} from 1400–1500 (r_M = 0.67, $p < 0.0001$) — almost double the first timeblock (Table D.6). On average, considerable overlap in assemblage similarity between spatial groups was evidence for both timeblocks, especially during the earlier period which had a significant R_{ANOSIM} of only 0.253 ($p < 0.0001$; Table D.8). In summary, H_2 was rejected for the first two timeblocks because the lack of support for spatially independent cultural population structure and robust correlation between polity centroid distance and pairwise Φ_{ST} suggested that any apparent differentiation was most likely caused by arbitrary geospatial partitioning of communities by spatial groups, and thus that random copying processes could account for the observed ceramic decorative variability among assemblages within them (Figure D.1). However, the early prevalence of random copying was later found to have region-specific differences that likely contributed to this substantial overall significance.

The peak of Northern Iroquoian community coalescence from 1450–1550 marked the initial disappearance of robust correlation between decorative similarity and spatial distance among all sites (Table D.1), although significant autocorrelation remained among the closest distance classes (Figure D.5). For the first time, average relative similarity among assemblages significantly decreased. About 36 percent of pairwise Φ_{ST} across spatial groups continued to be explained by geographic distance between them (r_M = 0.361, $p = 0.01$; Table D.6), roughly half as much as the preceding period. The third was also the only timeblock with robust — albeit quite weak — spatially independent supporting evidence for cultural population structure because assemblages' polity affiliation significantly correlated with their relative similarity even when distance between them was accounted for (partial Mantel r_M = 0.056, $p = 0.01$; Table D.7). Furthermore, average overlap between spatial groups breached the 0.5 threshold during this period (R_{ANOSIM} = 0.558, $p \leq 0.0001$; see also Figure 5.3), indicating that relative similarity among groups of communities from different spatial groups was noticeably different for the first time.

In summary, there was not enough evidence to accept H_1 for the third timeblock, although there remained evidence that random copying among closer sites was still occurring. Supporting evidence for spatially independent cultural population structure corresponding to spatial group membership was observed for the first and only time at this observational scale during the third timeblock, leading to the rejection of H_2. These observations suggested that random copying was no longer able to sufficiently explain the observed decorative variability among all spatial groups during the third timeblock, although it may have remained a major contributing factor alongside selective copying processes potentially driven by widespread regional coalescence. However, like the periods preceding it these overall trends were probably driven by differences between Northern Iroquoia's largest regional groups.

The final two timeblocks, spanning the years 1500–1600 and 1550–1650, did not have the same amount of supporting evidence for polity affiliation-based cultural population structure, and they were inconclusive as to whether random copying alone was sufficient to explain pottery decoration at the macroscale. The lack of overall association between geographic distance and similarity among all assemblages continued during both timeblocks. Spatial autocorrelation in the fourth timeblock had a similar structure to the previous periods, possibly indicating that random copying processes were still contributing to increased similarity between the closest neighboring sites — but by the final timeblock broad stochastic gaps emerged between sites that remained significantly more similar to one another even at distances of up to 240 km (Figure D.5). These gaps may reflect the imbalance in site distribution across spatial groups during this period, in which 19 of the 36 communities of timeslice VI were grouped in the Simcoe County/Tionontaté (9) spatial group (Figure C.3).

The weak but significant correlation between community assemblage similarity and spatial group membership of the previous timeblock did not recur in either of the coalescent timeblocks, which both had weak and insignificant partial Mantel r_M statistics (Table D.1). Distance between spatial group centroids once again had a strong impact on pairwise Φ_{ST}, explaining slightly more than half of the variability in the fourth (r_M = 0.54, $p = 0.0004$) and less than half of variability in the fifth (r_M = 0.467, $p = 0.02$) timeblocks. Relative spatial group separation remained above the 0.5 threshold during both timeblocks (Table D.8). The apparently robust cultural population structure during the third timeblock did not persist through the next two periods, both of which did not present enough supporting evidence to ratify their significant single Φ_{ST} and reject H_2; meanwhile, H_1 was once again rejected during both timeblocks. These inconclusive later periods could reflect greater opposition between regional trends (described in the next section), potentially because neither region's processes dominated the ranges of the complete sample of sites.

In summary, seriating the complete site sample into sequential timeblocks revealed potential temporal trajectories in ceramic decorative patterning, but was not enough to overcome the effects of site clustering. In all but the third timeblock, apparent robust cultural population structure was not distinguishable from differentiation introduced by arbitrary partitioning of decorative variation, making it difficult to accurately identify evidence of homophilic ties. Even though there was enough evidence to imply that homophilic ties were preserved in the third timeblock, the narrower observational scales showed that they did not persist to the same extent once the geographic scale was also broken down. Clearer supporting evidence for temporal trends in the prevalence of selective copying processes was potentially found in geospatial patterns of ceramic decorative variability amidst Northern Iroquoian communities within and between spatial groups, such as the apparent evaporation of an overall connection between distance and relative similarity by the third timeblock. As strong evidence of IBD, these geospatial patterns could have been generated by random copying processes alone. However, they were also subject to the same partitioning effects. The final case scenario applied both temporal seriation and a smaller geographical scale to understand how this partitioning may have affected the potential identification of random and selective copying processes across Northern Iroquoia.

5.3 Result 3: Over the Late Woodland, Random and Selective Copying Processes Differed in the Ontario & New York Regions

The case with the finest observational scale partitioned the complete sample into regional groups while maintaining the temporal seriation from the previous example. Communities within the thirteen spatial groups were separated into five regions (following Hart et al., 2017) — three defined by their inclusion of specific sites, and two defined by their geographic position on the landscape. The first three, Jefferson County (JC; Figure C.4), Lake Erie / Niagara (EN; Figure C.5), and St. Lawrence (STL; Figure C.6), were originally defined to study the interactions between communities within them and those in other regions, especially relating to their potential involvement in frontier geopolitics between the larger New York (NY; Figure C.7) and Ontario (ON; Figure C.8) regional groups (Dermarkar et al., 2016; Hart et al., 2016, 2017, 2019). Interactions among spatial groups from the latter two regions have previously been studied with the goals of understanding the connections between pottery decoration and ethnic identity, and potentially identifying the impact or appearance of the Confederacies known to have developed there (Birch and Hart, 2018; Birch et al., 2016; Hart and Engelbrecht, 2012; Hart et al., 2016).

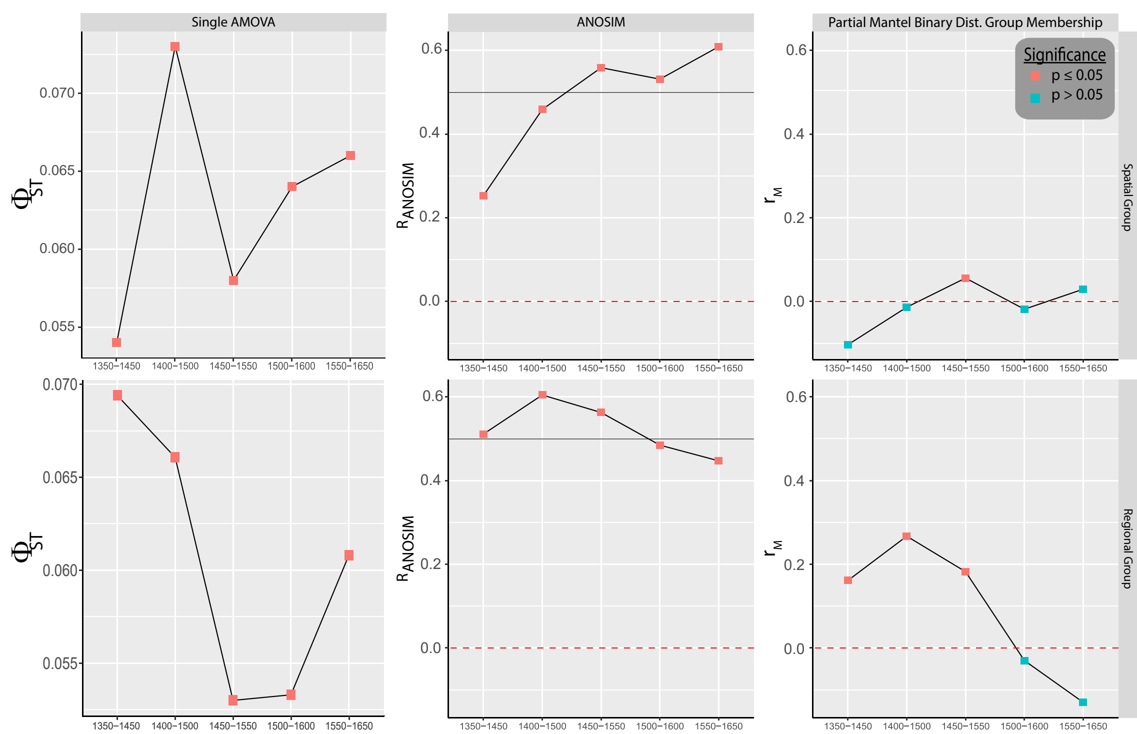


Figure 5.3: Temporal trends in group differentiation over the course of coalescence. Top row represents group differentiation test results among all spatial groups from each timeblock; bottom row represents group differentiation test results among all regional groups from each timeblock. Red squares represent significant test statistics at $p \leq 0.05$ (statistics from Table D.4, Table D.8, Table D.7).

5.3.1 Regional Groups Constrained More Ceramic Decorative Variation than Spatial Groups Until 1550 CE

While robust cultural population structure corresponding to spatial group membership was interpreted as evidence of homophilic ties among groups of communities entangled in interaction networks potentially driven by social signaling, robust cultural population structure between regional groups was interpreted as evidence of differences in landscape-scale interaction among collective groups of communities within and between the spatial groups in these regions. Although the two largest regional groups were the focus of this case study, there was an overall shift in the constraint of decorative variability over the course of Northern Iroquoian coalescence; a transition that contextualized the inverting trajectories of cultural transmission processes within the two largest regions.

Figure 5.3 contrasts the temporal trends in differentiation among spatial groups and regions; regional group membership independently correlated with relative similarity among all communities during the first three timeblocks, while spatial group membership did not share a similar relationship — only showing a weak but significant association during the timeblock at the peak of coalescence (Figure 5.3, right). After the peak, adequate supporting evidence for robust cultural population structure evaporated at both geographic scales; however, there were some indications that relative differentiation remained stronger between spatial groups for the remaining timeblocks. For example, R_{ANOSIM} tests showed that average separation between spatial groups met and exceeded that of regions after the third timeblock, remaining larger as spatial groups grew increasingly distinct until 1650 (Figure 5.3, middle). This reversal was also echoed by the average proportion of variation constrained between regional groups, which only exceeded that of spatial groups during the earliest timeblock (Figure 5.3, left).

The absence of robust supporting evidence for apparent polity-level cultural population structure during the same timeblocks wherein regional groups distinguished some degree of relative similarity among communities may reflect the greater prevalence of random copying processes broadly partitioned by landscape-scale transmission-isolating mechanisms (such as Lake Ontario). The elaboration of cross-cutting selective copying processes during the peak of coalescence may have helped counteract these barriers by establishing regional interaction networks that served to limit the restrictive effects of spatial distance on information exchange. Furthermore, extrapolating temporal trends in the smallest regions revealed that the majority of the apparent differentiation evident in Figure 5.3 was driven by variability in the two largest regions; nearly without exception, relative similarity between communities within the JC, EN, and STL regions was almost completely unaffected by geographic distance — both overall and across all distance classes (Table D.1; Table D.3 h, i, l, m, p, q, t). Moreover, the apparent significance of all these regions' average pairwise Φ_{ST} was a side effect of temporal aggregation, evaporating when individual timeblocks were considered (Table D.5). Given this sparse evidence H_1 was rejected and H_2 accepted for all these regions (Figure 5.1), indicating that random copying alone was not capable of sufficiently explaining the decorative variation observed within them.

5.3.2 Ceramic Decorative Variability in the Ontario Region Can Only Be Sufficiently Explained by Random Copying Processes Prior to the Peak of Community Coalescence, and Only After Coalescence in the New York Region

There were contrasting temporal trends in ceramic decorative variability within the two largest regional groups of Northern Iroquoia. Over the course of coalescence, a reversal in the prominence of random and selective copying processes occurred among communities in the NY and ON regions; at the start of the Late Woodland period, random copying processes sufficiently explained observed ceramic decorative variation in the latter region, while they could not adequately explain it for the former. As coalescence and broad regional geopolitical alignment progressed, selective copying processes subsequently increased in prevalence among the spatial groups of the ON region, while across the NY region less supporting evidence for robust cultural population structure and greater evidence of isolation by distance in ceramic decorative similarity indicated the increasing prominence of random copying processes among communities. This regional inversion echoed the landscape-scale transition towards spatial groups as structuring units in the decorative similarity of pottery assemblages among communities in Northern Iroquoia.

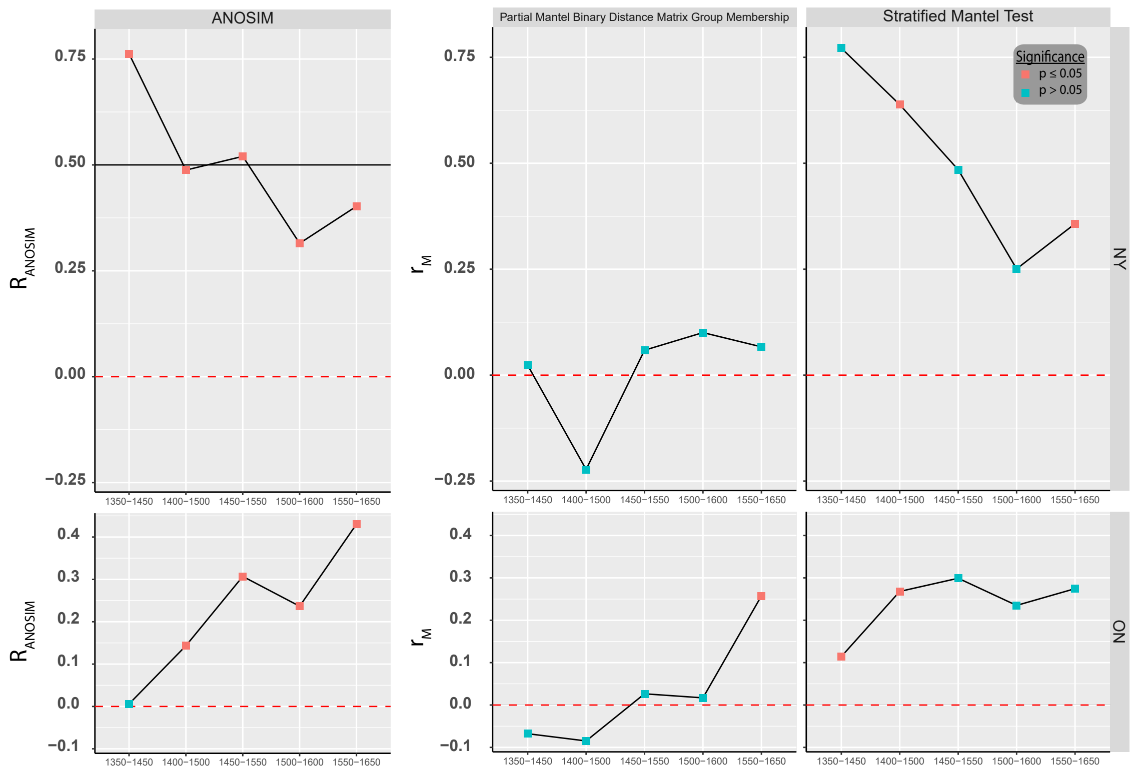


Figure 5.4: Temporal trends in the NY (top row) and ON (bottom row) regions showing changing spatial group differentiation (left, middle) and isolation by distance (right) over the course of coalescence. Red squares represent significant test statistics at $p \leq 0.05$ (statistics from Table D.8, Table D.7, Table D.1).

Geospatial Patterns of Ceramic Decorative Similarity Reflected a Regional Reversal of Copying Processes over the Course of Coalescence

There was little sufficient evidence to accept H_1 for the NY region until the final hundred years of the Late Woodland period. Although a strong connection was observed between NY assemblages' geographic separation and similarity during the second timeblock ($r_M = 0.638, p = 0.009$; Figure 5.4, right), the closest neighboring communities in this period were not any more alike than chance alone would suggest (Figure D.11). Given that the only communities in this timeblock with significantly more similar decorative assemblages were spaced at distances of 20–30 km apart (Table D.3, j), it is more likely that this robust overall correlation was driven by selective copying processes possibly operating between spatial groups. The only other timeblock where a similarly robust (albeit nearly twice as weak) overall correlation was observed was the final period, which also showed a reversal in positive autocorrelation patterns among communities; assemblages between 0–20 km showed significantly higher similarity than expected while those from 20–30 km were no more alike than random chance (Table D.3, u). Thus, based on the evaluation of H_1, random copying processes alone could only adequately explain patterns of regional decorative similarity in the NY region during the final hundred years of the Late Woodland (1550–1650).

In the larger ON region, temporal trajectories revealed early support for random copying processes that were eventually superseded by selective copying processes potentially echoing geopolitical realignments accompanying regional community coalescence. During the two earlier timeblocks, similarity of assemblages across the region was generally correlated with the spatial distance between them (Table D.1), and Mantel correlograms showed that this overall association was almost entirely driven by ties between the closest neighboring communities in the region (Figure D.12). The robustness of this general correlation disappeared among the 35 communities in the third timeblock (strat. $r_M = 0.29, p = 0.4$), echoing the temporal trajectory of the complete site sample (Section 5.2).

Contrasting with the complete sample, however, was the abject lack of significant similarity between assemblages beyond 20 km apart in ON (Table D.3, o). Despite this absence, random copying processes were still capable of sufficiently explaining the observed variation during this timeblock since no other distant ties contradicting the expectation of IBD were observed; thus, H_1 was accepted for the first three periods. Geospatial patterns observed during the two remaining timeblocks lacked the same uncontested evidence of random copying processes. A rapid reversal of geospatial similarity patterns among ON region communities occurred from 1500–1600, as the closest assemblages more alike than random chance alone were now separated by distances of 130 km (Figure D.12; Table D.3, s). As communities coalesced and relocated to the Simcoe County/Tionontaté (9) polity during the final hundred years of the Late Woodland, closer distance classes once again exhibited robust positive autocorrelation (Figure D.12), but the sudden appearance of an unbroken stretch of robust negative autocorrelation (where assemblages were significantly more *different* than expected) among communities from 70–120 km possibly reflected the amplification of group-distinguishing selective copying processes.

In the ON region, communities separated by longer distances were always located in different spatial groups — the smallest distance between average group centroids was 72 km between the Rouge (8) and Trent (12) spatial groups; thus, the sudden shift towards increased assemblage differences could have mirrored the robust cultural population structure also observed between spatial groups during this timeblock. In summary, in the ON region geospatial patterning furnished evidence that random copying processes were sufficient to explain ceramic decorative variability up until the peak of community coalescence across Northern Iroquoia, after which greater indications of the importance of distant connections began to appear across Ontario.

Apparent Cultural Population Structure within Regions Reflected Arbitrary Partitioning of Geospatial Trends in Ceramic Decorative Variation

Although some supporting evidence for robust cultural population structure was observed, during most timeblocks this support was not strong enough to rule out the potential impact of geographic clustering biases and accurately identify the potential existence of homophilic ties among spatial groups in both the largest regions. For example, insignificant Φ_{ST} were obtained among ON region spatial groups for all but the second timeblock; however, almost 60 percent of variability in pairwise Φ_{ST} was explained by geographic distance between groups in this period alone (and unrelated in all others; Table D.6). In the smaller NY region, only the final period did not have some significant proportion of overall between-group variation constrained by its three spatial groups (Table D.4), and distance between them apparently was not a substantial influence on this differentiation (Table D.6).

In the ON region's four earlier periods, and across the entire Late Woodland within the smaller NY region, partial Mantel tests revealed that the primary source of variability in apparent differentiation between spatial groups was the spatial separation of communities within them rather than their affiliation to those groups (Table D.1). The key exception was the final timeblock in the ON region, which was the sole instance when spatial group membership was independently related to assemblage similarity (Figure 5.4, middle bottom). However, as intimated above (Section 5.2) the lopsided distribution of communities towards a single polity of the four total was likely the source of this correlation, especially without further supporting evidence for robust population structure during the period. Despite some apparent growth after coalescence, spatial groups in the ON region never crossed the threshold towards clear between-group separation in mean ranked BR_{Dist} (remaining below $R_{ANOSIM} = 0.5$; Figure 5.4, left bottom). In contrast, NY region spatial groups apparently became less distinct as coalescence progressed, dropping below the threshold after the third timeblock (Figure 5.4, top left).

In summary, scaling down to look within the largest regional groups revealed that the apparent support for distinct temporal trajectories in robust population structure identified among all sites did not persist across time nor space. In both regions, clear supporting evidence for robust homophilic ties among groups of communities sharing spatial group membership was not observed in any timeblock; instead, results revealed inconsistent spatial group differentiation which could not be discerned from the possibility of arbitrary partitioning of geospatial variability. Because they could not be discerned from otherwise arbitrary patterning, H_2 was rejected for each of these timeblocks.

Shortening the geographical scale in combination with temporal seriation revealed a set of patterns that were primarily geospatially driven. As in previous cases, there was sparse supporting evidence for robust cultural population structure that could not also be generated by arbitrary partitioning of ceramic decorative variability through geographic clustering. The strongest evidence for this claim was the near-complete absence of a robust correlation between shared spatial group membership and assemblage similarity when the confounding influence of geographic distance was controlled by partial Mantel tests, sharply contrasting the results of previous applications of this approach to archaeological culture datasets (Shennan et al., 2015). The sole exception was the final timeblock within the ON region, a period in which communities across what is now Southern Ontario were actively relocating North to avoid endemic violent conflict (Birch et al., 2020).

The sparse evidence for group differentiation between the two largest regions was supplemented by clearly opposing geospatial trajectories which suggest it may subtly reflect a larger transition in the prevalence of copying processes. In Ontario, growing support for cultural population structure was complemented by diminishing evidence of uncontested IBD, while the opposite occurred in the NY region as the closest neighboring assemblages became more similar — culminating in a robust general correlation with distance by the final period.

5.4 Conclusion

Overall, hypotheses' outcomes were strongly affected by the observational scale at which they were evaluated. This scale-dependent outcome was most evident during the two case scenarios in which multiple regional groups were aggregated, such as the complete sample of sites and its seriation into timeblocks; complex geospatial trends between spatial groups were smoothed over by these cumulative scenarios, highlighting both the importance of geographical scale and the regional complexity of Northern Iroquoia. While the second hypothesis was almost always accepted across observational scales, the true scarcity of robust group differentiation revealed by temporal and regional partitioning was striking.

Cumulatively, random copying processes seemed sufficient to generate observed variability in pottery collar decoration among many Northern Iroquoian communities; however, closely evaluating smaller geographic scales highlighted the prominence and temporal trends of selective copying processes within different regional groups over the course of coalescence. This broad support for selective copying processes follows previous studies which have emphasized the cross-cutting social ties between Northern Iroquoian communities (Hart et al., 2016, 2017) — ties which would not exist under random copying alone.

Chapter 6

Discussion: Selective Copying and Northern Iroquoian Coalescence

> *For the average archaeologist, a shard [sic] is just a fragment of a bowl that "someone" threw onto a rubbish heap long ago, perhaps without a second thought. For the Amerindian it is a relic, charged with emotional significance, of a cooking pot in which a "grandmother" had often prepared the food that enabled life to be passed down to him or her. (Sioui, 1999, 216 n. 9)*

While the previous chapter made some tentative suggestions about which cultural transmission forces may have been most prominent during the trajectory of Northern Iroquoian community coalescence, without contextualization these suggestions can seem abstract and distant from the cultural reality of pottery-making practices responsible for generating ceramic decorative variability in the first place. The goal of this chapter is to transition from this state of relative mechanical abstraction toward a clearer description of how these regionally and temporally distinct random and selective copying forces — and their implications for the potential roles of stochastic cultural drift and intentional social signaling networks — may tie in with the broad geopolitical realignment of Northern Iroquoian community groups over the Late Woodland (Birch, 2019). Overall, this chapter aims to humanize the clinical depiction of macroscale social learning mechanisms depicted in the previous chapter; such an undertaking is important because, as Georges Sioui reminds us in the quote above, each of the 70,489 vessels in this collection is “charged with emotional significance” — made by the skilled labour of a potter who learned her craft over many years, likely within a complex network of entangled social institutions (Birch and Hart, 2018; Dorland and Ionico, 2020; Holland-Lulewicz et al., 2020; Holland-Lulewicz, 2021; Striker, 2018). The so-called “ceramic decorative variability” of these vessels, and its geospatial patterning, must be understood through this lens.

The first section of the chapter briefly addresses the predictions made based on previous regional studies and their fidelity with the actual results presented in the previous chapter. The outcome of these predictions further emphasize the importance of accommodating different observational scales. Moving on from predictions to interpretation, the final sections of the chapter recontextualize the temporal reversal of prominent selective copying processes between the Ontario (ON) and New York (NY) regions before and after the so-called “peak” of community coalescence, respectively. They aim to connect this inversion to changes in prominent local and regional social institutions driven by the geopolitical realignment that likely accompanied community coalescence (Birch, 2019, 2020; Holland-Lulewicz et al., 2020).

6.1 Expectations vs. Reality: Predictions vs. Outcomes

In the final paragraph of Chapter 3 above, I made five predictions for the expected results of this case study based on the outcomes of previous Northern Iroquoian macroscale studies (e.g. Birch et al., 2020; Hart and Engelbrecht, 2012; Hart et al., 2016, 2019). These studies concluded that clusters of Northern Iroquoian pottery assemblages ordinated by their relative decorative similarity bore little resemblance to other clusters grouped by their geographic propinquity-based spatial group membership. Rather than mirroring them, clusters of similar assemblages cut across space and time, ignoring polity membership and forming dense groupings that the authors argued may have reflected social signaling networks. This disjunction underlied my prediction that random copying processes would be unlikely to sufficiently explain most observed Northern Iroquoian ceramic decorative variability, regardless of the observational scale. These cross-cutting ties led me to predict that strong evidence of isolation by distance (IBD) would be inconsistent across the regions, and to expect little strong supporting evidence for robust population structure. Finally, I suggested that if robust evidence of IBD were observed, it would likely predate coalescence, while the opposite would likely be true for cultural population structure; however, I expected that these temporal trends would be consistent across the regions of Northern Iroquoia if they were found.

As Figure 5.1 reveals, most of my predictions were met by the results of the analyses. As expected, H_1 was rejected in more cases than it was accepted (especially at coarser observational scales), suggesting that random copying was typically incapable of independently generating observed ceramic decorative variability. In sharp contrast, H_2 was accepted in all but one case. Sufficient supporting evidence for "true" cultural population structure corresponding to spatial group membership was almost entirely absent with a single exception: the complete sample of sites from the third timeblock, spanning the peak of community coalescence from *ca.* 1450–1550 CE. Evidence for a possible inversion of regional copying processes contradicting the expectations of this general prediction was revealed when the observational scale was at its narrowest.

Supporting evidence for IBD matched my general prediction by being inconsistent over most of the study area, especially for observational scales that ignored temporal separation. However, region-specific temporal trends in strong evidence of IBD revealed by seriating the latter did not completely meet my expectations. For example, geospatial patterning in ceramic decorative variability consistent with IBD was prominently observed among ON region communities before the peak of community coalescence as predicted, but the opposite was true among communities in the NY region. The ensuing reversal of these geospatial trends during the final centuries of the Late Woodland contradicted my prediction and demonstrated the existence of distinct region-specific cultural transmission processes.

In other words, some of my predictions and their basis in previous studies' results were only partially accurate because they did not account for the unique geospatial patterns revealed within and between regions by the combination of multiple observational scales, both temporal and geospatial. At coarser grained scales, aggregation of communities with mutually exclusive occupation date ranges obscured connections among them that were revealed when these scales were partitioned and re-assessed.

6.2 Pre-Coalescence and Random Copying Processes in Northern Iroquoia: A Tale of Two Regions

As discussed in Chapter 2, the most recent radiocarbon models allow us to estimate that the widespread geopolitical realignment of Northern Iroquoian social institutions echoing the advent of primary coalescence likely began among communities located south of Lake Ontario in the NY region around the turn of the sixteenth century (Birch et al., 2020), before spreading Northward into the ON region in the following decades as village communities relocated and aggregated in defense of increasing conflict (Birch, 2019, 2020; Holland-Lulewicz et al., 2020). The revised radiocarbon chronologies made available by these models suggested that processes of community coalescence occurred asynchronously across Northern Iroquoia — even among communities within the same drainage basins (Birch et al., 2020, 21–22). Previous studies, including the regional signaling network analyses inspiring this case study, were conducted under the assumption that these signs of geopolitical realignment — including increasing settlement size and defensibility measures, increasingly structured organization of domestic space, and 'long' longhouses thought to indicate exogamous clan membership (Birch, 2015, 2019, 2020; Birch and Williamson, 2018; Creese, 2016; Williamson, 2014) — exploded almost unanimously across Northern Iroquoia by the mid-fifteenth century.

After programmatic redating, however, villages bearing the familiar indicators of community coalescence were found to be contemporary with others lacking some or all of them (Birch et al., 2020). Consistent evidence of geopolitical realignment roughly coincides with what I refer to as the "peak" of Northern Iroquoian community coalescence, around the earlier decades of the sixteenth century (the end of the third timeblock). These recent radiocarbon models improve our ability to accurately compare macroscale cultural transmission forces prevalent on either side of this "peak," potentially informing our understanding of the relevant social learning processes accompanying geopolitical realignment among Northern Iroquoian communities.

6.2.1 Pre-Coalescent Northern Iroquoian Social Institutions and Cultural Transmission Processes

Prior to the peak of community coalescence, most Northern Iroquoian social institutions probably remained internal to communities as instrumental components of a "locally based social network" (Birch and Williamson, 2018, 93). Although we are limited to speculation about how these social institutions may have operated at this scale due to the reconstructive capacity of the archaeological record (Birch, 2008; Perreault, 2019), inferences from organization of domestic architecture led some authors to suggest that extended family groups were the primary social unit in these communities (Birch, 2020; Birch and Williamson, 2018; Holland-Lulewicz et al., 2020; Williamson, 2014). Exogamous matrilineages may have already existed (Trigger, 1978), but before widespread coalescence they may not have been universally established across all regions (Birch, 2020; Holland-Lulewicz et al., 2020). Communities had substantially smaller population sizes overall (Creese, 2016; Warrick, 2008), making consensus decision-making practical and achievable without requiring unifying social institutions (Holland-Lulewicz et al., 2020). Finally, while maize agriculture certainly existed to some degree for most communities, it was not yet a staple of the economy important enough to drive community location decisions (Beales, 2014; Hart and Lovis, 2013; Jones, 2016; Pfeiffer et al., 2016). The localized social institutions may have had important implications for the kinds of *macroscale* social learning processes that they accompanied. Generally, interaction between communities probably occurred coincidentally through chance hunting encounters or raiding parties, rather than through crystallized external social institutions like clans and later Nations (Birch, 2015, 2020).

Since localized interaction networks likely characterized the social landscape of most Northern Iroquoian communities prior to widespread geopolitical realignment in the sixteenth century, it follows that the most prevalent macroscale cultural transmission forces among these communities were those that represent the cumulative outcome of many individuals' (here communities') decisions. As discussed above (Table 3.1), these include cultural mutation, drift, and inertia — all forms of random forces. Under the copying spectrum framework, cultural trait variation from a group of communities making decorative decisions independently of one another, each acting on information obtained within its own locally based social network, collectively resembles variation produced by stochastic change — in other words, by random copying.

The geospatially aggregated results presented in Section 5.2 and Section 5.3.1 contained some general supporting evidence for the existence of localized social learning processes consistent with the expectations of these random forces. For example, results for the complete sample of sites suggested that random copying processes were sufficient for generating the range of cumulative variability observed during the first two timeblocks (Figure 5.1). The IBD identified among these communities has previously been established as an expected outcome of uncontested random copying processes. Although it overlooks region-specific nuances, this broad temporal trend supports the idea that selective copying processes possibly associated with external social institutions connecting multiple communities were more common in the centuries following the onset of broad geopolitical realignment after primary coalescence than those preceding it.

The first part of Section 5.3 elaborated on this general temporal trend to consider the strength of constraint on decorative variability that regional group membership exhibited compared to that of spatial group membership. As shown in Figure 5.3, decorative variation among all sites was more strongly constrained by their regional position than by their spatial group, which only began to notably affect variation by the third timeblock (after which regional position ceased to affect decorative variation). It is significant that the timeblocks during which random copying processes showed the least evidence of being contested by additional selective copying processes were concurrent with the periods when regional group membership was more constrictive on decorative variability than polity affiliation. Substantial differentiation between regions without accompanying robust differentiation between smaller-scale spatial groups within them could be caused by clinal differences in decorative variability resulting from the geographic separation of localized random copying into broad regional groups (an archaeological example of the “clines vs. clusters” debate in population genetics; Aguillon et al., 2017; Battey et al., 2020; Handley et al., 2007; Perez et al., 2018; Scerri et al., 2018). The integrative external cultural transmission processes underlying selective copying processes were not substantial enough to displace the impact of local social networks, emphasizing the importance of random copying processes linked to these networks in the centuries prior to widespread coalescence.

In summary, geospatial patterning of ceramic decorative variation among all Northern Iroquoian community assemblages supported the increased importance of random copying processes up to and until the onset of community coalescence in the early sixteenth century. However, these broad temporal trends were found to incompletely reflect regional changes and thus are only a coarse summary of pre-coalescent copying processes across Northern Iroquoia. Narrowing the geospatial observational scale revealed that this broad temporal trend was driven by region-specific macroscale cultural transmission forces.

6.2.2 Region-Specific Copying Processes: Ontario vs. New York

Although evidence supporting the prevalence of random copying processes among all Northern Iroquoian communities prior to the peak of coalescence seemed to exist, region-specific analyses revealed that these overall trends were driven by distinct differences within the Ontario (ON) and New York (NY) regions, the two largest regional groups in Northern Iroquoia. Prior to coalescence, information exchange among communities within these two regions was characterized by different kinds of macroscale cultural transmission forces. Geospatial evidence suggested that random copying processes were sufficient to explain the decorative variability of ON communities; in contrast, additional selective copying processes were implicated for NY communities from the same periods. Given that communities from these regions probably shared similar social institutions centered on kinship and extended family groups prior to broad geopolitical realignment (Sioui, 1999), a potential contributing factor to these differences could be their distinct settlement patterns and how they may have shaped available cultural transmission forces.

Prior to the rapid increase in evidence of violent conflict accompanying population growth and spurring geopolitical realignment across the region around the turn of the sixteenth century, village communities in the ON region were small and widely spread across the landscape on the North Shore of Lake Ontario (Birch, 2015). These small pre-coalescent communities frequently relocated as they used local resources, often within the same river drainage basins (Birch and Williamson, 2015; Birch and Lesage, 2020). Although they often shared these watersheds with other villages, early ON region communities remained relatively dispersed across the landscape.

The earliest NY communities also developed within river drainage basins (Allen, 2000; Engelbrecht, 2003, 113), as well as relocating when their local resources were depleted (Snow, 1994). However, rather than relocating in a cardinal direction to new territory each time, NY region communities retained their general positions within broad settlement clusters (Engelbrecht, 2003; Snow, 1994; Williamson and Robertson, 1994; Wonderley and Sempowski, 2019). These clusters grew and evolved as primary coalescence swept the region, and they eventually formed an important component of ancestral Haudenosaunee identity and iconography (Wonderley and Sempowski 2019, 184–207; Wonderley 2009). Given these differing settlement patterns, it is salient that random copying processes denoted by geospatial patterns were uncontested in the ON region alone during the timeblocks predating the peak of coalescence. Indeed, these communities showed the strongest supporting evidence for random copying processes of the entire sample of sites. In this large and dispersed region, spatial groups were nearly indistinguishable and virtually the only examples of significant decorative similarity were found among communities that were less than 10 km away from each other.

Although no strong support for homophilic ties was obtained for NY communities in the same periods, the range of decorative variability among them could not be generated by random copying alone. It is possible that these additional forces reflect connections between early versions of the later post-coalescent settlement clusters in the region that reached their floruit by the end of the Late Woodland. The smaller distances separating these groups may have ensured that they were consistently more likely to interact, thereby promoting an earlier development of additional selective copying processes. Furthermore, recent mtDNA studies have shown that these populations have great antiquity in the region (Raff et al., 2011; Pfeiffer et al., 2014, 2016, 2020), further ratifying a notion long held by oral tradition (Sioui, 1999, 14) and linguistics (Schillaci et al., 2017). In other words, the antiquity of these settlement clusters may have further fostered external ties among their communities that were absent to the same degree among the more mobile village communities to the North.

In summary, supporting evidence for random copying processes across Northern Iroquoia before the peak of coalescence probably reflects a prevalence of these processes among ON region communities. Among these early pre-coalescent ON villages, localized interaction was probably limited to encounters with members of other communities, and it is unlikely that the kinds of external social institutions known to foster additional community connections were yet established. Thus, potters in these communities probably operated within their own internal family groups, learning and sharing decorative information from one another with limited external cultural transmission biases. While some of the same localized random copying processes were surely at work among early communities in the NY region, additional selective copying processes among them were influential enough to suggest that these communities likely developed within broader social networks that may have been the foundation of later Nations. However, these groups did not match the same scale as the spatial groups defined to represent them, and thus no strong evidence of homophilic ties was observed. At the peak of coalescence around the turn of the sixteenth century, geopolitical realignments occurring within both regions seemingly resulted in changes to their most prevalent macroscale cultural transmission forces. Those changes are discussed in the final section of this chapter.

6.3 Northern Iroquoian Coalescence: Geopolitical Realignment and the Trajectory of Selective Copying Processes among Ontario and New York Communities

As noted in Chapter 2, Jennifer Birch has argued that the widespread geopolitical realignment of Northern Iroquoian social institutions around the turn of the sixteenth century was driven by two connected demographic forces: rapidly rising population sizes, and a substantial increase in violent conflict between communities (Birch, 2010a, 2012, 2015, 2019, 2020). Although it is difficult to predict how these linked forces interacted with individual communities in the past, together they likely would have motivated the introduction or elaboration of external social institutions that eventually played a key role in intercommunity interaction after primary coalescence was mostly established (Birch, 2020).

A constellation of interconnected demographic forces were responsible for rising population sizes, which likely began to grow across Northern Iroquoia before primary coalescence was fully established within its regions (Birch, 2015, 2012; Warrick, 2008). Among the most influential of these forces may have been the role of maize in local and regional interaction (Beales, 2014; Pfeiffer et al., 2016). The resilience and stability offered by maize increased the carrying capacity of Northern Iroquoian communities like Jean-Baptiste Lainé and other coalescent communities like it (Birch and Williamson, 2013), indirectly leading to the development of additional integrative social institutions to manage domestic decision-making (Creese, 2013; Hart and Lovis, 2013) as larger communities relocated more frequently (Birch and Lesage, 2020; Birch and Williamson, 2015). As respected family matriarchs (Sioui, 1999; Trigger, 1978), women had pre-empted responsibility for the domestic sphere of village social life, and they quickly became entangled in the interaction of these new social institutions (Birch, 2016, 2019, 2020; Birch and Williamson, 2018).

