Ethnic Boundaries and Cultural Change in an Amazonian Population
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INTRODUCTION
Overview
This 25-month investigation examines the relationship between inter-ethnic interactions, perceptions, and the cultural content of ethnic groups. Evidence from ethnography, psychological experiments, and evolutionary models supports the intuition that inter-ethnic interactions among individuals play an important role in the changing “cultural content” of an ethnic group, i.e., the norms (beliefs about what is acceptable behavior) and the symbolic markers (dress, language, etc.) perceived to be shared by co-ethnics. However, the mechanisms underlying this relationship remain poorly understood. This study asks the question: How do patterns of interaction among people of different ethnicities relate to the actual and perceived distributions of ethnic-typical norms of behavior and symbolic markers across an ethnic boundary? This question is addressed in two ways. First, ethnographic and experimental methods are used to explore correlations among these variables in the field. Second, agent-based models are developed to explore causal mechanisms underlying the observed patterns. The study population consists of the minority indigenous Matsigenka ethnic group and the majority Mestizo ethnic group in lowland forests along the Manu River in southeastern Peru. Although still limited, Matsigenka-Mestizo interaction has increased steadily in the Manu region in recent years, spurring political debate about how such interaction leads to change in “traditional” Matsigenka norms of behavior (e.g., Terborgh 1999). This study aims to produce new insight into the roles of inter-ethnic interactions, markers, and out-group perceptions in cultural change across an ethnic boundary.

Theoretical Background
Definitions and Relationships among Terms
An ethnic group is here defined as a social group to which individuals ascribe themselves and to which they are ascribed by others, based on a perception of shared ancestry and, usually, a range of subjectively important shared norms (beliefs about what is appropriate behavior) and symbolic markers (language, dress, etc.) (adapted from: Barth 1998[1969]; Gil-White 1999; Weber 1968). A boundary between two ethnicities is usually characterized by a sharp division of perceived ancestry, norms, and markers between individuals identifying with different ethnic groups. People who can credibly claim membership in more than one ethnic group tend to choose to identify with only one at a time (Alba 1990; Nagel 1996; Waters 1990), or to create a new separate ethnicity (Nagata 1981), thereby preserving boundaries.

Boundaries between ethnicities can be maintained despite the fact that the norms and markers of ethnic groups may change over time. In particular, norms held by individuals of two frequently-interacting ethnic groups may evolve to become similar in the contexts of interaction, as shared norms tend to make coordinated interactions more mutually beneficial (Barth 1998[1969]; McElreath et al. 2003). For example, shared beliefs about what constitutes “fairness” make exchanges more efficient. Norms are broadly defined as beliefs about what is appropriate behavior, and encompass the personal, descriptive, and social norms of Bicchieri (2006). Norms can have important behavioral consequences (Schultz et al. 2007), and much inter-ethnic behavioral variation in a given context is here assumed to result from the application of different norms. Such norm differences may often result from inter-ethnic differences in
knowledge (Atran et al. 2002), though they need not. A coordination interaction ("interaction" below) is an interaction in which all actors receive a greater (though not necessarily equal) benefit if they act in concordant rather than discordant manners, and, by extension, hold concordant rather than discordant norms in the domain of interaction (McElreath et al. 2003). Examples of coordination interactions might include those between employers/employees, buyers/vendors, and spouses.

Choosing interaction partners with suitable norms is often difficult, as many norms are unobservable until they are put into practice (e.g., norms of spousal and parenting behavior: Nave 2000). One potential mechanism allowing individuals to bias interactions toward others who share similar, though unobservable, norms is the use of arbitrary markers (e.g., dress, language, etc.) that covary with, and can thereby signal, the norms of interest (McElreath et al. 2003). For example, in lowland Peru, most Mestizos habitually speak Spanish (a marker) and, as Christians, are averse to polygynous marriages (a norm). In contrast, most indigenous Matsigenka habitually speak Matsigenka and are not necessarily averse to polygyny (Johnson 2003). In a mixed Matsigenka-Mestizo population, high norm-marker covariance would mean that an unmarried person's language is a good indicator of her/his as yet unobservable marriage norm. As it is used here, a marker is simply the manifestation of a norm (usually a descriptive norm: Bicchieri 2006) that is readily observable without any significant interaction needing to occur between individuals. Norm-marker covariance refers to covariance between a marker and a different, less easily observable norm that has important consequences for a particular type of interaction (e.g., a language marker covarying with marriage norms).

Evolutionary Models: Inter-Ethnic Interactions and Markers

McElreath et al. (2003) developed an agent-based cultural evolutionary model to illustrate a mechanism by which groups of people with distinctive norms and markers can evolve from an initial population where such group distinctions do not exist. Under the assumptions, among others, that individuals can modify their markers and that people tend to bias coordination interactions toward others with similar markers, the model demonstrates that such group structure can develop provided there is some mixing of interaction partners (termed "migration"). The basic predictions of this model have been upheld in controlled experimental games with human participants (Efferson et al. 2008).

To better approximate the study population in the current investigation, additional simulations of the McElreath et al. (2003) model were run by Bunce (with the help of R. McElreath) using initial conditions modified to represent interacting minority and majority groups with initially distinct distributions of norms and markers. Under the assumptions of the original model, these simulations revealed that when interactions across the inter-group boundary are present but low, distinct distributions of norms can be maintained in both minority and majority groups, and norm-marker covariance is high among those individuals who engage in inter-group interactions. Both of these results are due to frequency-dependent selection. However, with even moderate increases in the level of inter-group interaction, the initially distinctive norms and markers of the minority group are quickly lost from the population.

