REASONING ABOUT CULTURAL AND GENETIC TRANSMISSION

DEVELOPMENTAL AND CROSS-CULTURAL EVIDENCE FROM PERU, FIJI, AND THE US ON HOW PEOPLE MAKE INFERENCES ABOUT TRAIT AND IDENTITY TRANSMISSION

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Abstract: Using samples from three diverse populations, we test evolutionary hypotheses regarding how people reason about the inheritance of various traits and ethnic identity. First, we provide a framework for differentiating the outputs of mechanisms that evolved for reasoning about variation within and between 1) biological taxa and 2) culturally-evolved ethnic categories, from 3) a broader set of beliefs and categories using structured learning mechanisms. Second, we describe the results of a "switched-at-birth" vignette study that was administered to examine folk beliefs among children and adults in Puno (Peru), Yasawa (Fiji) and adults in the US. This protocol permits us to study perceptions of 1) social and prenatal transmission pathways for various traits, 2) vertical (i.e. parental) versus horizontal (i.e. peer) cultural influence, and 3) the transmission pathway of group identity. These three lines of evidence suggest that people use all three mechanisms, to reason about the distribution of traits and social identities in the population. Participants at all three sites develop expectations that morphological traits are under prenatal influence, and that belief traits are more culturally influenced. On the other hand, each population holds culturally-specific beliefs about the degree of social influence on non-morphological traits, the degree of vertical transmission – with only participants in the US expecting parents to have much social influence over their children –, and about the transmission of group identity. People develop beliefs about the social inheritance of linguistic identities despite earlier developing biases toward treating linguistic group membership as prenatally inherited.

Keywords: folksociology ; folkbiology ; ethnic identity; cross-cultural ; cognitive development ; dual inheritance theory

1. INTRODUCTION

Cultural transmission is a more important source of variation in humans than in other species (Richerson & Boyd, 2005; Whiten, Hinde, Laland, & Stringer, 2011). While many non-human animals engage in social learning, this process affects a modest number of behaviors in a limited set of domains (Marler, 1997; Galef, 1993; Kenward et. al., 2006). Humans, on the other hand, acquire a vast range of their beliefs and behaviors by social learning, and evolve cumulative cultural traditions (Henrich & Henrich, 2010; Henrich & McElreath, 2003; Richerson & Boyd, 2005). Cultural transmission has given rise to stable cultural differences among both individuals and groups (Henrich et. al., 2010; Chudek & Henrich, 2011), and this generated a new adaptive problem: how should people best use information about social relations and population structure to make predictions about the features of individuals and groups?

There are at least three different kinds of evolved cognitive mechanisms that could be used to solve this problem. First, people may reason about cultural variation using mechanisms that evolved for reasoning about genetically-transmitted variation in other species. Second, people may reason about cultural variation using mechanisms that evolved in the human lineage in response to novel culturally-evolved social environments. A number of researchers have proposed accounts of social cognition that incorporate some combination of such folkbiological and folksociological adaptations (Gil-White, 2001; Henrich & Henrich, 2007; Hirschfeld, 1996; Kanovsky, 2007). Finally, people may use structured learning mechanisms that can be applied to a broad range of inputs to reason about cultural patterns. Structured learning mechanisms, such as Quinnian bootstrapping (Carey, 2009) or Hierarchical Bayesian-like inferential processes (Tenenbaum et. al., 2011) could solve this problem without being specifically designed for reasoning about conspecifics. We will refer to these hypothesized cognitive mechanisms as 1) folkbiology, 2) folksociology, and 3) structured learning, respectively. These are not mutually exclusive, and all three may be brought to bear on any given question. Here we use cross-cultural developmental data to address three specific questions:

1) Do people differentiate between the cultural and prenatal (e.g., genetic and epigenetic) transmission of traits? That is, are they predisposed to believe that some traits (e.g. morphology) are transmitted prenatally from parents to offspring, while others (e.g. beliefs) are socially transmitted?
2) Do people differentiate between parental and non-parental social influences? That is, are people predisposed to believe that parents are the main social influence?
3) How do people believe ethnic identity is inherited? That is, do they expect that ethnic identity is prenatally inherited from parents or the result of social influences?

As is detailed in Table 1, the answers to these questions can help determine the relative importance of folkbiology, folksociology, and structured learning in human social cognition.

Table 1. Predictions for each research question by hypothesized cognitive mechanisms engaged				
		Research Question		
		1. Cultural v. Prenatal transmission	**2. Vertical v. Horizontal transmission**	**3. Ethnic identity transmission**
Cognitive Mechanism	**Folkbiology**	prenatal transmission bias	asocial vertical transmission bias	prenatal transmission of identity bias
	Folksociology	differentiation of cultural and prenatal transmission	differentiation of vertical and horizontal transmission	cultural transmission of identity bias
	Structured learning	Culture-specific differentiation of cultural and prenatal transmission	Culture-specific differentiation of vertical and horizontal transmission	Culture-specific beliefs about identity transmission

2. THEORETICAL BACKGROUND

First we discuss the predictions of each evolutionary account and review the literature about relevant cognitive mechanisms involved.