New radiocarbon models suggest that evidence of endemic violence between Northern Iroquoian communities exploded in the early sixteenth century, although scattered communities were embroiled for centuries beforehand (Birch et al., 2020). These models suggest that widespread coalescence did not lead to endemic violence — it was a response to it, especially among ON communities (Birch et al., 2020; Birch and Lesage, 2020; Holland-Lulewicz et al., 2020; Holland-Lulewicz, 2021; Manning and Hart, 2019). In other words, navigating and representing military alliances — likely across multiple nested social institutions and among many sets of communities (Birch, 2016, 2020) — was yet another element of social life with which women were deeply entangled.

Despite their evolving roles within interlapping social institutions after coalescence, women seemed to remain the sole manufacturers of pottery until well after European colonists first observed them crafting it. Since pottery making is a skill that requires extensive guided social learning and teaching to master (i.e. pedagogy, Table 3.1; Roux 2019; Shennan and Steele 1999; Tehrani and Riede 2008), these new institutions may have inevitably introduced opportunities for cultural transmission biases reflecting the newly established importance of regional geopolitical connections to direct macroscale copying processes. If these geopolitical connections were similarly emphasized (i.e. signaled) by multiple affiliated communities of potters, then their collective ceramic decorative variation should match the expectations of selective copying. The establishment and evolution of these new social institutions would have inevitably altered the range of macroscale cultural transmission forces at work within and between communities. While these subtle changes likely affected all community members in different ways, their impact on the cultural transmission forces active among experienced Northern Iroquoian potters has the strongest implications for ceramic decorative diversity. The regional differences in prominent copying processes observed during the timeblocks following the peak of community coalescence could reflect these collectively motivated decorative decisions at a larger scale.

6.3.1 Post-Coalescent Northern Iroquoian Social Institutions and Cultural Transmission Processes

In the preceding chapter, Sections 5.2 and 5.3.1 presented supporting evidence for copying processes observed within the complete sample of sites and identified a temporal trend among them that seemed to meet the expectations of the theorized trajectory of community coalescence. During earlier periods, these expectations anticipated a predominance of random copying processes; in later timeblocks, after the geopolitical realignment of community social institutions was established, these expectations shifted to predict increased support for selective copying processes as external connections between communities became an important candidate for symbolic representation via ceramic decoration. However, aggregated evidence from the later timeblocks showed that these expectations were only partially met.

For example, temporal trends among all sites in Section 5.2 seemed to support especially increased importance of spatial groups as structuring units during the third timeblock

(1450–1550 CE), which contained several communities occupied during the "peak" of coalescence. Notably, this sample of Northern Iroquoian communities also presented the only direct supporting evidence for robust population structure (community polity affiliation significantly correlated with relative similarity independently of spatial distance; Table D.7), identified above as a key identifier of selective copying processes driven by social signaling networks reflecting spatial group divisions (see Figure 3.1, bottom left). Ultimately, however, narrower observational scales revealed that this line of evidence was likely a reflection of certain region-specific differentiation rather than a "true" cultural population structure directly reflecting spatial group definitions.

The temporal inversion in importance of regions versus spatial groups for constraining decorative variation across all sites described in Section 5.3.1 contextualizes this complete-sample trend. As shown by Figure 5.3, the third timeblock corresponding to the peak of regional coalescence was both the final instance where regional groups remained distinct and the first instance where spatial groups surpassed the same distinctiveness threshold. However, community differentiation by region was still slightly more strongly supported than differentiation by polity — random copying processes were no longer adequate for generating the range of ceramic decorative variation that was observed, but selective copying processes were probably not uncontested nor universal until some time after the peak at the turn of the sixteenth century.

Selective copying processes overshadowed any localized random copying between communities in the final two timeblocks. These periods spanned some of the most active years of geopolitical realignment across Northern Iroquoia (1500–1650 CE; Birch 2019), centuries that saw the crystallization of clans, phratries, Nations, and Confederacies and the delicate geopolitical balance between them described by European visitors of both the Huron-Wendat and Haudenosaunee (Birch, 2015; Engelbrecht, 2003; Fox, 2015; Trigger, 1976, 1986; Tooker, 1964). The tremendous variability of these nested social institutions potentially explains why these evident selective copying processes do not demonstrate convincing evidence for homophilic ties matching the structure of spatial group membership in any of these post-coalescent contexts. As explained by Figure 3.1, this support for selective copying is perhaps more accurately understood as incompatibility of random copying;

in other words, many different cultural transmission forces are supported by the decorative variation observed among these samples, but uncontested random copying is unlikely to be one of them.

Inasmuch as the inherent numerosity of these selective copying processes reflects the complexity of the social institutions brought to bear by Northern Iroquoian geopolitical realignment, it also stands as an indication of the exceptionally interconnected role of women as members of these institutions. However, as above these geographically aggregated trends appeared to be driven by region-specific cultural transmission forces rather than reflecting spatially homogenous copying processes.

6.3.2 Region-Specific Selective Copying Processes: Ontario vs. New York

Current understandings of post-coalescent settlement history in the two largest Northern Iroquoian regions provide useful context to interpret the different copying strategies supported among their spatial groups in the final two timeblocks (i.e. Birch and Williamson, 2013; Engelbrecht, 2003; Warrick and Lesage, 2016; Williamson, 2014, 2016; Wonderley and Sempowski, 2019). In particular, the ON region underwent some of the most substantial geopolitical realignment (Birch, 2015, 2019; Hart and Birch, 2021; Birch and Lesage, 2020), including displacement of entire spatial groups (e.g. Jefferson County [4], St. Lawrence [10,11]; Abel 2019; Gates St. Pierre 2016; Warrick and Lesage 2016) and wholesale relocation of others (e.g. Credit, Humber, Don Rivers [1], Trent River [13]; Birch and Williamson 2015; Ramsden 1990; Pfeiffer et al. 2020). These final 150 years also witnessed the establishment and crystallization of the Huron-Wendat confederacy and the Nations that comprised its members (Birch, 2015, 2020; Williamson, 2014). At the same time, connections within the settlement clusters of the NY region crystallized amidst endemic external conflict and eventually led to the formation of the Haudenosaunee Confederacy (Engelbrecht, 2003; Wonderley and Sempowski, 2019). These post-coalescent NY communities' involvement in this external conflict may have been one of the prevailing forces leading to widespread relocation and removal-from-place in other regions of

Northern Iroquoia (Abel, 2019; Birch et al., 2020; Birch and Lesage, 2020).

The region-specific cultural transmission forces identified among post-coalescent ON and NY communities seem to roughly reflect the broader expectations set by these settlement histories. For example, Section 5.3.2 suggested that random copying processes alone were not capable of generating the range of decorative variation observed among post-coalescent ON communities, while the opposite was noted for NY communities from the same periods.

Random copying became incompatible with the range of ceramic decorative variation observed among ON region communities by the peak of coalescence, and strong support for selective copying spiked by the final timeblock (Figure 5.4). Given the extensive geospatial consolidation of ON region communities during these final periods, it seems likely that the ultimate source of these additional selective copying forces may have been newly established external social institutions integrating these communities, as suggested by Birch and Hart (2018). It is not inconsequential that the seventeenth century expansion of the Simcoe County/Tionontaté polity (e.g. see Timeslice VI in Table 2.3) correlates with ethnohistoric evidence for the foundation of historic Wendake (e.g Peace and Labelle, 2016), which likely became a central hub for these entangled social institutions among postcoalescent ON region communities (Sioui, 1999; Trigger, 1976). Despite this prominence, homophilic ties matching the scale of spatial groups were not found among post-coalescent ON communities. As in the complete sample, support for selective copying is more accurately described as incompatibility of random copying alone; rather than explicit social signaling of spatial group membership as a shared external social institution, it reflects the collective decisions of many communities of potters and that they were likely informed by much more than probability of interaction alone.

In contrast, random copying processes were found to sufficiently explain decorative variability among NY communities in the last remaining timeblocks, although they were not as clearly uncontested as those among pre-coalescent ON communities. Just as the incompatibility of random copying was not unilaterally equivalent for social signaling networks among post-coalescent ON communities, the capacity of random copying to generate the range of decorative variability among post-coalescent NY communities does not imply that these communities suddenly lacked a clear settlement structure. As mentioned above, endemic external violence spiked during coalescence in the NY region, and probably remained a constant in the following decades as resources grew more important (Birch, 2010a; Birch et al., 2020). Furthermore, as these communities established and crystallized their settlement clusters, they may have shifted their interaction networks to reflect them (e.g. Engelbrecht, 1985; Williamson and Robertson, 1994). Figure 5.4 (top left, right) shows that relative group differentiation among NY region spatial groups in the final time-block spikes along with evidence of isolation by distance, after support for both declined for almost the entire Late Woodland period. Since the closest neighboring communities in the NY region are always found in the same settlement cluster (Figure C.7), these spikes may reflect renewed emphasis on localized interaction within the same clusters of communities — groups which do not seem to match the structure of the spatial groups defined for the region. Potters in these communities may have shifted their decorative emphasis in response to evolving macroscale cultural transmission biases reflecting localized social networks — the same networks that were emphasized among pre-coalescent ON region groups.

6.4 Conclusion

The database of community assemblages that forms the basis of this case study represents an unprecedented opportunity to study how cultural transmission forces can evolve alongside nested social institutions. Thanks to the extensive academic and commercial research of archaeologists on both sides of the border and the ethnohistoric accounts recorded centuries ago by European chroniclers, a paradoxically rich yet sparse array of cultural context is available to varying degrees to furnish possible explaNations for how these communities may have operated in the past.

In the discussion above, comparative observations made on the trends, patterns, and structure of decorative variability on the collars of more than 70,000 vessels from 234 assemblages and six timeslices were integrated with this cultural context to coherently frame them using the paradigms and frameworks of cultural transmission theory, the random-selective copying spectrum, and population thinking. By comparing several geographic and temporal scales, this case study revealed a temporal trend in the kinds of copying processes that were supported in each region, and how these copying processes connected to recent reconstructions of the trajectories of community coalescence among them.

As in previous studies, spatial groups were found to be almost unilaterally inconsequential as structuring factors for ceramic decorative variation, both collectively and within individual regions. They were found to be little more than groupings of geographic convenience that introduce more problems than they solve (as argued by many recent studies; Hart, 2020; Hart and Birch, 2021; Holland-Lulewicz et al., 2020; Holland-Lulewicz, 2021; Feinman and Neitzel, 2020). Contexts where random copying processes were adequate for generating decorative variability were found to occur when localized interaction was promoted, especially when it might have been a key element of the collective identity of a community. In Ontario, this was among pre-coalescent communities prior to the relocations and geopolitical realignment onsetting after peak coalescence in the sixteenth century. In New York, it seemed to be driven by renewed interest in localized interaction networks after the post-coalescent crystallization of settlement clusters. However, a consistency among all regions was that, when selective copying was supported, it was inevitably beset by rampant equifinality — an unfortunate downside of cultural transmission theory in general (Barrett, 2019; Kandler and Shennan, 2015). The problems introduced by this equifinality are one focus of the final chapter below.

Chapter 7

Conclusions and Suggestions

At the start of Chapter 1 I argued that one of cultural transmission theory's most valuable assets is its ability to reframe and systematically reassess older archaeological arguments in a way that is both deliberately mechanistic and stringently focused on the importance of population thinking and the empirical limitations it imposes on the conclusions of these arguments. In the case study above, my goal was to apply that argument to a case study of Northern Iroquoian regional geopolitical realignment during the Late Woodland period to demonstrate the value that such an approach can have, in a study area that has not seen many previous attempts at explicitly reconstructing macroscale cultural transmission forces (but, perhaps ironically, was the focus for one of the most influential macroscalar cultural transmission studies ever published; Neiman, 1995).

In this following and final chapter, I evaluate the extent to which this case study achieved that goal by considering some of the limitations of both the available dataset and the approaches I used to evaluate it, as well as the severity of information loss garnered by the somewhat brutally macroscalar approach mandated by proper population thinking. In the last part of the chapter, I wrap up these criticisms along with the broad conclusions of the case study as a whole to approach an answer to the primary research questions defined at its beginning. Finally, I synthesize the results, critiques, and answers to make some suggestions for future archaeologists interested in applying the methods and theoretical frameworks I designed for this case study, particularly in other Northern Iroquoian contexts.

7.1 From Theory to Data to Historical Process: Is the Random–Selective Copying Spectrum a Useful Theoretical Framework for Northern Iroquoia?

7.1.1 Theory: What is "Copying" Really?

As with many theoretical frameworks, almost immediately after cultural transmission theory (and its murky subfield of "neutral" theory; Kandler and Crema 2019) was coherently established, it garnered immediate and powerful criticism, particularly from human behavioural ecologists who were not used to allowing extra room for unknowns or human error in their generative models (Colleran and Mace, 2011; O'Brien et al., 1998; Schiffer, 2011). As remarked by Bentley et al. (2011), many early critics hastily connected its metaphorical application of "evolution" as a process of descent with modification of cultural information (i.e. Shennan, 2011) to long-debunked theories of social Darwinism akin to those of Herbert Spencer's 'survival of the fittest.' However, in Section 3.1 above I argued that a key turning point away from these idealized views happened when Mesoudi et al. (2006) first published their paper entitled "Towards a Unified Science of Cultural Evolution." In short, this watershed paper was among those on the edge of a Kuhnian paradigm shift (1962) that legitimized cultural evolution theory and, by extension, cultural transmission (Shennan, 2008; Prentiss, 2021).

Since then, many comprehensive studies have depended on the ideas and mechanisms underlying cultural transmission, often utilizing data collected several decades beforehand (e.g. Conolly, 2018; Jordan, 2015; Lycett, 2019, 2020; Roux, 2019; Tostevin, 2012). However, a key point of disagreement between cadres of "evolutionary" and "interpretive" archaeologists (Gardner and Cochrane, 2011) remains especially relevant in this case study: cultural transmission theory, by the nature of its approach, can appear dehumanizing in its staunch adherence to population thinking, and has been criticized for its deliberate omittance of specific intentionality and individual decision-making (Schiffer, 2011) — in other words, the core of human agency thinking in modern archaeological theory (Cowgill, 2000; Hodder, 2000; Smith, 2013). However, the theoretical framework that I used during this case study — the random–selective copying spectrum — is built on the foundation of complexity of individual decisions: “random copying” is the default state of any undirected social learning system. In other words, what I refer to above as “random copying” is perhaps more accurately understood as an absence of structured decisions rather than a system structured by absence of decision-making.

Macroscale cultural transmission forces (Table 3.1) are described as “random” if they are not driven by collective cultural transmission biases, which arise in response to contingent changes in the norms and precedents of a community — or the collective preferences of an affiliated group of communities. To echo a point made strongly by Perreault (2019), the material consequences of social learning (in our case, the decorative motifs each and every potter decides to apply to their vessels, and the incredibly complex psychological and sociocultural library of meanings from which they could be drawing; Bentley et al. 2011; Mesoudi 2011) are made much noisier by the particularities of taphonomy, sampling bias, loss, and recovery in the archaeological record we are handcuffed to. In short, as I argued above, the goals and intentions of the individual are opaque to the population. The value of the copying spectrum is its capacity to glean some valuable information from the record *despite* the effects of this opacity. However, this information is not without its caveats, and among the most consequential of them is the role of equifinality and the damper it sets on our empirical conclusiveness.

In many ways, the treatment of equifinality in cultural transmission has undergone its own paradigm shift (Barrett, 2019; Madsen, 2020; Perreault, 2019; Porčić, 2015), similar to how the discovery of radiocarbon date calibration restructured many established theories based on ideas preceding it. Recent studies have shown that the complexity of human social learning and the archaeological record make it unlikely to be able to coherently identify individual cultural transmission forces from material culture data (Crema et al., 2014, 2016; Kandler and Crema, 2019; Kandler and Shennan, 2013, 2015; Madsen, 2020). Fortunately, the copying spectrum framework I used was designed with the effects of equifinality in mind; rather than attempting to identify a particular transmission force, I simply took random copying as a null hypothesis — the absence of structured collective decisions, as reflected by decorative similarity between communities. However, I also accepted that my capability to differentiate between selective copying forces was limited by this concession. Although I described one possible selective copying outcome following the assertions of previous regional studies in the area, I ultimately accepted that numerous defined cultural transmission processes could be responsible for generating decorative variability outside the compatibility range of random copying expectations (described in Table 3.1), and also that it was likely for several of these forces to be operating simultaneously and potentially among different groups of communities. Nevertheless, despite the course that these equifinality-conscious hypotheses moved me to take, they ultimately produced meaningful answers to the primary research questions of this case study.

The distribution of results at various observational scales presented in Figure 5.1 clearly shows how the influence of equifinality limited the scope of my conclusions, but not enough that they were unimportant in the light of previous studies and the recent model of sixteenth century Northern Iroquoian geopolitical realignment (e.g. Birch et al., 2020). The axes of Figure 3.1 metaphorically represented the overall support for both primary hypotheses across different partitioned and unpartitioned geographic/temporal scales. In the chart, results distributed along the y axis (representing the outcome of the first hypothesis) were roughly divided by a temporal gradient that may have reflected the trajectory of regional community coalescence; in stark contrast, however, was their distribution about the x axis — showing a nearly unanimous acceptance of the second hypothesis. As I discussed above, the former example was heavily affected by equifinality since many cultural transmission forces can ultimately result in geospatial ceramic decorative variation unpredicted by isolation-by-distance, more accurately reflecting an incompatibility of random copying processes than distinct selective copying processes such as decorative social signaling. However, the outcome of the latter hypothesis has some unambiguous implications for macroscalar Northern Iroquoian cultural transmission forces that also support the conclusions of recent studies in the region (Hart, 2020; Hart and Birch, 2021).

As I explained above, robust cultural population structure corresponding to spatial group membership is one of the clearest signs that these collective groups reflected actual social networks and the homophilic community connections they would have engendered. In staunch contrast to previous archaeological applications of this approach (Shennan et al., 2015), spatial groups were almost completely irrelevant constraining factors for decorative variation, especially at larger geospatial observational scales. As suggested by other regional Northern Iroquoian studies on the same settlement database (Birch and Hart, 2018; Hart and Engelbrecht, 2012; Hart et al., 2016), this inconclusive support shows that spatial groups are little more than convenience groups, defined following outdated culture-historical approaches relying on geographic propinquity to establish shared identity (Hart and Brumbach, 2003; Hart, 2011, 2020). Furthermore, given that the other primary hypothesis supported the existence of selective copying processes, and that the latter portions of the Late Woodland saw unprecedented social change both internally and across the landscape (Birch, 2019; Creese, 2016; Sioui, 1999; Williamson, 2014), it is not unsurprising that selective copying likely had a prominent role in macroscale cultural transmission processes.

Despite equifinality and the noisy archaeological record dampening the specifics, it is clear that homophilic ties between communities were not strong at the scales these geographically-defined spatial groups consider. However, this does not imply that these ties did not exist, for oral tradition tells us that intercommunity diplomacy played an incredibly important role in the formation of the Huron-Wendat and Haudenosaunee Nations and their geopolitical interactions (Birch, 2020; Sioui, 1999; Fenton, 1998; Trigger, 1976; Gidigaa Migizi [Williams], 2018). Rather it suggests, as recent studies have, that homophilic ties between communities are not simply drawn on maps; they are entangled with the contingent settlement histories of village communities with overlapping social institutions that probably organized and reorganized themselves for generations after “coalescence” brought them together (Birch, 2012, 2020; Birch and Lesage, 2020; Birch and Williamson, 2013, 2015; Finlayson, 2020). Discovering and untangling these ties will require considerably more concern for the effects of spurious aggregation of incongruent groups, examples of which this case study has also documented.

7.1.2 Data: Are Pottery Collars Enough?

If we accept the value of the copying spectrum, we are still limited to the formal and pragmatic limitations of the material culture collections themselves, and these limitations are another source of critique for the results of this case study. Recent studies focusing on both past and present populations have shown that the connotations and/or decorative variability of various elements of ceramic production are often inconsistent (Bowser 2000, 2002; Braun 2012, 2015; David and Kramer 2001, 168–224, Dietler and Herbich 1998; Roe 1995; Roux 2019, 259–279; Striker 2018). For example, Sarah Striker (2018) studied a collection of fully excavated Northern Iroquoian communities from the Rouge, Duffins, and Durham Rivers spatial group (8) and found that different attributes of their pottery and pipe assemblages varied inconsistently over the course of community coalescence in the region. She found that trajectories of relative change among "decorative" attributes like collar motifs and pipe styles changed at different rates and magnitudes compared to "formal" attributes like surface treatment and wall thickness, which she argued reflected structural and gendered differences in the social institutions of pre-coalescent communities compared to post-coalescent ones (Striker, 2018, 199-219). Striker's study deliberately avoided isolating decorative variation to compare aspects of ceramic production and design — in agreement with the approach recommended by Shennan (2020, 292) quoted in Section 3.2 above.

Therefore, a serious critique of my case study is its limitation to pottery collar decorative motif combinations, which almost certainly were not the only aspect of Northern Iroquoian pottery into which producers instilled meaning (e.g. see Sioui 1999, 216 quoted at the start of Chapter 6 above). For example, ethnographic studies have shown that the social implications of a ceramic vessel's decoration (if any) are often inconsistent with those of its formal shape (Bowser and Patton, 2004; Dietler and Herbich, 1989; Miller, 1985) or the context where it is displayed (Hodder 1982; Sterner 1989; see Shennan 2020). These differences only further complicate the multi-step translation from material culture to social learning processes.

Accordingly, the geospatial and temporal patterns of ceramic decorative variability identified in this case study, and their connotations for macroscalar cultural transmission processes, should be understood with this difficult translation in mind. It is, like many other aspects of archaeology, somewhat of an inevitable problem that future studies should design themselves around rather than ignore or attempt to circumvent. Northern Iroquoian archaeologists in the commercial and academic realms should make a more concerted effort to collect and disseminate broader ranges of attributes beyond collar decoration types, as well as making the data they do collect available for future researchers (and especially to descendant groups of these communities interested in studying their ancestors' settlement histories). As I mentioned above, the format of the data collected for the case study above was reached through a pragmatic approach that facilitated inclusion of many different collections (e.g. see Hart et al., 2016, Table S1). Future research should endeavor to glean more information from these collections before deciding to excavate new settlements.

7.1.3 Historical Process: What can We Actually Learn from Macroscale Patterns?

A common theme of the archaeological, theoretical, and methodological frameworks applied in this case study is their characterization as macroscalar approaches that keep the explanatory limitations introduced by their observational scale explicit (Allen, 2000; Bevan and Conolly, 2006; Head, 2016; Premo and Scholnick, 2011). In the archaeological context, this limitation manifests itself as the inability to consider every community's internal organization of domestic space (and how this limitation impacts information exchange between potters; Creese 2016), as well as in the range of behaviours that are reliably preserved by the archaeological record (Perreault, 2019). In the theoretical context, it limits the range of discernable intra-community cultural transmission forces, forcing us to consider instead how they might manifest at collective scales. In the methodological framework, macroscalar limitations force us to design our tests to accommodate collective variability — adding tremendous interpretive complexity to get from statistics to implications about cultural process (Cowgill, 1964, 1977, 1990a,b).

Pragmatic "dirt archaeologists" akin to the Old Timer from Flannery's Golden Marshalltown (Flannery, 1982) might argue that these limitations make the value of such an approach almost nonexistent because of how distant it appears to be from that classic goal of learning what life was like for people in the past. And, as I mentioned above, they would be correct in some respects: the connotations of "selective copying" seem about as distant from being "charged with emotional significance" as anything can be. However, as I have repeated throughout this study, this distance is far from an oversight; through the macroscale approach I have applied here, my goal has not been to overlook the ingrained emotional significance of pottery and its meaningful connection to contemporary descendants of those who crafted it: it has been to *avoid* overlooking the importance of observational scale and the interpretive capacity it constrains (Bevan and Conolly, 2006). Rather than intentionally avoiding the notion of entangled social meaning in ceramic decoration, this case study has identified its widespread existence and provided further caution against misrepresenting it with inconsequential spatial group definitions.

7.2 Using and Abusing Mantel and AMOVA Tests: Suggestions for Future Archaeological Applications

The methodology I developed for this case study adapted similar approaches undertaken by Shennan et al. (2015), who applied them to European Neolithic archaeological cultures. In the process of adapting this approach to an archaeological database structured around Northern Iroquoian spatial groups I reached several conclusions that, while not directly related to intercommunity copying processes, had important implications for future studies interested in applying these methods. These conclusions focused on macroscalar archaeological applications of the Mantel test and cultural population structure, respectively.

As I discussed in Chapter 3, simulation studies testing the power of the single Mantel test have shown that it can be strongly biased towards Type-I error by the existence of inherent geographic clustering (Guillot and Rousset, 2013; Meirmans, 2012; Legendre et al., 2015). In other words, it produces falsely significant results if the sample of communities is clustered, even if similarity between individuals within each cluster is unaffected by distance. Stratifying the Mantel test, and also producing a Mantel correlogram, are two ways to counteract and/or visualize this potential bias (see Chapter 4). Of the recent archaeological studies that utilize the Mantel test to characterize geospatial similarity among assemblages (e.g. de Groot, 2019, 2020; Conolly, 2018; Lycett, 2019, 2020; Shennan et al., 2015), none attempted to identify nor control potential clustering biases, and only one evaluated their spatial autocorrelation using a Mantel correlogram (Conolly, 2018). Recent studies and the contrasting results presented above make it clear that a single significant Mantel test result is no longer enough to claim that isolation-by-distance is unequivocally represented by the geospatial patterning of a collection of assemblages without further clarifying the potential effects of spatial bias. For example, significant Mantel tests were found in 20 of 28 contexts (Table D.1), but stratification by spatial group showed that only seven of these examples actually represented unbiased geospatial patterning to some degree. Furthermore, individual single Mantel tests were often found to be "driven" by prominent spatial autocorrelation among a few distance classes (as in the NY region), while the opposite case was observed in many ON region contexts where single tests were inconclusive but correlograms indicated substantial similarity among only the closest neighboring sites.

Thus, researchers interested in applying Mantel tests to future macroscalar archaeological contexts should carefully consider the structure of their datasets and whether it introduces artificial spatial clustering likely to invoke biases. As shown in this case study, these situations are more likely to occur when the spatial classes of the dataset were extensionally defined by geographic position. Independent evidence of affiliation between communities (i.e. language dialects, for example; Jordan 2015; Lycett 2019, 2020), when available, can provide greater assurance that correlations identified by Mantel tests are robust.

Furthermore, researchers should seek to characterize the spatial autocorrelation of their datasets when investigating macroscale geospatial variability. Mantel tests and correlograms are not only anisotropic (i.e. they do not prioritize measuring spatial similarity in any specific cardinal distance; Jay et al. 2012) but also inherently ignore the gradating effects of specific environmental conditions (Battey et al., 2020; Manel et al., 2003). These are sometimes referred to as Transmission-Isolating Mechanisms (Durham 1991; Jordan 2015, 43–44), and the strength of their isolation often depends on further contingent factors like climate and landscape barriers (Terrell and Hart, 2016; Thomas, 2016). Mantel correlograms are a necessary step in the process of accommodating these factors that must continue to grow.

Although, to the best of my knowledge, cultural population structure analysis has only been explicitly applied to material archaeological data by Shennan et al. (2015), they took some steps to control for its potential biases (such as creating character matrices of group membership as a spatially-independent proxy for cultural population structure; see Section 4.4.2 above). As I noted in Chapter 5, almost all of the single AMOVA tests I conducted were heavily biased by the same clustering effects; however, narrowing the observational scale revealed that many of the between-polity pairwise Φ_{ST} were not significant, starkly contrasting Shennan et al. (2015). While this abject lack of robust pairwise differentiation was inevitably caused by the aggregative effect of spatial groups, it may also be driven by the observational scale I applied. For example, I found that almost all spatial group pairs were significantly differentiated in the Φ_{ST} matrices of the complete site sample, as well as those of many of the region-aggregated timeblocks and timeblock-aggregated regions (Table D.5). In contrast, timeblock-specific matrices of the ON timeblocks were almost completely insignificant. While this scalar difference may be driven in part by copying processes, it seems to be more strongly affected by the level of temporal or geospatial aggregation. In other words, the Φ_{ST} matrix of the complete sample of sites could have the most significant differentiation because it aggregates the most amount of variability, which is broken into components to calculate the ratios for Φ_{ST}.

Although constraints of space limited my ability to conduct sensitivity analyses for the potential effects of observational scale on the robustness of apparent cultural population structure here, future researchers interested in applying this approach to their own case studies should carefully consider how they aggregate their data, especially if they intend to compare its apparent population structure to geospatial patterning. Nevertheless, the approach pioneered for archaeology by Shennan et al. (2015) and applied here has great potential to reveal information about group differentiation across Northern Iroquoia and beyond, especially in a theoretical paradigm as versatile as cultural transmission and the copying spectrum. Recent studies like those of Striker (2018), who used approaches designed by ethnographers to find the most ‘correct’ answers to questions in informant surveys to characterize cultural norms of ceramic decoration, are good examples of the heuristic value of thinking outside the proverbial box. Molecular population genetics and ecology have a host of other approaches that could productively be applied to cultural datasets with the right amount of ingenuity (e.g. Battey et al., 2020; Excoffier, 2007; Premo, 2016; Waples and Gaggiotti, 2006). With contemporary archaeological thought determinedly shifting away from uncritical application of monothetic groups (Feinman and Neitzel, 2020; Holland-Lulewicz, 2021; Holland-Lulewicz et al., 2020; Roberts and Vander Linden, 2011) and towards population-focused thinking (Conolly, 2018; Groucutt, 2020; Kowalewski and Birch, 2020; Marwick, 2019; Prentiss, 2019a, 2021; Riede et al., 2019), cultural transmission theory and approaches like the copying spectrum are more relevant than they may have ever been.

7.3 Conclusions: The Future of Northern Iroquoia and Cultural Transmission

Above all else, this case study is yet another example of how settlement archaeology in Northern Iroquoia is changing. At the time of writing, the focus has shifted overwhelmingly in the balance of critical approaches that hesitate to use the same reified culture areas, categories defined three generations ago that have outlived their usefulness — especially in the eyes of descendant communities (Gaudreau and Lesage, 2016). Contemporary Northern Iroquoian studies, especially those focusing on macroscale patterning and interaction, constantly invoke this greater level of awareness in analyzing and writing about Northern Iroquoian cultural interaction (Abel, 2019; Birch, 2020; Birch et al., 2020; Birch and Lesage, 2020; Hart, 2020; Hart and Birch, 2021; Holland-Lulewicz, 2021; Holland-Lulewicz et al., 2020; Pfeiffer et al., 2020), a goal that also formed one of the baselines of the preceding case study. The following conclusions should be taken in these contexts.

In reframing ceramic decorative variability across the regions and “spatial groups” of Northern Iroquoia, the primary question asked by this case study was if geospatial patterns of ceramic decorative variability among Northern Iroquoian communities could first be adequately explained by random copying, to determine whether additional cultural transmission forces needed to be invoked to generate them. After evaluating temporal and regional trends in the geospatial and structural variability of these communities at rough- and fine-grained aggregative and partitioned observational scales, I can emphatically conclude that my answer to this question is "sometimes." More specifically, I identified some apparent regional differences that seemed to align with the most recent temporal trajectory of geopolitical realignment accompanying Late Woodland Northern Iroquoian population coalescence (Birch, 2019, 2020; Birch et al., 2020).

In short, geospatial patterns of ceramic decorative variability among communities in the Ontario region seemed to be mainly driven by random copying processes in earlier time periods but not after coalescence was broadly established, while the opposite may have been true among New York region communities. These changes may have reflected the way that external social institutions among these communities evolved to emphasize landscape-scale connections (Birch, 2020; Holland-Lulewicz et al., 2020; Holland-Lulewicz, 2021). In Ontario, as villages coalesced, grew, and organized, selective copying forces stemming from distant ties between communities and their growing importance to the potter symbolizing them may have led to the observed decrease in prominent isolation-by-distance in the region. In New York, where communities developed within the same distinct settlement clusters instead of constantly relocating North, geospatial decorative variability characterized by distinct isolation-by-distance seemed to return after coalescence was established elsewhere in Northern Iroquoia, possibly as localized interaction networks between communities replaced the more distant networks that could have been prominent at the start of the Late Woodland.

Overall, the copying spectrum has proven itself to be a valuable tool for understanding macroscale social learning patterns, even if the range of information available about them is limited without stronger historical context. Future research in Northern Iroquoian contexts could productively make use of cultural transmission theory generally, and selective copying in particular, as a theoretical framework that is primed for an upcoming paradigm shift in archaeological thought that more strongly reflects the limitations of scale, materiality, and symbolic meaning.

Appendices

A Pottery Collar Motif Combination (PCMC) Codes

This section of the Appendix contains a table of William Engelbrecht's original PCMCs that have been modernized from their original FORTRAN punchcard form (Figure A.1; Engelbrecht, 1996, 131, 137–138). The 30th PCMC is the "corn-ear" motif that was added by Dermarkar et al. (2016).

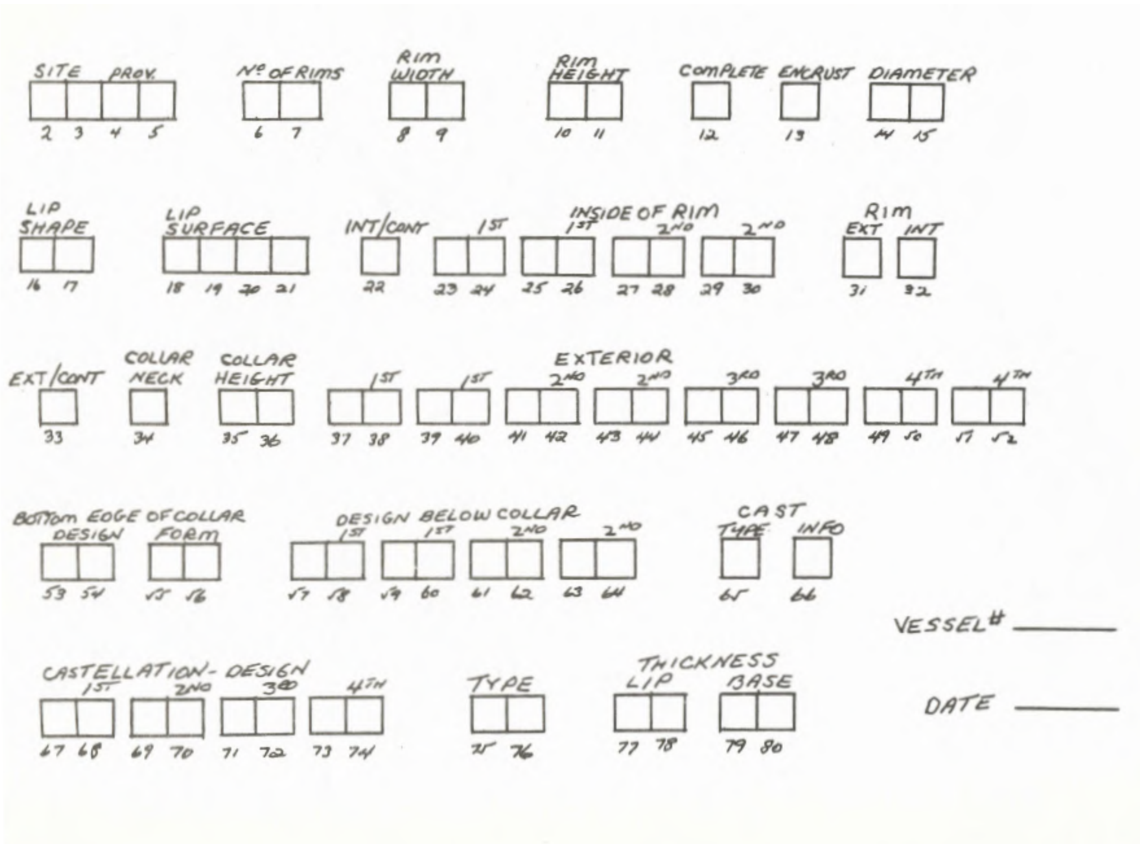
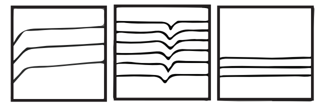
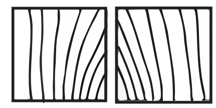
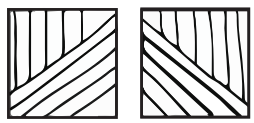
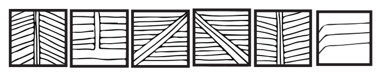
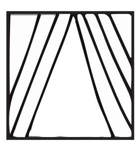
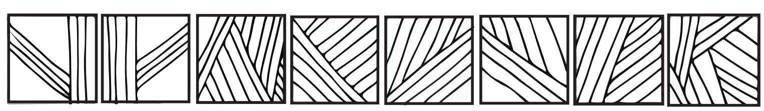
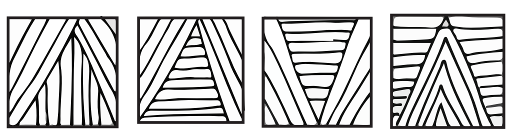
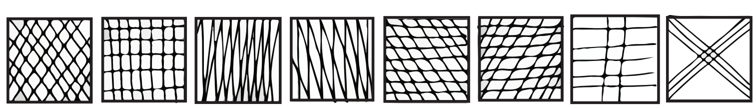
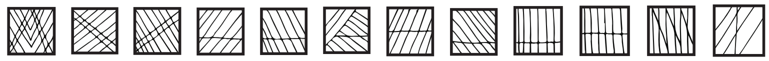
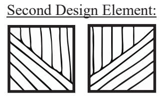
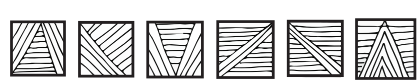
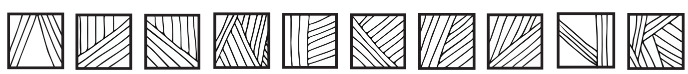


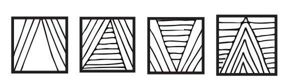
Figure A.1: Original FORTRAN attribute encoding form developed by William Engelbrecht (1971)

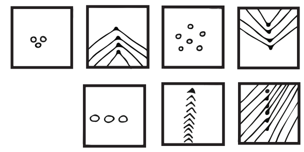
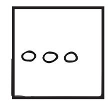
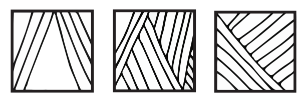
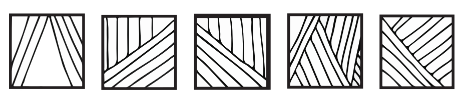
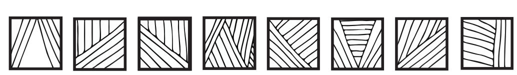
Collar Decoration Motif Combination Code	Combined motif attributes (Engelbrecht 1996: 129—138)
2	"Single horizontal line" "Double horizontal line" "Multiple horizontal lines" 
3	"Intermittent vertical or oblique lines" "Vertical lines" "Oblique lines sloping left" "Oblique lines sloping right" "Short vertical lines (less than 1 cm)" "Short lines sloping left" "Short lines sloping right" 
4	
5	"Horizontal and vertical lines" "Horizontal and oblique lines sloping left" "Horizontal and oblique lines sloping right" "Horizontal and oblique lines sloping left and right" "Oblique lines left and right and horizontal and vertical lines" 
6	
7	"Oblique lines left and right and horizontal and vertical lines" "Multiple oblique lines" 
8	
9	