This model generates two important predictions in need of testing in the field: 1) change in the norm and marker distributions of an ethnic group can be mediated through peaceful inter-ethnic coordination interactions (also predicted by Barth 1998[1969]); and 2) high norm-marker
covariance among inter-ethnic interactors is a characteristic of a population in which ethni-
typical norm distributions are being maintained in the face of inter-ethnic interactions.

Social Psychology: Importance of Out-Group Perceptions

When people are divided into social groups, they tend to perceive individuals in out-
groups as: 1) more similar to each other than are members of the in-group (the out-group
homogeneity effect: Ostrom & Sedikides 1992); 2) more different from members of the in-group
than individuals within the in-group are from each other (social accentuation: Tajfel 1982); and
3) inferior to and less worthy of resources than members of the in-group (inter-group bias and
discrimination: Tajfel 1982). Thus, where an ethnic boundary exists, one might predict that
individuals in each ethnic group would perceive the norms and markers of the out-group as
homogenously distributed, different from, and inferior to those of the in-group. Even if not
objectively accurate, these perceptions may influence people’s inter-ethnic interaction behavior.

However, several other factors also influence out-group perceptions. Wilder (1978)
demonstrated that discrimination against the out-group decreases when out-group members are
perceived as individuals rather than as members of a group (“individuation”). Tajfel (1982)
suggested that individuation might be achieved through increased personal inter-group
interactions. Additionally, the nature of inter-group interactions may influence perception.
Riketta and Sacramento (2008) showed that people more readily projected characteristics of
themselves onto members of the out-group when the out-group was perceived as cooperative
rather than competitive. This was true even though the projected characteristics were unrelated
to the domain of cooperative or competitive interaction. Thus, where an ethnic boundary exists, one
might predict that as inter-ethnic coordination interactions (a form of cooperation) increase,
people begin to perceive out-group individuals as more similar to themselves, even in domains
where no inter-ethnic interaction has yet taken place. Such perceptions might motivate
individuals to expand inter-ethnic interaction into these new domains, thereby exposing new
norms to the possibility of cultural change.

The relative status of social groups may also affect perceptions of the out-group. Brauer
(2001), interpreting the results of several studies, proposed that, all else being equal, high status
groups may be perceived by both in-group and out-group members as more heterogeneous than
low status groups. This may be because everyone pays more attention to (i.e., more readily
individuates) successful high status people compared to low status people (e.g., indirect bias:
Boyd & Richerson 1985). Status may be determined in the context of coordination interactions
with unequal payoff structures, such that the individual perceived to be receiving the most
benefit from an interaction is the lower-status party. Power (resulting in high status) may rest
with the individual receiving the least benefit, as refusing the interaction would cost her/him less
than it would cost the lower-status individual. For instance, buying a machete from a Mestizo
yields a large benefit to a Matsigenka who can get one nowhere else. However, this particular
interaction yields only a small benefit to the Mestizo vender who has many other customers for
the same machete. A Matsigenka would have lower status in this buyer/vender interaction
context. Thus, status may be inversely proportional to coordination payoff, and may affect how
people perceive the distribution of norms in the out-group. This may in turn affect the extent and
nature of inter-group interactions, and thus the process of cultural change.
Emic Boundary Perspectives

Anthropological and sociological work on ethnicity emphasizes the importance of emic perspectives of ethnic boundaries. All individuals have multiple nested social identities (e.g., Amazonian Indian, Peruvian, Matsigenka, Manu resident) that can be invoked in different contexts for different purposes (Marggraff 2004; Nagata 1981; Tilly 2005; Wimmer 2008). For any two domains of coordination interaction (e.g., marriage versus trade), the relevant in-group versus out-group distinction, and the norms and markers of importance, may be different. Thus, a researcher must take care that the ethnic boundary of interest is in fact the social boundary perceived to be most relevant to the subjects in the context under study, and that the subjects and the researcher perceive the boundary in the same way (e.g., Rosengren 2003).

Ethnographic Complexities: Inter-Ethnic Interaction and Cultural Change

In general, the ethnographic record supports the hypothesis that, where ethnic boundaries exist, inter-ethnic interactions can have an important influence on cultural change within ethnic groups. However, as shown below, this influence is often complex and unpredictable.

Gans (1979) argued that, for descendants of European-American immigrants to the U.S., behavioral (i.e., norm) differences among ethnic groups tend to be attenuated as interaction across ethnic boundaries increases each generation. However, the unique identity of these minority ethnic groups can be maintained in later generations through an increased emphasis on a few minimally-costly symbolic markers perceived as ethnic-typical (e.g., Irish-Americans wearing green on St. Patrick’s Day). In support of this theory of “symbolic ethnicity”, Waters (1990) and Alba (1990) present evidence that most individuals of mixed European-American ancestry are free, within genealogical constraints, to choose to identify with one or more ethnic group. However, because many of the extensive ethnic community-oriented behaviors of European-Americans immigrants have been replaced in subsequent generations by more personal and symbolic ethnic commitments, the ethnicity choices of these descendants may have little impact on their everyday behavior. Thus, in the context of European-Americans, increasing inter-ethnic interaction has, in many cases, resulted in the loss of distinctive norms governing important interactions. The cultural content of many such ethnic groups is now limited almost entirely to markers which have become decoupled from these now-absent norms.