2.1. Do people differentiate between the cultural and prenatal transmission of traits?

Several studies using "switched-at-birth" vignettes suggest that people reason differently about cultural and genetic influences (Hirschfeld, 1996; Solomon, Johnson, Zaitchik, & Carey, 1996). In these studies, participants are asked to make predictions about a child who is born to one set of parents, but is adopted in infancy by an unrelated set of parents. People tend to answer that the child will inherit his adoptive parents' beliefs, but his birth parents' bodily traits. That is, people reason *as if* beliefs are socially inherited and bodily traits are prenatally acquired (i.e. due to genetic, epigenetic, or environmental influence in utero) and fixed at birth. Cross-cultural data suggests that this pattern, labeled the "differentiated pattern", develops reliably by middle childhood in the US (Solomon et. al. , 1996; Taylor, Rhodes, & Gelman, 2009), by adolescence in India (Mahalingam, 1998a), and by adulthood in Madagascar (Bloch, Solomon, & Carey, 2001; Astuti, Carey, & Solomon, 2004).

Various hypotheses have been offered to explain this observation. First, many researchers believe that the differentiated pattern results from folkbiology, although they debate the extent to which this system requires evolved conceptual primitives (Atran, 1998; Carey, 1985) and interpret the pattern as an indicator of a mature causal understanding of biological inheritance (Solomon, et. al. 1996). Furthermore, adults also show a differentiated pattern when reasoning about cross-species adoptions (Johnson & Solomon, 1997; Astuti et. al., 2004 ; Taylor et. al., 2009), strengthening the implication that a folkbiological system is at play.

This interpretation is puzzling because other animals are not much affected by cultural transmission (Richerson & Boyd, 2005). Information about social influences does not improve predictions about much of their behavior---ducks raised by cows do not start mooing. Well-designed folkbiological theories for reasoning about other species should ignore cultural transmission and either use species category to infer species-typical behavior, or use kinship to make inferences about heritable features that vary within a species.

There is evidence that a folkbiological heuristic with these properties develops earlier than mechanisms responsible for the differentiated pattern. Children reason about the inheritance of all traits, including belief traits, as if they were prenatally inherited in cross-species adoption scenarios (S. A. Gelman & Wellman, 1991). Additionally, more 4-7 year olds maintain prenatal inheritance theories for cross-species adoption scenarios than for within-human adoption vignettes (Solomon et. al., 1996; Johnson and Solomon, 1997; Taylor et. al., 2009). In the Supplementary Materials (SM) section 1 we consider an alternate folkbiological account that incorporates folkpsychological mechanisms that may account for the differentiated patterns demonstrated in the literature. However, we show that it cannot account for the differentiated pattern in our full set of experiments.

A second hypothesis focuses on folksociological cognitive mechanisms. Here people have phylogenetically older “prenatal inheritance” expectations that track the effects of genetic variation within or between species, and more recently evolved “cultural transmission” expectations for making predictions about cultural influences in humans. The older folkbiological mechanism may be used more to reason about bodily traits, and the latter about culturally influenced traits, such as beliefs. According to this account individuals should reliably develop the differentiated pattern cross-culturally.

Finally, a third hypothesis relies on more domain-general, but structured learning mechanisms. These might be sufficient to allow individuals to acquire local beliefs about how various traits are transmitted, without the need for folksociological or folkbiological conceptual primitives. In this case, the fact that concepts were functional for making predictions in the local environment would be a result of individual learning and cultural evolutionary processes rather than natural selection (Richerson & Boyd 2005; Henrich & Henrich 2010). Such a process could produce cross-cultural convergence on a differentiated pattern if morphology and beliefs are similarly affected by prenatal, and cultural transmission processes across sites. However, it might also lead to cross-cultural divergence in transmission beliefs depending on the population-specific heritabilities of characteristics. Both the folksociological and structured learning accounts are premised on people's beliefs reflecting useful and generally accurate ways of interacting with their world, given the distribution of different kinds of traits across the social landscape. However, the structured learning mechanisms allow beliefs to adapt to local realities more quickly through cultural evolution.

2.2. Do people differentiate between parental and non-parental cultural influences?

The "switched-at-birth" vignettes describe a situation that is rare in the real world. In these vignettes an infant is adopted by non-kin. Adoption is rare in most societies, and when it does occur, it is almost always among kin (Silk, 1987). Thus, it is unlikely to be the context for which an adaptation for reasoning about cultural transmission was selected – i.e. adoptions are unlikely to be the proper domain of the adaptation (Sperber, 1996).

It is plausible that folksociological mechanisms are attuned to expect much social influence from peers and non-parental adults (McElreath & Strimling, 2008; Richerson & Boyd, 2005). Empirical evidence – including from the Fijian site studied in the current paper (Henrich & Broesch, 2011; Henrich & Henrich, 2010) – suggests that non-parental models are often more important than parents in cultural transmission (Harris, 1995; Reyes-García et al., 2009; Hewlett, Fouts, Boyette, & Hewlett, 2011). Moreover, it is precisely because non-parental social influences are important that there is a need to distinguish genetic from cultural transmission pathways. Otherwise, folkbiological mechanisms that assumed individuals would resemble their birth parents for both morphology and beliefs would produce reasonable predictions.