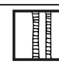
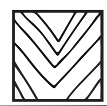
10	
11	First Design Element: "Single horizontal line" "Double horizontal line" "Multiple horizontal lines"
	Second Design Element: "Intermittent vertical or oblique lines" "Vertical lines" "Oblique lines sloping left" "Oblique lines sloping right" "Short vertical lines (less than 1 cm)" "Short lines sloping left" "Short lines sloping right"
12	First Design Element: "Single horizontal line" "Double horizontal line" "Multiple horizontal lines"
	Second Design Element: "Oblique lines sloping right" "Multiple oblique lines" 

13	First Design Element: "Single horizontal line" "Double horizontal line" "Multiple horizontal lines"
	Second Design Element: 
14	First Design Element: "Single horizontal line" "Double horizontal line" "Multiple horizontal lines"
	Second Design Element: "Horizontal and vertical lines" "Horizontal and oblique lines sloping left" "Horizontal and oblique lines sloping right" "Horizontal and oblique lines sloping left and right" 
15	First Design Element: "Short vertical lines (less than 1 cm)" "Short lines sloping left" "Short lines sloping right"
	Second Design Element: "Horizontal and vertical lines" "Horizontal and vertical lines" "Horizontal and oblique lines sloping left" "Horizontal and oblique lines sloping right" "Horizontal and oblique lines sloping left and right" 

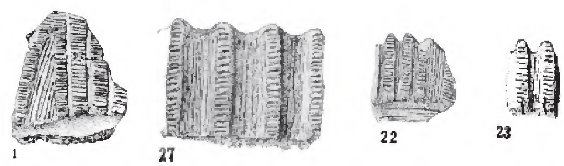
16	<u>First Design Element:</u> "Short vertical lines (less than 1 cm)" "Short lines sloping left" "Short lines sloping right"
	<u>Second Design Element:</u> "Single horizontal line" "Double horizontal line" "Multiple horizontal lines"
	<u>Third Design Element:</u> "Vertical lines" "Oblique lines sloping right" "Oblique lines sloping left"
17	<u>First Design Element:</u> "Short vertical lines (less than 1 cm)" "Short lines sloping left" "Short lines sloping right"
	<u>Second Design Element:</u> "Single horizontal line" "Double horizontal line" "Multiple horizontal lines"
	<u>Third Design Element:</u> "Oblique lines left and right and horizontal and vertical lines" 

18	<u>First Design Element:</u> "Short vertical lines (less than 1 cm)" "Short lines sloping left" "Short lines sloping right"
	<u>Second Design Element:</u> "Single horizontal line" "Double horizontal line" "Multiple horizontal lines"
	<u>Third Design Element:</u> "Horizontal and vertical lines" "Horizontal and oblique lines sloping left" "Horizontal and oblique lines sloping right" "Horizontal and oblique lines sloping left and right" 
19	<u>First Design Element:</u> "Vertical lines" "Oblique lines sloping left" "Oblique lines sloping right" "Short vertical lines (less than 1 cm)" "Short lines sloping left" "Short lines sloping right"
	<u>Second Design Element:</u> "Single horizontal line" "Double horizontal line" "Multiple horizontal lines"
	<u>Third Design Element:</u> Same attributes as first design element

20	(Multiple) "Row of circular punctates" (Multiple) "Row of elliptical punctates" (Multiple) "Row of crescentic punctates" (Multiple) "Row of square or rhomboid punctates" (Multiple) "Reed punctates" (Multiple) "Bossing" (Multiple) "Vertical row of punctates" (Multiple) "Double vertical row of punctates" 
21	(Single) "Row of circular punctates" (Single) "Row of elliptical punctates" (Single) "Row of crescentic punctates" (Single) "Row of square or rhomboid punctates" (Single) "Reed punctates" (Single) "Bossing" 
22	First Design Element: "Row of circular punctates" "Row of elliptical punctates" "Row of crescentic punctates" "Row of square or rhomboid punctates"
	Second Design Element: "Single horizontal line" "Double horizontal line" "Multiple horizontal lines" "Vertical lines" "Oblique lines sloping left" "Oblique lines sloping right" "Horizontal and oblique lines sloping left" 
22 (cont'd)	Third Design Element: "Row of circular punctates" "Row of elliptical punctates" "Row of crescentic punctates" "Row of square or rhomboid punctates"
23	First Design Element: "Single horizontal line" "Double horizontal line" "Multiple horizontal lines" "Vertical lines" "Oblique lines sloping left" "Oblique lines sloping right" "Horizontal and oblique lines sloping left" 
	Second Design Element: "Row of circular punctates" "Row of elliptical punctates" "Row of crescentic punctates" "Row of square or rhomboid punctates"
24	First Design Element: "Single horizontal line" "Double horizontal line" "Multiple horizontal lines"
	Second Design Element: "Vertical lines" "Oblique lines sloping left" "Oblique lines sloping right" 

24 (cont'd)	Third Design Element: "Row of circular punctates" "Row of elliptical punctates" "Row of crescentic punctates"
25	First Design Element: "Short vertical lines (less than 1 cm) "Short lines sloping left"
	Second Design Element: "Vertical lines" "Oblique lines sloping left"
26	Any from motif combinations 11—18 **plus** ladder plait motif: 
27	First Design Element: "Vertical lines" "Oblique lines sloping left" "Oblique lines sloping right" "Short vertical lines (less than 1 cm)" "Short lines sloping left" "Short lines sloping right"
	Second Design Element: Repeated from first element (can also be repeated a third time)
	Additional Attributes in this Group: "Chevron open on top" "Chevron open on bottom" "Chevron open to the left" "Chevron open to the right" "Herringbone" 

28	First Design Element: "Row of circular punctates" "Row of elliptical punctates" "Row of crescentic punctates" "Row of square or rhomboid punctates"
	Second Design Element: "Single horizontal line" "Double horizontal line" "Multiple horizontal lines" "Vertical lines" "Oblique lines sloping left" "Oblique lines sloping right" "Short vertical lines (less than 1 cm)" "Short lines sloping left" "Short lines sloping right"
29	"Any combination of attributes [of one, two, or three elements] with horizontal lines underneath (Durfee Underlined)."  "Durfee Underlined" sherd from the Scott Site (BcGk-1; photo by author)

30	St. Lawrence “Corn-eared motif”  Vessel from Masson site (Gates St. Pierre 2016:55)  Rimsherd from Mantle site (Striker 2018:73)  Corn-ear motifs from the Roebuck site (Wintemberg 1936:Plate V:22,23,27; X:1)

B Site Information

Table B.1: Archaeological Sites

Site ID	Site Name	Spatial Group Code	Timeslice Code	Number of Vessels	Source
1	27VII	11	IV	26	Jamieson 1990
2	Adams	2	V	38	Macneish 1952
3	Alexandra	8	I	205	Archaeological Services Inc. 2008a
4	Alonzo	9	VI	96	Fitzgerald 1990
5	Ames	7	II	114	Hart et al. 2016
6	Antrex	1	I	746	Archaeological Services Inc. 2010a
7	Arbor Ridge	7	II	209	Adams 2003
8	Atwell	6	IV[a]	45	Engelbrecht 2004
9	Auger	9	VI	67	Latta 1985
10	Augoutenc	9	IV	94	Bursey 1993
11	Aurora	8	IV	120	Hart et al. 2016
12	Bach	6	V	67	Engelbrecht 1971
13	Baker	1	II[a]	134	Archaeological Services Inc. 2006b
14	Bark	12	II	103	Sutton 1989
15	Barker	5	V	136	Engelbrecht 1971
16	Barker (Baine)	12	V	139	Hart et al. 2016
17	Barnes	6	IV	29	Engelbrecht 1971
18	Barrie	9	I	280	Sutton 1999
19	Bathurst	8	I	108	Archaeological Services Inc. 2016a
20	Baumann	9	II	852	Hart et al. 2016
21	Beaumier	10	II	44	Marois 1978
22	Beckstead	11	II	234	Pendergast 1984
23	Belcher	2	IV	88	Engelbrecht 1971
24	Benson	12	V[a]	978	Hart et al. 2016
25	Bernault	9	VI	36	Hart et al. 2016
26	Berry	11	I	48	Pendergast 1966a
27	Best	8	II	164	Birch et al. 2016
28	Bidmead	9	VI	431	Bursey 1993
29	Black Creek	1	II[a]	380	Hart et al. 2016
30	Bloody Hill	6	II[a]	113	Tuck 1971
31	Boyle-Atkinson	1	III	123	BAIF Associates, Inc. 1984
32	Bradt	13	V	48	Hart et al. 2016
33	Brigg's Run	5	VI	35	Snow 1995
34	Buffum	4	IV	117	Engelbrecht 1971
35	Burke	6	III	92	Engelbrecht 1971
36	Buyea	6	III	105	Engelbrecht 1971
37	Cabin	6	I	103	Tuck 1971
38	Cameron	2	V	40	Engelbrecht 1971
39	CameronQ	11	I	57	Pendergast 1964
40	Campbell	13	I	174	Smith 1997a
41	Carlos	3	IV[c]	56	Engelbrecht et al. 1990
42	Carson	9	II	285	Bursey 1993
43	Cayadutta	5	IV	74	Snow 1995
44	Cedar Point	9	VI	112	Latta 1971
45	Cemetery	6	III[a]	32	Engelbrecht 1971
46	Charlebois	9	VI	153	Latta 1971
47	Chase	6	V	33	Engelbrecht 1971
48	Chaumont	3	III	81	Engelbrecht et al. 1990
49	Chew	9	VI	118	Glencross et al. 2015
50	Chicoutimi	10	III	27	Simard 1971
51	Christianson	13	VI	388	Fitzgerald 1982
52	Chypchar	13	I	146	Smith 1997a
53	Cleary	11	IV	112	Jamieson 1990
54	Clifton Springs	2	II	97	Engelbrecht 1971
55	Cooper	9	V	39	Hart et al. 2016

56	Copeland	9	IV	1470	Bursey 1993
57	Cornish	2	VI	94	Engelbrecht 1971
58	Coulter	12	IV	382	Hart et al. 2016
59	Crawford Lake	13	I	118	Smith 1997a
60	Cromwell	5	IV	71	Engelbrecht 1971
61	Damiani	1	IV[a]	322	Archaeological Services Inc. 2012a
62	Dawson	10	IV	213	Pendergast 1972a
63	Deowingo	5	I	55	Lenig 1965
64	Deshambault	9	V	102	Latta 1976
65	Diable	6	V	64	Engelbrecht 1971
66	Dockerstader	5	V	28	Hart and Engelbrecht 2012
67	Draper	8	IV[a]	11359	Pihl 1984
68	Drumholm	13	I	52	Smith 1997a
69	Drury	9	V	27	Hart et al. 2016
70	Dunn 1	9	II	27	Hart et al. 2016
71	Dunsmore	9	III	173	Robertson and Williamson 2003
72	Durfee	3	IV[c]	479	Engelbrecht 2004
73	Durham	3	III	89	Engelbrecht 2004
74	Dutch Hollow	2	VI	130	Sempowski and Saunders 2001
75	Dykstra	9	I	57	Archaeological Services Inc. 2006a
76	Eaton	4	V	114	Wright 1966
77	Ellery	9	VI	26	Hart et al. 2016
78	Ellis	4	VI	181	Engelbrecht 1984
79	Elwood	5	III[b]	213	Snow 1995
80	Emmerson Springs	1	IV	143	Hawkins 2004
81	England’s Woods	5	V	33	Hart and Engelbrecht 2012
82	Factory Hollow	2	VI	260	Sempowski and Saunders 2001
83	Farlain Lake	9	VI	150	Latta 1971
84	Farrell	2	II[a]	149	Engelbrecht 1985
85	Finch	13	II	26	Pihl and Thomas 1997
86	Footer	2	IV[a]	515	Engelbrecht 1985
87	Forget	9	VI	120	Bursey 1993
88	Fort Drum	3	II	127	Engelbrecht 1995
89	Fournier	9	III	914	Bursey 1993
90	Frank	3	III	37	Engelbrecht 1995
91	Freeman	3	II	27	Engelbrecht 2004
92	Furnace Brook	6	I	211	Tuck 1971
93	Ganada	5	IV	88	Bamann 1993
94	Garoga	5	IV[b]	534	Bamann 1993
95	Genoa Fort	2	V	62	Lenig 1965
96	Getman	5	III	36	Lenig 1965
97	Gibson	12	I	52	Archaeological Services Inc. 2008b
98	Glebe	9	VI	104	Hart et al. 2016
99	Glenbrook	11	IV	2672	Pendergast 1979
100	Goff	6	III	42	Pratt 1976
101	Gogo	11	I	39	Pendergast 1964
102	Goodeve	9	IV	75	Hart et al. 2016
103	Goodyear	4	V	408	Wright 1966
104	Grandview	8	I	174	Williamson et al. 2003
105	Grays Creek	11	II	147	Pendergast 1966b
106	Green Lake	4	V	500	Wright 1966
107	Gregor	9	I	105	Archaeological Resource Associates 2003
108	Hamilton	13	VI	197	Lennox 1977
109	Hanes	13	IV	132	Hart et al. 2016
110	Haney-Cook	9	VI	126	Hart et al. 2016
111	Hardrock	12	III	228	Hart et al. 2016
112	Heath	3	IV[c]	220	Engelbrecht 1995
113	Heron	9	II	25	Hart et al. 2016
114	Hidden Springs	1	III	154	Archaeological Services Inc. 2010c
115	Hillier	7	II	121	Hart et al. 2016
116	Holly	9	I	559	Archaeological Services Inc. 2009

117	Hood	13	VI	72	Fitzgerald 1979
118	Hope	1	III[a]	174	Archaeological Services Inc. 2011
119	Howlet Hill	6	II[a]	114	Tuck 1971
120	Hubbert	9	II	93	MacDonald and Williamson 2001
121	Hunter's Oro 17	9	V	119	Hart et al. 2016
122	Ivan Elliot	13	II	124	Hart et al. 2016
123	Jackes	1	II	60	Noble 1974
124	Jarrett-Lahmer	1	IV[a]	346	Archaeological Services Inc. 2005a
125	Joseph Picard	8	III	871	Archaeological Services Inc. 2016b
126	Keffer	1	IV[a]	5526	Hart et al. 2016
127	Kelly-Campbell	9	VI	432	Hart et al. 2016
128	Kelso	6	II[a]	207	Tuck 1971
129	Kienuka	4	V	136	Engelbrecht 1996
130	Kirche	12	IV	892	Hart et al. 2016
131	Kleis	4	VI	114	Engelbrecht 1984
132	Klinko	2	III	40	Engelbrecht 1980
133	Klock	5	IV[b]	291	Bamann 1993
134	Lalonde	9	II	125	Bursey 1993
135	Lanoraie	10	I	88	Lenig 1965
136	Lawson	13	III	702	Wright 1966
137	LeCaron aka Santimo	9	VI	710	Cameron 2011
138	Lite	7	III	360	Pendergast 1972b
139	Logan	1	II	98	Hart et al. 2016
140	Long Point	2	III	203	Lenig 1965
141	Lougheed	9	II	205	Finlayson 2003
142	MacDougald	11	II	81	Pendergast 1969
143	MacMurchy	9	V	227	Hart et al. 2016
144	Mailhot-Curran	11	IV	253	Chapdelaine 2015
145	Mantle	8	VI[a]	1575	Birch and Williamson 2013
146	Martin	5	V	144	Engelbrecht 1971
147	Masson	10	III	58	Chapdelaine 2004
148	Matteson	3	III	36	Engelbrecht 2004
149	Maynard-McKeown	11	IV	394	Pendergast 1990
150	McAllister	9	V	80	Hart et al. 2016
151	McDonald	11	I	233	Gagné 2010
152	McGaw	1	II	43	Archaeological Services Inc. 2003
153	McNair	1	III[a]	506	Archaeological Services Inc. 2012b
154	Messenger	13	I	153	Smith 1997a
155	Milton	13	II	99	Smith 1997a
156	Molson	9	V	505	Lennox 2000
157	Morse	3	IV[c]	214	Engelbrecht 2004
158	Mud Creek	3	III	39	Engelbrecht 2004
159	New	8	I	44	Archaeological Services Inc. 2010b
160	Newton-Hopper	4	V	151	Engelbrecht 1984
161	Nichols Pond	6	III	83	Engelbrecht 2004
162	Nohle	3	II	36	Engelbrecht 2004
163	Nott	13	III	35	Smith 1997a
164	Orion-Murphy-Golding	1	III	80	Archaeological Services Inc. 2008c, 1998
165	Orr Lake	9	VI	508	Kidd 1950
166	Otsungo	5	III	134	Bamann 1993
167	Parsons	1	IV[a]	169	Williamson and Powis 1998
168	Payne	7	III	245	Emerson 1968
169	Pengilly	1	II	55	Hart et al. 2016
170	Pine Hill	11	III[c]	46	Abel 2001
171	Pipeline	13	I	386	Smith 1997a
172	Plater-Martin	9	VI	59	Hart et al. 2016
173	Pompey Center	6	VI	85	Bradley 1977
174	Potaki	3	IV[c]	162	Engelbrecht 2004
175	Pound	13	II	599	Wright 1966
176	Power House	2	VI	30	Jones 2008, 357
177	Pugh	8	II	204	Hart et al. 2016

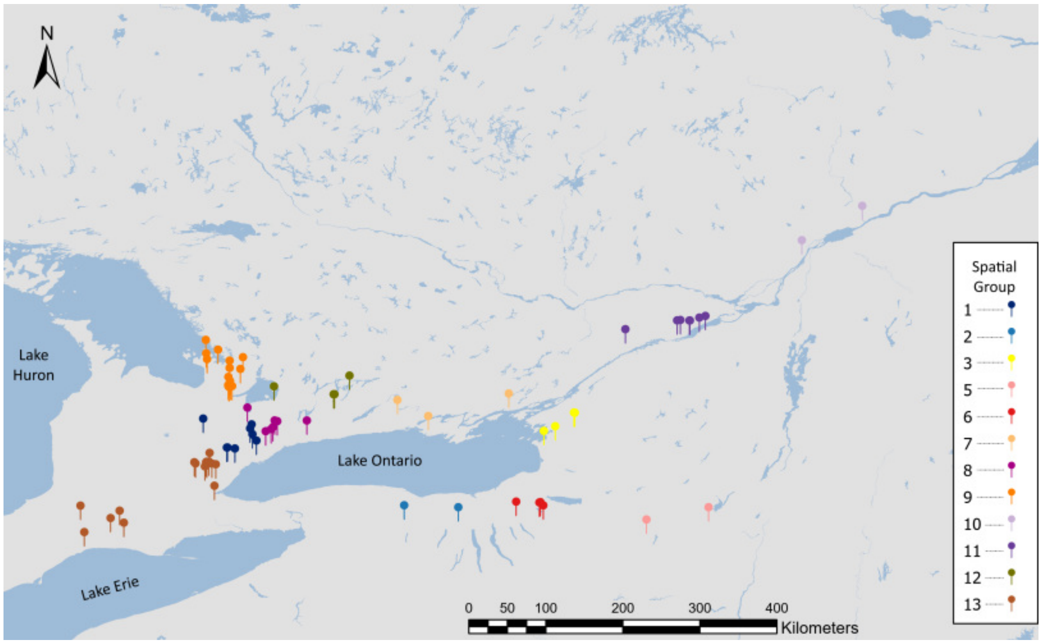
178	Putnam	3	II	138	Engelbrecht 2004
179	Quackenbush	12	III	159	Hart et al. 2016
180	Raymond Reid	13	II	63	Hart et al. 2016
181	Rice's Woods	5	V	177	Snow 1995
182	Richmond Mills	2	IV	154	Engelbrecht 1971
183	Rife	13	I	287	Smith 1997a
184	Ripley	4	V	281	Wright 1966
185	Risebrough	1	II	97	Hart et al. 2016
186	River	1	II	144	Hart et al. 2016
187	Robb	8	I	582	Archaeological Services Inc. 2010d
188	Robitaille	9	VI	631	Latta 1976
189	Roebuck	11	IV	4518	Abel 2001
190	Rumney Bay	12	III	28	Hart et al. 2016
191	Salem	11	III	2229	Pendergast 1966b
192	Schenck 1	5	V	35	Snow 1995
193	Second Lake	9	II	49	Hart et al. 2016
194	Seed-Barker	1	IV	412	Birch et al. 2016
195	Serena	13	I	26	Archaeological Services Inc. 2004
196	Shelby	4	V	210	Wright 1966
197	Sidey-Mackay	9	V	276	Hart et al. 2016
198	Silverheels	4	VI	123	Engelbrecht 1984
199	Simmons	4	V	303	Engelbrecht 1971
200	Smith	5	III	344	Engelbrecht 2004
201	Smokes Creek	4	VI	86	Engelbrecht 1984
202	Snodden	12	I	120	Hart et al. 2016
203	Southwold	13	II	362	Wright 1966
204	Spang	8	V[a]	362	Birch et al. 2016
206	St Lawrence	9	II	29	Engelbrecht 2004
207	Starr	11	III	126	Hart et al. 2016
205	Steward	3	III	271	Jamieson 1982
208	Sugarbush	11	III	356	Pendergast 1974
209	Summerstown	11	III	588	Pendergast 1968
210	Swarthout	3	III	93	Engelbrecht 2004
212	Talcott Falls	3	IV[c]	107	Engelbrecht 1995
213	Temperance House	6	V[a]	26	Engelbrecht 2004
211	Thurston	5	I	45	Engelbrecht 1974
214	Train	6	VI	50	Hart et al. 2016
215	Trent-Foster	9	II	26	Hart et al. 2016
216	Tribes Hill Oak Woods	12	V	39	Hart and Engelbrecht 2012
217	Unick	13	I	54	Smith 1997a
218	Van Eden	13	I	87	Smith 1997a
219	Vints	9	VI	89	Fitzgerald 1990
220	Wagners Hollow	5	V	137	Engelbrecht 2004
221	Walkington 2	1	III[a]	100	Archaeological Services Inc. 2010e
222	Warminster/Cahiague	9	VI	277	Hart et al. 2016
223	Warren	2	VI	40	Engelbrecht 1970
224	Washburn	11	III[c]	65	Abel 2001
225	Waupoos	7	III	267	Pendergast 1964
226	Wayland-Smith	6	VI	283	Engelbrecht 1969
227	Webb	9	I	68	Hart et al. 2016
228	Wellington	9	I	135	Archaeological Services Inc. 2005b
229	White	9	IV	104	Hart et al. 2016
230	Whitford	3	IV[c]	146	Engelbrecht 2004
231	Wiacek	9	I	152	Robertson et al. 1995
232	Wilson	12	I	190	Sutton 1990
233	Woodbridge	1	IV	288	Hart et al. 2016
234	Wormuth	5	V[b]	73	Bamann 1993

[a] = assigned after Birch et al. 2020

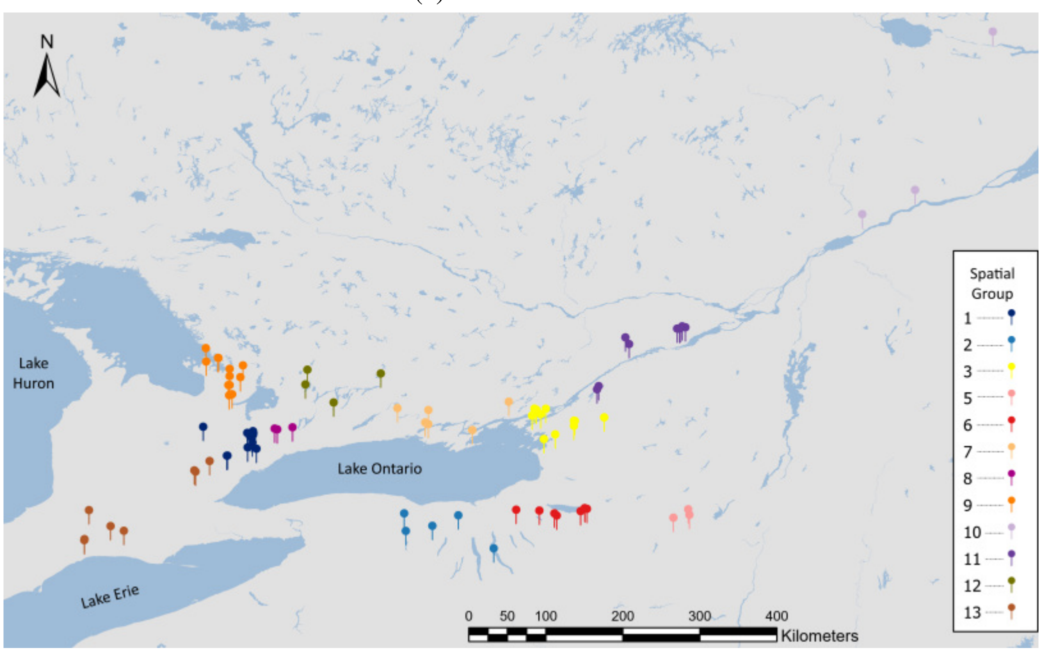
[b] = assigned after Manning and Hart 2019

[c] = assigned after Abel 2019

C Maps

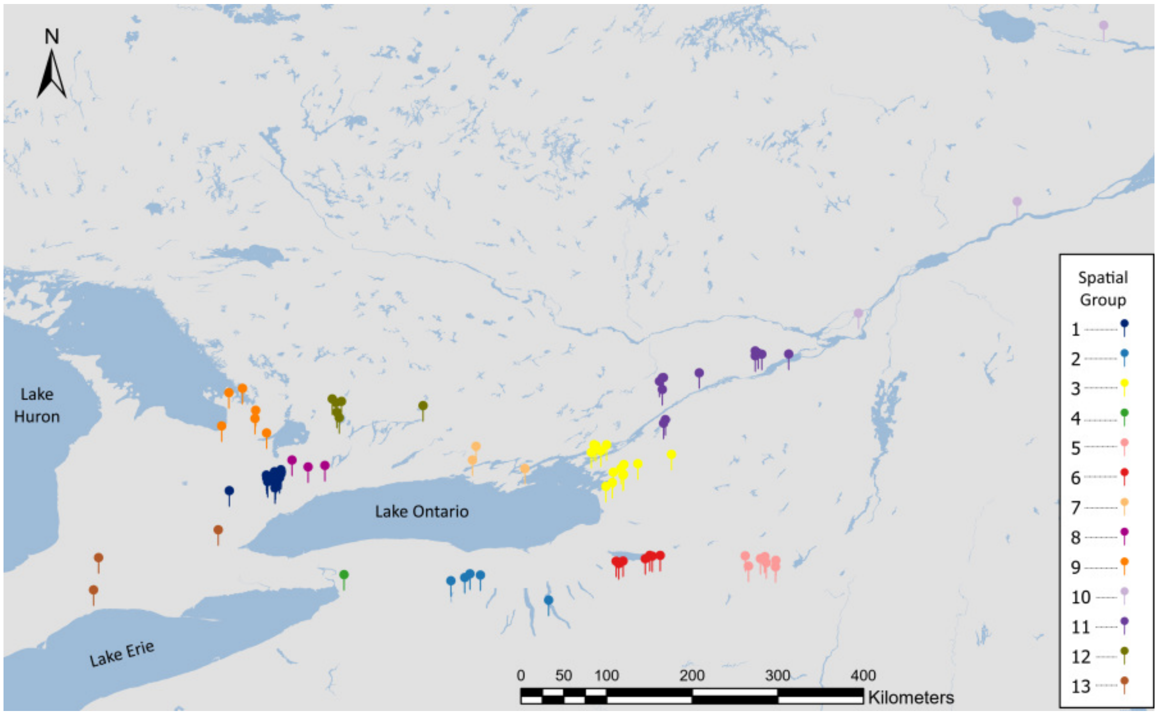


(a) Timeblock I–II

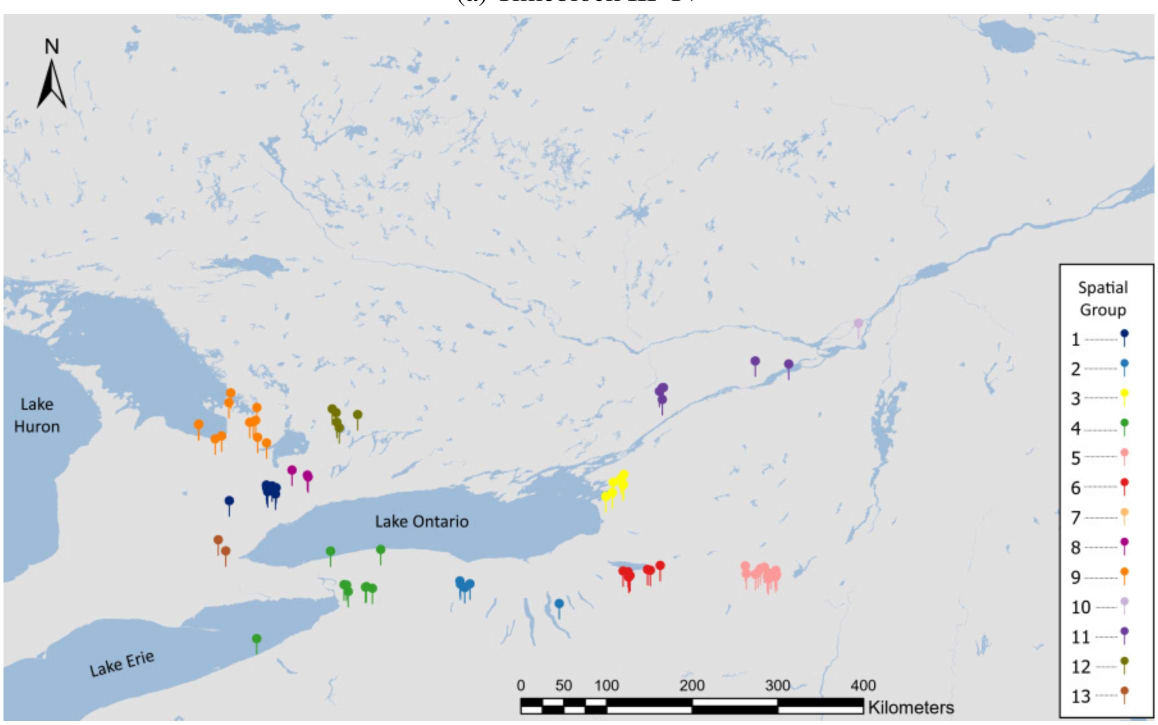


(b) Timeblock II–III

Figure C.1: Map of all sites contained in Timeblocks 1 and 2.



(a) Timeblock III–IV



(b) Timeblock IV–V

Figure C.2: Map of all sites contained in Timeblocks 3 and 4.

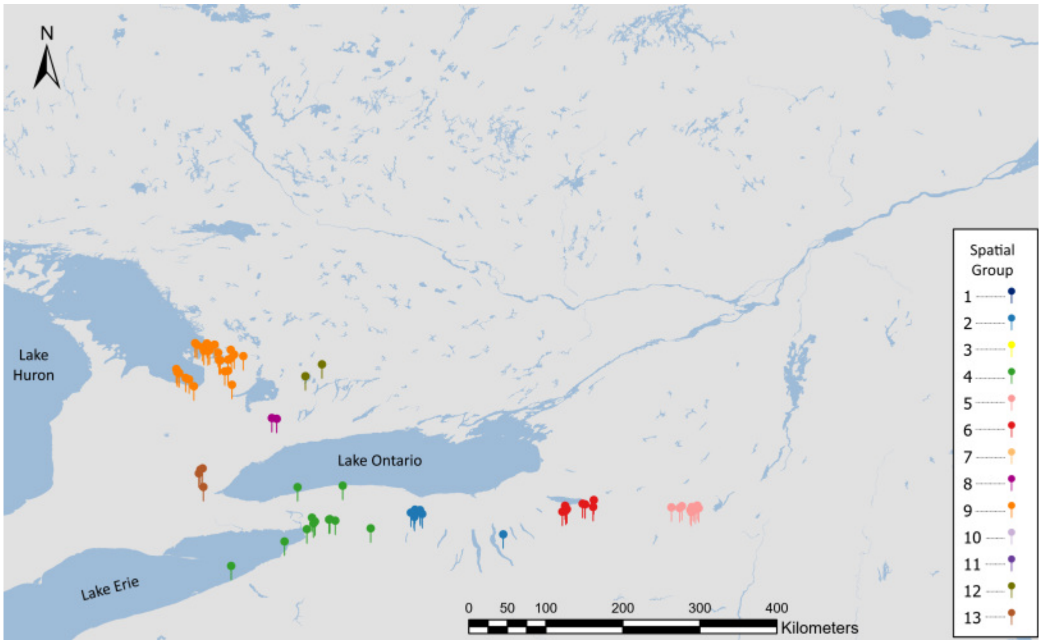


Figure C.3: Map of all sites contained in Timeblock 5.

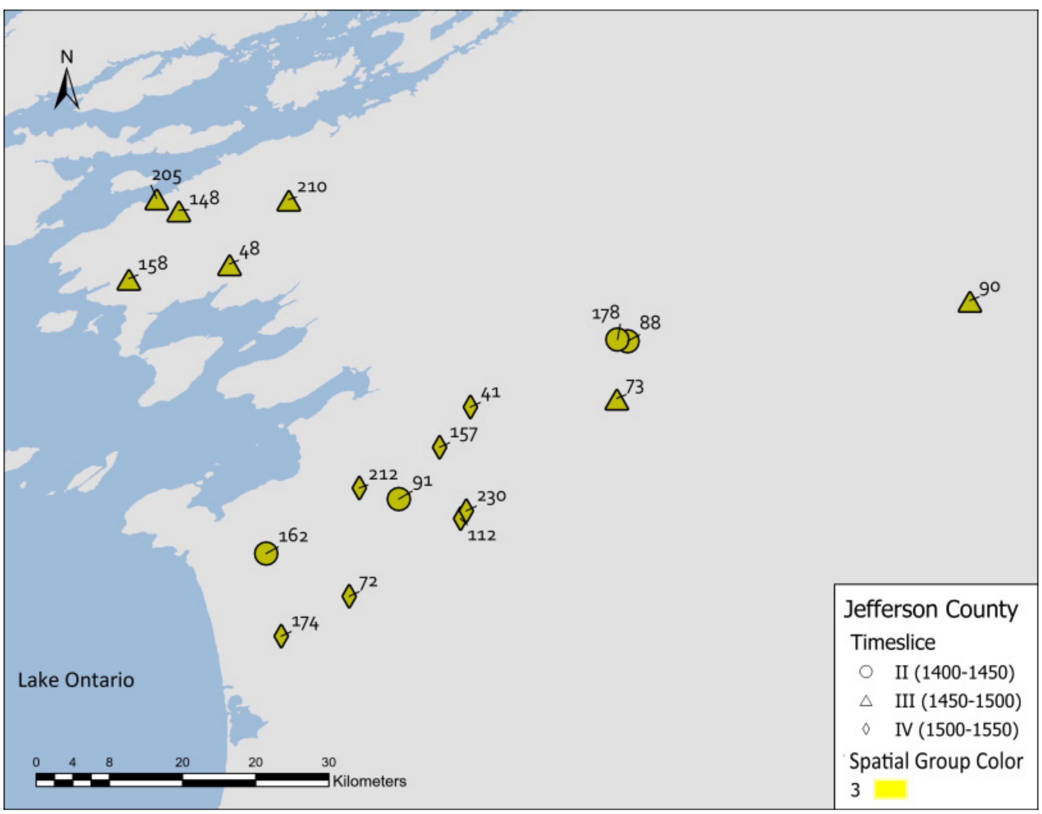


Figure C.4: Map of Jefferson County regional group sites. Number labels correspond to Site ID in Table B.1

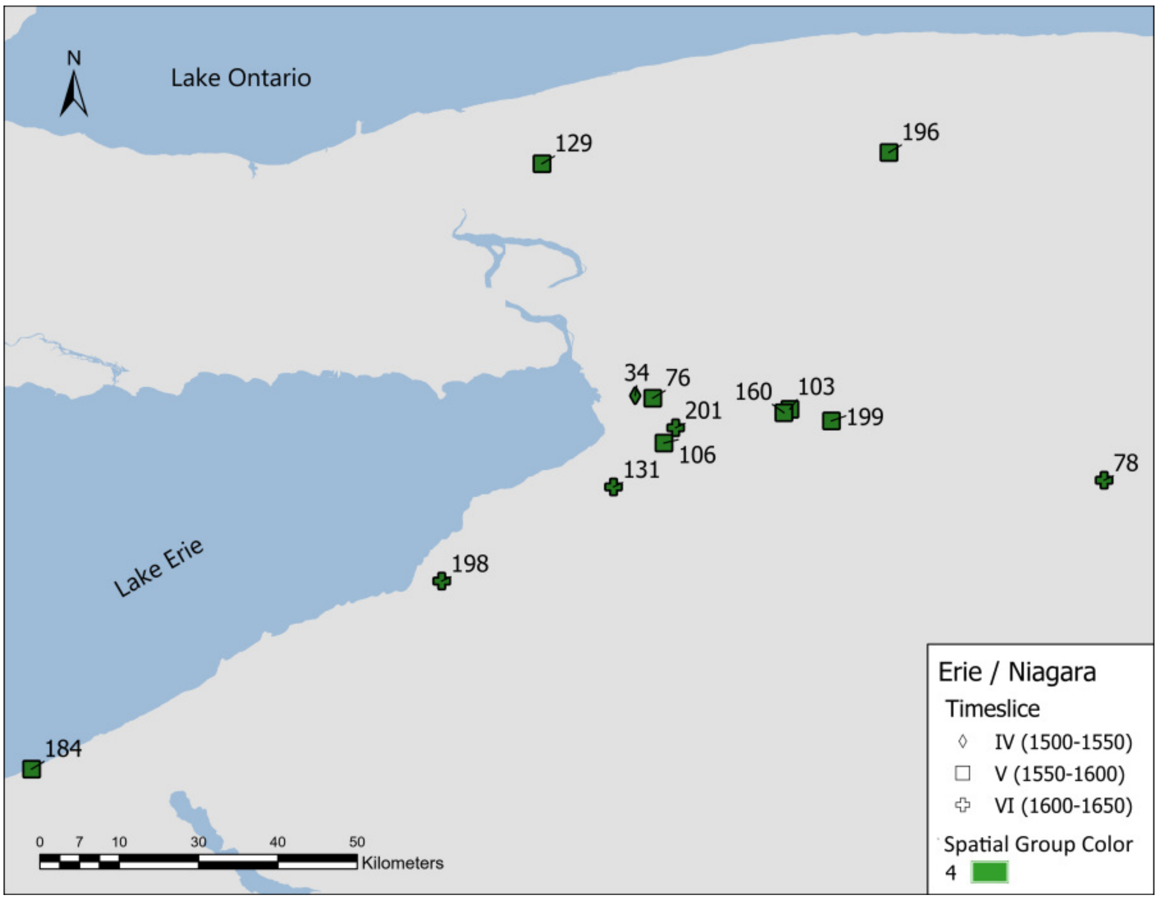


Figure C.5: Map of Lake Erie / Niagara regional group sites. Number labels correspond to Site ID in Table B.1