The effect of inter-ethnic contact on the norms and markers of ethnic groups is not always unidirectional or predictable, however. Nagel (1996) argues that attempts by the U.S. government to eliminate distinctive Native American cultural behavior by emphasizing the use of English and forcing assimilation of Native Americans into the “mainstream” of U.S. society, actually laid the necessary groundwork for the Native American ethnic and cultural resurgence of the 1960s and 1970s. This movement, whose roots go back at least to the early 20th century (Zamir 2007), consisted of a reemphasis, rediscovery, and, in some cases, reinvention of the distinctive symbolic markers, as well as important behavioral norms, characterizing tribal (ethnic) groups. Similarly, when inter-ethnic interaction is present but limited to certain domains, changes in norm and marker distributions can be difficult to predict. For instance, Merrill (1993) argues that the rejection by Tarahumara indians of Catholic doctrine preached by Jesuit missionaries in 17th and 18th century Mexico (New Spain) contributed to the creation of a new Tarahumara religion with a unique set of norms and symbolic markers. This occurred despite Tarahumara engagement with European technology, political organization, and religious ritual. Huntington and Hostetler (2002) show how Hutterite ethno-religious groups have been
remarkably successful in preserving their distinctive set of norms for over 400 years by restricting inter-ethnic interactions in some domains (e.g., friendships) while encouraging them in others (community economic exchange). Thus, inter-ethnic contact need not relate in a straightforward way to changes in the norms and markers of ethnic groups.

For indigenous ethnic groups in Amazonian South America, cultural change is often a strategic choice between adoption of majority market-based behaviors (and associated norms) in order to obtain political, economic, educational, and/or health benefits, versus maintenance of “traditional” cultural characteristics in order to receive aid or recognition from governments and NGOs. For instance, in lowland Ecuador, many indigenous Secoya believe that their survival as an ethnic group depends on gaining control over their lives, land, and resources. Many attempt to achieve this through adoption of market-based activities such as ranching, which brings them economic power. In contrast, the nearby indigenous Cofán have largely elected to maintain “traditional” subsistence practices and enlist the economic and political support of conservation NGOs to help them assert rights over their land (Valdivia 2005). Thus, these two groups have made different strategic decisions about how to modify (or not) their ethnic norms and markers.

The cases of strategic cultural decisions by the Secoya and Cofán are not unique among indigenous Amazonians. Harakmbut indigenous groups in lowland Peru have adopted destructive gold mining practices and individual entrepreneurial norms as a way to secure access to resources on their land before government-backed Mestizo miners do (Urteaga Crovetto 2007). Similar to the opposing strategies of the Secoya and Cofán, several Matsigenka communities in Peru have chosen to remain under the protection of the government in Manu National Park, where they are obligated to maintain “traditional” subsistence practices. Other Matsigenka, however, have made the strategic decision to leave the park and move to the Urubamba River system in order to establish communities where they are free to engage in market-based agriculture, animal husbandry, and wage labor (Marggraff 2004). Even in Matsigenka communities outside the park there is considerable internal debate between “modernists” who favor enlisting the support of NGOs to “modernize” communities and engage in legal battles for traditional land rights, and “orthodox” individuals who emphasize traditional norms of personal independence rather than community cooperation, and care little for material possessions or land titles (Rosengren 2003). Thus, changes in the norms and markers of an ethnic group can be a strategic response to inter-ethnic interaction. Importantly, such cultural change can, in turn, have profound effects on the nature of subsequent inter-ethnic interactions. For instance, an indigenous group may be treated by conservationists as an enemy or an ally depending on which strategic direction of cultural change it adopts (Holt 2005).

**Motivation for the Proposed Study**

As shown above, the relationship between inter-ethnic interaction and cultural change is complex. However, few field studies have yet attempted to explicitly measure several variables that are believed, on the theoretical grounds presented above, to play important roles in this complex relationship. These variables include: 1) individual variation in the frequency and nature of inter-ethnic interactions; 2) covariance of markers and norms important in inter-ethnic interactions; and 3) individual variation in perceptions of out-group norm and marker distributions. The results of several pioneering studies of populations with ethnic boundaries suggest that important relationships exist between cultural norm, knowledge, and behavior distributions and several of these variables, e.g., market integration (inter-ethnic interaction)
(Godoy et al. 2009; Henrich et al. 2010), cross-ethnic social networks (inter-ethnic interaction) (Atran et al. 2002), and perceived out-group norm distributions (Ross et al. 2007). This study, however, will be the first to measure all three variables in the same population, and can thus evaluate the relative importance of the roles played by each in cultural change.

OBJECTIVES AND HYPOTHESES

The overall aim of this investigation is to determine the effects of inter-ethnic interactions on the actual and perceived norm and marker complements of individuals on either side of a Matsigenka-Mestizo ethnic boundary. Specific objectives, with corresponding hypotheses, are:

Objective 1: Identify and ethnographically describe a set of behavioral norms and ethnic markers in each ethnic group, and a corresponding set of intra- and inter-ethnic coordination interactions.

Hypothesis 1A: There exists a set of norms in each ethnic group that govern interactions between individuals, and, in some contexts, these norms are signaled by markers.

Hypothesis 1B: The Matsigenka-Mestizo ethnic boundary is perceived by individuals of both groups to be a salient boundary structuring a set of inter-ethnic interactions.

Objective 2: Measure the distributions of identified norms, markers, and interactions among individuals of each ethnic group.

Hypothesis 2A: The distributions of norms and markers differ across the ethnic boundary, i.e., Matsigenka and Mestizo cultural content differs at the population level.

Hypothesis 2B: Within each ethnic group there is inter-individual variation in norm and marker complements, as well as in the frequency and nature of intra- and inter-ethnic interactions involving those norms.

Hypothesis 2C: The norms of individuals will match those of their most frequent or most important interaction partners, regardless of whether those partners are co-ethnics or belong to the out-group.

Corollary 2C: Individuals perceived to receive the most benefit from a particular interaction (low-status individuals) will change their norms to match those of individuals perceived to receive less benefit from the particular interaction (high-status individuals). When inter-ethnic interactions are frequent, the Matsigenka (lower-status) tend to adopt Mestizo (higher-status) norms, and not vice versa.