"Switched-at-birth" vignettes provide, no information about non-parental adults or peers. If human folksociology is designed to be sensitive to non-parental cultural transmission, participants should attempt to infer the child's traits using attributes of other cultural models. Since the infant described in the vignettes is adopted by people unrelated to his birth parents, it is likely that his other cultural models will be more similar to his adoptive parents than to his birth parents. Therefore, we hypothesize that participants use the adoptive parents in these scenarios as proxies for other non-parental social influences. For example, if the adoptive parents are described as having a food taboo, participants might infer that the adopted child will grow up in a social environment in which most people share this taboo.

To the best of our knowledge, no one has tested the extent to which humans reason about non-parental versus vertical cultural transmission pathways. To address this question, we compare an "Adoption vignette" (i.e. the usual "switched-at-birth" task), with a "Migration vignette" in which the focal child and his birth parents from group A migrate to group B, where the child is raised by his group A parents among group B peers. While Kanovsky (2007) used migration vignettes, the stories specified the target characters' language use – thus giving away information about his cultural traits – and only asked about his ethnic identity.

Given the limited cultural transmission in other species, a folkbiological account would make the same predictions in the Migration and Adoption conditions. A well-designed folksociological account predicts that children should resemble others in their social environment, including but not limited to their parents. Finally a structured learning account would predict cross-cultural variation in beliefs about parental influence depending on the actual local importance of such transmission pathways.

2.3. How do people think ethnic group membership is inherited?

A number of authors have proposed that humans reason as if ethnic group membership is determined by an invisible and immutable essence that is prenatally transmitted from birth parents to children and controls a child's observable traits (Hirschfeld, 1996; Hirschfeld & Gelman, 1997; Gil-White, 2001; Jones, 2009). While belief in the prenatal transmission of an essence is not a necessary element in essentialist folk theories (Kanovsky, 2007; Strevens, 2000), some argue that such an assumption was favored by selection because it led to reasonable predictions under ancestral circumstances with low intergroup migration (Gil-White, 2001).

Folk theories incorporating a prenatally transmitted essence have been documented in several groups (Astuti et al., 2004; Gil-White, 2001; Hirschfeld & Gelman, 1997; Hirschfeld, 1996; Jones, 2009; Mahalingam, 1998), but theories in which ethnic identity is socially transmitted are also common (Astuti et al., 2004; Kanovsky, 2007; Mahalingam, 1998; Moya & Scelza, n.d.).

At least two distinct evolutionary explanations of these essentialist and prenatal transmission theories for ethnic kinds have been put forward. Gil-White (2001) argues that these predispositions are rooted in folkbiological cognitive mechanisms originally evolved to reason about other species. Gil-White argues that ethnic groups and species are similar in being endogamous and having descent-based membership. Because of these resemblances, ethnic groups trigger cognitive adaptations for reasoning about species.

Others have argued that folksociology is independent of folkbiology and derives from cognition evolved to reason about social groups of conspecifics (Sperber & Hirschfeld, 2004). Evolutionary psychologists often assume that residential social groups common to all primates serve as the proper domain of these adaptations (Schaller & Neuberg, 2008; Mahajan et al., 2011). However, essentialist beliefs about identity as immutable and prenatally inherited are not consistent with this evolutionary account because primates readily change group membership – i.e. members of at least one sex leave their natal group at sexual maturity (Pusey & Packer, 1987). Similarly, high migration rates of both sexes lead to rapid turnover in hunter-gatherer band membership (Hill et al., 2011). Thus, an account of a folksociological mechanism that derived exclusively from reasoning about conspecific residential groups in primates should not predict that folk theories of identity would include an expectation of immutability, nor that they be based on cues of genetic relationship.

Similarly, a folksociological mechanism that evolved to reason about ethnic groups should not necessarily default to a prenatal inheritance heuristic. Well-designed cognitive mechanisms for reasoning about ethnic groups should track the porosity of ethnic boundaries. The assumption that identity is acquired prenatally only results in useful predictions when children in fact share the same group membership as their parents. However, shifts in ethnic membership are common (Barth, 1969; Jackson, 1983), and new ethnic identities can arise within a few generations (Malan, 1995), and disappear as quickly (Kelly, 1995, Soltis, Boyd, & Richerson, 1995). A well-designed system for reasoning about ethnic identity should be sensitive to the actual process by which group membership is acquired. A heuristic that assumes prenatal transmission of identity should *not* be our *a priori* functionalist prediction for a folksociological mechanism for processing ethnic groups unless their boundaries were very rigid in ancestral environments.

We test these predictions by measuring people's beliefs about the inheritance pathways of group identity in a "switched-at-birth" task with respect to various groups. Evidence that children privilege certain theories early in their socialization, or that some patterns reliably develop by adulthood across populations would be consistent with the existence of cognitive attractors (Sperber 1996). Prenatal transmission attractors would be more consistent with folkbiological mechanisms, and social transmission attractors would be more consistent with folksociological mechanisms. However, a very functionalist folksociological account or structured learning mechanisms should predict folk theories of cultural transmission of identity in contexts with high levels of intergroup fluidity, and prenatal transmission folk theories when group boundaries are very rigid. The accounts are different insofar as the outcome is accomplished through the natural selection of nuanced and flexible conceptual primitives, or through the cultural evolution of concepts that fit the local context.