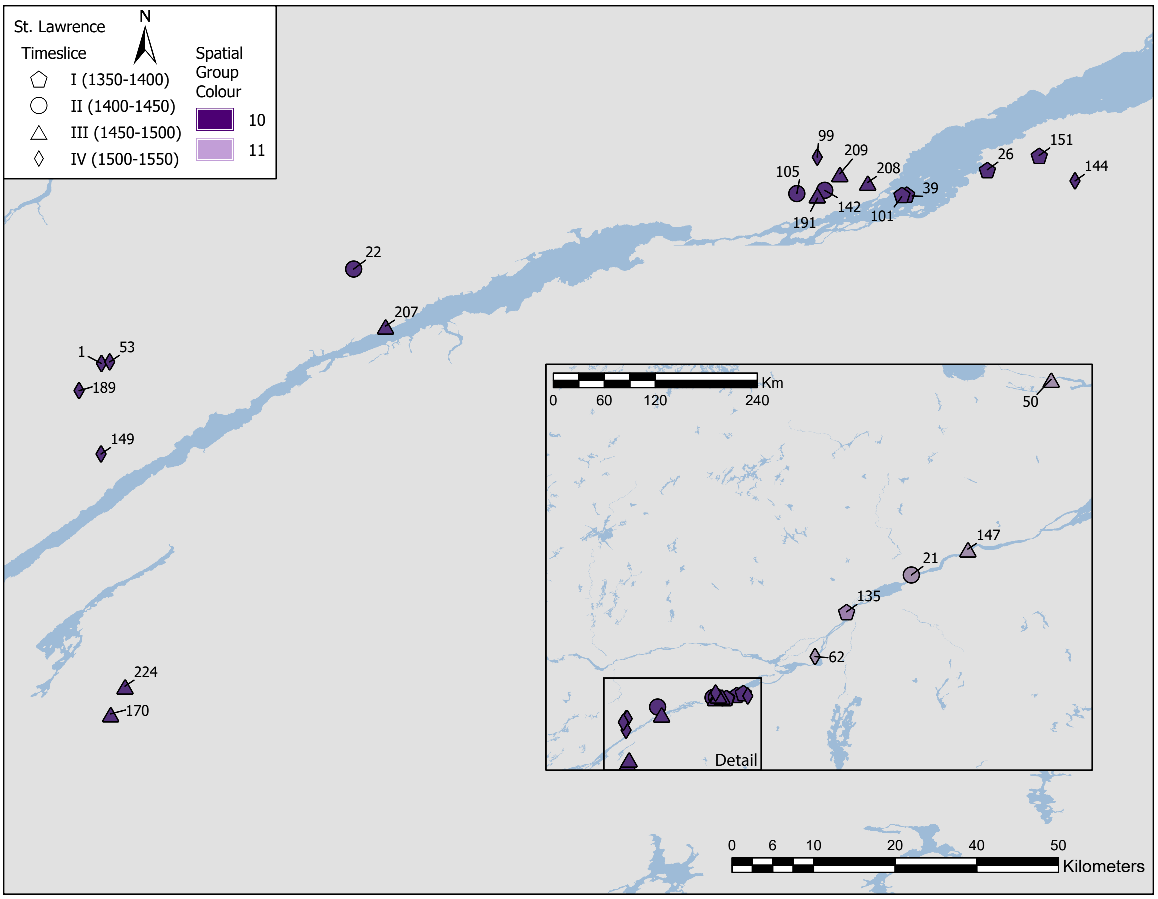


Figure C.6: Map of St. Lawrence regional group sites. Number labels correspond to Site ID in Table B.1

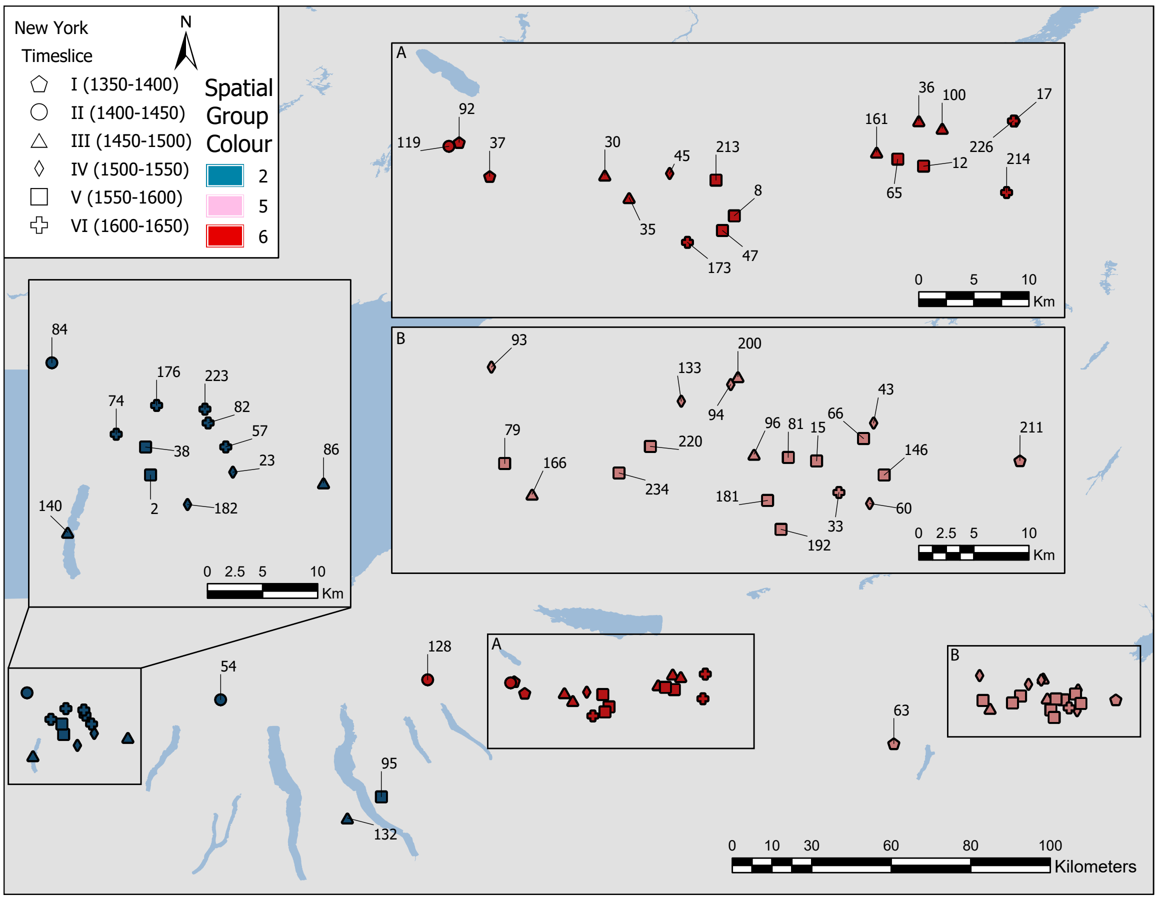


Figure C.7: Map of New York regional group sites. Number labels correspond to Site ID in Table B.1

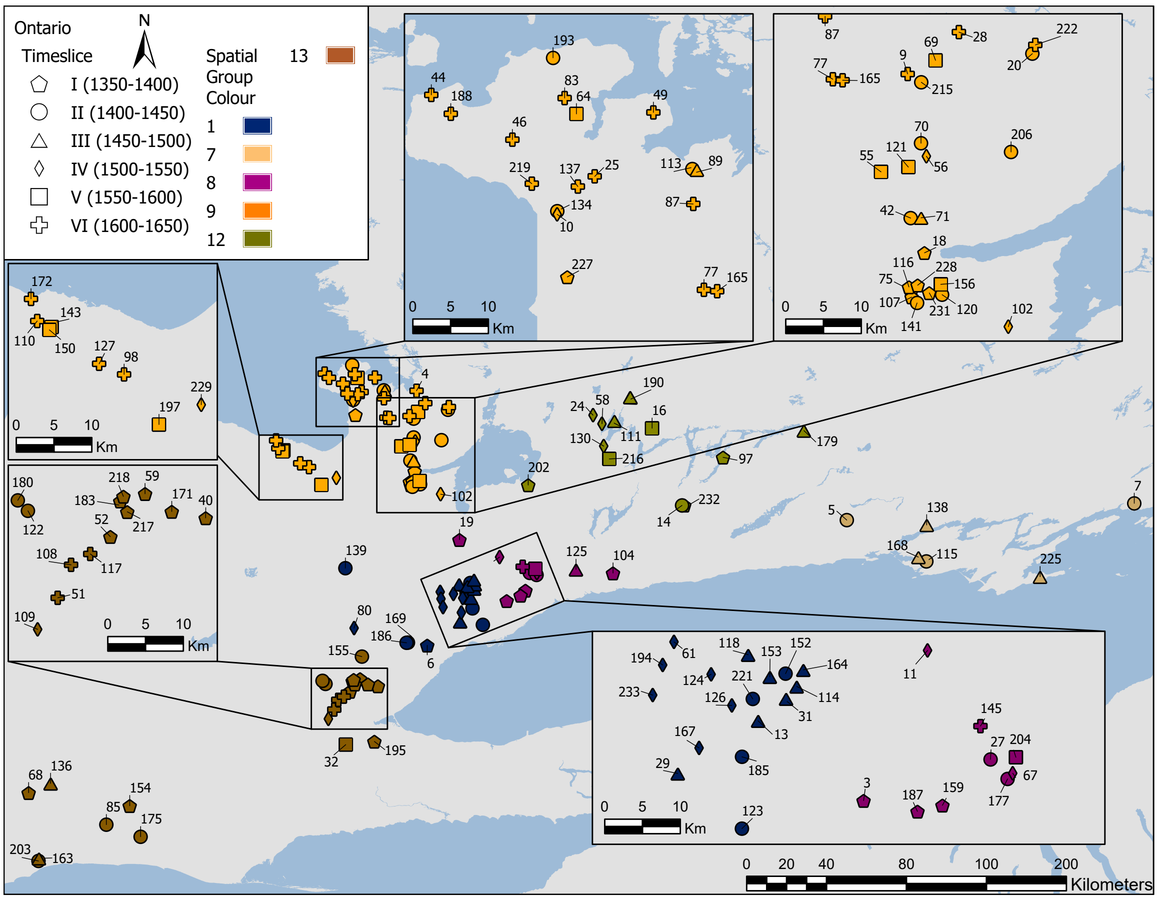


Figure C.8: Map of Ontario regional group sites. Number labels correspond to Site ID in Table B.1

D Technical Appendix

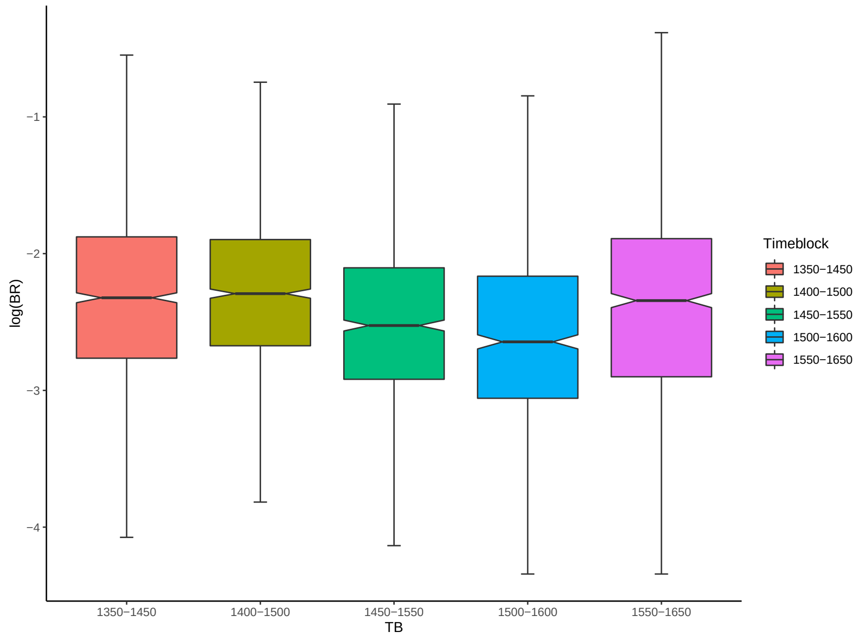


Figure D.1: Box-and-whisker plots of log-transformed, corrected and rescaled BR coefficients for all five timeblocks. Upper and lower box hinges represent the first and third quartiles, and upper and lower whiskers extend to the largest BR coefficient no further than $1.5 \times IQR$ from the upper and lower hinges, respectively. Box median notches roughly correspond to 95% confidence interval; if two boxes' notches overlap they are significantly different.

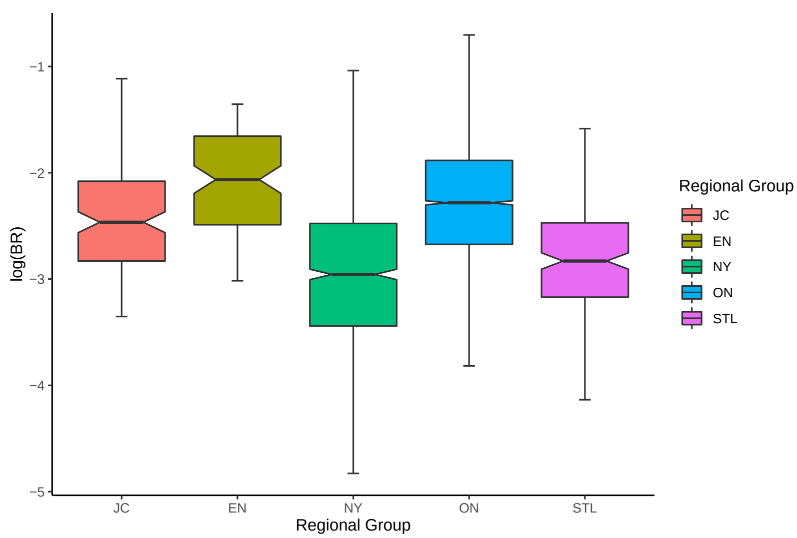


Figure D.2: Box-and-whisker plots of log-transformed, corrected and rescaled BR coefficients for each regional group over all timeblocks.

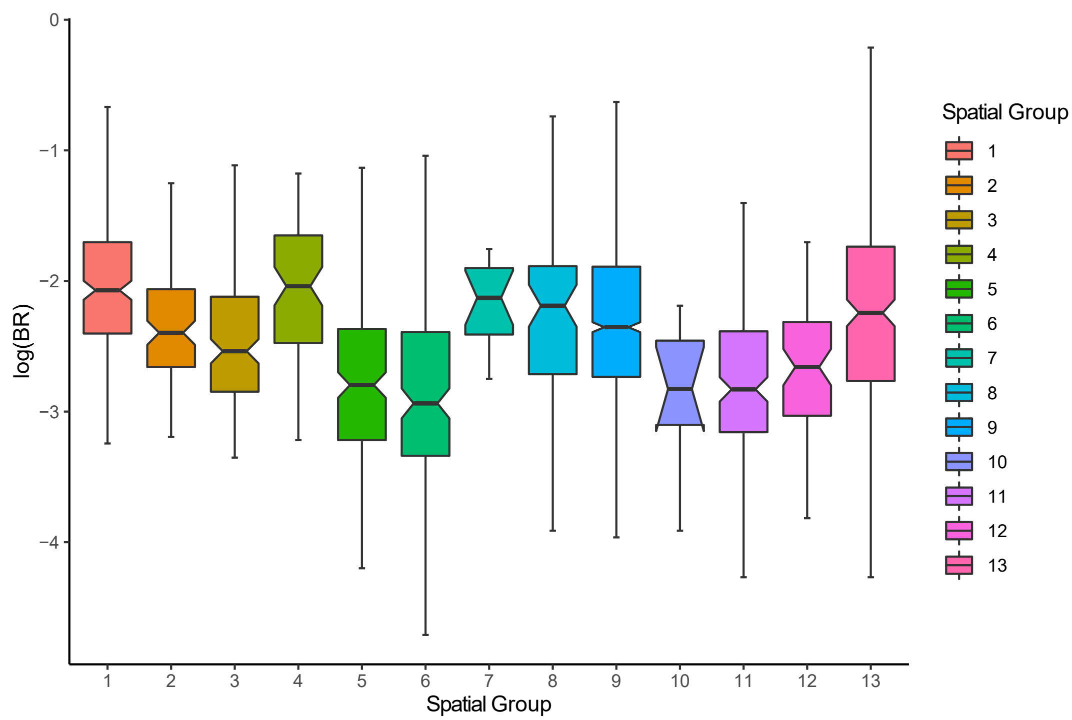


Figure D.3: Box-and-whisker plots of log-transformed, corrected and rescaled BR coefficients for all thirteen spatial groups. Group codes correspond to Table 2.3.

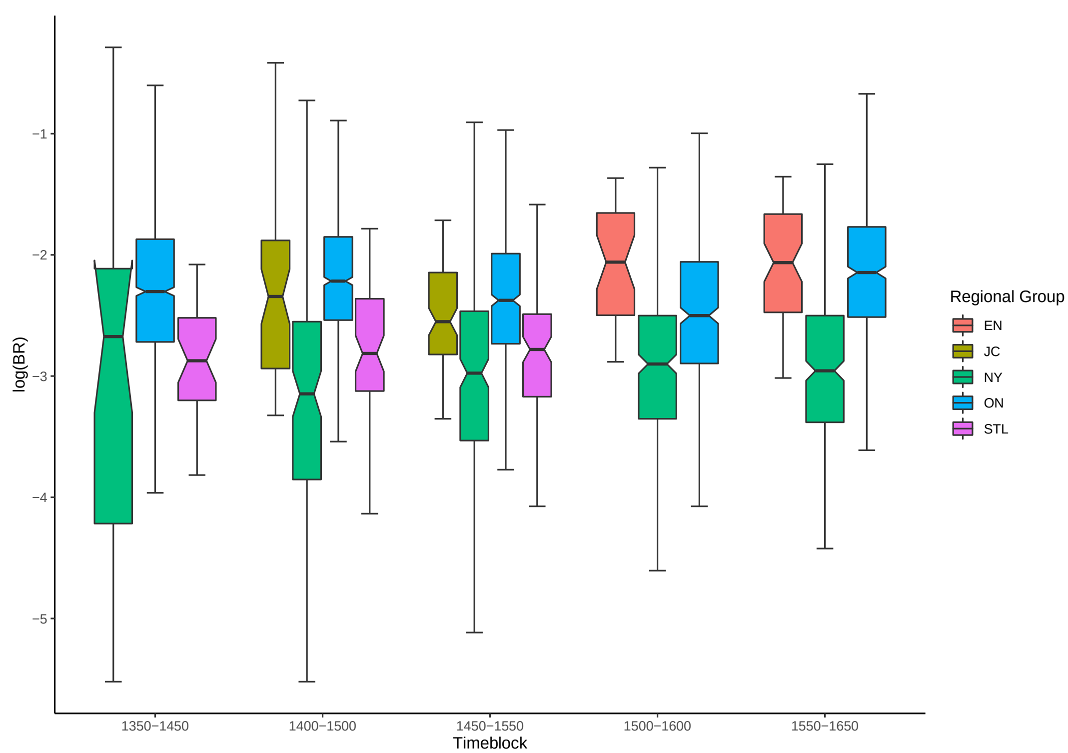


Figure D.4: Box-and-whisker plots of log-transformed, corrected and rescaled BR coefficients for each regional group within each timeblock.

Case Scenario	Single Mantel Test			Stratified Mantel Test		
	n_{sites}	r_M	p value	n_{strata}	r_M	p value
All Sites All Timeblocks	235	0.502	**0.00001**	13	0.502	0.2
All Sites Timeblock 1	75	0.442	**0.00001**	12	0.442	**0.03**
All Sites Timeblock 2	86	0.502	**0.00001**	12	0.502	**0.03**
All Sites Timeblock 3	87	0.494	**0.00001**	13	0.494	0.2
All Sites Timeblock 4	77	0.568	**0.00001**	12	0.568	0.5
All Sites Timeblock 5	72	0.588	**0.00001**	8	0.588	0.2
Jefferson County Regional Group All Timeblocks	18	0.109	0.1	1	—	—
Erie / Niagara Regional Group All Timeblocks	13	0.221	0.1	1	—	—
New York Regional Group All Timeblocks	54	0.412	**0.00001**	3	0.412	**0.001**
Ontario Regional Group All Timeblocks	125	0.110	**0.005**	6	0.110	0.4
St. Lawrence Regional Group All Timeblocks	24	0.161	0.07	2	—	—
Jefferson County Regional Group Timeblock 2	11	0.139	0.2	1	—	—
Jefferson County Regional Group Timeblock 3	14	0.220	**0.04**	1	—	—
Erie / Niagara Regional Group Timeblock 4	7	0.223	0.2	1	—	—
Erie / Niagara Regional Group Timeblock 5	12	0.185	0.2	1	—	—
New York Regional Group Timeblock 1	8	0.772	**0.002**	3	0.772	0.2
New York Regional Group Timeblock 2	16	0.638	**0.00001**	3	0.638	**0.009**
New York Regional Group Timeblock 3	21	0.485	**0.00001**	3	0.485	0.5
New York Regional Group Timeblock 4	25	0.251	**0.002**	3	0.251	0.2
New York Regional Group Timeblock 5	25	0.357	**0.00001**	3	0.357	**0.009**
Ontario Regional Group Timeblock 1	54	0.114	**0.04**	6	0.114	**0.02**
Ontario Regional Group Timeblock 2	47	0.268	**0.0005**	6	0.268	**0.01**
Ontario Regional Group Timeblock 3	36	0.299	**0.005**	6	0.299	0.4
Ontario Regional Group Timeblock 4	29	0.235	**0.002**	5	0.235	0.2
Ontario Regional Group Timeblock 5	35	0.275	**0.006**	4	0.275	0.06
St. Lawrence Regional Group Timeblock 1	9	-0.060	0.6	2	—	—
St. Lawrence Regional Group Timeblock 2	12	0.219	**0.04**	2	—	—
St. Lawrence Regional Group Timeblock 3	15	0.273	0.053	2	—	—

Table D.1: Single and Stratified Mantel Test Results.