Hypothesis 2D: When exposed to a range of potential interaction partners with coinciding and conflicting norms, individuals will signal their norm with a marker, thereby resulting in high norm-marker covariance.

Corollary 2D: The highest norm-marker covariance will be found in the subset of Matsigenka and Mestizos with intermediate levels of inter-ethnic interaction, as these individuals run the highest risk of choosing an interaction partner with conflicting norms. The norms of individuals with high levels of inter-ethnic contact will match those of the out-group (Hypothesis 2C) so the risk of miscoordination, and the importance of markers, for such individuals is reduced.

Objective 3: Compare the actual and perceived distributions of norms and markers, in relation to inter-ethnic interactions.
**Hypothesis 3A**: The greater the frequency or importance of an individual’s inter-ethnic interactions, the more the individual “individuates” the out-group, and consequently, the more accurate (less stereotyped) is her/his perception of the out-group norm and marker distributions and norm-marker covariance for norms both related and unrelated to the domains of interaction.

**Hypothesis 3B**: Members of the lower-status ethnic group (Matsigenka) will, in general, have more accurate perceptions of norm and marker distributions in the out-group than will members of the higher-status ethnic group (Mestizos).

**Objective 4**: Use the patterns encountered in this study population to develop and refine general agent-based evolutionary models illustrating causal mechanisms of cultural change among ethnic groups. These models can then be compared using this and future data sets.

**METHODS**

**Study Population**

This study takes place in the indigenous Matsigenka community of Tayakome (July 2010 population: 62 adults in 33 households) located inside Manu National Park (MNP), and the nearby Mestizo town of Boca Manu (approximately 25 households) located just outside the park boundary in lowland tropical forests in the Department of Madre de Dios, Peru.

Within MNP, approximately 400 Matsigenka live in settled communities, of which Tayakome is the oldest and second-largest (Ohl-Schacherer et al. 2007; Shepard et al. *in press*). According to park regulations, the Matsigenka are allowed to live in MNP on the condition that they maintain their “traditional” subsistence practices of swidden horticulture, gathering, hunting, and fishing (Johnson 2003), which are thought to be less detrimental to the park’s biodiversity (Levi et al. 2009; Ohl-Schacherer et al. 2007; Ohl et al. 2008; Shepard et al. *in press*). Cash-cropping, livestock (other than chickens), firearms, and any economic activity involving the extraction of forest products are prohibited (Shepard et al. *in press*). Some Tayakome residents habitually travel outside the community and the park to participate in ecotourism (Ohl-Schacherer et al. 2008), wage labor, and limited purchasing. Almost all inter-ethnic interactions occur outside of the community, as non-Matsigenka cannot enter Tayakome, or the park, without a government permit. Most residents speak limited Spanish.

Boca Manu is the first community encountered upon leaving MNP’s one principal entrance/exit. Residents are mostly Spanish-speaking Mestizos of Andean ancestry, with some lowland indigenous members. The economy of Boca Manu depends on the regional ecotourism and boat-building industries (Shepard et al. *in press*). Nearly all Tayakome residents have visited Boca Manu at least once in their lives, usually entailing a visit to one of the small general stores.

**Tayakome and Boca Manu constitute an excellent study population** for investigating the relationship between inter-ethnic interactions and changing norm and marker distributions. Because these communities are small and isolated, inter-ethnic interactions between the Matsigenka and Mestizos are, on the whole, relatively limited in scope, easy to monitor, and easy for people to recall. Additionally, in Tayakome, there is much individual variation in the extent of inter-ethnic interaction with Mestizos, and similar variation in inter-ethnic interaction experience is expected in Boca Manu. Such variation is necessary to evaluate Hypotheses 2C-D and 3A.
Pilot Study

Bunce conducted a pilot study in Tayakome in June-July 2010, investigating the distribution of social norms and ideas about ethnic identity. In this two-month period he conducted 72 15-minute structured interviews with 47 of the 62 resident adults in the community, including at least one member from 30 of the 33 households occupied during the study period. With the help of local collaborators, interview questions were translated from Spanish into Matsigenka, and then read by Bunce in Matsigenka to participants during interviews. One set of interviews examined the distribution of a social norm specifying a man’s obligations to the community versus his obligations to his family. Interviewees (10 women, 21 men) were read a vignette in which a man decided to skip a community work party (high-intensity “obligatory” community function) so that he could stay at home to construct arrows (a low-intensity activity necessary for family food acquisition). Interviewees were asked if the hypothetical man’s behavior was acceptable (kameti) or unacceptable (tera kameti). As a rough measure of interaction experience with Mestizos, each interviewee was also asked if he/she had ever visited a Mestizo city outside of the national park (Cusco, Puerto Maldonado, etc.). Results (Table 1) show a surprisingly clear pattern that, of those who believe the man in the vignette is wrong to shirk his community obligations (Unacceptable), all have been to a city. One plausible explanation (among several) for this pattern is that increased interaction with, or exposure to, Mestizos is associated with a change from traditional Matsigenka family-centered norms (Johnson 2003) to more community-oriented norms typical of Peruvian Mestizo society.

Table 1.