3. METHODS

We attempted to maintain methodological consistency across the three sites where we collected data, while making the methods ecologically valid for participants at each site. In this section we describe the fieldsites, experimental procedures, and analyses.

3.1 Participants and fieldsites

Participants were recruited in three different contexts: a rural town in the Peruvian Altiplano state of Puno, two rural Fijian villages, and from Anglophone volunteer sites online. In Peru, the sample (n = 193, ages 4-75, mean = 26) was collected in Huatasani, an agro-pastoralist town on the Aymara-Quechua linguistic border. The Fijian sample (n = 224, ages 5-73, mean = 27) was collected in Teci and Dalomo, neighboring villages on Yasawa Island with a total of 240 inhabitants. Residents rely on subsistence fishing and horticulture. At both field sites, participants were interviewed individually, in private. We also recruited 297 Anglophone online volunteers, 84% of whom were from the United States, (n=297, ages 18-64, mean =32; see Figure S1 for age distributions). We will refer to this as the "US sample", and to the Peruvian and Fijian samples by the regional designations of Puno and Yasawa respectively, since they are not representative of these nations.

The residents of Puno and Yasawa have very different ideologies about social group identities. The ethnographic literature emphasizes that in the Andes ethnic and racial identities are fluid. Indigenous migrants to cities who conform to local norms are perceived as losing some of their indigenous status (Orlove, 1998). It is likely that the boundaries between ethnolinguistic indigenous identities, like Aymara and Quechua speakers, are as fluid and non-racialized as the boundary between indigenous and non-indigenous groups (Primov, 1974).

On the other end of the spectrum, Yasawans have strongly essentialist notions of prenatal identity transmission. As an illustration, group membership must be designated by the use of the prefix "kai" meaning "from", or "of", to denote provenience and the term for Indo-Fijians is "kai India" despite the fact that most Indo-Fijians were born in Fiji, descended from 19th century immigrants, and have spent little time in India. Similarly, the identity of urban Fijians is traced to their "home villages" even when they have never visited these places (see Henrich & Henrich, 2010 for further details about the Yasawan fieldsite).

The Anglophone online sample mostly represents urban Americans. While the American ethnic taxonomy is dominated by racialized groups (L. Hirschfeld, 1996), it is unclear whether this reflects a strongly biological folk theory of ethnic identity generally, or such beliefs only about specific groups.

3.2 Procedures

We used a protocol based on Astuti et. al.'s adoption vignettes (2004), modified for each cultural context. Participants were randomly assigned to one of two Vignette conditions: (1) an Adoption vignette – where they are told of a boy born to one set of parents and raised by another set when he is orphaned in infancy, or (2) a Migration vignette – where they are told of a boy who is raised by his biological parents who migrate from group A when he is an infant and and raise him in group B among group B peers (full text in Table S1).

Participants were also randomly assigned to a Group condition—Ingroup or Intergroup. In the Ingroup condition both the biological parents and the cultural models are drawn from the same group. In the Intergroup condition, biological parents and the people who served as cultural models (i.e. adoptive parents in the Adoption vignette, and individuals from the community in the Migration vignette) are identified as belonging to different social groups. While the Ingroup condition was constant at all sites, the specific groups used for the Intergroup conditions varied by site (Table 2).

Table 2. Group conditions by Site.
Half of the participants in the Intergroup conditions were assigned to the Adoption vignette and half to the Migration vignette condition.

Site	Group Conditions	Description
Puno	Ingroup	Within Huatasani
	Intergroup: Linguistic	Quechua / Aymara linguistic divide
	Intergroup: Regional	Lima (urban) / Huatasani (rural) divide
Yasawa	Ingroup	Within Kadavu
	Intergroup: Native Fijian	Kadavu / Yasawa regional archipelagos
	Intergroup: Racial Fijian	Indo-Fijian / Native Fijian racial divide
US	Ingroup	Within fictional region
	Intergroup: Fictional regional	Fictional regional divide

All Group conditions were crossed with the Vignette conditions with one exception. The Ingroup condition was only run with the Adoption vignette since the migration always happened *between* groups. In the Adoption vignette, participants were told that a child's birth father had one feature, and the adoptive father had a different feature. Participants were asked whether the child would be more likely to share the same trait as his adoptive or birth father once he reached adulthood. This was done for a series of traits. In the Migration vignette the parents' features and the peers' features were contrasted.

Traits were chosen to represent various domains (identity, beliefs, skills, personality, and morphology) and to minimize participants' prior beliefs about the distribution of the trait across groups (see Tables S2-S3). Identity traits ("Will the child be, or belong to, group A or group B) could not be asked in the Ingroup condition since this story made no mention of alternate groups.

3.3 Analysis

We tested our hypotheses using logistic regressions predicting the probability of choosing "like birth parent" as a function of age and condition. To control for the non-independence of each individual's responses across traits, we included a random effect of participant. Psychologists usually average a participant's observations into a single score. These analyses are shown in the SM section 4 and give qualitatively similar results. Using individual random effects models yield increased statistical power, and allows easier comparison across a wider array of experimental structures.