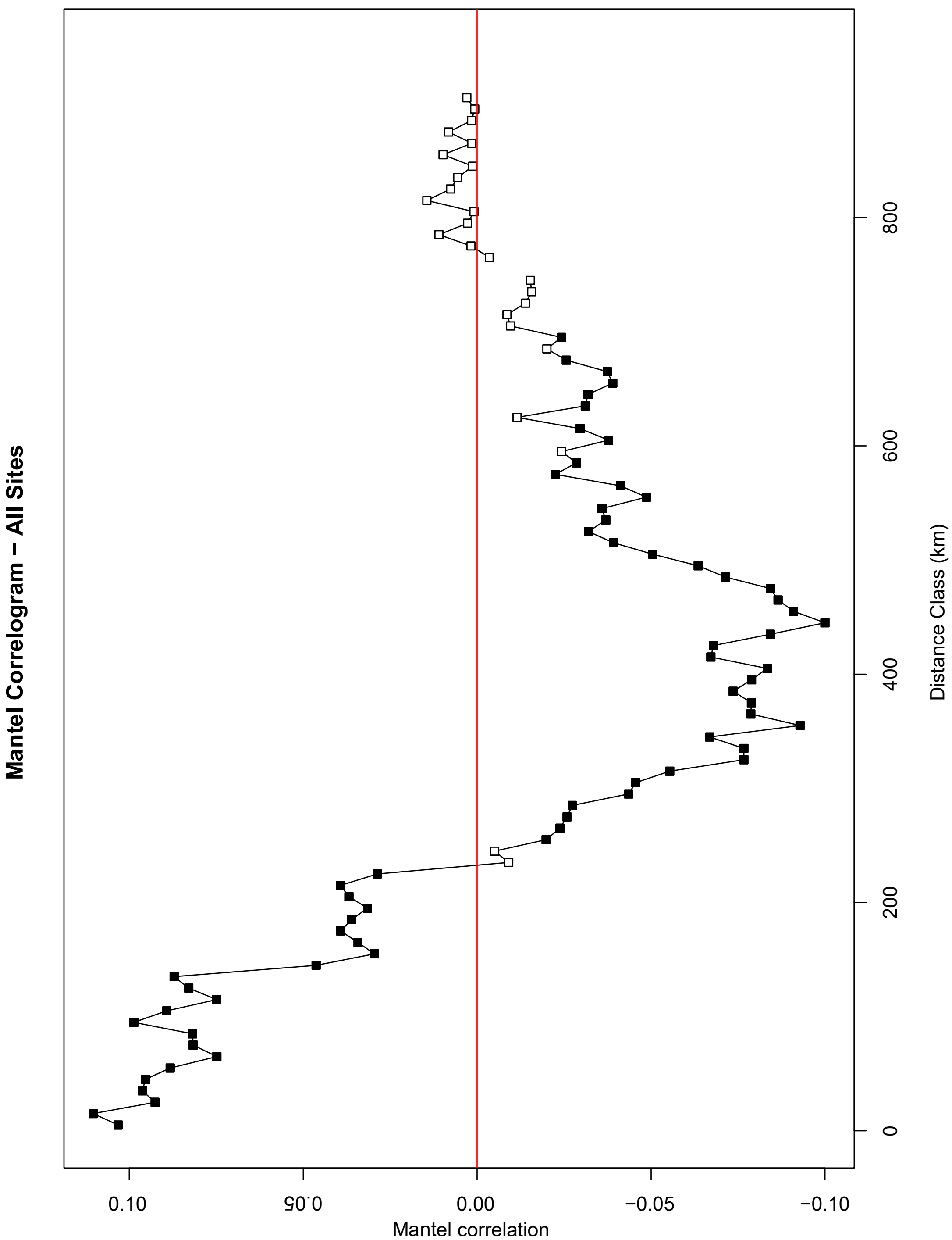


Figure D.5: Mantel Correlogram — All Spatial Groups

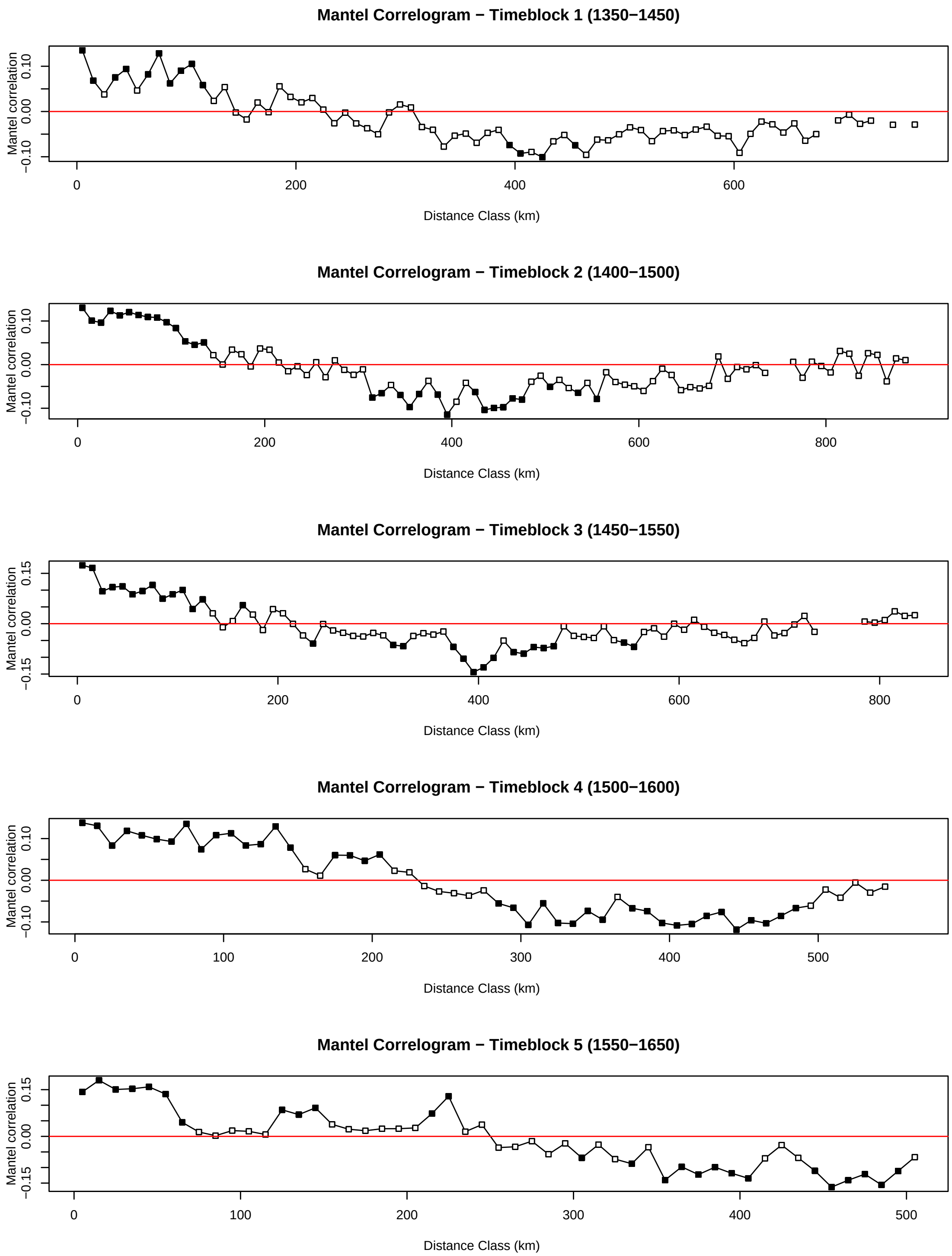


Figure D.6: Mantel Correlogram — All Timeblocks

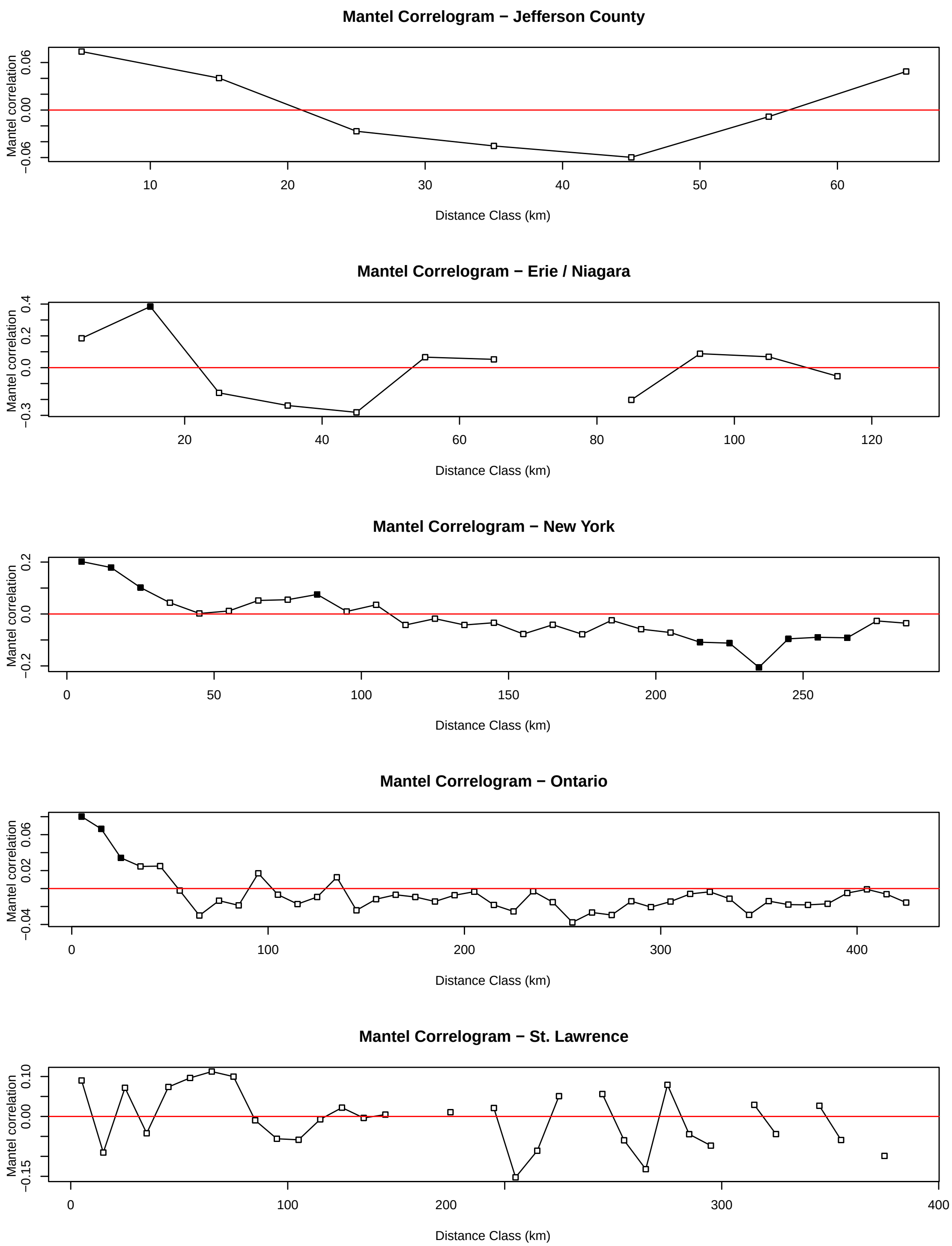


Figure D.7: Mantel Correlogram — All Regional Groups

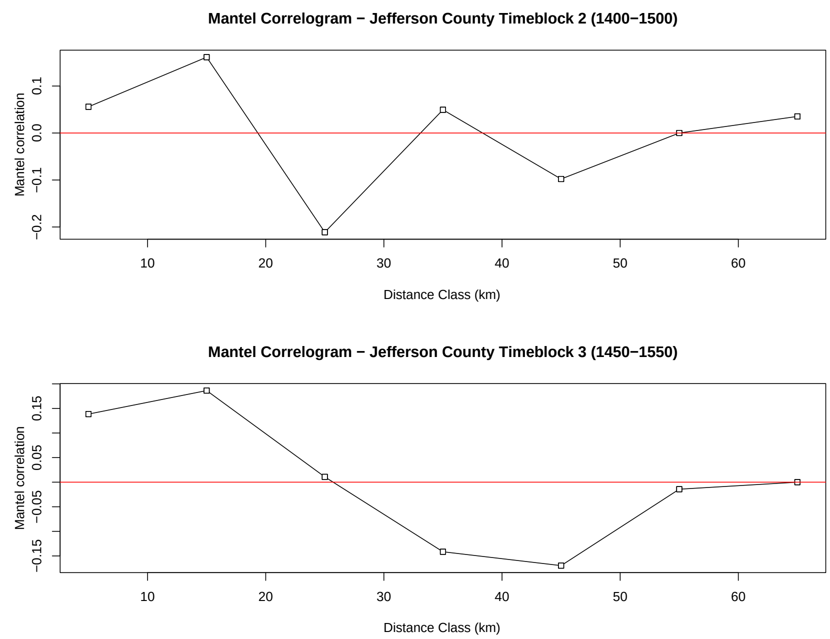


Figure D.8: Mantel Correlogram — Jefferson County Regional Group Timeblocks

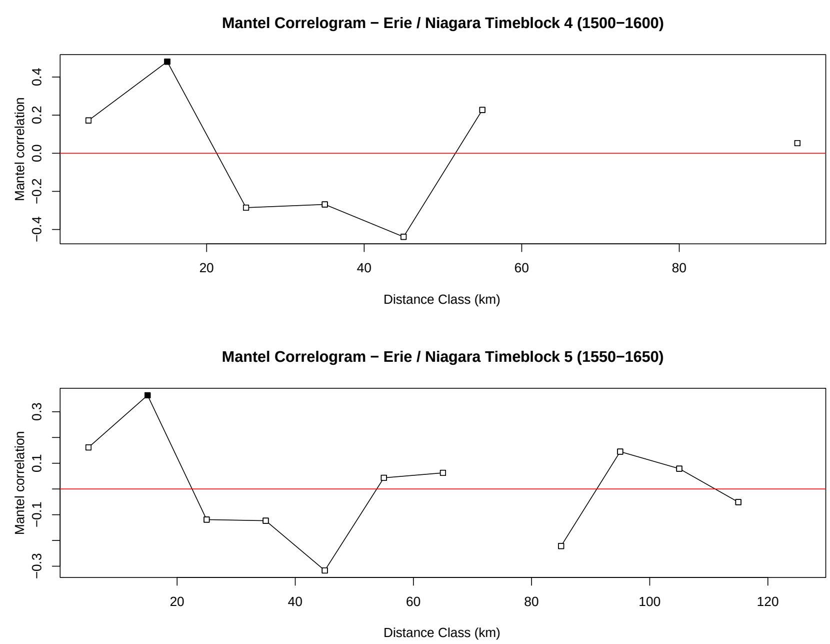


Figure D.9: Mantel Correlogram — Lake Erie / Niagara Regional Group Timeblocks

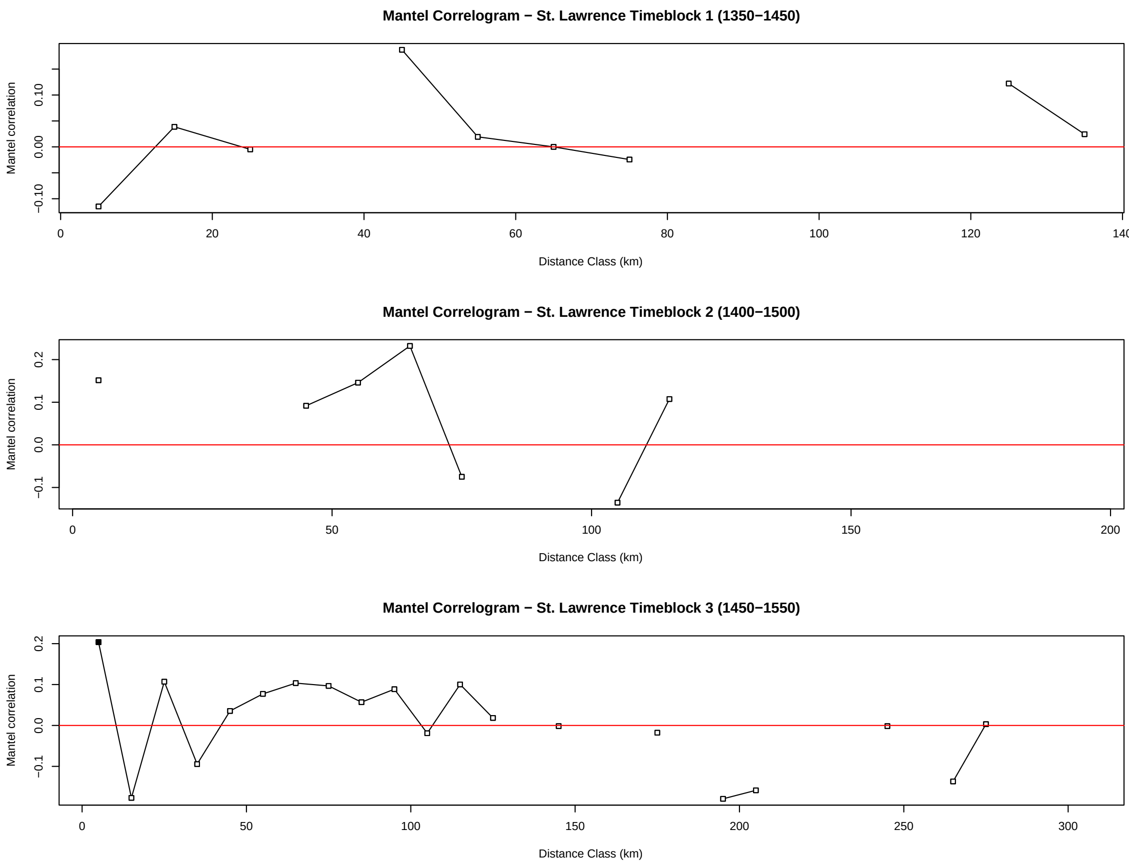


Figure D.10: Mantel Correlogram — St. Lawrence Regional Group Timeblocks

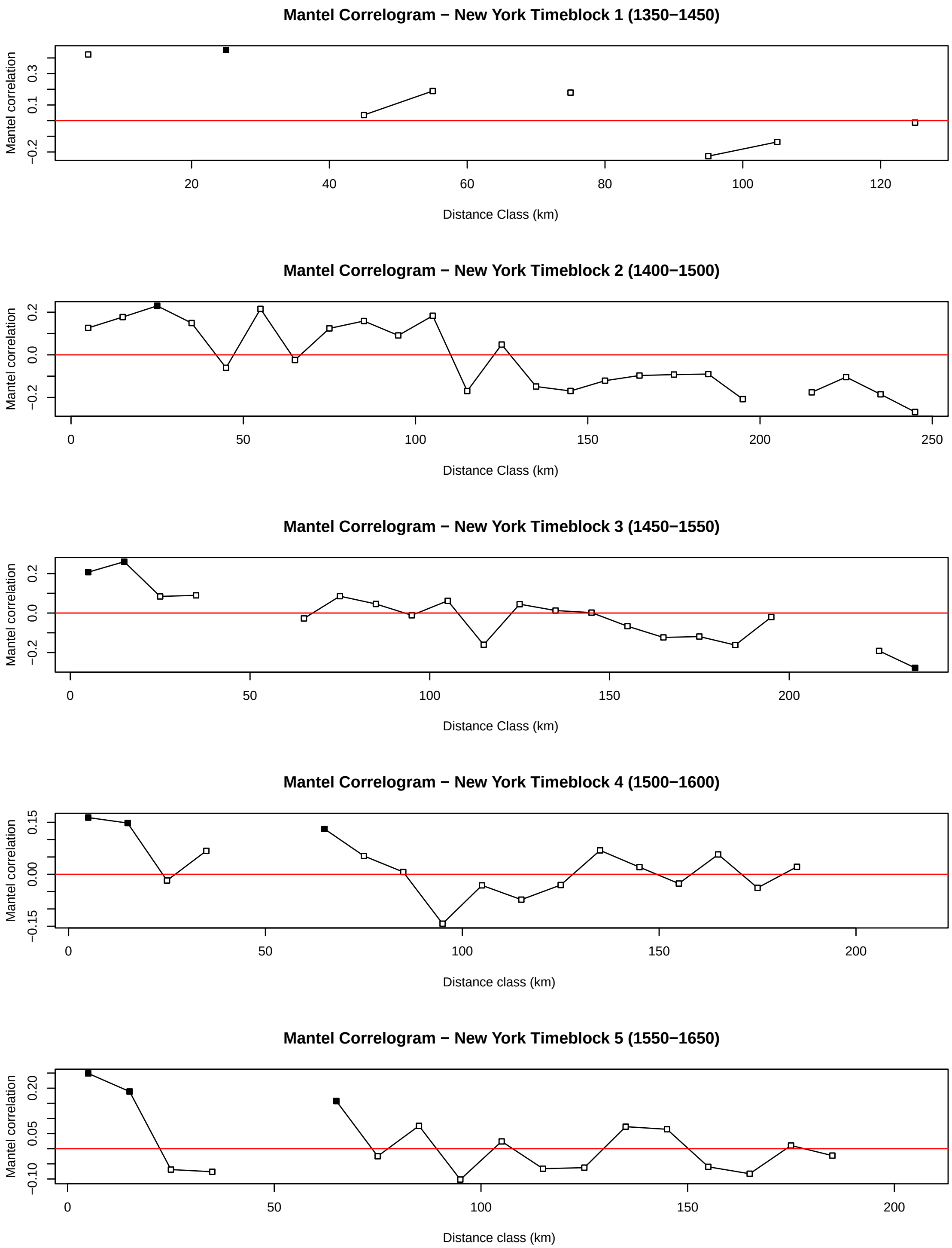


Figure D.11: Mantel Correlogram — New York Regional Group Timeblocks

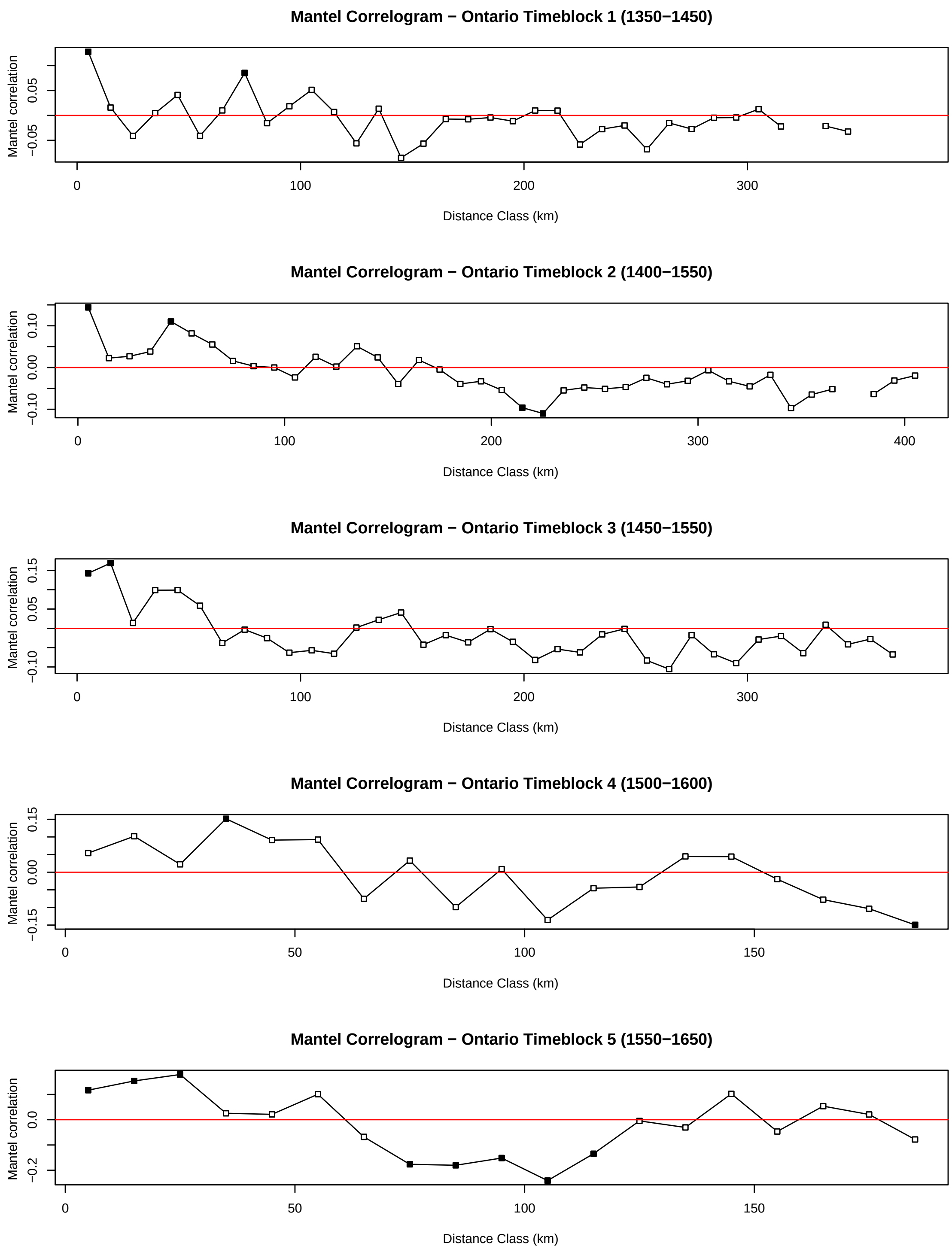


Figure D.12: Mantel Correlogram — Ontario Regional Group Timeblocks

a — All Sites All Timeblocks

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	976	0.103	**0.0001**	**0.0001**
10–20	1170	0.110	**0.0001**	**0.0002**
20–30	1028	0.093	**0.0001**	**0.0003**
30–40	1056	0.096	**0.0001**	**0.0004**
40–50	1072	0.095	**0.0001**	**0.0005**
50–60	1054	0.088	**0.0001**	**0.0006**
60–70	1000	0.075	**0.0001**	**0.0007**
70–80	1092	0.082	**0.0001**	**0.0008**
80–90	1384	0.082	**0.0001**	**0.0009**
90–100	1660	0.099	**0.0001**	**0.001**
100–110	1596	0.089	**0.0001**	**0.001**
110–120	1484	0.075	**0.0001**	**0.001**
120–130	1388	0.083	**0.0001**	**0.001**
130–140	1344	0.087	**0.0001**	**0.001**
140–150	1102	0.046	**0.0001**	**0.001**
150–160	1082	0.029	**0.0004**	**0.002**
160–170	1126	0.034	**0.0002**	**0.002**
170–180	1186	0.039	**0.0001**	**0.002**
180–190	1318	0.036	**0.0004**	**0.002**
190–200	1116	0.031	**0.0005**	**0.002**
200–210	1070	0.037	**0.0001**	**0.002**
210–220	1050	0.039	**0.0001**	**0.002**
220–230	1104	0.029	**0.001**	**0.002**
230–240	1388	-0.009	0.2	0.2
240–250	1154	-0.005	0.3	0.3
250–260	1238	-0.020	**0.01**	**0.04**
260–270	1260	-0.024	**0.004**	**0.02**
270–280	1182	-0.026	**0.002**	**0.01**
280–290	976	-0.027	**0.001**	**0.008**
290–300	1048	-0.044	**0.0001**	**0.003**
300–310	1108	-0.046	**0.0001**	**0.003**
310–320	1144	-0.055	**0.0001**	**0.003**
320–330	1216	-0.077	**0.0001**	**0.003**
330–340	1266	-0.077	**0.0001**	**0.003**
340–350	1134	-0.067	**0.0001**	**0.003**
350–360	1042	-0.093	**0.0001**	**0.004**
360–370	836	-0.079	**0.0001**	**0.004**
370–380	632	-0.079	**0.0001**	**0.004**
380–390	696	-0.074	**0.0001**	**0.004**
390–400	726	-0.079	**0.0001**	**0.004**
400–410	918	-0.083	**0.0001**	**0.004**
410–420	1022	-0.067	**0.0001**	**0.004**
420–430	784	-0.068	**0.0001**	**0.004**
430–440	812	-0.084	**0.0001**	**0.004**
440–450	796	-0.100	**0.0001**	**0.004**
450–460	856	-0.091	**0.0001**	**0.005**
460–470	588	-0.087	**0.0001**	**0.005**
470–480	520	-0.084	**0.0001**	**0.005**
480–490	406	-0.071	**0.0001**	**0.005**
490–500	290	-0.064	**0.0001**	**0.005**
500–510	154	-0.051	**0.0001**	**0.005**
510–520	118	-0.039	**0.0001**	**0.005**
520–530	114	-0.032	**0.0007**	**0.006**
530–540	120	-0.037	**0.0003**	**0.005**
540–550	114	-0.036	**0.0030**	**0.01**
550–560	114	-0.049	**0.0001**	**0.006**
560–570	122	-0.041	**0.0001**	**0.006**
570–580	68	-0.022	**0.004**	**0.02**
580–590	66	-0.029	**0.0009**	**0.009**
590–600	72	-0.024	**0.02**	0.06
600–610	120	-0.038	**0.001**	**0.01**
610–620	70	-0.030	**0.003**	**0.02**
620–630	32	-0.011	0.06	0.2
630–640	46	-0.031	**0.0011**	**0.02**
640–650	44	-0.032	**0.002**	**0.02**
650–660	76	-0.039	**0.004**	**0.03**
660–670	68	-0.037	**0.001**	**0.02**
670–680	42	-0.026	**0.004**	**0.03**
680–690	26	-0.020	**0.01**	0.07
690–700	36	-0.024	**0.004**	**0.04**
700–710	14	-0.010	0.1	0.4
710–720	28	-0.009	0.2	0.5
720–730	28	-0.014	0.1	0.3
730–740	24	-0.016	**0.04**	0.3
740–750	8	-0.015	**0.006**	0.07
750–760	0	—	—	—
760–770	4	-0.003	0.3	0.7
770–780	18	0.002	0.4	0.9
780–790	32	0.011	0.2	1.0
790–800	66	0.003	0.5	1.0
800–810	32	0.001	0.5	1.0
810–820	14	0.014	**0.04**	0.5
820–830	34	0.008	0.3	1.0
830–840	18	0.006	0.3	1.0
840–850	8	0.001	0.4	1.0
850–860	10	0.010	0.1	1.0
860–870	14	0.002	0.4	1.0
870–880	10	0.008	0.2	1.0
880–890	14	0.002	0.5	1.0
890–900	8	0.001	0.5	1.0
900–910	4	0.003	0.3	1.0
910–920	0	—	—	—
920–930	0	—	—	—
930–940	0	—	—	—
940–950	0	—	—	—
950–960	2	-0.001	0.5	—
960–970	0	—	—	—
970–980	0	—	—	—
980–990	4	0.001	0.4	—
990–1000	4	0.002	0.4	—
1000–1010	2	0.002	0.4	—
1010–1020	0	—	—	—
1020–1030	4	0.003	0.4	—

b — All Sites Timeblock 1 (1350-1450)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	154	0.135	**0.0001**	**0.0001**
10–20	130	0.068	**0.003**	**0.003**
20–30	144	0.038	0.07	0.07
30–40	158	0.075	**0.002**	**0.007**
40–50	142	0.094	**0.0004**	**0.002**
50–60	148	0.046	**0.04**	0.09
60–70	198	0.082	**0.006**	**0.02**
70–80	182	0.129	**0.0001**	**0.001**
80–90	158	0.062	**0.007**	**0.02**
90–100	226	0.090	**0.001**	**0.005**
100–110	214	0.105	**0.0001**	**0.001**
110–120	158	0.058	**0.007**	**0.028**
120–130	136	0.024	0.2	0.2
130–140	156	0.054	**0.01**	0.1
140–150	124	-0.002	0.5	0.5
150–160	126	-0.018	0.2	0.5
160–170	60	0.020	0.2	0.7
170–180	74	-0.002	0.5	0.9
180–190	126	0.056	**0.02**	0.1
190–200	98	0.032	0.1	0.5
200–210	88	0.020	0.2	1.0
210–220	94	0.030	0.1	0.7
220–230	76	0.004	0.4	1.0
230–240	98	-0.026	0.2	1.0
240–250	56	-0.003	0.4	1.0
250–260	96	-0.026	0.2	1.0
260–270	102	-0.037	0.1	1.0
270–280	104	-0.050	**0.02**	0.3
280–290	90	-0.002	0.5	1.0
290–300	126	0.016	0.3	1.0
300–310	94	0.009	0.4	1.0
310–320	158	-0.034	0.1	1.0
320–330	96	-0.040	0.1	1.0
330–340	84	-0.078	**0.002**	0.06
340–350	54	-0.053	**0.01**	0.3
350–360	40	-0.049	**0.02**	0.5
360–370	56	-0.069	**0.003**	0.1
370–380	20	-0.047	**0.02**	0.5
380–390	54	-0.040	**0.04**	0.8
390–400	56	-0.074	**0.0001**	**0.004**
400–410	104	-0.093	**0.001**	**0.045**
410–420	138	-0.089	**0.002**	0.07
420–430	108	-0.101	**0.0002**	**0.01**
430–440	74	-0.066	**0.01**	0.3
440–450	38	-0.052	**0.01**	0.3
450–460	48	-0.075	**0.0008**	**0.03**
460–470	88	-0.096	**0.002**	0.08
470–480	64	-0.062	**0.01**	0.3
480–490	34	-0.064	**0.007**	0.2
490–500	14	-0.050	**0.007**	0.2
500–510	6	-0.035	**0.03**	0.6
510–520	10	-0.041	**0.02**	0.6
520–530	20	-0.066	**0.003**	0.1
530–540	20	-0.043	0.1	1.0
540–550	24	-0.042	0.1	1.0
550–560	8	-0.052	**0.002**	0.08
560–570	18	-0.040	**0.03**	0.8
570–580	22	-0.034	0.06	1.0
580–590	18	-0.054	**0.007**	0.3
590–600	30	-0.055	**0.02**	0.5
600–610	48	-0.091	**0.007**	0.3
610–620	10	-0.049	**0.003**	0.2
620–630	2	-0.022	0.2	1.0
630–640	2	-0.028	0.07	1.0
640–650	6	-0.047	**0.02**	0.7
650–660	2	-0.026	0.1	1.0
660–670	12	-0.064	**0.02**	0.6
670–680	8	-0.050	**0.03**	0.9
680–690	0	—	—	—
690–700	2	-0.020	0.2	1.0
700–710	2	-0.007	0.4	1.0
710–720	2	-0.027	**0.09**	1.0
720–730	2	-0.020	0.2	1.0
730–740	0	—	—	—
740–750	2	-0.029	0.06	1.0
750–760	0	—	—	—
760–770	2	-0.029	0.07	1.0
770–780	4	-0.039	**0.03**	—
780–790	0	—	—	—
790–800	2	-0.028	0.07	—
800–810	2	-0.031	**0.03**	—

c — All Sites Timeblock 2 (1400-1500)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	146	0.130	**0.0001**	**0.0001**
10–20	112	0.101	**0.0001**	**0.0002**
20–30	128	0.096	**0.0001**	**0.0003**
30–40	176	0.123	**0.0001**	**0.0004**
40–50	110	0.113	**0.0001**	**0.0005**
50–60	124	0.120	**0.0001**	**0.0006**
60–70	160	0.114	**0.0001**	**0.0007**
70–80	140	0.109	**0.0001**	**0.0008**
80–90	148	0.108	**0.0001**	**0.0009**
90–100	184	0.097	**0.0001**	**0.001**
100–110	168	0.084	**0.0001**	**0.001**
110–120	164	0.053	**0.003**	**0.003**
120–130	178	0.045	**0.01**	**0.01**
130–140	200	0.051	**0.007**	**0.01**
140–150	132	0.022	0.1	0.1
150–160	190	0.000	0.5	0.5
160–170	194	0.034	0.06	0.2
170–180	220	0.024	0.1	0.4
180–190	186	-0.004	0.4	0.8
190–200	128	0.037	**0.03**	0.2
200–210	148	0.034	0.052	0.3
210–220	132	0.005	0.4	1.0
220–230	146	-0.015	0.2	1.0
230–240	162	-0.004	0.4	1.0
240–250	134	-0.024	0.1	0.8
250–260	196	0.005	0.4	1.0
260–270	238	-0.029	0.08	0.8
270–280	186	0.010	0.3	1.0
280–290	118	-0.012	0.3	1.0
290–300	232	-0.023	0.1	1.0
300–310	120	-0.011	0.3	1.0
310–320	240	-0.075	**0.0004**	**0.008**
320–330	130	-0.065	**0.0006**	0.01
330–340	150	-0.047	**0.007**	0.1
340–350	114	-0.070	**0.0002**	**0.005**
350–360	122	-0.097	**0.0001**	**0.004**
360–370	112	-0.067	**0.002**	**0.04**
370–380	58	-0.037	**0.03**	0.5
380–390	78	-0.069	**0.0003**	**0.008**
390–400	96	-0.115	**0.0001**	**0.004**
400–410	154	-0.085	**0.003**	**0.06**
410–420	142	-0.042	0.06	1.0
420–430	78	-0.063	**0.0005**	**0.01**
430–440	84	-0.104	**0.0001**	**0.004**
440–450	88	-0.099	**0.0001**	**0.004**
450–460	74	-0.098	**0.0001**	**0.005**
460–470	46	-0.077	**0.0001**	**0.005**
470–480	48	-0.080	**0.0001**	**0.005**
480–490	12	-0.039	**0.02**	0.4
490–500	12	-0.025	0.09	1.0
500–510	16	-0.051	**0.001**	**0.04**
510–520	16	-0.035	**0.03**	0.6
520–530	22	-0.054	**0.003**	0.1
530–540	18	-0.065	**0.0001**	**0.01**
540–550	10	-0.042	**0.01**	0.3
550–560	22	-0.079	**0.0001**	0.0
560–570	16	-0.018	0.2	1.0
570–580	22	-0.040	**0.02**	0.5
580–590	18	-0.046	**0.01**	0.3
590–600	18	-0.050	**0.02**	0.4
600–610	40	-0.060	**0.01**	0.3
610–620	22	-0.038	0.06	1.0
620–630	10	-0.009	0.3	1.0
630–640	8	-0.024	0.1	1.0
640–650	18	-0.058	**0.004**	0.1
650–660	18	-0.052	**0.02**	0.6
660–670	20	-0.055	**0.04**	0.8
670–680	12	-0.049	**0.005**	0.2
680–690	4	0.019	0.2	1.0
690–700	14	-0.032	0.07	1.0
700–710	4	-0.006	0.4	1.0
710–720	8	-0.011	0.3	1.0
720–730	4	-0.001	0.5	1.0
730–740	8	-0.019	0.2	1.0
740–750	0	—	—	—
750–760	0	—	—	—
760–770	2	0.006	0.4	1.0
770–780	6	-0.030	**0.049**	1.0
780–790	18	0.007	0.4	1.0
790–800	14	-0.003	0.4	1.0
800–810	8	-0.018	0.2	1.0
810–820	10	0.031	0.08	1.0
820–830	14	0.025	0.1	1.0
830–840	6	-0.026	0.08	1.0
840–850	2	0.026	**0.046**	1.0
850–860	4	0.022	0.1	1.0
860–870	4	-0.038	**0.008**	0.4
870–880	2	0.014	0.3	1.0
880–890	4	0.010	0.3	1.0
890–900	0	—	—	—
900–910	0	—	—	—
910–920	0	—	—	—
920–930	0	—	—	—
930–940	0	—	—	—
940–950	0	—	—	—
950–960	0	—	—	—
960–970	0	—	—	—
970–980	0	—	—	—
980–990	2	0.000	0.5	—
990–1000	4	0.001	0.5	—
1000–1010	0	—	—	—
1010–1020	0	—	—	—
1020–1030	4	0.002	0.5	—

d — All Sites Timeblock 3 (1450-1550)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	220	0.174	**0.0001**	**0.0001**
10–20	180	0.166	**0.0001**	**0.0002**
20–30	106	0.097	**0.0001**	**0.0003**
30–40	122	0.109	**0.0001**	**0.0004**
40–50	96	0.111	**0.0001**	**0.0005**
50–60	56	0.088	**0.0001**	**0.0006**
60–70	130	0.097	**0.0001**	**0.0007**
70–80	154	0.115	**0.0001**	**0.0008**
80–90	176	0.074	**0.0001**	**0.0009**
90–100	208	0.088	**0.0001**	**0.001**
100–110	232	0.101	**0.0001**	**0.001**
110–120	126	0.044	**0.01**	**0.01**
120–130	172	0.073	**0.0002**	**0.001**
130–140	142	0.031	0.06	0.06
140–150	128	-0.011	0.3	0.3
150–160	154	0.008	0.3	0.6
160–170	208	0.055	**0.002**	**0.01**
170–180	230	0.027	0.1	0.2
180–190	188	-0.019	0.2	0.5
190–200	196	0.043	**0.02**	0.1
200–210	146	0.031	0.1	0.3
210–220	146	-0.001	0.5	0.9
220–230	150	-0.035	**0.04**	0.3
230–240	178	-0.059	**0.001**	**0.02**
240–250	164	-0.001	0.5	1.0
250–260	196	-0.020	0.1	0.8
260–270	272	-0.027	0.1	0.7
270–280	210	-0.036	**0.03**	0.4
280–290	170	-0.038	**0.02**	0.3
290–300	202	-0.028	0.1	0.7
300–310	132	-0.035	**0.03**	0.4
310–320	152	-0.063	**0.002**	**0.04**
320–330	266	-0.067	**0.001**	**0.02**
330–340	174	-0.037	**0.04**	**0.5**
340–350	116	-0.028	0.1	0.7
350–360	86	-0.033	**0.047**	0.6
360–370	82	-0.023	0.1	0.9
370–380	62	-0.069	**0.0001**	**0.004**
380–390	82	-0.104	**0.0001**	**0.004**
390–400	112	-0.144	**0.0001**	**0.004**
400–410	146	-0.130	**0.0001**	**0.004**
410–420	186	-0.102	**0.0001**	**0.004**
420–430	98	-0.050	**0.01**	0.2
430–440	100	-0.085	**0.0001**	**0.004**
440–450	72	-0.089	**0.0001**	**0.004**
450–460	82	-0.070	**0.0002**	**0.006**
460–470	40	-0.073	**0.0001**	**0.005**
470–480	28	-0.067	**0.0002**	**0.006**
480–490	18	-0.008	0.3	1.0
490–500	28	-0.036	**0.045**	0.7
500–510	32	-0.039	**0.04**	0.7
510–520	20	-0.043	**0.02**	0.4
520–530	16	-0.008	0.3	1.0
530–540	10	-0.049	**0.01**	0.2
540–550	10	-0.056	**0.0004**	**0.01**
550–560	18	-0.069	**0.0006**	**0.02**
560–570	10	-0.025	0.08	1.0
570–580	4	-0.014	0.2	1.0
580–590	18	-0.039	**0.03**	0.7
590–600	2	0.000	0.5	1.0
600–610	14	-0.018	0.2	1.0
610–620	10	0.012	0.3	1.0
620–630	14	-0.009	0.3	1.0
630–640	8	-0.027	0.1	1.0
640–650	10	-0.033	**0.045**	1.0
650–660	14	-0.048	**0.01**	0.2
660–670	24	-0.058	**0.01**	0.3
670–680	20	-0.042	**0.02**	0.8
680–690	6	0.007	0.4	1.0
690–700	10	-0.035	**0.04**	1.0
700–710	4	-0.028	**0.04**	1.0
710–720	8	-0.002	0.4	1.0
720–730	2	0.023	0.09	1.0
730–740	8	-0.024	0.1	1.0
740–750	0	—	—	—
750–760	0	—	—	—
760–770	0	—	—	—
770–780	0	—	—	—
780–790	6	0.006	0.4	1.0
790–800	14	0.003	0.5	1.0
800–810	4	0.011	0.3	1.0
810–820	8	0.037	**0.03**	1.0
820–830	16	0.023	0.2	1.0
830–840	10	0.025	0.1	1.0
840–850	0	—	—	—
850–860	0	—	—	—
860–870	6	0.007	0.3	—
870–880	0	—	—	—
880–890	0	—	—	—
890–900	2	0.017	0.2	—
900–910	0	—	—	—
910–920	0	—	—	—
920–930	0	—	—	—
930–940	0	—	—	—
940–950	0	—	—	—
950–960	0	—	—	—
960–970	0	—	—	—
970–980	0	—	—	—
980–990	0	—	—	—
990–1000	2	0.005	0.4	—
1000–1010	0	—	—	—
1010–1020	0	—	—	—
1020–1030	2	0.009	0.3	—

e — All Sites Timeblock 4 (1500-1600)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	184	0.138	**0.0001**	**0.0001**
10–20	148	0.131	**0.0001**	**0.0002**
20–30	86	0.083	**0.0001**	**0.0003**
30–40	68	0.118	**0.0001**	**0.0004**
40–50	64	0.108	**0.0001**	**0.0005**
50–60	44	0.099	**0.0001**	**0.0006**
60–70	94	0.093	**0.0001**	**0.0007**
70–80	134	0.135	**0.0001**	**0.0008**
80–90	142	0.074	**0.0002**	**0.0009**
90–100	192	0.108	**0.0001**	**0.001**
100–110	220	0.113	**0.0001**	**0.001**
110–120	144	0.084	**0.0001**	**0.001**
120–130	112	0.087	**0.0001**	**0.001**
130–140	128	0.129	**0.0001**	**0.001**
140–150	88	0.078	**0.0002**	**0.001**
150–160	128	0.027	0.1	0.1
160–170	130	0.011	0.3	0.3
170–180	110	0.060	**0.003**	**0.01**
180–190	108	0.060	**0.002**	**0.009**
190–200	110	0.047	**0.01**	**0.03**
200–210	132	0.062	**0.002**	**0.01**
210–220	130	0.023	0.1	0.3
220–230	132	0.019	0.2	0.5
230–240	160	-0.014	0.2	0.6
240–250	184	-0.027	0.1	0.6
250–260	160	-0.031	0.09	0.6
260–270	132	-0.037	**0.04**	0.3
270–280	78	-0.024	0.1	0.7
280–290	118	-0.056	**0.003**	**0.03**
290–300	112	-0.066	**0.001**	**0.02**
300–310	128	-0.107	**0.0001**	**0.003**
310–320	88	-0.055	**0.003**	**0.04**
320–330	190	-0.103	**0.0001**	**0.003**
330–340	206	-0.104	**0.0001**	**0.003**
340–350	152	-0.074	**0.0002**	**0.004**
350–360	122	-0.095	**0.0001**	**0.004**
360–370	80	-0.040	**0.04**	0.4
370–380	60	-0.067	**0.0003**	**0.005**
380–390	90	-0.074	**0.0006**	**0.01**
390–400	116	-0.103	**0.0001**	**0.004**
400–410	100	-0.108	**0.0001**	**0.004**
410–420	90	-0.105	**0.0001**	**0.004**
420–430	110	-0.085	**0.0002**	**0.005**
430–440	94	-0.076	**0.0006**	**0.01**
440–450	86	-0.118	**0.0001**	**0.004**
450–460	98	-0.096	**0.0003**	**0.006**
460–470	54	-0.103	**0.0001**	**0.005**
470–480	54	-0.085	**0.0003**	**0.007**
480–490	64	-0.067	**0.002**	**0.04**
490–500	44	-0.061	**0.007**	**0.09**
500–510	24	-0.022	0.2	0.8
510–520	12	-0.042	**0.03**	0.4
520–530	2	-0.005	0.4	0.9
530–540	8	-0.030	0.08	0.8
540–550	2	-0.015	0.3	1.0
550–560	0	—	—	—
560–570	0	—	—	—
570–580	4	-0.033	0.052	—
580–590	0	—	—	—
590–600	0	—	—	—
600–610	2	-0.016	0.3	—

f — All Sites Timeblock 5 (1500-1600)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	222	0.143	**0.0001**	**0.0001**
10–20	180	0.180	**0.0001**	**0.0002**
20–30	144	0.150	**0.0001**	**0.0003**
30–40	166	0.153	**0.0001**	**0.0004**
40–50	186	0.159	**0.0001**	**0.0005**
50–60	102	0.136	**0.0001**	**0.0006**
60–70	32	0.045	**0.03**	**0.03**
70–80	70	0.014	0.3	0.3
80–90	112	0.002	0.5	0.6
90–100	130	0.018	0.2	0.7
100–110	142	0.016	0.3	0.9
110–120	110	0.006	0.4	1.0
120–130	112	0.085	**0.0009**	**0.01**
130–140	124	0.070	**0.005**	**0.03**
140–150	76	0.092	**0.0001**	**0.001**
150–160	102	0.039	0.06	0.4
160–170	64	0.023	0.2	1.0
170–180	94	0.018	0.3	1.0
180–190	74	0.025	0.2	1.0
190–200	72	0.025	0.2	1.0
200–210	134	0.027	0.2	1.0
210–220	96	0.073	**0.002**	**0.03**
220–230	144	0.129	**0.0001**	**0.002**
230–240	162	0.015	0.3	1.0
240–250	186	0.038	0.06	0.8
250–260	212	-0.036	0.1	1.0
260–270	138	-0.033	0.1	1.0
270–280	116	-0.015	0.3	1.0
280–290	140	-0.057	**0.02**	0.4
290–300	48	-0.023	0.2	1.0
300–310	24	-0.069	**0.002**	**0.04**
310–320	22	-0.027	0.1	1.0
320–330	34	-0.073	**0.004**	0.08
330–340	90	-0.088	**0.0005**	**0.01**
340–350	56	-0.035	0.06	1.00
350–360	116	-0.140	**0.0001**	**0.004**
360–370	106	-0.098	**0.0002**	**0.006**
370–380	76	-0.123	**0.0001**	**0.004**
380–390	124	-0.099	**0.0001**	**0.004**
390–400	116	-0.118	**0.0001**	**0.004**
400–410	64	-0.135	**0.0001**	**0.004**
410–420	18	-0.071	**0.006**	0.1
420–430	4	-0.028	0.1	1.0
430–440	22	-0.069	0.01	0.2
440–450	54	-0.111	**0.0001**	**0.004**
450–460	112	-0.163	**0.0001**	**0.005**
460–470	80	-0.141	**0.0001**	**0.005**
470–480	72	-0.121	**0.0001**	**0.005**
480–490	128	-0.156	**0.0001**	**0.005**
490–500	82	-0.111	**0.0001**	**0.005**
500–510	22	-0.067	**0.004**	0.1

Table D.2: Mantel Correlogram Test Statistics — All Sites and Timeblocks

a Jefferson County All Timeblocks

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	50	0.074	0.2	0.2
10–20	56	0.040	0.3	0.3
20–30	54	-0.027	0.4	0.6
30–40	92	-0.045	0.3	0.9
40–50	36	-0.060	0.2	1.0
50–60	8	-0.008	0.4	1.0
60–70	10	0.049	0.3	1.0

b Lake Erie / Niagara All Timeblocks

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	20	0.185	0.09	0.09
10–20	24	0.384	**0.002**	**0.003**
20–30	14	-0.158	0.1	0.2
30–40	14	-0.238	**0.03**	0.1
40–50	24	-0.281	**0.02**	0.1
50–60	28	0.066	0.3	0.3
60–70	4	0.052	0.3	0.6
70–80	0	—	—	—
80–90	8	-0.203	**0.04**	0.2
90–100	8	0.088	0.3	0.9
100–110	4	0.068	0.3	1.0
110–120	4	-0.054	0.3	1.0
120–130	0	—	—	—
130–140	2	0.084	0.3	—
140–150	2	-0.051	0.4	—

c New York All Timeblocks

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	286	0.202	**0.0001**	**0.0001**
10–20	266	0.179	**0.0001**	**0.0002**
20–30	164	0.102	**0.0002**	**0.0003**
30–40	66	0.043	0.06	0.06
40–50	72	0.002	0.5	0.5
50–60	42	0.012	0.4	0.7
60–70	34	0.052	**0.03**	0.1
70–80	86	0.055	**0.03**	0.2
80–90	122	0.075	**0.01**	**0.03**
90–100	174	0.010	0.4	1.0
100–110	150	0.035	0.1	0.4
110–120	164	-0.042	0.1	0.4
120–130	178	-0.018	0.3	1.0
130–140	154	-0.042	0.1	0.5
140–150	106	-0.034	0.1	0.6
150–160	106	-0.077	0.01	0.1
160–170	94	-0.041	0.09	0.7
170–180	40	-0.078	**0.005**	0.1
180–190	26	-0.024	0.2	1.0
190–200	20	-0.058	**0.02**	0.3
200–210	16	-0.071	**0.006**	0.1
210–220	28	-0.109	**0.0003**	**0.006**
220–230	26	-0.112	**0.0001**	**0.002**
230–240	74	-0.206	**0.0001**	**0.002**
240–250	118	-0.096	**0.002**	**0.03**
250–260	146	-0.090	**0.002**	**0.047**
260–270	82	-0.092	**0.002**	**0.046**
270–280	20	-0.027	0.2	1.0
280–290	2	-0.035	0.1	0.9

d Ontario All Timeblocks

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	550	0.080	**0.0001**	**0.0001**
10–20	792	0.066	**0.0003**	**0.0003**
20–30	760	0.034	**0.02**	**0.02**
30–40	860	0.025	0.08	0.08
40–50	902	0.025	0.1	0.2
50–60	910	-0.002	0.5	0.5
60–70	884	-0.030	0.1	0.2
70–80	880	-0.013	0.2	0.5
80–90	1002	-0.019	0.1	0.4
90–100	1154	0.017	0.1	0.5
100–110	1088	-0.007	0.3	0.7
110–120	900	-0.017	0.1	0.8
120–130	618	-0.009	0.3	0.9
130–140	560	0.013	0.2	1.0
140–150	528	-0.024	0.1	0.9
150–160	410	-0.012	0.2	1.0
160–170	320	-0.007	0.3	1.0
170–180	260	-0.009	0.3	1.0
180–190	336	-0.014	0.2	1.0
190–200	240	-0.007	0.3	1.0
200–210	236	-0.004	0.4	1.0
210–220	258	-0.018	0.2	1.0
220–230	290	-0.026	0.1	1.0
230–240	162	-0.003	0.4	1.0
240–250	100	-0.015	0.2	1.0
250–260	158	-0.038	0.1	1.0
260–270	88	-0.027	0.1	1.0
270–280	54	-0.029	0.052	1.0
280–290	50	-0.014	0.2	1.0
290–300	40	-0.021	0.1	1.0
300–310	28	-0.015	0.1	1.0
310–320	18	-0.006	0.3	1.0
320–330	10	-0.004	0.4	1.0
330–340	8	-0.011	0.2	1.0
340–350	18	-0.029	**0.02**	0.5
350–360	6	-0.014	0.1	1.0
360–370	2	-0.018	0.0	1.0
370–380	2	-0.018	**0.04**	1.0
380–390	8	-0.017	0.09	1.0
390–400	2	-0.005	0.4	1.0
400–410	2	-0.001	0.5	1.0
410–420	2	-0.006	0.3	1.0
420–430	4	-0.016	0.1	1.0

e St. Lawrence All Timeblocks

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	70	0.090	0.1	0.1
10–20	32	-0.090	0.09	0.2
20–30	30	0.072	0.2	0.3
30–40	14	-0.042	0.3	0.4
40–50	18	0.074	0.1	0.5
50–60	32	0.096	0.08	0.5
60–70	10	0.112	**0.03**	0.2
70–80	32	0.100	0.06	0.4
80–90	46	-0.010	0.4	0.6
90–100	24	-0.056	0.2	0.7
100–110	44	-0.059	0.2	0.8
110–120	8	-0.007	0.5	1.0
120–130	18	0.022	0.4	1.0
130–140	2	-0.004	0.5	1.0
140–150	20	0.005	0.5	1.0
150–160	0	—	—	—
160–170	0	—	—	—
170–180	10	0.011	0.5	1.0
180–190	0	—	—	—
190–200	12	0.021	0.4	1.0
200–210	8	-0.153	**0.01**	0.2
210–220	12	-0.086	0.1	1.0
220–230	8	0.051	0.3	1.0
230–240	0	—	—	—
240–250	6	0.056	0.2	1.0
250–260	8	-0.060	0.2	1.0
260–270	14	-0.132	**0.046**	1.0
270–280	4	0.079	0.1	1.0
280–290	4	-0.045	0.3	1.0
290–300	4	-0.073	0.2	1.0
300–310	0	—	—	—
310–320	8	0.029	0.3	1.0
320–330	2	-0.044	0.3	1.0
330–340	0	—	—	—
340–350	6	0.027	0.4	1.0
350–360	2	-0.059	0.2	1.0
360–370	0	—	—	—
370–380	6	-0.099	0.06	1.0
380–390	0	—	—	—
390–400	0	—	—	—
400–410	0	—	—	—
410–420	0	—	—	—
420–430	0	—	—	—
430–440	0	—	—	—
440–450	6	-0.012	0.4	—
450–460	12	0.050	0.3	—
460–470	4	-0.075	0.2	—
470–480	0	—	—	—
480–490	0	—	—	—
490–500	2	-0.076	0.1	—
500–510	2	0.034	0.3	—
510–520	0	—	—	—
520–530	6	0.027	0.4	—
530–540	2	-0.104	**0.004**	—
540–550	0	—	—	—
550–560	0	—	—	—
560–570	4	-0.049	0.2	—