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A second set of interviews with the same sample examined the distribution of ideas about the definition of Matsigenka ethnicity. Interviewees were read a series of vignettes about a hypothetical adoption situation (e.g., a Matsigenka baby adopted by Mestizos, a Mestizo baby adopted by Matsigenka, etc.) where respondents indicated whether the adoptee, once grown, would be a Matsigenka or not. Using non-linear PCA methods (Michailidis & de Leeuw 1998), responses were reduced to a score on a single component axis (x-axis in Figure 1) that could be interpreted as the degree to which a respondent believed that ethnicity is inherited from biological parents versus acquired (e.g., consists of norms that are learned) from adoptive parents. Figure 1 shows that there was much variation in interviewee responses, both among those with more exposure to Mestizos (City) and those with less (No City). Although several interpretations are possible, these data suggest that most people in Tayakome perceive at least some fundamental differences between the Matsigenka and Mestizos to consist of cultural characteristics (e.g., norms and markers) that can be learned by children (i.e., all people are not clustered at the “Ethnicity Inherited” pole). If true, then a salient Matsigenka-Mestizo ethnic boundary involving norms and markers is likely to exist. This pilot study allowed Bunce to develop rapport in the community (including a formal invitation to continue investigation in 2011), engage in much participant observation, and begin study of the Matsigenka language. Bunce spent 23 months between 2003 and 2006 conducting fieldwork for his dissertation on
primate ecology at a remote site along the Manu River between Tayakome and Boca Manu. His familiarity with the region, its residents, and its ecology greatly facilitated the pilot study.

**Proposed Investigation: Data Collection**


Bunce will live in Tayakome for 11 months. During the first 10 months he will use ethnographic data collection methods to identify domains of interaction. During the last month, he will use structured interviews to identify norms and markers in those interaction domains, as well as individual inter-ethnic interaction experience. Ethnographic methods consist of:

1) **Learning the Matsigenka language.** In order to discuss complex topics relating to ethnic boundaries, norms, and coordination interactions, proficiency in the Matsigenka language (niagantsi) is a necessity, even when a local interpreter is available. The Matsigenka, like other lowland Amazonian peoples, may have unique conceptions of ethnicity (Rosengren 2003) that are expressed through language in ways that are not intuitive to an outsider. Such meanings would be missed in a literal translation (e.g., Gow 1993). Bunce began study of the Matsigenka language in 2010. A Matsigenka-Spanish dictionary is available (Snell 1998).

2) **Participant observation of community life.** The presence of certain norms is often difficult for an outside observer to detect, either because such norms are rarely violated by the subjects, or because people avoid situations where the norms would apply (e.g., reciprocal exchange) (Bicchieri 2006). By participating in many community activities, people’s expectations of Bunce begin to converge, in some respects, on those of a typical community member. Thus, when Bunce’s behavior deviates from these expectations, people tend to be more forthcoming with corrective advice, rather than simply accepting the deviation as an incorrigible foreign eccentricity. In this way, subjects’ ideas about “proper” (normative) behavior can be discovered in many contexts where it would otherwise be difficult to observe. Additionally, participant observation serves to build rapport (Bernard 2006), which facilitates both ethnographic and quantitative data collection. Participant observation will be particularly focused on food production (work in the manioc gardens, fishing, hunting), neighborly interactions (sharing, social obligations, manioc-beer parties), community functions (meetings, communal work parties, soccer matches), and interactions with Mestizos (visits to Boca Manu and ecotourism lodges).

3) **Identification of coordination interaction domains and boundary perspectives.** Through participant observation and informal interviews, Bunce will identify domains (contexts) in which behavioral norms and markers appear to be important in structuring inter-individual interactions (**Hypothesis 1A**). As his language proficiency improves, he will use semi-structured interviews (Bernard 2006) to ask a **purposive sample of 10 representative adults** how, and in what domains, they distinguish the Matsigenka from Mestizos, i.e., when/if the Matsigenka/Mestizo ethnic boundary is meaningful for them (**Hypothesis 1A-B**). In addition, these 10 participants will be asked to recount their life histories, with a focus on their personal history of interactions with non-Matsigenka. This **autobiographical narrative methodology** has been shown to be effective in revealing important aspects of personal inter-ethnic communication and interaction, such as food and meal sharing (Oakdale 2008), which may be
especially important for the Matsigenka (Baer 2004). Particular attention will be paid to evidence of cross-cultural competence, where individuals change their norms depending on the ethnicity of their interaction partner. This should become apparent through the autobiographical narratives and observations of Matsigenka-Mestizo interactions. All formal interviews will be recorded for later transcription. Interviews will be conducted in private, and interviewees (in all phases of this project) will be read an appropriate statement of informed consent and assured of their anonymity and right to stop an interview at any time.

During the final month of Phase 1, Bunce, with the help of a Matsigenka assistant for language support, will identify norms and markers through structured interviews with a random sample of 30 adults (names drawn at random from a pool of willing adult participants). The interview schedule is based on that of the pilot study (above), and will result in sampling of approximately half of the community adult population. Interviewees will be asked to free-list behaviors they think are appropriate, i.e., their personal norms of behavior (Norm Free-list), and the observable characteristics they would use to distinguish a Matsigenka from a Mestizo (Marker Free-list), in a set of six domains of coordinated interaction identified during participant observation and prior interviews. Bunce will choose six domains where most participants in the previous ethnographic purposive sample (above) perceived the Matsigenka-Mestizo ethnic boundary to be salient, and where cross-cultural competence tended to be minimal. For example, interviewees might be asked the following questions about the domain of marriage interaction:

What should a man do in order to be a good husband? (Possible Norm Free-list responses: provide meat for his family, not hit his wife, not get angry). What should a woman do in order to be a good wife? (Possible Norm Free-list responses: cook for her family, avoid “contaminating” others during menstruation, not be envious of a co-wife: Izquierdo et al. 2008; Johnson 2003; Shepard 2002). Imagine your son left Tayakome to go look for a wife, and then returned bringing his new wife with him. When you first meet her, how would you be able to tell that she was a Matsigenka and not a Mestiza? (Possible Marker Free-list responses: she wears a bead necklace [nenkétsiki], she is barefoot, she speaks Matsigenka, her head is shaved).