Because we sampled from all people older than 4 or 5 years of age in the fieldsites, we examined the developmental trajectory in more detail than a categorical analysis allows. We constructed a Socialization Index (SI) using a negative exponential function of age (Moya, 2013) Specifically, SI = $1 - e^{(-0.2*age)}$. This reflects the asymptotic way in which adult competence is acquired, that is, socialization effects are largest at early ages, and gradually decline. Using this index has the benefit of collapsing variation among adults that might be due to recent historical changes and which are not of immediate interest for testing our hypotheses. See SM section S5 for derivation SI, Table S15 for analysis of several SIs, and section S4 for categorical age analyses that yield broadly similar results.

To visualize these developmental trajectories we plotted the predicted probabilities from the models as a function of age in years. This is for ease of interpretation even though we used SIs as predictors in the model. The shaded areas on graphs represent the 95% confidence intervals of the predicted probabilities and were calculated using the Delta-Method of Standard Error estimation. We did not plot developmental trajectories for the US sample as it only included adults. Full model comparisons are shown in the SM section 6.

4. RESULTS

4.1. PEOPLE DIFFERENTIATE CULTURAL AND GENETIC INFLUENCES BY MIDDLE CHILDHOOD

First, we tested whether people reason that morphological traits are inherited from birth parents and beliefs from adoptive parents. We replicated previous work using data from the Adoption condition, and then ran the same analysis in the Migration condition. We pooled data from all the Group conditions as these did not affect the results. The models we evaluate include SI (Socialization Index), trait type (morphological traits vs. beliefs) and their interaction as predictors of choosing “like birth parent” – i.e. of choosing a prenatal transmission pathway for the trait.

Analyses of the Adoption condition strongly support the hypothesis that a differentiated pattern develops reliably around middle childhood (Figure 1). By middle to late childhood participants reason that morphological traits are more likely to be prenatally inherited than belief traits. Regression models with trait type, Socialization Index, and their interaction fit each site’s data better than any simpler model (Table S9). Not only do younger participants fail to differentiate the two kinds of traits, they show a slight birth bias for all traits, choosing a birth parent resemblance around 60-80% of the time.

The pattern is similar if, instead of looking at the aggregate patterns across participants, we examine the proportion of individuals who show a bias towards choosing an adoptive parent similarity, a birth parent similarity, or differentiating between morphological and belief traits (see SM Section 4.1). Even in adulthood more individuals than would be expected by chance alone show a birth bias in Yasawa and Puno. This analysis reveals that a significant number of children in Yasawa, but not Puno, show a differentiated pattern.

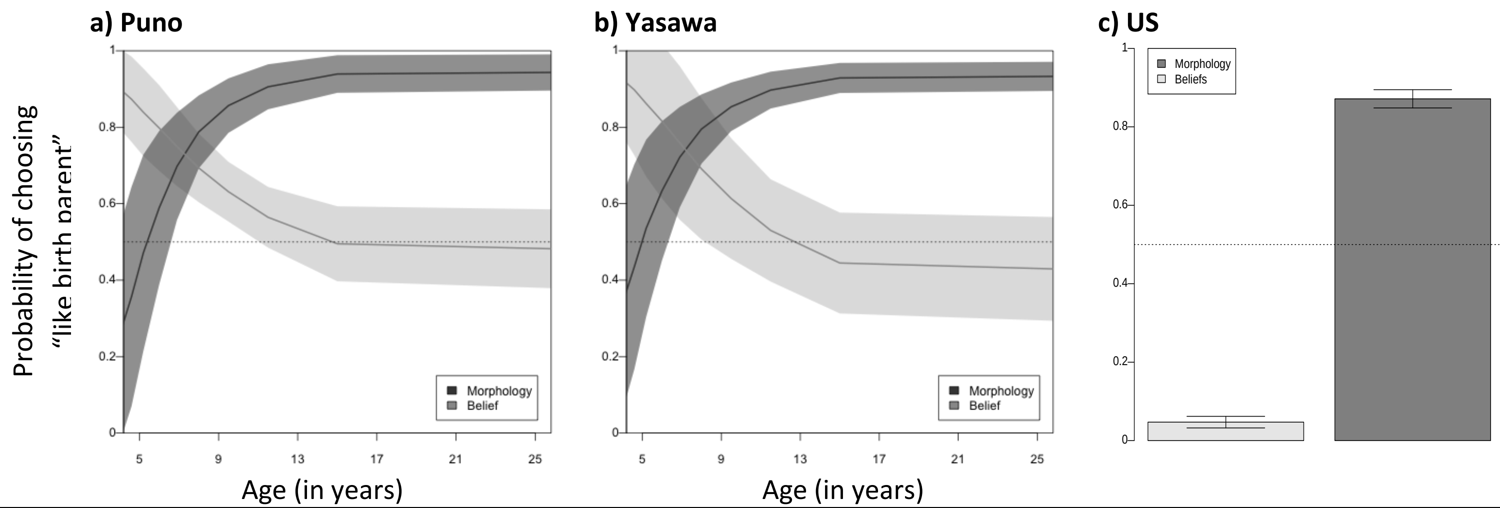
The differentiated pattern persists in the Migration vignette when the child in the story lives with his birth parents (Figure S9, Table S10). This suggests that it not just the fact that birth parents are dead in the Adoption vignette that leads people to reason that beliefs are acquired from non-parental sources.