f New York Timeblock 1 (1350-1450)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	6	0.422	0.09	0.09
10–20	0	—	—	—
20–30	6	0.451	**0.02**	**0.04**
30–40	0	—	—	—
40–50	2	0.036	0.5	0.5
50–60	4	0.189	0.2	0.3
60–70	0	—	—	—
70–80	6	0.179	0.3	0.5
80–90	0	—	—	—
90–100	2	-0.227	0.2	0.7
100–110	6	-0.136	0.2	0.9
110–120	0	—	—	—
120–130	8	-0.013	0.5	1.0
130–140	0	—	—	—
140–150	0	—	—	—
150–160	6	-0.329	0.1	—
160–170	0	—	—	—
170–180	4	-0.395	**0.01**	—
180–190	0	—	—	—
190–200	0	—	—	—
200–210	0	—	—	—
210–220	0	—	—	—
220–230	2	-0.274	0.1	—
230–240	2	-0.072	0.4	—
240–250	0	—	—	—
250–260	0	—	—	—
260–270	0	—	—	—
270–280	0	—	—	—
280–290	2	-0.131	0.3	—

g Ontario Timeblock 1 (1350-1450)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	132	0.128	**0.0006**	**0.0006**
10–20	118	0.016	0.3	0.3
20–30	128	-0.041	0.1	0.2
30–40	154	0.005	0.4	0.6
40–50	138	0.041	0.1	0.4
50–60	134	-0.041	0.1	0.5
60–70	190	0.010	0.4	0.9
70–80	174	0.085	**0.004**	**0.03**
80–90	156	-0.015	0.3	1.0
90–100	214	0.018	0.3	1.0
100–110	202	0.051	0.1	0.6
110–120	136	0.007	0.4	1.0
120–130	120	-0.056	**0.04**	0.5
130–140	130	0.014	0.3	1.0
140–150	92	-0.085	**0.01**	0.1
150–160	82	-0.057	0.1	0.7
160–170	40	-0.007	0.4	1.0
170–180	36	-0.008	0.4	1.0
180–190	86	-0.004	0.4	1.0
190–200	58	-0.012	0.4	1.0
200–210	60	0.010	0.4	1.0
210–220	54	0.010	0.4	1.0
220–230	50	-0.058	**0.049**	0.9
230–240	32	-0.027	0.2	1.0
240–250	20	-0.020	0.3	1.0
250–260	38	-0.068	0.1	1.0
260–270	14	-0.015	0.3	1.0
270–280	12	-0.027	0.2	1.0
280–290	22	-0.005	0.4	1.0
290–300	12	-0.004	0.4	1.0
300–310	6	0.013	0.3	1.0
310–320	6	-0.022	0.2	1.0
320–330	0	—	—	—
330–340	4	-0.021	0.2	1.0
340–350	2	-0.032	0.1	1.0
350–360	0	—	—	—
360–370	0	—	—	—
370–380	0	—	—	—
380–390	4	-0.002	0.5	—
390–400	2	-0.016	0.3	—
400–410	0	—	—	—
410–420	2	-0.019	0.3	—
420–430	2	-0.029	0.2	—

h St. Lawrence Timeblock 1 (1350-1450)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	14	-0.115	0.3	0.3
10–20	10	0.039	0.4	0.5
20–30	6	-0.005	0.5	0.8
30–40	0	—	—	—
40–50	2	0.187	0.2	0.8
50–60	6	0.019	0.5	1.0
60–70	4	0	0.5	1.0
70–80	2	-0.024	0.5	1.0
80–90	0	—	—	—
90–100	0	—	—	—
100–110	0	—	—	—
110–120	0	—	—	—
120–130	2	0.122	0.3	1.0
130–140	2	0.024	0.5	1.0
140–150	2	-0.013	0.5	—
150–160	0	—	—	—
160–170	0	—	—	—
170–180	0	—	—	—
180–190	0	—	—	—
190–200	4	0.164	0.2	—
200–210	6	-0.324	**0.04**	—
210–220	4	0.047	0.4	—
220–230	0	—	—	—
230–240	0	—	—	—
240–250	0	—	—	—
250–260	2	0.138	0.3	—

i Jefferson County Timeblock 2 (1400-1500)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	22	0.056	0.3	0.3
10–20	6	0.161	0.1	0.3
20–30	16	-0.211	0.1	0.2
30–40	50	0.049	0.4	0.7
40–50	4	-0.098	0.3	0.8
50–60	4	0.000	0.5	1.0
60–70	8	0.035	0.4	1.0

j New York Timeblock 2 (1400-1500)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	12	0.126	0.09	0.09
10–20	12	0.177	**0.03**	0.052
20–30	18	0.230	**0.01**	**0.02**
30–40	10	0.149	0.051	0.10
40–50	6	-0.061	0.3	0.3
50–60	10	0.216	**0.02**	0.1
60–70	8	-0.024	0.4	0.5
70–80	10	0.124	0.1	0.4
80–90	14	0.159	**0.04**	0.3
90–100	20	0.091	0.2	0.5
100–110	16	0.183	**0.02**	0.2
110–120	10	-0.170	**0.04**	0.3
120–130	16	0.048	0.3	0.8
130–140	10	-0.149	0.1	0.4
140–150	12	-0.169	**0.03**	0.4
150–160	4	-0.121	0.1	0.6
160–170	14	-0.097	0.1	0.7
170–180	2	-0.093	0.2	0.9
180–190	4	-0.090	0.2	1.0
190–200	4	-0.208	**0.01**	0.1
200–210	0	—	—	—
210–220	4	-0.176	**0.04**	0.5
220–230	4	-0.104	0.1	1.0
230–240	4	-0.185	**0.02**	0.5
240–250	8	-0.268	**0.003**	0.06
250–260	0	—	—	—
260–270	8	-0.209	**0.02**	—

k Ontario Timeblock 2 (1400-1500)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	88	0.144	**0.0009**	**0.0009**
10–20	94	0.023	0.2	0.2
20–30	88	0.027	0.2	0.5
30–40	108	0.038	0.1	0.4
40–50	82	0.110	**0.002**	**0.01**
50–60	80	0.082	**0.02**	0.1
60–70	112	0.055	0.1	0.3
70–80	118	0.016	0.4	0.7
80–90	126	0.003	0.5	1.0
90–100	118	0.000	0.5	1.0
100–110	96	-0.024	0.2	1.0
110–120	80	0.026	0.2	1.0
120–130	72	0.002	0.5	1.0
130–140	94	0.051	0.1	0.9
140–150	50	0.024	0.3	1.0
150–160	66	-0.040	0.1	1.0
160–170	78	0.018	0.3	1.0
170–180	82	-0.005	0.4	1.0
180–190	60	-0.039	0.2	1.0
190–200	60	-0.033	0.2	1.0
200–210	80	-0.054	0.1	1.0
210–220	34	-0.096	**0.002**	**0.04**
220–230	60	-0.110	**0.002**	**0.04**
230–240	48	-0.055	0.1	1.0
240–250	28	-0.048	0.1	1.0
250–260	34	-0.051	0.1	1.0
260–270	26	-0.047	0.1	1.0
270–280	12	-0.025	0.2	1.0
280–290	6	-0.040	0.1	1.0
290–300	10	-0.032	0.2	1.0
300–310	14	-0.007	0.4	1.0
310–320	10	-0.033	0.2	1.0
320–330	8	-0.045	0.1	1.0
330–340	4	-0.018	0.3	1.0
340–350	14	-0.097	**0.003**	0.1
350–360	6	-0.065	**0.02**	0.5
360–370	2	-0.052	**0.01**	0.3
370–380	0	—	—	—
380–390	6	-0.064	**0.02**	0.6
390–400	2	-0.031	0.2	1.0
400–410	2	-0.019	0.3	1.0
410–420	0	—	—	—
420–430	4	-0.062	0.0	—

l St. Lawrence Timeblock 2 (1400-1500)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	24	0.152	0.1	0.1
10–20	0	—	—	—
20–30	0	—	—	—
30–40	0	—	—	—
40–50	10	0.092	0.2	0.2
50–60	14	0.146	0.1	0.3
60–70	4	0.232	**0.04**	0.1
70–80	2	-0.075	0.3	0.5
80–90	0	—	—	—
90–100	0	—	—	—
100–110	18	-0.136	0.1	0.6
110–120	2	0.107	0.3	0.7
120–130	0	—	—	—
130–140	0	—	—	—
140–150	0	—	—	—
150–160	0	—	—	—
160–170	0	—	—	—
170–180	0	—	—	—
180–190	0	—	—	—
190–200	0	—	—	—
200–210	2	-0.199	**0.04**	—
210–220	10	-0.152	0.1	—
220–230	0	—	—	—
230–240	0	—	—	—
240–250	0	—	—	—
250–260	4	-0.014	0.4	—
260–270	8	-0.163	0.1	—
270–280	4	0.144	0.1	—
280–290	0	—	—	—
290–300	0	—	—	—
300–310	0	—	—	—
310–320	6	0.078	0.3	—
320–330	2	-0.117	0.2	—
330–340	0	—	—	—
340–350	0	—	—	—
350–360	0	—	—	—
360–370	0	—	—	—
370–380	4	-0.160	0.1	—
380–390	0	—	—	—
390–400	0	—	—	—
400–410	0	—	—	—
410–420	0	—	—	—
420–430	0	—	—	—
430–440	0	—	—	—
440–450	0	—	—	—
450–460	6	0.208	**0.04**	—
460–470	4	-0.165	0.1	—
470–480	0	—	—	—
480–490	0	—	—	—
490–500	2	-0.166	0.1	—
500–510	2	0.062	0.4	—
510–520	0	—	—	—
520–530	0	—	—	—
530–540	0	—	—	—
540–550	0	—	—	—
550–560	0	—	—	—
560–570	4	-0.121	0.2	—

m Jefferson County Timeblock 3 (1450-1550)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	32	0.138	0.1	0.1
10–20	32	0.186	**0.04**	0.1
20–30	26	0.011	0.5	0.5
30–40	46	-0.142	0.1	0.3
40–50	30	-0.170	0.1	0.2
50–60	8	-0.014	0.4	0.8
60–70	8	0.000	0.5	1.0

n New York Timeblock 3 (1450-1550)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	44	0.207	**0.002**	**0.002**
10–20	46	0.260	**0.0004**	**0.0008**
20–30	28	0.084	0.1	0.1
30–40	8	0.090	0.1	0.2
40–50	0	—	—	—
50–60	0	—	—	—
60–70	2	-0.027	0.4	0.4
70–80	22	0.086	0.1	0.4
80–90	24	0.046	0.3	0.6
90–100	30	-0.011	0.4	0.8
100–110	34	0.062	0.2	0.8
110–120	18	-0.161	0.0	0.2
120–130	28	0.045	0.3	1.0
130–140	12	0.013	0.4	1.0
140–150	10	0.002	0.5	1.0
150–160	14	-0.067	0.2	1.0
160–170	10	-0.124	**0.04**	0.5
170–180	6	-0.119	**0.04**	0.6
180–190	8	-0.162	**0.02**	0.3
190–200	4	-0.021	0.4	1.0
200–210	0	—	—	—
210–220	0	—	—	—
220–230	10	-0.192	**0.005**	0.08
230–240	16	-0.278	**0.0001**	**0.002**
240–250	24	-0.072	0.2	—
250–260	12	-0.035	0.3	—
260–270	8	-0.169	**0.02**	—
270–280	2	-0.055	0.3	—

o Ontario Timeblock 3 (1450-1550)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	122	0.143	**0.03**	**0.03**
10–20	98	0.169	**0.002**	**0.004**
20–30	42	0.014	0.4	0.4
30–40	54	0.099	**0.02**	0.06
40–50	56	0.099	**0.04**	0.1
50–60	22	0.059	0.2	0.4
60–70	86	-0.038	0.3	0.6
70–80	100	-0.003	0.4	0.9
80–90	64	-0.025	0.3	1.0
90–100	98	-0.063	0.1	0.8
100–110	88	-0.057	0.2	0.9
110–120	40	-0.066	0.09	0.8
120–130	32	0.002	0.5	1.0
130–140	30	0.022	0.4	1.0
140–150	20	0.041	0.3	1.0
150–160	26	-0.042	0.2	1.0
160–170	64	-0.018	0.4	1.0
170–180	40	-0.036	0.2	1.0
180–190	18	-0.002	0.5	1.0
190–200	26	-0.035	0.2	1.0
200–210	42	-0.082	0.07	1.0
210–220	22	-0.054	0.1	1.0
220–230	12	-0.062	0.06	1.0
230–240	6	-0.016	0.4	1.0
240–250	8	-0.001	0.5	1.0
250–260	8	-0.083	**0.02**	0.5
260–270	8	-0.106	**0.01**	0.2
270–280	2	-0.018	0.4	1.0
280–290	2	-0.067	**0.01**	0.3
290–300	6	-0.090	**0.04**	0.9
300–310	2	-0.029	0.3	1.0
310–320	2	-0.020	0.4	1.0
320–330	2	-0.064	**0.04**	1.0
330–340	2	0.009	0.4	1.0
340–350	4	-0.042	0.2	1.0
350–360	2	-0.028	0.3	1.0
360–370	2	-0.068	**0.01**	0.5
370–380	0	—	—	—
380–390	2	-0.068	**0.01**	—

p St. Lawrence Timeblock 3 (1450-1550)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	22	0.204	**0.03**	**0.03**
10–20	4	-0.177	0.06	0.06
20–30	10	0.107	0.2	0.2
30–40	10	-0.094	0.2	0.4
40–50	10	0.035	0.4	0.5
50–60	12	0.077	0.2	0.7
60–70	2	0.104	0.2	0.9
70–80	10	0.097	0.2	1.0
80–90	28	0.057	0.3	1.0
90–100	6	0.089	0.2	1.0
100–110	22	-0.019	0.4	1.0
110–120	2	0.100	0.2	1.0
120–130	4	0.018	0.4	1.0
130–140	0	—	—	—
140–150	2	-0.002	0.5	1.0
150–160	0	—	—	—
160–170	0	—	—	—
170–180	10	-0.018	0.4	1.0
180–190	0	—	—	—
190–200	4	-0.179	0.1	0.9
200–210	2	-0.159	**0.03**	0.6
210–220	0	—	—	—
220–230	0	—	—	—
230–240	0	—	—	—
240–250	2	-0.002	0.5	1.0
250–260	0	—	—	—
260–270	6	-0.137	0.1	1.0
270–280	2	0.003	0.5	1.0
280–290	0	—	—	—
290–300	0	—	—	—
300–310	0	—	—	—
310–320	2	0.008	0.5	—
320–330	0	NA	NA	—
330–340	0	NA	NA	—
340–350	6	0.023	0.4	—
350–360	2	-0.097	0.2	—
360–370	0	—	—	—
370–380	6	-0.174	**0.04**	—
380–390	0	—	—	—
390–400	0	—	—	—
400–410	0	—	—	—
410–420	0	—	—	—
420–430	0	—	—	—
430–440	0	—	—	—
440–450	2	-0.087	0.3	—
450–460	6	-0.010	0.5	—
460–470	2	-0.112	0.2	—
470–480	0	—	—	—
480–490	0	—	—	—
490–500	0	—	—	—
500–510	2	0.052	0.4	—
510–520	0	—	—	—
520–530	6	0.048	0.4	—
530–540	2	-0.168	**0.009**	—
540–550	0	—	—	—
550–560	0	—	—	—
560–570	4	-0.093	0.2	—

q Lake Erie / Niagara Timeblock 4 (1500-1600)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	12	0.172	0.2	0.2
10–20	12	0.481	**0.008**	**0.02**
20–30	6	-0.285	0.1	0.2
30–40	2	-0.269	0.055	0.2
40–50	18	-0.439	**0.03**	0.1
50–60	6	0.227	0.1	0.3
60–70	0	—	—	—
70–80	0	—	—	—
80–90	0	—	—	—
90–100	6	0.053	0.4	0.4
100–110	4	0.093	0.3	—
110–120	4	-0.082	0.3	—
120–130	0	—	—	—
130–140	0	—	—	—
140–150	2	-0.065	0.4	—

r New York Timeblock 4 (1500-1600)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	102	0.164	**0.008**	**0.008**
10–20	80	0.148	**0.01**	**0.02**
20–30	26	-0.018	0.4	0.4
30–40	2	0.068	0.2	0.3
40–50	0	—	—	—
50–60	0	—	—	—
60–70	8	0.131	**0.01**	**0.048**
70–80	8	0.053	0.2	0.5
80–90	26	0.007	0.5	0.8
90–100	40	-0.143	**0.02**	0.1
100–110	46	-0.032	0.3	0.9
110–120	38	-0.073	0.1	0.8
120–130	40	-0.031	0.3	1.0
130–140	26	0.069	0.2	1.0
140–150	6	0.021	0.4	1.0
150–160	18	-0.027	0.3	1.0
160–170	10	0.057	0.2	1.0
170–180	12	-0.039	0.3	1.0
180–190	8	0.022	0.4	1.0
190–200	0	—	—	—
200–210	0	—	—	—
210–220	0	—	—	—
220–230	2	-0.090	0.06	—
230–240	10	-0.133	**0.02**	—
240–250	32	-0.097	0.1	—
250–260	44	-0.074	0.1	—
260–270	16	-0.109	0.053	—

s Ontario Timeblock 4 (1500-1600)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	46	0.054	0.2	0.2
10–20	32	0.102	**0.03**	0.0504
20–30	46	0.022	0.3	0.4
30–40	64	0.151	**0.003**	**0.01**
40–50	46	0.091	0.06	0.2
50–60	38	0.093	0.1	0.2
60–70	86	-0.075	0.1	0.3
70–80	102	0.033	0.3	0.6
80–90	72	-0.099	**0.04**	0.2
90–100	78	0.009	0.4	0.9
100–110	80	-0.136	**0.01**	0.1
110–120	44	-0.045	0.2	0.9
120–130	18	-0.042	0.2	1.0
130–140	16	0.045	0.2	1.0
140–150	12	0.044	0.3	1.0
150–160	4	-0.020	0.4	1.0
160–170	12	-0.078	0.1	1.0
170–180	8	-0.104	**0.03**	0.4
180–190	8	-0.149	**0.001**	**0.02**

t Lake Erie / Niagara Timeblock 5 (1550-1650)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	14	0.161	0.1	0.1
10–20	18	0.364	**0.007**	**0.01**
20–30	12	-0.119	0.2	0.2
30–40	10	-0.123	0.2	0.4
40–50	24	-0.317	**0.02**	0.1
50–60	24	0.043	0.4	0.6
60–70	4	0.063	0.3	0.7
70–80	0	—	—	—
80–90	8	-0.222	**0.04**	0.2
90–100	6	0.145	0.2	0.8
100–110	4	0.079	0.3	1.0
110–120	4	-0.051	0.4	1.0
120–130	0	—	—	—
130–140	2	0.094	0.3	—
140–150	2	-0.055	0.4	—

u New York Timeblock 5 (1550-1650)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	106	0.249	**0.0003**	**0.0003**
10–20	44	0.189	**0.0008**	**0.0008**
20–30	18	-0.069	0.2	0.2
30–40	2	-0.076	0.1	0.2
40–50	0	—	—	—
50–60	0	—	—	—
60–70	8	0.158	**0.003**	**0.008**
70–80	6	-0.025	0.3	0.4
80–90	32	0.076	0.2	0.5
90–100	36	-0.102	0.08	0.4
100–110	34	0.024	0.4	0.7
110–120	36	-0.066	0.2	0.8
120–130	24	-0.063	0.2	0.9
130–140	44	0.073	0.2	1.0
140–150	16	0.064	0.2	1.0
150–160	28	-0.060	0.2	1.0
160–170	26	-0.083	0.1	1.0
170–180	8	0.011	0.5	1.0
180–190	6	-0.023	0.4	1.0
190–200	0	—	—	—
200–210	0	—	—	—
210–220	0	—	—	—
220–230	0	—	—	—
230–240	8	-0.122	**0.03**	—
240–250	36	-0.098	0.1	—
250–260	64	-0.167	**0.01**	—
260–270	18	-0.140	**0.02**	—

v Ontario Timeblock 5 (1550-1650)

Distance Class (km)	N_{pairs}	r_M	p-value$_{Mantel}$	p-value$_{Corrected}$
0–10	102	0.117	**0.01**	**0.01**
10–20	118	0.154	**0.002**	**0.005**
20–30	114	0.179	**0.000**	**0.001**
30–40	154	0.025	0.3	0.3
40–50	154	0.021	0.4	0.7
50–60	72	0.101	**0.04**	0.1
60–70	20	-0.068	0.1	0.4
70–80	26	-0.177	**0.001**	**0.01**
80–90	46	-0.180	**0.01**	**0.03**
90–100	48	-0.152	**0.008**	**0.047**
100–110	70	-0.241	**0.001**	**0.01**
110–120	42	-0.135	**0.001**	**0.01**
120–130	44	-0.005	0.5	1.0
130–140	26	-0.031	0.3	1.0
140–150	48	0.103	**0.02**	0.2
150–160	56	-0.047	0.2	1.0
160–170	24	0.054	0.2	0.9
170–180	20	0.021	0.4	1.0
180–190	6	-0.078	0.1	0.7

Table D.3: Mantel Correlogram Test Statistics — All Regional Groups

Case Scenario	AMOVA Test			
	n_{sites}	n_{strata}	ϕ_{ST}	p-value
All Sites All Timeblocks	235	13	0.056	**<0.0001**
All Sites by Regional Group	235	5	0.052	**<0.0001**
All Sites Timeblock 1	75	12	0.054	**<0.0001**
All Sites Timeblock 1 by Regional Group	75	4	0.069	**<0.0001**
All Sites Timeblock 2	86	12	0.073	**<0.0001**
All Sites Timeblock 2 by Regional Group	86	4	0.066	**<0.0001**
All Sites Timeblock 3	87	13	0.058	**<0.0001**
All Sites Timeblock 3 by Regional Group	87	5	0.053	**<0.0001**
All Sites Timeblock 4	77	12	0.064	**<0.0001**
All Sites Timeblock 4 by Regional Group	77	5	0.053	**<0.0001**
All Sites Timeblock 5	72	8	0.066	**<0.0001**
All Sites Timeblock 5 by Regional Group	72	3	0.061	**<0.0001**
Jefferson County Regional Group All Timeblocks	18	1	—	—
Erie / Niagara Regional Group All Timeblocks	13	1	—	—
New York Regional Group All Timeblocks	54	3	0.043	**<0.0001**
Ontario Regional Group All Timeblocks	125	6	0.025	**0.0004**
St. Lawrence Regional Group All Timeblocks	24	2	0	0.5
Jefferson County Regional Group Timeblock 2	11	1	—	—
Jefferson County Regional Group Timeblock 3	14	1	—	—
Erie / Niagara Regional Group Timeblock 4	7	1	—	—
Erie / Niagara Regional Group Timeblock 5	12	1	—	—
New York Regional Group Timeblock 1	8	3	0.18	**0.03**
New York Regional Group Timeblock 2	16	3	0.035	**0.014**
New York Regional Group Timeblock 3	21	3	0.052	**0.003**
New York Regional Group Timeblock 4	25	3	0.064	**0.002**
New York Regional Group Timeblock 5	25	3	0.024	0.06
Ontario Regional Group Timeblock 1	54	6	0.011	0.2
Ontario Regional Group Timeblock 2	47	6	0.038	**0.03**
Ontario Regional Group Timeblock 3	36	6	0.025	0.1
Ontario Regional Group Timeblock 4	29	5	0.013	0.2
Ontario Regional Group Timeblock 5	35	4	0.042	0.1
St. Lawrence Regional Group Timeblock 1	9	2	0	0.9
St. Lawrence Regional Group Timeblock 2	12	2	0.001	0.5
St. Lawrence Regional Group Timeblock 3	15	2	0	0.6

Table D.4: AMOVA Framework Test Results

All Sites All Timeblocks

Spatial Group Code	1	2	3	4	5	6	7	8	9	11	10	12	13
1		0	0	0.06	0	0	0.04	0.9	0.01	0	0.01	0.04	0.01
2	0.083		0.01	0.003	0	0.01	0.01	0.004	0	0	0.00	0.02	0.001
3	0.095	0.030		0	0	0.001	0.01	0	0	0.07	0.01	0.01	0
4	0.030	0.053	0.075		0	0	0.03	0.19	0.09	0	0.01	0.01	0.12
5	0.118	0.067	0.057	0.099		0.0003	0	0	0	0	0.09	0	0
6	0.095	0.028	0.033	0.086	0.035		0	0	0	0.00	0.02	0	0
7	0.056	0.062	0.065	0.069	0.097	0.090		0.1	0.01	0.01	0.01	0.36	0.01
8	0.000	0.043	0.063	0.016	0.079	0.060	0.032		0.2	0.0002	0.01	0.44	0.3
9	0.022	0.070	0.079	0.016	0.096	0.078	0.065	0.009		0	0.004	0.004	0.06
11	0.076	0.042	0.015	0.073	0.045	0.026	0.051	0.049	0.064		0.56	0.05	0
10	0.096	0.075	0.054	0.093	0.026	0.050	0.094	0.063	0.083	0.000		0.01	0.00
12	0.032	0.029	0.034	0.047	0.059	0.040	0.005	0.001	0.037	0.018	0.041		0.00
13	0.034	0.058	0.083	0.021	0.108	0.081	0.078	0.007	0.013	0.080	0.108	0.054	

All Sites Timeblock 1 (1350-1450)

Spatial Group Code	1	2	3	5	6	7	8	9	11	10	12	13
1		0.09	0.05	0.05	0.01	0.4	0.7	0.2	0.07	0.06	0.1	0.05
2	0.084		0.3	0.3	0.3	0.6	0.2	0.1	0.5	0.3	0.8	0.1
3	0.097	0.058		0.33	0.03	0.15	0.10	0.02	0.01	0.1	0.2	0.02
5	0.137	0.059	0.052		0.07	0.1	0.02	0.04	0.5	0.7	0.07	0.01
6	0.208	0.147	0.237	0.267		0.06	0.02	0.01	0.01	0.07	0.06	0.00
7	0.002	0	0.075	0.092	0.214		0.5	0.2	0.3	0.1	0.7	0.3
8	0	0.032	0.060	0.110	0.130	0		0.8	0.1	0.03	0.3	0.8
9	0.014	0.048	0.074	0.093	0.124	0.020	0		0.02	0.07	0.1	0.3
11	0.052	0.003	0.062	0.003	0.150	0.010	0.031	0.039		0.9	0.52	0.00
10	0.129	0.056	0.095	0	0.268	0.081	0.104	0.071	0		0.07	0.02
12	0.055	0	0.055	0.072	0.168	0	0.013	0.026	0	0.052		0.049
13	0.050	0.087	0.097	0.153	0.169	0.016	0	0.008	0.084	0.145	0.074	

All Sites Timeblock 2 (1400-1500)

Spatial Group Code	1	2	3	5	6	7	8	9	11	10	12	13
1		0.006	0	0.001	0.001	0.046	0.5	0.02	0.001	0.04	0.8	0.03
2	0.116		0.02	0.008	0.08	0.100	0.2	0.007	0.006	0.07	0.2	0.03
3	0.101	0.068		0.003	0.06	0.041	0.1	0.014	0.081	0.022	0.3	0.002
5	0.168	0.114	0.103		0.2	0.004	0.03	0.005	0.007	0.1	0.03	0.004
6	0.104	0.046	0.037	0.024		0.000	0.007	0.005	0.02	0.02	0.2	0.001
7	0.067	0.069	0.056	0.138	0.096		0.6	0.055	0.002	0.04	0.4	0.04
8	0	0.056	0.049	0.123	0.080	0		0.5	0.049	0.1	0.5	0.3
9	0.046	0.097	0.052	0.117	0.071	0.057	0		0.001	0.02	0.4	0.120
11	0.097	0.071	0.030	0.072	0.038	0.079	0.076	0.069		0.5	0.2	0.000
10	0.114	0.097	0.096	0.053	0.072	0.119	0.112	0.096	0.001		0.2	0.02
12	0	0.046	0.018	0.107	0.023	0.007	0	0.002	0.032	0.046		0.09
13	0.068	0.111	0.115	0.183	0.133	0.093	0	0.040	0.131	0.175	0.084	

All Sites Timeblock 3 (1450-1550)

Spatial Group Code	1	2	3	4	5	6	7	8	9	11	10	12	13
1		0.002	0	0.3	0	0	0.09	0.6	0.04	0	0.048	0.2	0.4
2	0.119		0.1	0.3	0.003	0.0	0.052	0.03	0.1	0.005	0.1	0.04	0.053
3	0.097	0.027		0.1	0	0.0	0.1	0.07	0.04	0.6	0.1	0.046	0.02
4	0.070	0.101	0.066		0.1	0.1	0.5	0.8	0.7	0.2	0.8	0.6	0.8
5	0.143	0.084	0.066	0.096		0.1	0.01	0.006	0	0	0.1	0.000	0.004
6	0.114	0.057	0.037	0.077	0.026		0.02	0.006	0.001	0.0	0.03	0.005	0.007
7	0.073	0.069	0.025	0.014	0.079	0.060		0.5	0.5	0.3	0.3	0.2	0.1
8	0	0.086	0.053	0	0.085	0.075	0		0.3	0.1	0.5	0.6	0.4
9	0.057	0.071	0.043	0.018	0.095	0.076	0	0.028		0.0	0.1	0.2	0.3
11	0.096	0.060	0	0.060	0.059	0.028	0.009	0.033	0.038		0.6	0.003	0.001
10	0.089	0.070	0.031	0	0.034	0.047	0.009	0	0.050	0.000		0.4	0.1
12	0.018	0.059	0.036	0.001	0.082	0.059	0.022	0	0.026	0.047	0.004		0.2
13	0.009	0.098	0.089	0	0.116	0.096	0.071	0.031	0.027	0.087	0.071	0.046	

All Sites Timeblock 4 (1500-1600)

Spatial Group Code	1	2	3	4	5	6	8	9	11	10	12	13
1		0.01	0.001	0.8	0.0003	0.01	0.9	0.6	0.0005	0.1	0.01	0.6
2	0.079		0.1	0.02	0.01	0.1	0.04	0.00	0.03	0.2	0.01	0.1
3	0.089	0.076		0.0002	0.001	0.2	0.04	0	0.2	0.50	0.002	0.1
4	0	0.076	0.113		0.0001	0.001	0.7	0.5	0.001	0.1	0.002	0.5
5	0.075	0.076	0.066	0.093		0.01	0.02	0	0.047	0.1	0.004	0.1
6	0.070	0.066	0.027	0.104	0.054		0.1	0.0001	0.02	0.1	0.004	0.1
8	0	0.112	0.098	0	0.081	0.075		0.6	0.01	0.3	0.04	0.5
9	0	0.089	0.107	0	0.084	0.088	0		0.001	0.1	0.003	0.7
11	0.056	0.065	0.022	0.087	0.034	0.049	0.065	0.060		0.6	0.1	0.04
10	0.091	0.160	0.027	0.151	0.066	0.101	0.102	0.106	0		0.3	0.3
12	0.056	0.115	0.082	0.093	0.073	0.085	0.061	0.065	0.034	0.052		0.04
13	0	0.109	0.129	0	0.102	0.098	0	0	0.079	0.147	0.094	

All Sites Timeblock 5 (1550-1650)

Spatial Group Code	2	4	5	6	8	9	12	13
2		0.1	0.02	0.2	0.1	0.0001	0.1	0.01
4	0.026		0.002	0.004	0.3	0.1	0.1	0.3
5	0.041	0.079		0.2	0.1	0	0.3	0.001
6	0.014	0.076	0.017		0.1	0	0.1	0.007
8	0.039	0.029	0.055	0.052		0.1	0.3	0.3
9	0.091	0.027	0.119	0.113	0.043		0.1	0.6
12	0.036	0.104	0.019	0.050	0.028	0.127		0.1
13	0.060	0.015	0.100	0.083	0.036	0	0.109	

New York All Timeblocks

Spatial Group Code	2	5	6
2		0	0.01
5	0.067		0.0002
6	0.028	0.035	

New York Timeblock 1 (1350-1450)

Spatial Group Code	2	5	6
2		0.3	0.3
5	0.059		0.1
6	0.147	0.267	

New York Timeblock 2 (1400-1500)

Spatial Group Code	2	5	6
2		0.009	0.08
5	0.114		0.2
6	0.04592	0.02428	

New York Timeblock 3 (1450-1550)

Spatial Group Code	2	5	6
2		0.004	0.053
5	0.084		0.1
6	0.057	0.026	

New York Timeblock 4 (1500-1600)

Spatial Group Code	2	5	6
2		0.01	0.06
5	0.076		0.01
6	0.066	0.054	

New York Timeblock 5 (1550-1650)

Spatial Group Code	2	5	6
2		0.01	0.2
5	0.041		0.2
6	0.01354	0.01691	

Ontario All Timeblocks

Spatial Group Code	1	7	8	9	12	13
1		0.04	0.9	0.01	0.04	0.01
7	0.056		0.1	0.01	0.4	0.01
8	0.000	0.032		0.2	0.4	0.3
9	0.022	0.065	0.009		0.004	0.06
12	0.032	0.005	0.001	0.037		0.001
13	0.034	0.078	0.007	0.013	0.054	

Ontario Timeblock 1 (1350-1450)

Spatial Group Code	1	7	8	9	12	13
1		0.4	0.7	0.2	0.1	0.1
7	0.002		0.6	0.2	0.7	0.3
8	0	0		0.8	0.3	0.8
9	0.014	0.020	0		0.1	0.3
12	0.055	0	0.013	0.026		0.050
13	0.050	0.016	0	0.008	0.074	

Ontario Timeblock 2 (1400-1500)

Spatial Group Code	1	7	8	9	12	13
1		0.046	0.6	0.03	0.8	0.03
7	0.067		0.6	0.1	0.4	0.04
8	0	0		0.5	0.5	0.3
9	0.046	0.057	0		0.4	0.1
12	0	0.007	0	0.002		0.1
13	0.068	0.093	0	0.040	0.084	

Ontario Timeblock 3 (1450-1550)

Spatial Group Code	1	7	8	9	12	13
1		0.1	0.7	0.04	0.2	0.4
7	0.073		0.5	0.5	0.2	0.1
8	0	0		0.3	0.6	0.4
9	0.057	0	0.028		0.2	0.3
12	0.018	0.022	0	0.026		0.2
13	0.009	0.071	0.031	0.027	0.046	

Ontario Timeblock 4 (1500-1600)

Spatial Group Code	1	8	9	12	13
1		0.9	0.6	0.01	0.6
8	0		0.6	0.03	0.5
9	0	0		0.002	0.7
12	0.056	0.061	0.065		0.049
13	0	0	0	0.094	

Ontario Timeblock 5 (1550-1650)

Spatial Group Code	8	9	12	13
8		0.1	0.3	0.3
9	0.04305		0.1	0.6
12	0.02848	0.12735		0.07
13	0.03565	0	0.1088	

All Sites by Combined Group

Combined Group	ON	NY	JC	EN	STL
ON		0	0	0.07	0
NY	0.058		0.0004	0	0
JC	0.068	0.025		0	0.008
EN	0.0141	0.064	0.075		0
STL	0.059	0.027	0.023	0.075	

Timeblock 1 (1350-1450) Combined Group

Combined Group	ON	NY	JC	STL
ON		0.0008	0.01	0.0004
NY	0.071		0.03	0.03
JC	0.074	0.089		0.01
STL	0.067	0.057	0.076	

Timeblock 2 (1400-1500) Combined Group

Combined Group	ON	NY	JC	STL
ON		0	0.001	0
NY	0.074		0.002	0.0002
JC	0.063	0.041		0.007
STL	0.081	0.042	0.045	

Timeblock 3 (1450-1550) Combined Group

Combined Group	ON	NY	JC	EN	STL
ON		0	0	0.5	0
NY	0.076		0.004	0.0499	0.0003
JC	0.063	0.029		0.07	0.3
EN	0	0.056	0.066		0.1
STL	0.058	0.033	0.004	0.052	

Timeblock 4 (1500-1600) Combined Group

Combined Group	ON	NY	JC	EN	STL
ON		0	0	0.6	0.001
NY	0.060		0.03	0.0004	0.04
JC	0.093	0.034		0.0001	0.3
EN	0	0.068	0.113		0.0005
STL	0.058	0.027	0.017	0.088	

Timeblock 5 (1550-1650) Combined Group

Combined Group	NY	EN	ON
NY		0.001	0
EN	0.049		0.09
ON	0.082	0.022	

Table D.5: Pairwise Φ_{ST} Matrices. Lower triangle = Φ_{ST}, red/**bold** cells significant; upper triangle = p–value, **bold** = $p \leq 0.05$

Case Scenario	Pairwise ϕ_{ST} Polity Centroid Distance Mantel Test			
	n_{sites}	n_{strata}	r_M	p-value
All Sites All Timeblocks	235	13	0.639	**<0.0001**
All Sites Timeblock 1	75	12	0.387	**0.03180**
All Sites Timeblock 2	86	12	0.670	**<0.0001**
All Sites Timeblock 3	87	13	0.361	**0.01**
All Sites Timeblock 4	77	12	0.540	**0.0004**
All Sites Timeblock 5	72	8	0.467	**0.02**
Jefferson County Regional Group All Timeblocks	18	1	—	—
Erie / Niagara Regional Group All Timeblocks	13	1	—	—
New York Regional Group All Timeblocks	54	3	0.5	0.5
Ontario Regional Group All Timeblocks	125	6	0.757	**0.004**
St. Lawrence Regional Group All Timeblocks	24	2	—	—
Jefferson County Regional Group Timeblock 2	11	1	—	—
Jefferson County Regional Group Timeblock 3	14	1	—	—
Erie / Niagara Regional Group Timeblock 4	7	1	—	—
Erie / Niagara Regional Group Timeblock 5	12	1	—	—
New York Regional Group Timeblock 1	8	3	-1.0	1.0
New York Regional Group Timeblock 2	16	3	1.0	0.2
New York Regional Group Timeblock 3	21	3	1.0	0.2
New York Regional Group Timeblock 4	25	3	1.0	0.2
New York Regional Group Timeblock 5	25	3	0.5	0.5
Ontario Regional Group Timeblock 1	54	6	0.233	0.29
Ontario Regional Group Timeblock 2	47	6	0.596	**0.02**
Ontario Regional Group Timeblock 3	36	6	0.353	0.07
Ontario Regional Group Timeblock 4	29	5	0.294	0.3
Ontario Regional Group Timeblock 5	35	4	0.086	0.5
St. Lawrence Regional Group Timeblock 1	9	2	—	—
St. Lawrence Regional Group Timeblock 2	12	2	—	—
St. Lawrence Regional Group Timeblock 3	15	2	—	—

Table D.6: Pairwise Φ_{ST} vs. Spatial Centroid Distance Mantel Test Results

Case Scenario	Partial Mantel Test Polity Group Affiliation Holding Geographic Distance		
	n_{sites}	r_M	p value
All Sites All Timeblocks	235	-0.040	0.99
All Sites Grouped by Regional Group	235	0.070	**0.01**
All Sites Timeblock 1	75	-0.103	0.998
All Sites Timeblock 1 by Regional Group	75	0.161	**0.008**
All Sites Timeblock 2	86	-0.014	0.7
All Sites Timeblock 2 by Regional Group	86	0.267	**<0.00001**
All Sites Timeblock 3	87	0.056	**0.01**
All Sites Timeblock 3 by Regional Group	87	0.182	**<0.00001**
All Sites Timeblock 4	77	-0.019	0.8
All Sites Timeblock 4 by Regional Group	77	-0.030	0.8
All Sites Timeblock 5	72	0.029	0.3
All Sites Timeblock 5 by Regional Group	72	-0.130	1.0
Jefferson County Regional Group All Timeblocks	18	—	—
Erie / Niagara Regional Group All Timeblocks	13	—	—
New York Regional Group All Timeblocks	54	0.018	0.3
Ontario Regional Group All Timeblocks	125	0.015	0.3
St. Lawrence Regional Group All Timeblocks	24	-0.026	0.6
Jefferson County Regional Group Timeblock 2	11	—	—
Jefferson County Regional Group Timeblock 3	14	—	—
Erie / Niagara Regional Group Timeblock 4	7	—	—
Erie / Niagara Regional Group Timeblock 5	12	—	—
New York Regional Group Timeblock 1	8	0.023	0.5
New York Regional Group Timeblock 2	16	-0.223	0.999
New York Regional Group Timeblock 3	21	0.059	0.2
New York Regional Group Timeblock 4	25	0.100	0.1
New York Regional Group Timeblock 5	25	0.067	0.2
Ontario Regional Group Timeblock 1	54	-0.068	0.9
Ontario Regional Group Timeblock 2	47	-0.085	0.95
Ontario Regional Group Timeblock 3	36	0.026	0.4
Ontario Regional Group Timeblock 4	29	0.017	0.4
Ontario Regional Group Timeblock 5	35	0.257	**0.004**
St. Lawrence Regional Group Timeblock 1	9	0.089	0.3
St. Lawrence Regional Group Timeblock 2	12	-0.010	0.5
St. Lawrence Regional Group Timeblock 3	15	0.003	0.5

Table D.7: spatial group membership Binary Distance Matrix Partial Mantel Test Results

Case Scenario	ANOSIM Test			
	n_{sites}	n_{strata}	R_{ANOSIM}	p value
All Sites All Timeblocks	235	13	0.426	**<0.00001**
All Sites by Regional Group	235	5	0.490	**<0.00001**
All Sites Timeblock 1	75	12	0.253	**<0.00001**
All Sites Timeblock 1 by Regional Group	75	4	0.511	**<0.00001**
All Sites Timeblock 2	86	12	0.459	**<0.00001**
All Sites Timeblock 2 by Regional Group	86	4	0.604	**<0.00001**
All Sites Timeblock 3	87	13	0.558	**<0.00001**
All Sites Timeblock 3 by Regional Group	87	5	0.563	**<0.00001**
All Sites Timeblock 4	77	12	0.531	**<0.00001**
All Sites Timeblock 4 by Regional Group	77	5	0.485	**<0.00001**
All Sites Timeblock 5	72	8	0.609	**<0.00001**
All Sites Timeblock 5 by Regional Group	72	3	0.447	**<0.00001**
Jefferson County Regional Group All Timeblocks	18	1	—	—
Erie / Niagara Regional Group All Timeblocks	13	1	—	—
New York Regional Group All Timeblocks	54	3	0.421	**<0.00001**
Ontario Regional Group All Timeblocks	125	6	0.112	**0.002**
St. Lawrence Regional Group All Timeblocks	24	2	0.125	0.2
Jefferson County Regional Group Timeblock 2	11	1	—	—
Jefferson County Regional Group Timeblock 3	14	1	—	—
Erie / Niagara Regional Group Timeblock 4	7	1	—	—
Erie / Niagara Regional Group Timeblock 5	12	1	—	—
New York Regional Group Timeblock 1	8	3	0.763	**0.006**
New York Regional Group Timeblock 2	16	3	0.488	**0.001**
New York Regional Group Timeblock 3	21	3	0.520	**<0.00001**
New York Regional Group Timeblock 4	25	3	0.315	**0.0007**
New York Regional Group Timeblock 5	25	3	0.402	**<0.00001**
Ontario Regional Group Timeblock 1	54	6	0.006	0.4
Ontario Regional Group Timeblock 2	47	6	0.143	**0.01**
Ontario Regional Group Timeblock 3	36	6	0.307	**0.002**
Ontario Regional Group Timeblock 4	29	5	0.237	**0.01**
Ontario Regional Group Timeblock 5	35	4	0.430	**0.002**
St. Lawrence Regional Group Timeblock 1	9	2	0	0.5
St. Lawrence Regional Group Timeblock 2	12	2	0.211	0.1
St. Lawrence Regional Group Timeblock 3	15	2	0.246	0.1

Table D.8: ANOSIM Test Results

Bibliography

Abel, T. J.