Where possible, correspondence between free-listed and practiced behavior of interviewees in each of the six interaction domains will be noted. Three of the six domains will be domains where Matsigenka-Mestizo interactions tend to be rare (e.g., marriage, communal work, child socialization), and three will be domains where interactions are more frequent (e.g. employment, economic exchange, healthcare). The most frequently mentioned norm in all interviewees’ Norm Free-lists and the most frequently mentioned marker in all interviewees’ Marker Free-lists will be designated the Matsigenka Popular Norm and the Matsigenka Popular Marker, respectively, for each of the six interaction domains. Thus, in total, six Matsigenka Popular Norms and six Matsigenka Popular Markers will be identified, where particular norms and markers may be duplicated across domains. This procedure to identify norms and markers for subsequent quantitative analysis minimizes observer bias by requiring the norms and markers under investigation to be those most salient to the subjects, rather than to the investigator.

Guided by the previous ethnographic observations and autobiographical narratives, each of the 30 interviewees will be asked about the frequency and nature of their interactions across the Matsigenka-Mestizo ethnic boundary, and their interactions within their own ethnic group, for each of the six interaction domains. Particular attention will be paid to whether the
The interviewee was satisfied or dissatisfied with each interaction, whether the interaction was perceived as necessary or important, and whether an interaction with another person could have accomplished the same thing according to the interviewee. Such responses suggest the subjective payoff structure of the coordination interaction. In each domain, the frequency of reported out-group interactions (discounted by the number of in-group interactions, and weighted by the relative subjective importance of out-group versus in-group interactions, if appropriate) will be used to calculate an **out-group interaction index** for each interviewee, for each interaction domain. In addition, each interviewee will be asked to: 1) name any number of people who she/he considers to be knowledgeable about each domain of interaction; 2) to rank order this list in terms of knowledge; and 3) to order the list in terms of people with whom she/he socializes the most (not necessarily in the domain of interaction). This ego-centered **social network data** (Wasserman & Faust 1994), will be used to identify groups of socialization partners, e.g., close friends, and also prestigious individuals with disproportionate influence on community norms. This grouping variable will be included in subsequent analyses to control for the possibility that an individual’s norms and perceptions are influenced by frequent socialization partners outside of the interaction domains in which the norms of interest apply. Phase 1 will result in a set of six Matsigenka Popular Norms and six Matsigenka Popular Markers for Tayakome, as well as six out-group interaction index values and six social network group designations (one for each of the six identified interaction domains) for each of the 30 Matsigenka participants.

**Phase 2: Identification of Mestizo Norms and Markers (1 Jul 2012 – 30 Nov 2012)**

Bunce will repeat the procedures of Phase 1 in the Mestizo Community of Boca Manu. Only five months will be required for this phase as language is not constraining (Bunce speaks Spanish). Interaction domains for the Norm Free-lists and Marker Free-lists will be chosen to match the six domains used in Phase 1 (e.g., marriage, communal work, employment, economic exchange, etc.). Phase 2 will result in a set of six Mestizo Popular Norms and six Mestizo Popular Markers for the community of Boca Manu, as well as six out-group interaction index values and six social network group designations for each of the 30 Mestizo participants.

**Phase 3: Measurement of Norm and Marker Distributions (1 Dec 2012 – 28 Feb 2013)**

A binary-choice vignette (Bernard 2006: 291) will be designed for each of the six Matsigenka Popular Norms and six Mestizo Popular Norms (12 total vignettes). Each vignette will describe a hypothetical interaction corresponding to one of the six interaction domains identified in Phase 1. There will be two vignettes for each domain, one illustrating violation of the Matsigenka Popular Norm for that domain, and the other illustrating violation of the Mestizo Popular Norm for that domain. During re-interviews with the 30 Matsigenka participants in Tayakome (aided by a local assistant) and the 30 Mestizo participants in Boca Manu, interviewees will indicate either approval or disapproval of the action portrayed in each of the 12 vignettes, along with a narrative explanation of how they arrived at their conclusion. The set of 12 responses (approval/disapproval) constitutes a participant’s **Norm Complement**.

During each interview, Bunce will record whether the interviewee physically displays the Matsigenka Popular Marker and/or the Mestizo Popular Marker identified for each of the six interaction domains (12 total markers). If a particular marker is not of a nature that is continuously displayed (e.g., shaved heads re-grow), the interviewee will be asked to recall his/her last interaction in that domain, and whether he/she displayed the marker. The set of
markers displayed by the interviewee (during the interview or during the last interaction) from among the set of 12 identified markers constitutes a participant’s **Marker Complement**.

Distributions of particular norms and markers, as well as norm-marker covariance, both within ethnic groups and across the ethnic boundary, are taken directly from the individual-level Norm and Marker Complements and are used to address **Hypotheses 2A-D**.

**Phase 4: Perceptions of Norm and Marker Distributions (1 Mar 2013 – 30 Apr 2013)**

The Norm and Marker Complements of each of the 60 study participants (Tayakome and Boca Manu) will be recorded on index cards (without names). During re-interviews with the 30 Matsigenka participants in Tayakome (aided by a local assistant) and the 30 Mestizo participants in Boca Manu, interviewees will be re-familiarized with the vignettes from the previous series of interviews and: 1) Choose an index card at random, and, without looking, guess the 12 recorded answers of the card’s Norm Complement (each of the card’s answers corresponding to one of the 12 vignettes from the previous series of interviews), knowing only to which community the card belongs. Guesses indicate the norms the interviewee perceives to be held by most members of the card’s community. 2) Repeat 1, but now the interviewee is told the card’s Marker Complement as well as the card’s community. Modifications to guesses dependent on marker indicate that the interviewee perceives norm-marker covariance among members of the community to which the card belongs.