There is also cross-cultural variation in the extent to which adults respond that beliefs are prenatally inherited. American adults show the fewest such responses at less than 5%, while Yasawa and Puno adults' respond as if beliefs are prenatally transmitted about half of the time. Cross-cultural diversity is also apparent for responses about norms, skill and personality traits (Figures S10 and S11). On the other hand, expectations that morphological traits are prenatally acquired seem less labile.

Figure 1. Predicted probability of choosing prenatal transmission by Trait Types – Adoption condition.

For (a) Puno, (b) Yasawa, and (c) US from random effects logistic regression models. For the US sample, predicted probabilities are calculated at the mean age of the participants as all were over 18 years old.

Shaded regions represent the 95% confidence intervals for the model predictions. A restricted adult age range is plotted below to improve resolution. Reversals in the youngest children are partially products of plotting the best-fit line (see SM section S4.1.2 to see why it arises).



4.2. There is cross-cultural variation in the perceived importance of horizontal and vertical cultural transmission.

The effect of Vignette condition distinguishes between vertical social influence from the adoptive parents and non-parental social influences from other community members. In the Migration vignette birth parents can influence the child both prenatally and socially, whereas in the Adoption condition the birth parents can only influence the child prenatally. Additional "like birth parent" choices in the Migration vignette are evidence that subjects place importance on vertical cultural transmission. However, the Migration vignette also emphasized that the peers in the adoptive group had different traits from the birth parents. This means that any reduction in "like birth parent" choices in the Migration vignette likely results from the belief that peers will have a greater social influence than parents (horizontal cultural influence), at least in this inter-cultural migration context (Table S4).

For comparability's sake, we only include Intergroup conditions. We collapse across Intergroup scripts for the analysis as they did not interact with Vignette condition at either site. We include all non-identity traits that were used in both Vignette conditions in the analysis.

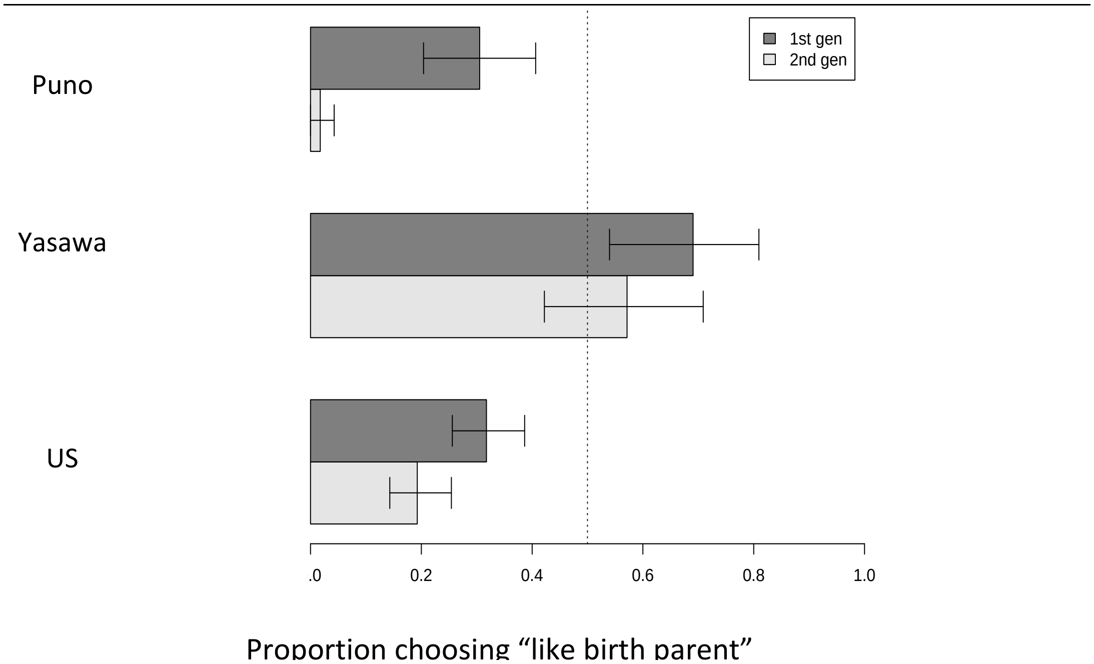
Only Americans show a modest belief that vertical cultural transmission occurs, as evidenced by their choosing "birth parent" similarity somewhat *more* often in the Migration condition – 49% of the time across all traits, compared to 37% in the Adoption condition (Figure S4, controlling for SI OR=1.68, 95%CI=[1.4,2.0]). In contrast, in Yasawa the best-fit model does not include Migration condition as a predictor (controlling for SI OR=0.92, 95%CI=[0.69,1.24]), while in Puno the best-fit model indicates that people believe that the child will resemble the "birth parents" slightly *less* in the Migration condition (controlling for SI OR=0.74, 95%CI=[0.52,1.05], Table S11). This suggests that participants in Yasawa and Puno do not believe that vertical cultural transmission has much of an effect on most traits. However, interactions between Migration condition and Trait type suggest Yasawa adults expect beliefs to be vertically transmitted (see SM Section 9). The interaction effect of SI and Vignette condition are weak.