2001. *The Clayton Cluster: Cultural Dynamics of a Late Prehistoric Village Cluster in the Upper St. Lawrence Valley*. PhD thesis, Department of Anthropology, University at Albany, State University of New York, Albany, New York.

Abel, T. J.

2019. The Iroquoian occupations of Northern New York. In *The Archaeology of New York State, Revisited*, S. E. Maguire and L. M. Anselmi, eds., P. in press. Albany, NY: New York State Museum.

Abel, T. J., J. J. Vavrasek, and J. P. Hart

2019. Radiocarbon dating the Iroquoian occupation of Northern New York. *American Antiquity*, 84:748–761.

Adams, N. R.

2003. The Arbor Ridge site: A study in settlement dynamics and population movement during the Fifteenth Century at the Eastern end of Lake Ontario. Master's thesis, University of Leicester, Leicester, England.

Aguillon, S. M., J. W. Fitzpatrick, R. Bowman, S. J. Schoech, A. G. Clark, G. Coop, and N. Chen

2017. Deconstructing isolation-by-distance: The genomic consequences of limited dispersal. *PLOS Genetics*, 13(8):e1006911.

Alberti, G.

2020. Gmamisc: ’Gianmarco Alberti’ Miscellaneous. R package version 1.1.1, https://CRAN.R-project.org/package=GmAMisc.

Allen, K. M. S.

2000. Considerations of scale in modeling settlement patterns using GIS: an Iroquois example. In *Practical Applications of GIS for Archaeologists: A Predictive Modelling Toolkit*, K. L. Westcott and R. J. Brandon, eds., Pp. 107–120. London, England: CRC Press.

Apicella, C. L., F. W. Marlowe, J. H. Fowler, and N. A. Christakis

2012. Social networks and cooperation in hunter-gatherers. *Nature*, 481(7382):497–501.

Archaeological Resource Associates

2003. Stage 4 Archaeological Assessment Gregor Site (BbGw-16) North Part of Lot 1, Concession 11 City of Barrie, County of Simcoe Former Township of Innisfil. Technical report, Ontario Ministry of Tourism, Culture, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

1998. Final Report on the Archaeological Salvage Excavation of the Murphy-goulding Site (AlGu-3), Town of Richmond Hill, Regional Municipality of York. Technical report, Ontario Ministry of Tourism, Culture, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2003. McGaw Site (AlGu-88) Archaeological Interpretive Program: Results of the 2003 Field Season. Technical report, Ontario Ministry of Tourism, Culture, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2004. Report on Stage 4 Excavation of the Serena Site (AhGx-274), Allison Estates, Subdivision (25t-91014), City of Hamilton, Regional Municipality of Hamilton, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2005a. The 1999 Stage 2-4 Assessment of Part of the Jarrett-lahmer Site (AlGv-18), Lot 17, Concession 5 (wys), Former Township of Vaughan, City of Vaughan, Regional Municipality of York, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2005b. The Archaeology of the Wellington Site (BcGw-55), a Report on the Stage 4 Salvage Excavations of the Wellington Site, Holly Secondary Planning Area (43t-92023), Part of the East Half of Lot 3, Concession 12, City of Barrie, Simcoe County, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport.

Archaeological Services Inc.

2006a. The Archaeology of the Dykstra Site (BbGw-5), a Report on Stage 4 Excavations at the Holly Secondary Planning Area (43t-92026), Part of the Northwest Half of Lot 2, Concession 12, City of Barrie, Simcoe County, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport.

Archaeological Services Inc.

2006b. The Stage 4 Salvage Excavation of the Baker Site (AkGu-15) Lot 11 Concession 2 (wys) Block 10 O.p.a. 400 Former Township of Vaughan, City of Vaughan, Regional Municipality of York, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto. Report on file.

Archaeological Services Inc.

2008a. Report on the Stage 3-4 Salvage Excavation of the Alexandra Site (AkGt-53) Draft Plan of Subdivision Sc-t20000001 (55t-00601) Geographic Township of Scarborough Now in the City of Toronto, Ontario. Technical report, Ontario Ministry of Tourism, Culture and Sport, Toronto. Report on file.

Archaeological Services Inc.

2008b. Stage 3 Archaeological Assessment of the Gibson Site (BcGo-14), Gibson Subdivision, Part of Lot 18, Concession 10, Township of Smith-Ennismore-Lakefield, County of Peterborough, Ontario. Technical report, Ontario Ministry of Tourism, Culture, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2008c. The Stage 4 Salvage Excavation of the Orion Site (AlGu-45) Lot 56, Concession 1 W.y.s, Town of Richmond Hill, Regional Municipality of York, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2009. The Archaeology of the Holly Site (BcGw-58), Stage 4 Salvage Excavation of the Holly Site, Dykstra Subdivision, Holly Secondary Planning Area (43T92026), Part of Northeast Half of Lot 2, Concession 12, City of Barrie, Simcoe County, Ontario. Technical report, Ontario Minstry of Culture, Tourism, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2010a. Report on Salvage Excavations of the Antrex Site (AjGv-38), City of Mississuagua, Regional Municipality of Peel, Ontario. Technical report, Ontario Ministry of Tourism, Culture and Sport, Toronto. Report on file.

Archaeological Services Inc.

2010b. Stage 4 Archaeological Excavation of the New Site (AlGt-36), Ibrans Box Grove Property, Draft Plan of Subdivision 19tm-04001, Town of Markham, Regional Municipality of York, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport. Report on file.

Archaeological Services Inc.

2010c. The Archaeology of the Hidden Spring Site (AlGu-368): Stage 4 Salvage Excavation of the Hidden Spring Site, Oxford West Subdivision Development, Part of Lots 13-16 and 37-40, Registered Plan 1931, Town of Richmond Hill, Regional Municipality of York, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2010d. The Archaeology of the Robb Site (AlGt-4): A Report on the Stage 4 Mitigative Excavation of the Angus Meadows Subdivision 19t-95030 (revised) Part of Lot Concession 8 Town of Markham Regional Municipality of York, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2010e. The Archaeology of the Walkington 2 Site (AlGu-341), Draft Plan of Subdivision 19t-95066 (revised), Part of Lots 16 and 17, Con. 2, City of Vaughan, R.M. Of York, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2011. The Stage 3-4 Archaeological Excavation of the Hope Site (AlGv-199), Draft Plan of Subdivision 19T-02V07 and 19T-02V08, City of Vaughan, Regional Municipality of York, Ontario. Technical report, Ontario Ministry of Tourism, Culture, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2012a. Report on the Stage 3-4 Mitigative Excavation of the Damiani Site (AlGv-231). City of Vaughan, Regional Municipality of York, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2012b. The Archaeology of the McNair Site (AlGu-8), a Report on the Stage 3-4 Mitigative Excavation of the McNair Site (AlGu-8), Block 12, Opa 400, Draft Plan of Subdivision 19t-89124 (major Bob Farms Inc.) and Draft Plan of Subdivision 19t-99v-08 (Andridge Homes Limited Lands) Part of Lots 24 and 25, Concession 2 in the City of Vaughan Regional Municipality of York, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2016a. Stage 4 Archaeological Salvage Excavation and Monitoring of Site BaGv-75, Bathurst Street Reconstruction, Lot 10, Concession 2, Township of King and Lots 103-104, Concession 1, Town of East Gwillimbury Regional Municipality of York. Technical report, Ontario Ministry of Tourism, Culture and Sport, Toronto, Ontario. Report on file.

Archaeological Services Inc.

2016b. The Archaeology of the Picard Site (AlGs-376): A Report on the Stage 3 & 4 Mitigative Excavation of the Joseph Picard Site (AlGs-376) Highway 407 East, Lot 32, Concession Vi, Whitby Township, Former Ontario County Regional Municipality of Durham, Ontario. Technical report, Ontario Ministry of Tourism, Culture, and Sport.

Axelrod, R.

1997. The dissemination of culture: A model with local convergence and global polarization. *Journal of Conflict Resolution*, 41(2):203–226.

BAIF Associates, Inc.

1984. The 1984 Salvage Excavations at the Boyle-Atkinson Site (AlGu-1), Town of Richmond Hill, Ontario. Technical report, Ontario Ministry of Culture, Tourism, and Sport, Toronto. Report on file.

Bamann, S. E.

1993. *Settlement Nucleation in Mohawk Iroquois Prehistory: An Analysis of Site Sequence in the Lower Otstungo Drainage of the Mohawk Valley*. PhD thesis, Department of Anthropology, University at Albany, State University of New York, Albany, NY.

Barrett, B. J.

2019. Equifinality in empirical studies of cultural transmission. *Behavioural Processes*, 161:129–138.

Battey, C. J., P. L. Ralph, and A. D. Kern

2020. Space is the place: Effects of continuous spatial structure on analysis of population genetic data. *Genetics*, 215(1):193–214.

Beales, E.

2014. A critical analysis of the adoption of maize in Southern Ontario and its spatial, demographic, and ecological signatures. Master's thesis, Department of Anthropology, Peterborough, ON.

Bell, A. V., P. J. Richerson, and R. McElreath

2009. Culture rather than genes provides greater scope for the evolution of large-scale human prosociality. *Proceedings of the National Academy of Sciences*, 106(42):17671–17674.

Bentley, R. A.

2007. Fashion versus reason — then and now. *Antiquity*, 81:1071–1073.

Bentley, R. A.

2011. 'Style Vesus Function' 30 years on. In *Evolutionary and Interpretive Archaeologies: A Dialogue*, A. Gardner and E. E. Cochrane, eds., Pp. 11–30. Walnut Creek, CA: Left Coast Press Inc.

Bentley, R. A., M. Earls, and M. J. O'Brien

2011. *I'll Have What She's Having: Mapping Social Behavior*. Cambridge, MA: Massechusetts Institute of Technology Press.

Bentley, R. A., M. W. Hahn, and S. J. Shennan

2004. Random drift and culture change. *Proceedings: Biological Sciences*, 271(1547):1443–1450.

Bentley, R. A., C. P. Lipo, H. A. Herzog, and M. W. Hahn

2007. Regular rates of popular culture change reflect random copying. *Evolution and Human Behavior*, 28(3):151–158.

Bentley, R. A. and S. Shennan

2003. Cultural transmission and stochastic network growth. *American Antiquity*, 63:459–485.

Bettinger, R. L., R. Boyd, and P. J. Richerson

1996. Style, function, and cultural evolutionary processes. In *Darwinian Archaeologies*, H. D. G. Maschner, ed., Pp. 133–164. New York: Springer.

Bettinger, R. L. and J. Eerkens

1999. Point typologies, cultural transmission, and the spread of bow-and-arrow technology in the Prehistoric Great Basin. *American Antiquity*, 64(2):231–242.

Bevan, A. and J. Conolly

2006. Multiscalar approaches to settlement pattern analysis. In *Confronting Scale in Archaeology: Issues of Theory and Practice*, G. Lock and B. L. Molyneux, eds., Pp. 217–234. New York, NY: Springer.

Birch, J.

2008. Rethinking the archaeological application of Iroquoian kinship. *Journal of Canadian Archaeology*, 32:194–213.

Birch, J.

2010a. Coalescence and conflict in Iroquoian Ontario. *Archaeological Review from Cambridge*, 25(1):29–48.

Birch, J.

2010b. Project: Social network analysis of Northern Iroquoia. https://1n.pm/3JmpG.

Birch, J.

2012. Coalescent communities: Settlement aggregation and social integration in Iroquoian Ontario. *American Antiquity*, 77(4):646–670.

Birch, J.

2015. Current research on the historical development of Northern Iroquoian societies. *Journal of Archaeological Research*, 23:263–323.

Birch, J.

2016. Relations of power and production in Ancestral Wendat communities. *Palethnologie. Archéologie et sciences humaines*, 8. https://bit.ly/3t2IXA3.

Birch, J.

2019. Settlement aggregation and geopolitical realignment in the Northeastern woodlands. In *Coming Together: Comparative Approaches to Population Aggregation and*

Early Urbanization, A. Gyucha, ed., number 8 in Institute for European and Mediterranian Archaeology Proceedings, Pp. 349–368. Albany, NY: State University of New York Press.

Birch, J.

2020. Social institutions and the differential development of Northern Iroquoian confederacies. In *The Evolution of Social Institutions*, D. M. Bondarenko, S. A. Kowalewski, and D. B. Small, eds., Pp. 419–435. Cham,Switzerland: Springer International Publishing.

Birch, J. and J. P. Hart

2018. Social networks and Northern Iroquoian confederacy dynamics. *American Antiquity*, 83(1):13–33.

Birch, J. and L. Lesage

2020. When detachment is not complete: Emplacement and displacement in Huron-Wendat ancestral landscapes. In *Detachment from Place: Beyond an Archaeology of Settlement Abandonment*, M. Lamoureaux-St-Hilaire and S. Macrae, eds., Pp. 45–62. Boulder, CO: University Press of Colorado.

Birch, J., S. W. Manning, S. Sanft, and M. A. Conger

2020. Refined radiocarbon chronologies for Northern Iroquoian site sequences: Implications for coalescence, conflict, and the reception of European goods. *American Antiquity*, Pp. 1–29.

Birch, J. and R. F. Williamson

2013. *The Mantle Site: An Archaeological History of an Ancestral Wendat Community*. Lanham, Maryland: Rowman and Littlefield.

Birch, J. and R. F. Williamson

2015. Navigating ancestral landscapes in the Northern Iroquoian world. *Journal of Anthropological Archaeology*, 39:139–150.

Birch, J. and R. F. Williamson

2018. Initial Northern Iroquoian coalescence. In *The Archaeology of Villages in Eastern North America*, J. Birch and V. D. Thompson, eds., Pp. 89–105. Gainsville: University of Florida Press.

Birch, J., R. B. Wojtowicz, A. Pradzynski, and R. H. Pihl

2016. Multi-scalar perspectives on Iroquioan ceramics: Aggregation and integration in Precontact Ontario. In *Process and Meaning in Spatial Archaeology: Investigations into Pre-Columbian Iroquoian Space and Place*, E. E. Jones and J. L. Creese, eds., Pp. 111–144. Boulder, CO: University Press of Colorado.

Bird, D. W. and R. B. Bird

2018. Signaling theory and durable symbolic expression. In *The Oxford Handbook of the Archaeology and Anthropology of Cave Art*, B. David and I. J. McNiven, eds., Pp. 343–362. New York: Oxford University Press.

Bird, R. B. and E. A. Smith

2005. Signaling theory, strategic interaction, and symbolic capital. *Current Anthropology*, 46(2):221–248.

Blythe, R. A.

2012. Random copying in space. *Advances in Complex Systems*, 15(1 & 2):1150012.

Borcard, D. and P. Legendre

2012. Is the Mantel correlogram powerful enough to be useful in ecological analysis? a simulation study. *Ecology*, 93(6):1473–1481.

Bowser, B. J.

2000. From pottery to politics: An ethnoarchaeological study of political factionalism, ethnicity, and domestic pottery style in the Ecuadorian Amazon. *Journal of Archaeological Method and Theory*, 7(3):219–248.

Bowser, B. J.

2002. *The Perceptive Potter: An Ethnoarchaeological Study of Pottery, Ethnicity, and*

Political Action in Amazonia. PhD thesis, Department of Anthropology, University of California Santa Barbara, Santa Barbara, CA.

Bowser, B. J. and J. Q. Patton

2004. Domestic spaces as public places: An ethnoarchaeological case study of houses, gender, and politics in the Ecuadorian Amazon. *Journal of Archaeological Method and Theory*, 11(2):157–181.

Bowser, B. J. and J. Q. Patton

2008. Learning and transmission of pottery style: Women's life histories and communities of practice in the Ecuadorian Amazon. In *Cultural Transmission and Material Culture: Breaking Down Boundaries*, M. T. Stark, B. J. Bowser, and L. Horne, eds., Pp. 105–129. Tucson, AZ: University of Arizona Press.

Boyd, R., M. Borgerhoff-Mulder, and W. H. Durham

1997. Are cultural phylogenies possible? In *Human By Nature: Between Biology and the Social Sciences*, P. Weingart, S. D. Mitchell, P. J. Richerson, and S. Maasen, eds., Pp. 355–386. London: Erlbaum.

Boyd, R. and P. J. Richerson

1985. *Culture and the Evolutionary Process*. Chicago: University of Chicago Press.

Bradburd, G. S., P. L. Ralph, and G. M. Coop

2013. Disentangling the effects of geographic and ecological isolation on genetic differentiation. *Evolution*, 67(11):3258–3273.

Bradley, J. W.

1977. The Pompey Center site: The impact of European trade goods 1600–1620. *New York State Archaeological Association: Beauchamp Chapter Bulletin*, 2(1):2–16.

Brainerd, G. W.

1951. The place of chronological ordering in archaeological analysis. *American Antiquity*, 16(4):301–313.

Braun, D. P.

1995. Style, selection, and historicity. In *Style, Society, and Person: Archaeological and Ethnological Perspectives*, C. Carr and J. E. Neitzel, eds., Pp. 27–76. New York: Plenum Press.

Braun, G. V.

2012. Petrography as a technique for investigating Iroquoian ceramic production and smoking rituals. *Journal of Archaeological Science*, 39(1):1–10.

Braun, G. V.

2015. *Ritual, Materiality, and Memory in an Iroquoian Village*. PhD thesis, Department of Anthropology, University of Toronto, Toronto, ON.

Brown, J. K.

1970. Economic organization and the position of women among the Iroquois. *Ethnohistory*, 17(3/4):151–167.

Brumbach, H. J.

2011. The history of the collared rim in the Finger Lakes, New York. In *Current Research in New York Archaeology:* A.D. *700–1300*, C. B. Rieth and J. P. Hart, eds., Pp. 83–93. Albany, NY: University of the State of New York.

Bursey, J. A.

1993. Prehistoric Huronia: Relative chronology through ceramic seriation. *Ontario Archaeology*, 55:3–34.

Cameron, K. L.

2011. *Pots and People: An Examination of the Relationships between Production, Function, and Distribution at the Le Caron Site, Simcoe County, Ontario*. PhD thesis, Department of Anthropology, Trent University Durham, Durham, ON.

Carr, C.

1995. Building a unified theory of artifact design: Historical perspectives and tactics. In

Style, Society, and Person: Archaeological and Ethnological Perspectives, C. Carr and J. E. Neitzel, eds., Pp. 171–258. New York: Plenum Press.

Carr, C. and J. E. Neitzel, eds.

1995. *Style, Society, and Person: Archaeological and Ethnological Perspectives*. New York: Plenum Press.

Cavalli-Sforza, L. L. and M. W. Feldman

1981. *Cultural Transmission and Evolution: A Quantitative Approach*. Princeton, NJ: Princeton University Press.

Centola, D., J. C. González-Avella, V. M. Eguíluz, and M. S. Miguel

2007. Homophily, cultural drift, and the co-evolution of cultural groups. *Journal of Conflict Resolution*, 51(6):905–929.

Chapdelaine, C.

2004. A review of the latest developments in St. Lawrence Iroquoian archaeology. In *A Passion for the Past: Papers in Honour of James F. Pendergast*, J. V. Wright and J. L. Pilon, eds., number 164 in Mercury Series Archaeology, Pp. 63–75. Canadian Museum of Civilization.

Chapdelaine, C., ed.

2015. *Mailhot-Curran: Un Village Iroquoien Du Xvie Siècle.*, number 35 in Paléo-Québec. Montreal: Recherches amérindiennes au Québec.

Chilton, E. A.

1996. *Embodiments of Choice: Native American Ceramic Diversity in the New England Interior*. PhD thesis, Department of Anthropology, University of Massechusetts, Amherst, MA.

Chung, C.

2003. On the origin of the typological/population distinction in Ernst Mayr's changing views of species, 1942–1959. *Studies in History and Philosophy of Science Part C:*

Studies in History and Philosophy of Biological and Biomedical Sciences, 34(2):277–296.

Clarke, K. R.

1993. Non-parametric multivariate analysis of changes in community structure. *Australian Journal of Ecology*, 18:117–143.

Colleran, H. and R. Mace

2011. Contrasts and conflicts in anthropology and archaeology: The evolutionary/interpretive dichotomy in human behavioural research. In *Evolutionary and Interpretive Archaeologies*, E. E. Cochrane and A. Gardner, eds., Pp. 281–305. Walnut Creek, CA: Left Coast Press Inc.

Conkey, M. A. and C. A. Hastorf, eds.

1990. *The Uses of Style in Archaeology*, New Directions in Archaeology. New York: Cambridge University Press.

Conolly, J.

2017. Costly signalling in archaeology: Origins, relevance, challenges, and prospects. *World Archaeology*, 49(4):435–445.

Conolly, J.

2018. Revisiting the Laurentian concept: Evaluating the contribution of isolation by distance and biogeography on the morphological and geospatial variation in Laurentian biface forms. *Archaeology of Eastern North America*, 46:69–92.

Cowgill, G. L.

1964. Statistics and sense: More on the Purum case. *American Anthropologist, New Series*, 6(1):1358–1365.

Cowgill, G. L.

1977. The trouble with significance tests and what we can do about it. *American Antiquity*, 42(3):350–368.

Cowgill, G. L.

1990a. Artifact classification and archaeological purposes. In *Archaeology: A Flexible Framework*, A. Voorips, ed., Pp. 61–78. Bonn: HOLOS Verlag.

Cowgill, G. L.

1990b. Why Pearson's R is not a good similarity coefficient for comparing collections. *American Antiquity*, 55(3):512–521.

Cowgill, G. L.

2000. "Rationality" and contexts in agency theory. In *Agency in Archaeology*, M.-A. Dobres and J. E. Robb, eds., Pp. 51–60. New York, NY: Routledge.

Creanza, N., O. Kolodny, and M. W. Feldman

2017. Cultural evolutionary theory: How culture evolves and why it matters. *Proceedings of the National Academy of Sciences*, 114(30):7782–7789.

Creese, J. L.

2013. Rethinking early village development in Southern Ontario: Toward a history of place-making. *Canadian Journal of Archaeology*, 37(2):185–218.

Creese, J. L.

2016. Growing pains: Explaining long-term trends in Iroquoian village scale, density, and layout. In *Process and Meaning in Spatial Archaeology : Investigations into Pre-Columbian Iroquoian Space and Place*, E. E. Jones, ed., Pp. 45–78. Boulder: University Press of Colorado.

Crema, E., K. Edinborough, T. Kerig, and S. Shennan

2014. An approximate Bayesian computation approach for inferring patterns of cultural evolutionary change. *Journal of Archaeological Science*, 50:160–170.

Crema, E. R., A. Kandler, and S. Shennan

2016. Revealing patterns of cultural transmission from frequency data: Equilibrium and non-equilibrium assumptions. *Scientific Reports*, 6(39122).

David, N. and C. Kramer

2001. *Ethnoarchaeology in Action*. Cambridge, MA: Cambridge University Press.

Day, G. M.

1968. Iroquois: An etymology. *Ethnohistory*, 15(4):389–402.

de Groot, B.

2020. The impact of population fluctuations on the spatial spread of Neolithic ceramic traditions in West Anatolia and South-East Europe. *Journal of Anthropological Archaeology*, 57:101121.

de Groot, B. G.

2019. A diachronic study of networks of ceramic assemblage similarity in Neolithic Western Anatolia, the Aegean and the Balkans (c. 6600–5500 BC). *Archaeometry*, 61(3):600–613.

Dermarkar, S.

2019. *Identity Formation at the Keffer Village: A Relational Network Approach to Communities of Practice*. PhD thesis, Department of Anthropology, University of Toronto, Toronto, ON.

Dermarkar, S., J. Birch, T. Shafie, J. P. Hart, and R. F. Williamson

2016. St. Lawrence Iroquoians and pan-Iroquoian social network analysis. *Ontario Archaeology*, 96:87–103.

Dietler, M. J. and I. Herbich

1989. *Tich Matek*: The technology of Luo pottery production and the definition of ceramic style. *World Archaeology*, 21(1):148–164.

Dietler, M. J. and I. Herbich

1998. *Habitus*, techniques, style: An integrated approach to the social understanding of material culture. In *The Archaeology of Social Boundaries*, M. T. Stark, ed., Pp. 233–263. Washington, DC: Smithsonian Institution Press.

Dietz, E. J.

1983. Permutation tests for association between two distance matrices. *Systematic Biology*, 32(1):21–26.

Dorland, S. G. H. and D. Ionico

2020. Learning from each other: A communities of practice approach to decorative traditions of Northern Iroquoian communities in the Late Woodland. *Journal of Archaeological Method and Theory*.

Drost, C. J. and M. Vander Linden

2018. Toy story: Homophily, transmission and the use of simple simulation models for assessing variability in the archaeological record. *Journal of Archaeological Method and Theory*, 25(4):1087–1108.

Drummond, C. S. and M. B. Hamilton

2007. Hierarchical components of genetic variation at a species boundary: Population structure in two sympatric varieties of *Lupinus microcarpus* (leguminosae). *Molecular Ecology*, 16:753–769.

Dunnell, R. C.

1978. Style and function: A fundamental dichotomy. *American Antiquity*, 43(2):192–202.

Dunnell, R. C.

1980. Evolutionary theory and archaeology. In *Advances in Archaeological Method and Theory*, M. B. Schiffer, ed., Pp. 35–99. New York: Academic Press.

Dunnell, R. C.

1982. Science, social science, and common sense: The agonizing dilemma of modern archaeology. *Journal of Archaeological Research*, 38(1):1–26.

Dunnell, R. C.

2001. Foreword. In *Style and Function: Conceptual Issues in Evolutionary Archaeology*, T. D. Hurt and G. M. F. Rakita, eds., Pp. xii–xxiv. Westport, CN: Bergin and Garvey.

Durham, W.

1991. *Coevolution : Genes, Culture, and Human Diversity*. Stanford, Calif: Stanford University Press.

Eerkens, J. and C. Lipo

2005. Cultural transmission, copying errors, and the generation of variation in material culture and the archaeological record. *Journal of Anthropological Archaeology*, 24(4):316–334.

Eerkens, J. W., R. L. Bettinger, and P. J. Richerson

2014. Cultural transmission theory and hunter-gatherer archaeology. In *The Oxford Handbook of the Archaeology and Anthropology of Hunter-Gatherers*, V. Cummings, P. Jordan, and M. Zvelebil, eds., Pp. 1127–1142. Oxford, England: Oxford University Press.

Eerkens, J. W. and C. P. Lipo

2007. Cultural transmission theory and the archaeological record: Providing context to understanding variation and changes in material culture. *Journal of Archaeological Research*, 15(3):239–274.

Emerson, J. N.

1968. *Understanding Iroquois Pottery: A Rethinking*, Special Publication of the Ontario Archaeological Society. Toronto, ON: Ontario Archaeological Society.

Engelbrecht, W.

1969. Wayland-Smith site regrouped ceramic data. 10.6067/XCV8CN72FQ, Accessed September 21, 2020.

Engelbrecht, W.

1970. Warren site regrouped ceramic data. 10.6067/XCV8DZ06J5, Accessed September 21, 2020.

Engelbrecht, W.

1974. The Iroquois: Archaeological patterning on the Tribal level. *World Archaeology*, 6(1):52–65.

Engelbrecht, W.

1980. Inferring prehistoric social and political organization in the Northeast. In *Proceedings of the Conference on Northeastern archaeology*, J. A. Moore, ed., number 19 in University of Massachusetts Anthropology Department Research Reports, Pp. 109–122. Amherst, MA: University of Massachusetts Amherst.

Engelbrecht, W.

1984. The Kleis site ceramics: An interpretive approach. In *Extending the rafters: Interdisciplinary approaches to Iroquoian studies*, M. K. Foster, J. Campisi, and M. Mithun, eds., Pp. 325–339. Albany, New York: SUNY Press.

Engelbrecht, W.

1985. New York Iroquois political development. In *Cultures in Contact: The European Impact on Native Cultural Institutions in Eastern North America,* A.D. *1000–1800.*, W. Fitzhugh, ed., Pp. 163–183. Washington, DC: Smithsonian Institution Press.

Engelbrecht, W.

1995. The case of the disappearing Iroquoians: Early contact period superpower politics. *Northeast Anthropology*, 50:35–59.

Engelbrecht, W.

1996. Appendix A: Pottery code and data. In *Reanalyzing the Ripley Site: Earthworks and Late Prehistory on the Lake Erie Plain*, L. P. Sullivan, ed., number 489 in New York State Museum Bulletin, Pp. 129–138. University of the State of New York.

Engelbrecht, W.

1999. Iroquoian archaeology and archaeological taxa. In *Taming the Taxonomy: Toward a New Understanding of Great Lakes Archaeology*, R. F. Williamson and C. M. Watts, eds., Pp. 51–60. Toronto: eastendbooks.

Engelbrecht, W.

2003. *Iroquoia: Development of a Native World*. Syracuse, NY: Syracuse University Press.

Engelbrecht, W.

2004. Northern New York revisited. In *A passion for the past: Papers in honor of James F. Pendergast*, J. V. Wright and J. L. Pilon, eds., Pp. 125–144. Ottawa: Canadian Museum of Civilization.

Engelbrecht, W., E. Sidler, and M. Walko

1990. The Jefferson County Iroquoians. *Man in the Northeast*, 39:65–77.

Engelbrecht, W. E.

1971. *A Stylistic Analysis of Iroquois Pottery*. PhD thesis, University of Michigan, Ann Arbor, MI.

Excoffier, L.

2007. Analysis of population subdivision. In *Handbook of Statistical Genetics*, D. J. Balding, M. Bishop, and C. Cannings, eds., volume 2, Pp. 980–1020. Chichester, England: John Wiley & Sons, Ltd.

Excoffier, L., P. E. Smouse, and J. M. Quattro

1992. Analysis of molecular variance inferred from metric distances among DNA haplotypes: Application to human mitochondrial DNA restriction data. *Genetics*, 131(2):479–491.

Feinman, G. M. and J. E. Neitzel

2020. Excising culture history from contemporary archaeology. *Journal of Anthropological Archaeology*, 60:101230.

Fenton, W.

1998. *The Great Law and the Longhouse : A Political History of the Iroquois Confederacy*. Norman, OK: University of Oklahoma Press.

Finlayson, W.

2020. *The Draper Site, an Ontario Woodland Tradition Frontier Coalescent Village in Southern Ontario, Canada: Looking Back, Moving Forward*, number 2 in Our Lands Speak — Occasional Papers in Ontario Archaeology. East Gwillimbury, ON: I C Publishing.

Finlayson, W. D.

2003. Stage 3 & 4 Archaeological Assessment of the Lougheed Site (BbGw-13), North Half of Lot 1, Concession 11, City of Barrie, County of Simcoe, Former Township of Innisfil. Technical report, Ontario Ministry of Tourism, Culture, and Sport, Toronto, Ontario. Report on file.

Fitzgerald, W. R.

1979. The Hood site: Longhouse burials in an historic Neutral village. *Ontario Archaeology*, 32:43–60.

Fitzgerald, W. R.

1982. *Lest the Beaver Run Loose: The Early 17th Century Christianson Site and Trends in Historic Neutral Archaeology*, number 114 in Mercury Series. Ottawa, ON: University of Ottawa Press.

Fitzgerald, W. R.

1990. *Chronology to Cultural Process: Lower Great Lakes Archaeology, 1500–1650*. PhD thesis, Department of Anthropology, McGill University, Ottawa, ON.

Flannery, K. V.

1982. The Golden Marshalltown: A parable for the archeology of the 1980s. *American Anthropologist*, 84(2):265–278.

Fox, W.

2015. Ethnogenesis in the Lower Great Lakes and St. Lawrence region. *Ontario Archaeology*, 95:21–32.

Fu, F., M. A. Nowak, N. A. Christakis, and J. H. Fowler

2012. The evolution of homophily. *Scientific Reports*, 2:845.

Furholt, M.

2008. Pottery, cultures, people? the European Baden people material re-examined. *Antiquity*, 82:617–628.

Gagné, M.

2010. L'occupation villageoise Iroquoienne dans la région de Saint-Anicet, Mrc du Haut-Saint-Laurent (2007). fouille du site McDonald (BgFo-18). Technical report, Ministère de la Culture et des Communications et la M.R.C. du Haut-Saint-Laurent.

Gardner, A. and E. E. Cochrane

2011. Evolutionary and interpretive archaeologies: A dialogue. In *Evolutionary and Interpretive Archaeologies: A Dialogue*, A. Gardner and E. E. Cochrane, eds., Pp. 11–29. Walnut Creek, CA: Left Coast Press Inc.

Garvey, R.

2018. Current and potential roles of archaeology in the development of cultural evolutionary theory. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1743):20170057.

Gates St. Pierre, C.

2016. Iroquoians in the St. Lawrence river valley before European contact. *Ontario Archaeology*, 96:47–64.

Gaudreau, M. and L. Lesage

2016. Understanding ethnicity and cultural affiliation: Huron-Wendat and anthropological perspectives. *Ontario Archaeology*, 96:6–16.

Gidigaa Migizi [Williams], D.

2018. *Michi Saagiig Nishnaabeg: This Is Our Territory*. Winnipeg, Manitoba: Arbeiter Ring.

Gidigaa Migizi [Williams], D.

2020. Foreward. In *The Draper Site, An Ontario Woodland Tradition Frontier Coalescent Village in Southern Ontario, Canada: Looking Back, Moving Forward*, W. D. Finlayson, ed., number 2 in Our Lands Speak — Occasional Papers in Ontario Archaeology, Pp. xxiii–xxviii. Holland Landing, ON: I C Publishing.

Glencross, B., G. Warrick, K. Anderson, S. MacKinnon, S. Millar, and S. Patterson

2015. The Chew Site (BeGx-9): A case study in the value of archived collections. *Ontario Archaeology*, 95:3–20.

Goodale, N.

2019. Natural selection, material culture, and archaeology. In *Handbook of Evolutionary Research in Archaeology*, A. Prentiss, ed., Pp. 71–81. Springer International Publishing.

Grene, M.

1990. Evolution, "typology" and population thinking. *American Philosophical Quarterly*, 27(3):237–244.

Groucutt, H., ed.

2020. *Culture History and Convergent Evolution : Can We Detect Populations in Prehistory*, Vertebrate Paleobiology and Paleoanthropology. Cham, Switzerland: Springer International Publishing.

Grove, M.

2019. Evolving conformity: Conditions favouring conformist social learning over random copying. *Cognitive Systems Research*, 54:232–245.

Guillot, G., R. Leblois, A. Coulon, and A. C. Frantz

2009. Statistical methods in spatial genetics. *Molecular Ecology*, 18(23):4734–4756.

Guillot, G. and F. Rousset

2013. Dismantling the Mantel tests. *Methods in Ecology and Evolution*, 4:336–344.

Handley, L. J. L., A. Manica, J. Goudet, and F. Balloux

2007. Going the distance: Human population genetics in a clinal world. *Trends in Genetics*, 23(9):432–439.

Hart, J. P.

2011. The death of Owasco – redux. In *Current Research in New York Archaeology: A.D. 700–1300*, C. B. Rieth and J. P. Hart, eds., Pp. 95–107. Albany, NY: University of the State of New York.

Hart, J. P.

2012. The effects of geographical distances on pottery assemblage similarities: A case study from Northern Iroquoia. *Journal of Archaeological Science*, 39(1):128–134.