To motivate deliberated responses, interviewees will receive a compensatory reward for each correct guess (12 possible rewards for each of the two cards drawn per interviewee), similar to the “guess game” of Gurven et al. (2008). In practice, the “strategy method” of Camerer and Fehr (2004) will be used, so that interviewees make guesses about a card’s Norm Complement under all possible combinations of the card’s community membership and Marker Complement, before a card is actually drawn. The interviewee then draws a card at random and rewards are calculated based only on those guesses that pertain to the card’s actual characteristics. Interviewees will be asked to explain each of their guesses, e.g., Does your guess of “disapprove” for norm 5 indicate that you believe that all people in Tayakome would disapprove of this vignette, that most would disapprove, or that you don’t know and guessed at random?

Phase 4 will result in a set of perceptions (guesses), for each of the 60 participants, about the most common norms in the in-group and the out-group under differing marker complements, as well as a qualitative approximation of perceptions of variance in those norms (from the explanations of guesses). These perceived norm distributions and norm-marker covariance will be compared to actual distributions and covariance in order to address **Hypotheses 3A-B**.

**Phase 5: Development of Agent-Based Evolutionary Model (1 May 2013 – 31 Jul 2013)**

Bunce will spend three months in residence at the University of California, Davis, developing a formal model relating inter-ethnic coordination interactions to changing norm and marker distributions in ethnic groups. This effort will use the model of McElreath et al. (2003) as a starting point, but will incorporate new insights gained through analysis of the field data from the study population. Particular attention will be paid to the incorporation of unbalanced **payoff structures** in coordination interactions, i.e., coordinating (or failing to coordinate) on norms yields different net benefits to the two interaction participants. This modification is addressed only briefly by McElreath et al. (2003), and may be an important characteristic of Matsigenka-Mestizo interactions, relating to a difference in status between the two ethnic groups.
The relevance of an unbalanced payoff structure in the study population will be assessed by using data from Phases 1, 2, and 3 to address Corollary 2C.

A second modification of the McElreath et al. (2003) model will be the **incorporation of agents’ perceptions** of norm and marker distributions and norm-marker covariance. The new model will explore the effects of such perceptions on the frequency of out-group interaction, and, by extension, on changes in actual norm and marker distributions. The frequency of out-group interactions will also be allowed to affect perceptions. These effects will be incorporated into the model based on analyses using perception data from Phase 4 to address Hypotheses 3A-B.

The value of formal model development lies in the unique insights into causal **mechanisms** that can be gained by making relationships explicit between variables that are hypothesized to be important to the dynamics of the system (i.e., changing norm and marker distributions). A long-term goal of this research program is to collect a dataset of cultural change across the Matsigenka-Mestizo ethnic boundary that can be used to compare the original model of McElreath et al. (2003) with the new model(s) that will be formulated in this investigation. These comparisons will determine whether the proposed modifications to the model actually add to our understanding of cultural change. Such a dataset requires a temporal dimension, and thus the data collected in this investigation will constitute a baseline, to be augmented in the future.

This phase of the project will include the **collaboration of an advanced Ph.D. student** in the Anthropology or Ecology graduate program at UC Davis who is trained in the development and simulation of evolutionary models. This student collaborator will be appointed to a half-time Research Assistant position, will work closely with Bunce (who will be devoted full-time to the project), and will co-author resulting publications as appropriate. This collaboration will enrich the research and publication experience of a graduate student, as well as provide valuable assistance and bring new perspectives to the project.

**Data Analysis**

**Hypotheses 1A**, that norms (signaled by markers) govern a set of coordination interactions, and **Hypothesis 1B**, that the Matsigenka-Mestizo ethnic boundary is salient and structures a set of inter-individual interactions, will be examined through content analysis (Bernard 2006) of the transcribed and coded ethnographic data collected during Phases 1 and 2 (e.g., field notes during participant observation and autobiographical narratives).

Inter-ethnic and inter-individual differences in norm and marker distributions will be examined using principal components-based methods on data from Phase 3. For instance, individual responses to the 12 norm vignettes (Norm Complement) can be reduced to component scores using non-linear PCA (Michailidis & de Leeuw 1998). Inter-ethnic norm differences (**Hypothesis 2A**) would be indicated if Matsigenka and Mestizo individuals tend to cluster in two separate groups when their component scores are plotted on component-based axes. In such a plot, the extent of inter-individual variation (**Hypothesis 2B**) would be indicated by the spread of data points corresponding to individuals within the Matsigenka or Mestizo ethnic group.

Multilevel statistical models (Gelman & Hill 2007) will be used to examine the effect of variables such as out-group interaction index, ethnic group, age, and sex (predictor variables) on individuals’ binary responses to a particular norm vignette (an outcome variable). For instance, in a multilevel logistic regression, the importance of out-group interaction index and ethnicity as predictors of vignette response might suggest support for the hypothesis that people’s norms match those of their most frequent interaction partners (**Hypothesis 2C**). An (out-group
interaction index) *(ethnicity) interaction might support the hypothesis that inter-ethnic interaction is more important for one ethnic group than for the other in terms of its effect on an individual’s norm complement (perhaps due to status differences in ethnicity: Corollary 2C). In such a regression, the grouping variable of social network can be included as a random effect to control for social influences on individual Norm Complements outside of the relevant interaction domain. The accuracy of perceptions (guesses from Phase 4) about norm and marker distributions can be expressed as a binary outcome variable [1 - |guessed response – mode( observed responses)|] and included in similar multilevel statistical models to examine the effect of out-group interaction index and ethnicity (and their interaction) on the accuracy of perceptions (Hypotheses 3A-B). The hypothesized relationship between norm-marker covariance and out-group interaction index (Hypothesis 2D) can be tested by comparing the fit of quadratic versus linear equations to a plot of these two variables.