4.3. Social identity is sometimes perceived as prenatally acquired

To determine whether people believe that group identity is prenatally transmitted, we restricted ourselves to the Adoption condition, because it most clearly distinguishes prenatal and social influences. We asked two identity questions: (1) Will the target child have the group identity of his birth parents or the group identity of his adoptive parents? (2) Will his child have the group identity of the paternal grandparents, or of the new group. Mixed identity answers were not allowed. For the US and Yasawa we only had one response per participant whereas in Puno we asked each participant identity questions about multiple Group conditions. Therefore, we included participant random effects for the Puno sample. This did not qualitatively change the results relative to using a comparable limited sample (Table S14), but does increase our confidence in them.

Overall rates of “like birth parent” choices vary significantly across sites (Figure 2). Yasawan adults believe more strongly that social identity is prenatally transmitted than either Puneño or American adults. Yasawans’ failure to significantly reduce prenatal ascriptions for the second generation question implies skepticism that acculturation, admixture and birthplace affect one’s social identity. On the other hand, Puneño and American participants choose prenatal transmission less than expected by chance.

Figure 2. Adult rates of “prenatal identity acquisition” attributions.
The probability of choosing “like birth parent” is shown for all adults (≥18 y.o.) with age collapsed, and with 95% confidence intervals. Only responses to the Adoption vignette are considered.



To consider the development of this cross-cultural variation we examined the effects of SI and Group condition in Puno and Yasawa. We focus on the 1st generation identity question, but most 2nd generation identity patterns are similar (SM section 10). We tested the effect of Group condition, Socialization Index, and their interaction on “like birth parent” choices (Table S12). One Group condition at each fieldsite corresponded to a boundary that was both more difficult to cross and associated with morphological differences. In Puno this was the Regional (Lima/Huatasani) boundary, while in Yasawa it was the Racial (Indo- / Native- Fijian) boundary.

Group condition is always a predictor in the best-fit models in Puno and Yasawa, but the developmental trajectories differ between the sites.

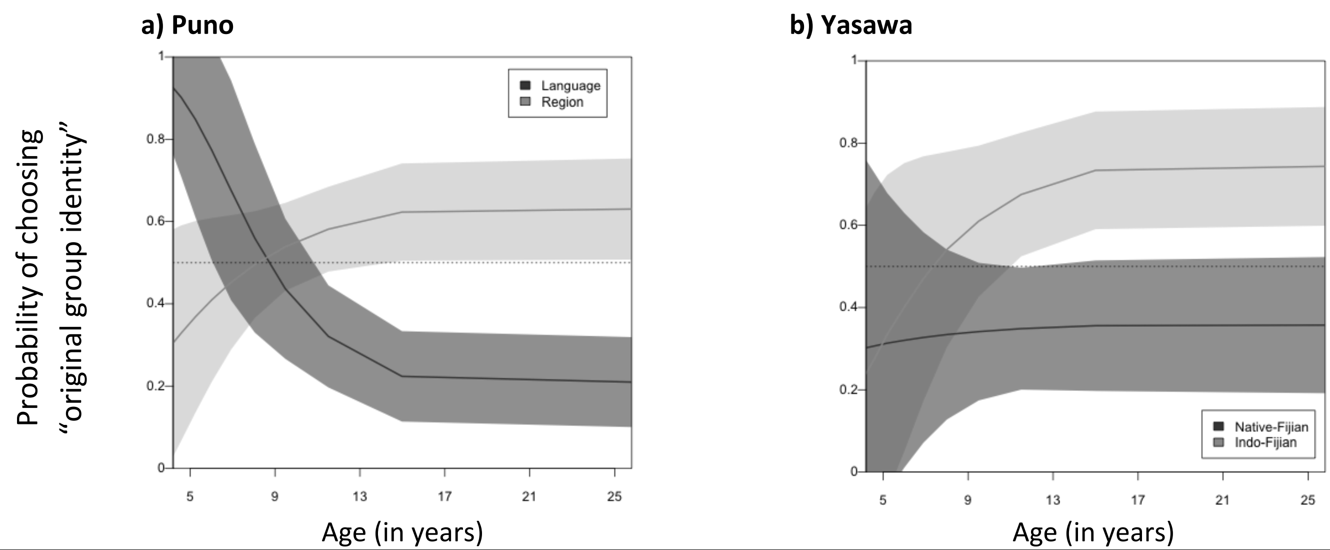
In Puno children have different folk theories about group identity inheritance than adults do (see Table S12). Below 7 years of age children are predicted to reason as if Linguistic category membership is prenatally transmitted at above chance levels, but do not show any strong priors about Regional categories (Figure 3a, section S4.3). This pattern reverses with age, that is, adults believe the target in the vignette has the same identity as his birth parents in the Regional condition only, and not at all in the Linguistic condition. A separate set of experiments showed that adults in Puno have this "birth bias" in the Regional Group condition because they think birthplace is relevant to regional identities not because they believe that the regional identity is prenatally transmitted (SM section S11).