Hart, J. P.

2020. Reassessing an inferred Iroquoian village removal sequence in the Mohawk River Basin, New York, USA. *Journal of Anthropological Archaeology*, 60:101236.

Hart, J. P. and J. Birch

2021. Conflict, population movement, and microscale social networks in Northern Iroquoian archaeology. *American Antiquity*, in press.

Hart, J. P., J. Birch, and C. Gates St. Pierre

2017. Effects of population dispersal on regional signalling networks: An example from Northern Iroquoia. *Science Advances*, 3:e1700497.

Hart, J. P. and H. J. Brumbach

2003. The death of Owasco. *American Antiquity*, 68(4):737–752.

Hart, J. P. and W. Engelbrecht

2012. Northern Iroquoian ethnic evolution: A social network analysis. *Journal of Archaeological Method and Theory*, 19:322–349.

Hart, J. P. and W. E. Engelbrecht

2016. Revisiting Onondaga Iroquois prehistory through social network analysis. In *Process and Meaning in Spatial Archaeology : Investigations into Pre-Columbian Iroquoian Space and Place*, E. E. Jones, ed., Pp. 189–214. Boulder: University Press of Colorado.

Hart, J. P. and W. A. Lovis

2013. Reevaluating what we know about the histories of maize in Northeastern North America: A review of current evidence. *Journal of Archaeological Research*, 21(2):175–216.

Hart, J. P., T. Shafie, J. Birch, S. Dermarkar, and R. F. Williamson

2016. Nation building and social signaling in Southern Ontario: A.D. 1350–1650. *PLoS ONE*, 11(5):e0156178.

Hart, J. P., S. Winchell-Sweeney, and J. Birch

2019. An analysis of network brokerage and geographic location in Fifteenth-century AD Northern Iroquoia. *PLoS ONE*, 14(1):e0209689.

Haun, D. and H. Over

2015. Like me: A homophily-based account of human culture. In *Epistemological Dimensions of Evolutionary Psychology*, T. Breyer, ed., Pp. 117–130. New York: Springer.

Hawkins, A. L.

2004. Recreating home? A consideration of refugees, microstyles, and frilled pottery in Huronia. *Ontario Archaeology*, 77/78:62–80.

Head, L.

2016. Geographical scale in understanding human landscapes. In *Handbook of Landscape Archaeology*, B. David and J. Thomas, eds., World Archaeological Congress Research Handbooks in Archaeology, Pp. 379–385. New York: Routledge.

Hegmon, M.

1992. Archaeological research on style. *Annual Review of Anthropology*, 21:517–536.

Hodder, I.

1982. *Symbols in Action: Ethnoarchaeological Studies of Material Culture*, New Studies in Archaeology. New York: Cambridge University Press.

Hodder, I.

2000. Agency and individuals in long-term processes. In *Agency in Archaeology*, M.-A. Dobres and J. E. Robb, eds., Pp. 21–33. New York, NY: Routledge.

Holland-Lulewicz, J.

2021. From categories to connections in the archaeology of Eastern North America. *Journal of Archaeological Research. First Look*, 10.1007/s10814-020-09154-w.

Holland-Lulewicz, J., M. A. Conger, J. Birch, S. A. Kowalewski, and T. W. Jones

2020. An institutional approach for archaeology. *Journal of Anthropological Archaeology*, 58:101163.

Jamieson, J. B.

1982. The Steward site: A study in St. Lawrence Iroquoian chronology. Master's thesis, Department of Anthropology, Montreal, Quebec.

Jamieson, J. B.

1990. The archaeology of the St. Lawrence Iroquoians. In *The Archaeology of Southern Ontario to A.D. 1651*, C. J. Ellis and N. Ferris, eds., number 5 in Occasional Publications of the London Chapter, OAS, Pp. 385–404. London Chapter, Ontario Archaeological Society.

Jay, F., P. Sjödin, M. Jakobsson, and M. G. Blum

2012. Anisotropic isolation by distance: The main orientations of human genetic differentiation. *Molecular Biology and Evolution*, 30(3):513–525.

Jones, E. E.

2008. *Iroquois Population History and Settlement Ecology,* A.D. *1500-1700*. PhD thesis, College of the Liberal Arts, Pennsylvania State University, Pittsburgh, PA.

Jones, E. E.

2010. Population history of the Onondaga and Oneida Iroquois, A.D. 1500–1700. *American Antiquity*, 75(2):387–407.

Jones, E. E.

2016. Refining our understanding of sixteenth- and seventeenth-century Haudenosaunee settlement location choices. In *Process and Meaning in Spatial Archaeology: Investigations into Pre-Columbian Iroquoian Space and Place*, E. E. Jones and J. L. Creese, eds., Pp. 145–170. Boulder, CO: University Press of Colorado.

Jordan, P. and S. Shennan

2003. Cultural transmission, language, and basketry traditions amongst the California Indians. *Journal of Anthropological Archaeology*, 22(1):42–74.

Jordan, P. D.

2015. *Technology As Human Social Tradition: Cultural Transmission among Hunter-gatherers*. Oakland, CA: University of California Press.

Kandler, A. and E. R. Crema

2019. Analysing cultural frequency data: Neutral theory and beyond. In *Handbook of Evolutionary Research in Archaeology*, A. M. Prentiss, ed., Pp. 83–109. Cham, Switzerland: Springer-Verlag GmbH.

Kandler, A. and A. Powell

2018. Generative inference for cultural evolution. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1743):20170056.

Kandler, A. and S. Shennan

2013. A non-equilibrium neutral model for analysing cultural change. *Journal of Theoretical Biology*, 330:18–25.

Kandler, A. and S. Shennan

2015. A generative inference framework for analysing patterns of cultural change in sparse population data with evidence for fashion trends in LBK culture. *Journal of The Royal Society Interface*, 12(113):20150905.

Kidd, K.

1950. Orr Lake pottery: A study of the ceramics of an early Historic Huron site. *Transactions of the Royal Canadian Institute*, 28:165–185.

Kirch, P. V.

1980. The archaeological study of adaptation: Theoretical and methodological issues. In *Advances in Archaeological Method and Theory*, M. B. Schiffer, ed., Pp. 101–156. New York: Academic Press.

Klimek, S.

1935. *Culture Element Distributions, Vol. 1: The Structure of California Indian Culture*, volume 37 of *University of California Publications in American Archaeology and Ethnography*. Berkley, CA: University of California Press.

Kohler, T. A., S. VanBuskirk, and S. Ruscavage-Barz

2004. Vessels and villages: Evidence for conformist transmission in early village aggregations on the Pajarito Plateau, New Mexico. *Journal of Anthropological Archaeology*, 23(1):100–118.

Kowalewski, S. A.

2006. Coalescent societies. In *Light on the Path: The Anthropology and History of the Southeastern Indians*, T. J. Pluckhahn and R. Ethridge, eds., Pp. 94–122. Tuscaloosa, AB: University of Alabama Press.

Kowalewski, S. A. and J. Birch

2020. How do people get big things done? In *The Evolution of Social Institutions*, D. M. Bondarenko, S. A. Kowalewski, and D. B. Small, eds., Pp. 29–50. Springer International Publishing.

Kuhn, T. S.

1962. *The Structure of Scientific Revolutions*. Chicago, IL: University of Chicago Press.

LaPierre, D. J.

2019. Ceramic variability and attribute analysis of the Scott Site (BcGk-01): A multi-component occupation at the confluence of the Trent and Crowe Rivers, Peterborough County, ON. Manuscript on file, Trent University.

Latta, M. A.

1971. Archaeology of the Penetang Peninsula. *Ontario Archaeology*, 20:3–24.

Latta, M. A.

1976. *The Iroquoian Cultures of Huronia: A Study of Acculturation through Archaeology*. PhD thesis, Department of Anthropology, University of Toronto, Toronto, ON.

Latta, M. A.

1985. A 17th century Attigneenongnahac village: Settlement patterns at the Auger site (BdGw-3). *Ontario Archaeology*, 44:41–54.

Legendre, P.

2000. Comparison of permutation methods for the partial correlation and partial Mantel tests. *Journal of Statistical Computation and Simulation*, 67(1):37–73.

Legendre, P., M.-J. Fortin, and D. Borcard

2015. Should the Mantel test be used in spatial analysis? *Methods in Ecology and Evolution*, 6(11):1239–1247.

Legendre, P. and L. Legendre

2012. *Numerical Ecology*, number 24 in Developments in Ecological Modelling, 3 edition. New York: Elsevier.

Lenig, D.

1965. *The Oak Hill Horizon and Its Relation to the Development of Five Nations Iroquois Culture*, number 15(1) in Researches and transactions of the New York State Archeological Association. Buffalo, NY: New York State Archaeological Association.

Lennox, P. A.

1977. The Hamilton site: A Late Historic Neutral town. Master's thesis, Department of Anthropology, Hamilton, ON.

Lennox, P. A.

2000. *The Molson Site: An Early Seventeenth Century, First Nations Settlement, Simcoe*

County, Ontario, number 18 in Bulletin. London, Ontario: London Museum of Archaeology.

Lipo, C. P., M. E. Madsen, R. C. Dunnell, and T. Hunt
1997. Population structure, cultural transmission, and frequency seriation. *Journal of Anthropological Archaeology*, 16:301–333.

Lycett, S. J.
2014. Dynamics of cultural transmission in Native Americans of the High Great Plains. *PLoS ONE*, 9(11):e112244.

Lycett, S. J.
2015a. Cultural evolutionary approaches to artifact variation over time and space: Basis, progress, and prospects. *Journal of Archaeological Science*, 56:21–31.

Lycett, S. J.
2015b. Differing patterns of material culture intergroup variation on the High Plains: Quantitative analyses of parfleche characteristics vs. moccasin decoration. *American Antiquity*, 80(4):714–731.

Lycett, S. J.
2017. Cultural patterns within and outside of the Post-contact Great Plains as revealed by parfleche characteristics: Implications for areal arrangements in artifactual data. *Journal of Anthropological Archaeology*, 48:87–101.

Lycett, S. J.
2019. Confirmation of the role of geographic isolation by distance in among-tribe variations in beadwork designs and manufacture on the High Plains. *Archaeological and Anthropological Sciences*, 11(6):2837–2847.

Lycett, S. J.
2020. Spatially mediated cultural transmission and the distribution of horse blanket styles among post-contact and reservation-period Tribes of western North America. *Archaeological and Anthropological Sciences*, 12(1).

Lyman, R. L.

2008. Cultural transmission in North American anthropology and archaeology, ca. 1895–1965. In *Cultural transmission and archaeology: Issues and case studies*, M. J. O'Brien, ed., Pp. 10–20. Washington, DC: Society for American Archaeology.

Lyman, R. L., M. J. O'Brien, and R. C. Dunnell

1997. *The Rise and Fall of Culture History*. New York: Plenum Press.

MacDonald, R. I.

1988. Northern Iroquoian sweat baths. *Ontario Archaeology*, 48:17–26.

MacDonald, R. I. and R. F. Williamson

2001. Sweat lodges and solidarity: The archaeology of the Hubbert site. *Ontario Archaeology*, 71:29–78.

Macneish, R. S.

1952. *Iroquois Pottery Types: A Technique for the Study of Iroquois Prehistory*, number 124 in National Museum of Canada Bulletin. Ottawa, ON: Ministry of Resources and Development.

Madsen, M. E.

2020. *Measuring Cultural Transmission at Archaeological Timescales: How Can We Improve Empirical Sufficiency?* PhD thesis, Department of Anthropology, University of Washington, Seattle, WA.

Malécot, G.

1948. *Les Mathématiques De L'hérédité*. Paris: Masson.

Manel, S., M. K. Schwartz, G. Luikart, and P. Taberlet

2003. Landscape genetics: Combining landscape ecology and population genetics. *Trends in Ecology & Evolution*, 18(4):189–197.

Manning, S. W., J. Birch, M. A. Conger, M. W. Dee, C. Griggs, and C. S. Hadden

2019. Contact-era chronology building in Iroquoia: Age estimates for Arendarhonon sites and implications for identifying Champlain's Cahiagué. *American Antiquity*, 84(4):684–707.

Manning, S. W., J. Birch, M. A. Conger, M. W. Dee, C. Griggs, C. S. Hadden, A. G. Hogg, C. B. Ramsey, S. Sanft, P. Steier, and E. M. Wild
2018. Radiocarbon re-dating of contact-era Iroquoian history in Northeastern North America. *Science Advances*, 4(12):eaav0280.

Manning, S. W., J. Birch, M. A. Conger, and S. Sanft
2020. Resolving time among non-stratified short-duration contexts on a radiocarbon plateau: Possibilities and challenges from the A.D. 1480–1630 example and Northeastern North America. *Radiocarbon*, Pp. 1–23.

Manning, S. W. and J. P. Hart
2019. Radiocarbon, bayesian chronological modeling and early European metal circulation in the Sixteenth-century A.D. Mohawk River Valley, USA. *PLOS ONE*, 14(12):e0226334.

Mantel, N.
1967. The detection of disease clustering and a generalized regression approach. *Cancer Research*, 27:209–220.

Marois, R. J. M.
1978. *Le Gisement Beaumier: Essai Sur L'evolution Des Decors De Al Céramique*, number 75 in Mercury Series, Archaeological Survey of Canada. Ottawa: National Museum of Man.

Martelle, H. A.
2002. *Huron Potters and Archaeological Constructs: Researching Ceramic Microstylistics*. PhD thesis, Department of Anthropology, University of Toronto, Toronto, ON.

Martin, S. W. J.
2008. Languages past and present: Archaeological approaches to the appearance of

Northern Iroquoian speakers in the Lower Great Lakes region of North America. *American Antiquity*, 73(3):441–463.

Marwick, B.

2019. Galisonian logic devices and data availability: Revitalising Upper Palaeolithic cultural taxonomies. *Antiquity*, 93(371):1365–1367.

Maxwell, T. D.

2001. Directionality, function, and adaptation in the archaeological record. In *Style and Function: Conceptual Issues in Evolutionary Archaeology*, T. D. Hurt and G. Rakita, eds., Pp. 41–49. Westport: Bergin and Garvey.

Mayr, E.

1959. Typological vs. population thinking. In *Evolution and Anthropology: A Centennial Appraisal*, B. J. Meggers, ed., Pp. 409–412. Washington: The Anthropological Society of Washington.

McPherson, M., L. Smith-Lovin, and J. M. Cook

2001. Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, 27(1):415–444.

Meirmans, P. G.

2006. Using the AMOVA framework to estimate a standardized genetic differentiation measure. *Evolution*, 60(11):2399–2402.

Meirmans, P. G.

2012. The trouble with isolation by distance. *Molecular Ecology*, 21:2839–2846.

Meirmans, P. G., J. Goudet, and O. E. Gaggiotti

2011. Ecology and life history affect different aspects of the population structure of 27 High-Alpine plants. *Molecular Ecology*, 20:3144–3155.

Meltzer, D. J.

1981. A study of style and function in a class of tools. *Journal of Field Archaeology*, 8:313–326.

Mengoni, A. and M. Bazzicalupo

2002. The statistical treatment of data and the analysisof molecular variance (AMOVA) in molecular microbial ecology. *Annals of Microbiology*, 59:95–101.

Mesoudi, A.

2011. *Cultural Evolution: How Darwinian Theory Can Explain Human Culture and Synthesize the Social Sciences*. Chicago, IL: The University of Chicago Press.

Mesoudi, A.

2020. The study of culture and evolution across disciplines. In *The Cambridge Handbook of Evolutionary Perspectives on Human Behavior*, Pp. 61–74. Cambridge University Press.

Mesoudi, A., A. Whiten, and K. N. Laland

2006. Towards a unified science of cultural evolution. *Behavioral and Brain Sciences*, 29(4):329–347.

Miller, D.

1985. *Artefacts As Categories: A Study of Ceramic Variability in Central India*. Cambridge, MA: Cambridge University Press.

Mithun, M.

2017. The Iroquoian language family. In *The Cambridge Handbook of Linguistic Typology*, A. Y. Aikhenvald and R. M. W. Dixon, eds., Pp. 747–781. Cambridge: Cambridge University Press.

Neff, H.

1993. Theory, sampling, and analytical techniques in the archaeological study of prehistoric ceramics. *American Antiquity*, 58(1):23–44.

Neff, H.

2001. Differential persistence of what? the scale of selection issue in evolutionary archaeology. In *Style and Function: Conceptual Issues in Evolutionary Archaeology*, T. D. Hurt and G. Rakita, eds., Pp. 25–40. Westport: Bergin and Garvey.

Neiman, F. D.

1995. Stylistic variation in evolutionary perspective: Inferences from decorative diversity and interassemblage distance in Illinois Woodland ceramic assemblages. *American Antiquity*, 60(1):7–36.

Noble, W. C.

1974. The Jackes (Eglinton) site: Another facet of southern Huron development in the Toronto region. *Ontario Archaeology*, 22:3–31.

O'Brien, M. J., R. Bentley, and W. A. Brock

2019. *The Importance of Small Decisions*. Cambridge, MA: The MIT Press.

O'Brien, M. J. and R. A. Bentley

2020. Learning strategies and population dynamics during the Pleistocene colonization of North America. In *Culture History and Convergent Evolution: Can We Detect Populations in Prehistory?*, H. Groucutt, ed., Vertebrate Paleobiology and Paleoanthropology, Pp. 261–281. Cham, Switzerland: Springer International Publishing.

O'Brien, M. J. and R. D. Leonard

2001. Style and function: An introduction. In *Style and Function: Issues in Evolutionary Archaeology*, T. D. Hurt and G. F. M. Rakita, eds., Pp. 1–23. Westport, CN: Bergin and Garvey.

O'Brien, M. J., R. L. Lyman, and R. D. Leonard

1998. Basic incompatibilities between evolutionary and behavioral archaeology. *American Antiquity*, 63(3):485–498.

Oksanen, J., F. G. Blanchet, M. Friendly, R. Kindt, P. Legendre, D. McGlinn, P. R. Minchin, R. B. O'Hara, G. L. Simpson, P. Solymos, M. H. H. Stevens, E. Szoecs, and H. Wagner

2019. Vegan: Community ecology package. R package version 2.5-6, https://CRAN.R-project.org/package=vegan.

Paradis, E.

2010. Pegas: An R package for population genetics with an integrated modular approach. *Bioinformatics*, 26:419–420.

Peace, T. and K. M. Labelle, eds.

2016. *From Huronia to Wendakes: Adversity, Migrations, and Resilience, 1650–1900*, New directions in Native American studies. Norman, OK: University of Oklahoma Press.

Pendergast, J. F.

1964. Nine small sites on Lake St. Francis representing an early Iroquois horizon in the Upper St. Lawrence River Valley. *Anthropologica, New Series*, 6(2):183–221.

Pendergast, J. F.

1966a. *The Berry Site*, number 206 in National Museum of Canada Bulletin. Ottawa: National Museum of Canada.

Pendergast, J. F.

1966b. *Three Prehistoric Components in Eastern Ontario: The Salem, Gray's Creek and Beckstead Sites*, number 208 in National Museum of Canada Bulletin. Ottawa: National Museum of Canada.

Pendergast, J. F.

1968. *The Summerstown Station Site*, number 18 in National Museum of Canada Anthropology Papers. Ottawa: National Museum of Canada.

Pendergast, J. F.

1969. The MacDougald site. *Ontario Archaeology*, 13:29–53.

Pendergast, J. F.

1972a. An analysis of the Dawson site archaeological material. In *Cartier's Hochelaga and the Dawson Site*, J. Pendergast and B. G. Trigger, eds., Pp. 109–265. Montreal, Quebec: McGill-Queens University Press.

Pendergast, J. F.

1972b. The Lite site: An early southern division Huron site near Belleville, Ontario. *Ontario Archaeology*, 17:24–61.

Pendergast, J. F.

1974. The Sugarbush site: A possible Iroquoian maplesugar camp. *Ontario Archaeology*, 23:31–61.

Pendergast, J. F.

1979. Ceramic motif mutations at Glenbrook. In *Proceedings of the Iroquois Pottery Conference*, C. F. Hayes III, ed., Pp. 133–145. Rochester, NY: Rochester Museum and Science Center.

Pendergast, J. F.

1984. *The Beckstead Site—1977*, number 123 in Mercury Series Archaeological Survey of Canada. Ottawa: University of Ottawa Press.

Pendergast, J. F.

1990. Emerging St. Lawrence Iroquoian settlement patterns. *Man in the Northeast*, 40:17–30.

Perelli, S. C.

2009. Iroquoian social organization in practice: A small-scale study of gender roles and site formation in Western New York. In *Iroquoian Archaeology and Analytic Scale*, L. E. Miroff and T. D. Knapp, eds., Pp. 19–50. Knoxville: University of Tennessee Press.

Perez, M. F., F. F. Franco, J. R. Bombonato, I. A. S. Bonatelli, G. Khan, M. Romeiro-Brito, A. C. Fegies, P. M. Ribeiro, G. A. R. Silva, and E. M. Moraes

2018. Assessing population structure in the face of isolation by distance: Are we neglecting the problem? *Diversity and Distributions*, 24(12):1883–1889.

Perreault, C.

2019. *The Quality of the Archaeological Record*. Chicago: The University of Chicago Press.

Pfeiffer, S., J. C. Sealy, R. F. Williamson, S. Needs-Howarth, and L. Lesage

2016. Maize, fish, and deer: Investigating dietary staples among Ancestral Huron-

Wendat villages, as documented from tooth samples. *American Antiquity*, 81(3):515–532.

Pfeiffer, S., R. F. Williamson, J. Newton, P. le Roux, C. Forrest, and L. Lesage

2020. Population movements of the Huron-Wendat viewed through strontium isotope analysis. *Journal of Archaeological Science: Reports*, 33:102466.

Pfeiffer, S., R. F. Williamson, J. C. Sealy, D. G. Smith, and M. H. Snow

2014. Stable dietary isotopes and mtDNA from Woodland Period Southern Ontario people: Results from a tooth sampling protocol. *Journal of Archaeological Science*, 42:334–345.

Pihl, R. H.

1984. Final Report on the Draper Rim Sherd Collection: 1975/1978 Excavated Samples. Technical report, Ontario Museum of Archaeology, London, ON. Report on file.

Pihl, R. H. and S. C. Thomas

1997. The Finch site: A late Iroquoian special-purpose site on West Catfish Creek. *Ontario Archaeology*, 63:37–84.

Porčić, M.

2015. Exploring the effects of assemblage accumulation on diversity and innovation rate estimates in neutral, conformist, and anti-conformist models of cultural transmission. *Journal of Archaeological Method and Theory*, 22(4):1071–1092.

Porčić, M. and M. Nešić

2014. Simulating cultural transmission: Preliminary results and their implications for the study of the formal variability of material culture in the Central Balkan Neolithic. *Documenta Praehistorica*, 41:137–148.

Pratt, P. P.

1976. *Archaeology of the Oneida Iroquois*, number 1 in Occasional Publications in Northeastern Anthropology. George's Mills: New Hampshire: Man in the Northeast Inc.

Premo, L. S.

2014. Cultural transmission and diversity in time-averaged assemblages. *Current Anthropology*, 55(1):104–114.

Premo, L. S.

2016. Effective population size and the effects of demography on cultural diversity and technological complexity. *American Antiquity*, 81(4):605–622.

Premo, L. S. and J. B. Scholnick

2011. The spatial scale of social learning affects cultural diversity. *American Antiquity*, 76(1):163–176.

Prentiss, A. M., ed.

2019a. *Handbook of Evolutionary Research in Archaeology*. Cham, Switzerland: Springer-Verlag GmbH.

Prentiss, A. M.

2019b. Introduction. In *Handbook of Evolutionary Research in Archaeology*, A. M. Prentiss, ed., Pp. 1–22. Cham, Switzerland: Springer-Verlag GmbH.

Prentiss, A. M.

2021. Theoretical plurality, the extended evolutionary synthesis, and archaeology. *Proceedings of the National Academy of Sciences*, 118(2):e2006564118.

Prentiss, A. M. and C. L. Laue

2019. Cultural macroevolution. In *Handbook of Evolutionary Research in Archaeology*, A. M. Prentiss, ed., Pp. 111–125. Cham, Switzerland: Springer International Publishing.

Quinn, C. P.

2019. Costly signaling theory in archaeology. In *Handbook of Evolutionary Research in Archaeology*, A. Prentiss, ed., Pp. 275–294. Springer International Publishing.

R Core Team

2020. R: A language and environment for statistical computing. Version 4.0.3, https://www.R-project.org.

Raff, J. A., D. A. Bolnick, J. Tackney, and D. H. O'Rourke

2011. Ancient DNA perspectives on American colonization and population history. *American Journal of Physical Anthropology*, 146(4):503–514.

Ramsden, P. G.

1990. Saint Lawrence Iroquoians in the Upper Trent River valley. *Man in the Northeast*, 39:87–95.

Richerson, P. J. and R. Boyd

2007. Response to our critics. *Biology & Philosophy*, 23(2):301–315.

Richerson, P. J. and R. Boyd

2008. *Not by Genes Alone: How Culture Transformed Human Evolution*. Chicago: University of Chicago Press.

Riede, F.

2011. Towards operationalizing an evolutionary archaeological definition of culture. In *Investigating Archaeological Cultures: Material Culture, Variability, and Transmission*, B. W. Roberts and M. Vander Linden, eds., Pp. 23–41. New York: Springer.

Riede, F., C. Hoggard, and S. Shennan

2019. Reconciling material cultures in archaeology with genetic data requires robust cultural evolutionary taxonomies. *Palgrave Communications*, 5(55).

Rigaud, S., F. d'Errico, and M. Vanhaeren

2015. Ornaments reveal resistance of North European cultures to the spread of farming. *PLOS ONE*, 10(4):e0121166.

Roberts, B. W. and M. Vander Linden

2011. Investigating archaeological cultures: Material culture, variability, and transmission. In *Investigating Archaeological Cultures: Material Culture, Variability, and Transmission*, B. W. Roberts and M. Vander Linden, eds., Pp. 1–22. New York: Springer.

Robertson, D. A., S. G. Monckton, and R. F. Williamson

1995. The Wiacek site revisited: The results of the 1990 excavations. *Ontario Archaeology*, 60:40–91.

Robertson, D. A. and R. F. Williamson

2003. The archaeology of the Dunsmore site: 15th-century community transformations in Southern Ontario. *Canadian Journal of Archaeology*, 27:1–61.

Robinson, W. S.

1951. A method for chronologically ordering archaeological deposits. *American Antiquity*, 16(4):293–301.

Robinson, W. S. and G. W. Brainerd

1952. Robinson's coefficient of agreement—a rejoinder. *American Antiquity*, 18(1):60–61.

Roe, P. G.

1995. Style, society, myth, and structure. In *Style, Society, and Person: Archaeological and Ethnological Perspectives*, C. Carr and J. E. Neitzel, eds., Pp. 123–141. New York: Plenum Press.

Rogers, D. S. and P. R. Ehrlich

2008. Natural selection and cultural rates of change. *Proceedings of the National Academy of Sciences*, 105(9):3416–3420.

Ross, R. M., S. J. Greenhill, and Q. D. Atkinson

2013. Population structure and cultural geography of a folktale in Europe. *Proceedings of the Royal Society B: Biological Sciences*, 280(1756):20123065.

Roux, V.

2019. *Ceramics and Society: A Technological Approach to Archaeological Assemblages*. Cham, Switzerland: Springer International Publishing.

Rzeszutek, T., P. E. Savage, and S. Brown

2012. The structure of cross-cultural musical diversity. *Proceedings of the Royal Society B: Biological Sciences*, 279(1733):1606–1612.

Scerri, E. M. L., M. G. Thomas, A. Manica, P. Gunz, J. T. Stock, C. Stringer, M. Grove, H. S. Groucutt, A. Timmermann, G. P. Rightmire, F. d'Errico, C. A. Tryon, N. A. Drake, A. S. Brooks, R. W. Dennell, R. Durbin, B. M. Henn, J. Lee-Thorp, P. deMenocal, M. D. Petraglia, J. C. Thompson, A. Scally, and L. Chikhi

2018. Did our species evolve in subdivided populations across Africa, and why does it matter? *Trends in Ecology & Evolution*, 33(8):582–594.

Schiffer, M. B.

2011. A behavioral archaeologist responds. *Journal of Archaeological Method and Theory*, 18(4):336–348.

Schillaci, M. A., C. Kopris, S. Wichmann, and G. Dewar

2017. Linguistic clues to Iroquoian prehistory. *Journal of Anthropological Research*, 73(3):448–485.

Sempowski, M. and L. P. Saunders

2001. *Dutch Hollow and Factory Hollow : the advent of Dutch trade among the Seneca*, Charles F. Wray series in Seneca archaeology. Collections Dept. of the Rochester Museum and Science Center.

Shennan, S.

1988. *Quantifying Archaeology*. San Diego, CA: Academic Press.

Shennan, S.

2002. *Genes, Memes and Human History: Darwinian Archaeology and Cultural Evolution*. London: Thames and Hudson.

Shennan, S.

2008. Evolution in archaeology. *Annual Review of Anthropology*, 37(1):75–91.

Shennan, S.

2011. Descent with modification in the archaeological record. *Philosophical Transactions of the Royal Society B*, 366:1070–1079.

Shennan, S.

2020. Style, function and cultural transmission. In *Culture History and Convergent Evolution: Can We Detect Populations in Prehistory?*, H. Groucutt, ed., Vertebrate Paleobiology and Paleoanthropology, Pp. 291–298. Cham, Switzerland: Springer International Publishing.

Shennan, S., E. R. Crema, and T. Kerig

2015. Isolation-by-distance, homophily, and "core" vs. "package" cultural evolution models in Neolithic Europe. *Evolution and Human Behaviour*, 36:103–109.

Shennan, S. J.

2000. Population, culture history, and the dynamics of culture change. *Current Anthropology*, 41:811–835.

Shennan, S. J. and R. A. Bentley

2008. Style, interaction, and demography among the earliest farmers of Central Europe. In *Cultural Transmission and Archaeology: Issues and Case Studies*, M. J. O'Brien, ed., Pp. 112–119. Washington, DC: Society for American Archaeology.

Shennan, S. J. and J. Steele

1999. Cultural learning in Hominids: A behavioural ecological approach. In *Mammalian social learning.*, H. Box and K. Gibson, eds., volume 70 of *Symposia of the Zoological Society of London*, Pp. 367–388. Cambridge: Cambridge University Press.

Shennan, S. J. and J. R. Wilkinson

2001. Ceramic style change and neutral evoluton: A case study from Neolithic Europe. *American Antiquity*, 66(4):577–593.

Simard, R.

1971. Le Site De Chicoutimi (DcEs-1). Fouille De Sauvetage, 1971. Technical report, Société d'Archéologie de Saguenay, Chicoutimi, Quebec.

Sioui, G.

1999. *Huron-Wendat: The Heritage of the Circle*. Vancouver: UBC Press.

Smith, D. G.

1997a. *Archaeological Systematics and the Analysis of Iroquoian Ceramics: A Case Study from the Crawford Lake Area, Ontario, Canada*, number 15 in London Museum of Archaeology Bulletin. London, Ontario: London Museum of Archaeology.

Smith, D. G.

1997b. Radiocarbon dating the Middle to Late Woodland transition and earliest maize in Southern Ontario. *Archaeology of Eastern North America*, 54:37–73.

Smith, E. A.

2013. Agency and adaptation: New directions in evolutionary anthropology. *Annual Review of Anthropology*, 42(1):103–120.

Smouse, P. E., J. C. Long, and R. R. Sokal

1986. Multiple regression and correlation extensions of the Mantel test of matrix correspondence. *Systematic Zoology*, 35(4):627–632.

Snow, D. R.

1994. *The Iroquois*. Cambridge, MA: Blackwell.

Snow, D. R.

1995. *Mohawk Valley Archaeology: The Sites*. Albany, NY: The Institute for Archaeological Studies, SUNY Albany.

Steele, J., C. Glatz, and A. Kandler

2010. Ceramic diversity, random copying, and tests for selectivity in ceramic production. *Journal of Archaeological Science*, 37(6):1348–1358.

Sterner, J.

1989. Who is signalling whom? ceramic style, ethnicity, and taphonomy among the Sirak Bulahay. *Antiquity*, 634:451–459.

Striker, S.

2018. *The Social Dynamics of Coalescence: Ancestral Wendat Communities 1400–1550* C.E. PhD thesis, Department of Anthropology, Arizona State University, Tempe, AZ.

Sutton, R. E.

1989. Middle and late Iroquoian occupations of the Middle Trent Valley. Master's thesis, McMaster University, Hamilton, Ontario.

Sutton, R. E.

1990. *Hidden Amidst the Hills: Middle and Late Iroquoian Occupations in the Middle Trent Valley*. Dundas, Ontario: Copetown Press.

Sutton, R. E.

1999. The Barrie site: A pioneering Iroquois village located in Simcoe County, Ontario. *Ontario Archaeology*, 67:40–85.

Taché, K. and J. P. Hart

2013. Chronometric hygiene of radiocarbon databases for early durable cooking vessel technologies in Northeastern North America. *American Antiquity*, 78(2):359–372.

Tehrani, J. J. and F. Riede

2008. Towards an archaeology of pedagogy: Learning, teaching, and the generation of material culture traditions. *World Archaeology*, 40:316–331.

Terrell, J. E. and J. P. Hart

2016. Domesticated landscapes. In *Handbook of Landscape Archaeology*, B. David and J. Thomas, eds., World Archaeological Congress Research Handbooks in Archaeology, Pp. 328–332. New York: Routledge.

Thomas, J.

2016. Archaeology, landscape, dwelling. In *Handbook of Landscape Archaeology*, B. David and J. Thomas, eds., World Archaeological Congress Research Handbooks in Archaeology, Pp. 300–307. New York: Routledge.

Tooker, E. E.

1964. *An Ethnography of the Huron Indians, 1615–1649*, number 190 in Smithsonian Institution Bureau of American Ethnology Bulletin. Washington, DC: U.S. Government Printing Office.

Tostevin, G. B.

2012. *Seeing Lithics: A Middle Range Theory for Testing for Cultural Transmission in the Pleistocene*. Oxford: Oxbow.

Trigger, B.

1976. *The Children of Aataentsic: A History of the Huron People to 1660*. Montreal, QC: McGill-Queens University Press.

Trigger, B. G.

1978. Iroquoian matriliny. *Pennsylvania Archaeologist*, 48(1–2):55–65.

Trigger, B. G.

1986. *Natives and Newcomers: Canada's "Heroic Age" Reconsidered*. Montreal, QC: McGill-Queen's University Press.

Tuck, J. A.

1971. *Onondaga Iroquois Prehistory: A Study in Settlement Archaeology*. Syracuse, NY: Syracuse University Press.

Walsh, M. J., A. M. Prentiss, and F. Riede

2019a. Introduction to cultural microevolutionary research in anthropology and archaeology. In *Handbook of Evolutionary Research in Archaeology*, A. M. Prentiss, ed., Pp. 25–48. Cham, Switzerland: Springer-Verlag GmbH.

Walsh, M. J., F. Riede, and S. O'Neill

2019b. Cultural transmission and innovation in archaeology. In *Handbook of Evolutionary Research in Archaeology*, A. M. Prentiss, ed., Pp. 49–70. Cham, Switzerland: Springer-Verlag GmbH.

Waples, R. S. and O. Gaggiotti

2006. What is a population? an empirical evaluation of some genetic methods for identifying the number of gene pools and their degree of connectivity. *Molecular Ecology*, 15(6):1419–1439.

Warrick, G.

1988. Estimating Ontario Iroquoian village duration. *Man in the Northeast*, 36:21–60.

Warrick, G.

2008. *A Population History of the Huron-Petun,* A.D. *500–1650*. New York: Cambridge University Press.

Warrick, G. and L. Lesage

2016. The Huron-Wendat and the St. Lawrence Iroquoians: New findings of a close relationship. *Ontario Archaeology*, 96:134–144.

Warrick, G. A.

2000. The Precontact Iroquoian occupation of Ontario. *Journal of World Prehistory*, 14(4):415–466.

Watts, C. M.

2008. *Pot/potter Entanglements and Networks of Agency in Late Woodland Period (c.* A.D. *900–1300), Southwestern Ontario, Canada*, number 1828 in BAR International Series. Oxford: Oxford University Press.

White, A.

2013. An abstract model showing that the spatial structure of social networks affects the outcomes of cultural transmission processes. *Journal of Artificial Societies and Social Simulation*, 16(3):9.

Williamson, R. and D. Snow

2016. The study of Northern Iroquoia: Before and after the international boundary. In *Process and Meaning in Spatial Archaeology: Investigations into Pre-Columbian Iroquoian Space and Place*, E. E. Jones and J. L. Creese, eds., Pp. 215–230. Boulder, CO: University Press of Colorado.

Williamson, R. F.

1990. The Early Iroquoian period of Southern Ontario. In *The Archaeology of Southern Ontario to A.D. 1651*, C. J. Ellis and N. Ferris, eds., number 5 in Occasional Publications of the London Chapter, OAS, Pp. 493–505. London Chapter, Ontario Archaeological Society.

Williamson, R. F.

2014. The archaeological history of the Wendat to A.D. 1651: An overview. *Ontario Archaeology*, 94:3–64.

Williamson, R. F.

2016. East-West interaction among fifteenth-century St. Lawrence Iroquoian and North Shore of Lake Ontario Ancestral Wendat communities. *Ontario Archaeology*, 96:104–120.

Williamson, R. F., S. J. Austin, and S. C. Thomas

2003. The archaeology of the Grandview site: A fifteenth century Iroquoian community on the North Shore of Lake Ontario. *Arch Notes*, 8(5):5–49.

Williamson, R. F. and T. G. Powis

1998. Parsons site ceramic vessels. *Ontario Archaeology*, 65/66:53–71.

Williamson, R. F. and D. A. Robertson

1994. Peer polities beyond the periphery: Early and Middle Iroquoian regional interaction. *Ontario Archaeology*, 58:27–44.

Wissler, C.

1927. Distribution of moccasin decorations among the Plains tribes. *Anthropological Papers of the American Museum of Natural History*, 29:5–23.

Wobst, H. M.

1977. Stylistic behaviour and information exchange. In *For the Director: Research Essays in Honour of James B. Griffin*, J. B. Griffin and C. F. Cleland, eds., Pp. 317–342. Ann Arbor, MA: Museum of Anthropology, University of Michigan.

Wonderley, A.

2009. *At the Font of the Marvelous: Exploring Oral Narrative and Mythic Imagery of the Iroquois and Their Neighbors*. Syracuse, NY: Syracuse University Press.

Wonderley, A. and M. L. Sempowski

2019. *Origins of the Iroquois League*. Syracuse, NY: Syracuse University Press.

Wray, C. and H. L. Schoff

1953. A preliminary report on the Seneca sequence in Western New York. *Pennsylvania Archaeologist*, 23(2):53–63.

Wright, J. V.

1966. *The Ontario Iroquois Tradition*, number 210 in National Museum of Canada Bulletin. Ottawa: National Museum of Canada.

Wright, S.

1943. Isolation by distance. *Genetics*, 28(3):114–138.

Wright, S.

1946. Isolation by distance under diverse systems of mating. *Genetics*, 31:39–59.

Wright, S.

1965. The interpretation of population structure by F-statistics with special regard to systems of mating. *Evolution*, 19(3):395–420.

Wright, S.

1969. *Evolution and the Genetics of Populations*, volume Vol. 2, The Theory of Gene Frequencies. Chicago, IL: University of Chicago Press.