**Work Schedule**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Title</th>
<th>Dates</th>
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<tbody>
<tr>
<td>1</td>
<td>Identification of Matsigenka Norms and Markers</td>
<td>15 Jul 2011 – 31 May 2012</td>
</tr>
<tr>
<td></td>
<td>Location: Tayakome</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Identification of Mestizo Norms and Markers</td>
<td>1 Jul 2012 – 30 Nov 2012</td>
</tr>
<tr>
<td></td>
<td>Location: Boca Manu</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Measurement of Norm and Marker Distributions</td>
<td>1 Dec 2012 – 28 Feb 2013</td>
</tr>
<tr>
<td></td>
<td>Location: Boca Manu (December), Tayakome (February)</td>
<td></td>
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<tr>
<td>4</td>
<td>Perceptions of Norm and Marker Distributions</td>
<td>1 Mar 2013 – 30 Apr 2013</td>
</tr>
<tr>
<td></td>
<td>Location: Tayakome (March), Boca Manu (April)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Development of Agent-Based Evolutionary Model</td>
<td>1 May 2013 – 31 Jul 2013</td>
</tr>
<tr>
<td></td>
<td>Location: University of California, Davis</td>
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Bunce will return to UC Davis to consult with members of the Project Advisory Committee and renew his Peruvian visa during 15 Dec 2011 – 15 Jan 2012, June 2012, and January 2013. This committee consists of Dr. Bruce Winterhalder (UC Davis, cultural ecology), Dr. Richard McElreath (UC Davis, evolutionary and cultural ecology), Dr. Norbert Ross (Vanderbilt U, cognitive anthropology and ethnography), and Dr. Mark Grote (UC Davis, statistics). Data analysis and write-up of the results will take place at UC Davis from 1 Aug 2013 - 31 Dec 2013.

**SIGNIFICANCE**

**Intellectual Merit**

The major contribution of this study to the Social Sciences will be a better understanding of how individual behavior (e.g., interpersonal interactions) and individual perceptions (e.g., about norms held by other people) relate to each other and to population-level cultural characteristics (e.g., ethnic-typical norm and marker distributions). Although ethnicity, inter-group interactions, and cultural change are topics that have historically been central to the fields of Anthropology, Sociology, and Social Psychology, no single dataset is available to examine hypotheses about the relationships among individual interactions, individual perceptions, and ethnic group-level cultural characteristics. These relationships constitute mechanisms fundamental to our understanding of: 1) the maintenance of cultural diversity among ethnic groups; 2) the nature and extent of inter-ethnic relations; and 3) the general process of cultural
change as it applies to an ethnically-stratified human population. This study breaks new ground by measuring interpersonal interactions, norm and marker distributions, and perceptions of out-group and in-group norm and marker distributions on both sides of an ethnic boundary. Consequently, this study will be the first to explicitly examine predictions about hypothesized relationships among these three variable classes, and may change the way social scientists view the importance of variables such as ethnic markers and out-group perceptions in the processes of inter-ethnic relations and cultural change.

The proposed study constitutes the first step in a long-term research program, where replication of this data-collection methodology will be conducted in the Matsigenka-Mestizo study population, and expanded over a series of years to include neighboring communities in the Manu and adjacent Urubamba river system. This will produce a longitudinal dataset appropriate for the comparison of cultural evolutionary models and the testing of other hypotheses about the nature of cultural change across an ethnic boundary. This study follows other pioneering investigations (Atran et al. 2002; Henrich et al. 2005) in demonstrating the utility and complementary nature of ethnographic, experimental, and agent-based modeling methodologies.

**Broader Impacts**

A long-term applied goal of this study is to describe how interaction and engagement with the market-oriented socioeconomic system of Mestizo communities is affecting (and is likely to further affect) the unique norms and markers characterizing Matsigenka ethnicity. With knowledge of how cultural change works, and what aspects of culture are likely to change with increasing extra-community engagement, the Matsigenka can decide for themselves which (if any) aspects of their culture they feel are important and would like to preserve, and which (if any) strategies would likely be effective in such preservation (e.g., documentation of “traditional” beliefs/practices, re-emphasis of such practices in daily life, education of Mestizos about Matsigenka culture, etc.). A central challenge of this project, requiring considerable and careful deliberation, will be the development of culturally and politically appropriate ways to present the research findings to Matsigenka and Mestizo communities, as well as to the administration of Manu National Park. The park administration is charged with “protecting” the Matsigenka from outside influences, preserving the continuity of their “traditional” culture (i.e., low-impact subsistence strategies), and, in this way, maintaining the biodiversity and ecological integrity of the park (Levi et al. 2009; Marggraff 2004; Shepard et al. in press). In addition to scientific publications, technical reports (in Spanish) and focused summaries (in Spanish and Matsigenka) of the results will be deposited with each community, the park administration, and the Universidad Nacional Antonio Abad de Cusco (Cusco, Peru) for public consumption.

This investigation integrates research and teaching. Included in Tayakome’s invitation to Bunce to continue fieldwork in 2011, is the expectation that he will offer English language classes one day per week for Matsigenka adults interested in working in nearby eco-tourism lodges. Over the long-term, Bunce aims to collaborate with professional culturally-trained educators in order to expand these adult classes to include mathematics and reading/writing in both Spanish and Matsigenka (to combat pervasive illiteracy). In the Mestizo town of Boca Manu, Bunce will offer instructional support and seminars to local middle- and high-school students and adults on the region’s cultural and biological diversity. Phase 5 of this study includes the collaboration of a graduate student, with an aim of advancing his or her research expertise and professional development through training in methods, analysis, and publication.
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Ethnic Boundaries and Cultural Change in an Amazonian Population

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