In Yasawa the Group Condition matters but the Socialization Index does not (Table S12). Yasawans do not have an early childhood bias towards "prenatal transmission" or "cultural transmission" theories for either of the group identities, nor a strong shift in this choice with age (Figure 3b). However, adults choose a prenatal transmission pathway in the Racial Fijian Group condition significantly more often than in the Native Fijian Group condition.

Figure 3. Probability of choosing "original group" identity in Adoption Condition By Age and Site – 1st generation.

For (a) Puno and (b) Yasawa.

Shaded regions represent the 95% confidence intervals for the model predictions. A restricted adult age range is plotted below to improve resolution. Non-racial/high mobility groups are shown in dark grey, and racial/low mobility group conditions are in light grey.



5. DISCUSSION

The results suggest that humans use a diverse set of cognitive mechanisms to reason about social life, including folkbiological, folksociological and structured learning mechanisms. Below we assess the predictions laid out in Table 1 in light of our evidence.

First, these data add to the growing evidence that people reliably acquire folk concepts that cultural transmission processes affect beliefs, but not morphology. Cross-culturally people show a differentiated pattern by late childhood; responding that morphological traits are more likely to be prenatally inherited than are belief traits. This result replicates much of the cross-cultural work on the topic (Astuti et. al., 2004; Bloch et. al., 2001; Mahalingam, 1998; Solomon et. al., 1996) and extends it by showing that the pattern is robust even when birth parents are alive in the Migration vignette. The developmental consistency suggests that differentiating kinds of influences on traits is a reliably developing feature of folksociology. The fact that reasoning about morphological traits is relatively similar across sites compared to other traits, and that children show “birth biases” suggests that those responses might be an output of a more canalized folkbiological mechanism. Additionally, structured learning mechanisms for acquiring culturally evolved beliefs are likely responsible for much of the variation across sites in terms of base rates of prenatal transmission folk theories and responses to specific traits.

Second, we show that perceptions of parental social influence versus peer influence vary across societies. Only Americans show a commitment to vertical cultural transmission making the “nurture assumption” (Harris, 1999). Puneños and Yasawans rejected vertical cultural transmission effects for most traits, possibly because of a belief that children use a wide set of cultural models, including peers. This cross-cultural difference may reflect the fact that Americans rely less on peer childcare and socialization compared to the Puno and Yasawa sites (Henrich & Broesch, 2011; Henrich & Henrich, 2010). This cross-cultural variability in folk theories about parental social influence, and the fact that children show few biases on the matter suggest that any evolved expectations about the matter are, at best, weak. Structured learning mechanisms are likely used to acquire culturally-evolved folk theories about the importance of vertical transmission.

Finally, there is cross-cultural variation in the tendency to reason as if identity is prenatally inherited, and variation in the extent to which different groups elicit such responses. Americans’ very low levels of “birth bias” responses likely reflect the regional nature of the hypothetical groups described in the vignettes. This contrasts with Americans’ tendency to biologize known racial categories (Hirschfeld, 1996). Similarly, Puneño adults showed low levels of prenatal transmission responses for both known linguistic and regional groups. However, Yasawan adults showed higher rates of “birth bias”, driven primarily by their strong belief in the “prenatal transmission" of the Native Fijian versus Indo-Fijian group membership (i.e. groups across which intermarriage and migration is rare). Both the Yasawan and Puneño patterns are consistent with qualitative field ethnography. The adult patterns suggest that structured learning mechanisms lead individuals to adopt culturally appropriate theories for different groups that reflect the actual difficulty of crossing different ethnic boundaries.

Only children in Puno showed prenatal transmission biases in the Linguistic Group condition. This is noteworthy given adults' beliefs to the contrary, and given that the Linguistic Group condition reflected the less morphologically marked and the higher mobility group boundary. Children's bias with respect to linguistic groups may reflect the output of folkbiological mechanisms in combination with folksociological ones for reasoning about relatively stable ethnolinguistic boundaries. This is consistent with previous work showing that American children believe language use is prenatally inherited, even though adults do not (S. Gelman & Hirschfeld, 1999). The absence of strong biases among Yasawan children is opposite to the developmental pattern reported by Astuti et. al. in Madagascar (2004) with respect to a similar community of Indian descent.

These three lines of evidence support the need to consider folkbiological, folksociological, and structured learning mechanisms to explain peoples' reasoning about the inheritance of traits and identity. Some components of folksociology may be derived from, or integrate with, folkbiological heuristics such as those for reasoning about linguistic group identity and morphological traits. Folksociological adaptations may also combine with structured learning abilities for acquiring folk beliefs about parental influence, the extent of social influence on non-morphological traits, and the permeability of group boundaries. Humans cross-culturally come to expect both social and prenatal influences, develop culturally-specific beliefs about the degree of parental social influence, and develop culturally-specific beliefs about ethnic identity transmission, despite possible innate biases that are at odds with the culturally evolved concepts.

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SUPPLEMENTARY ONLINE MATERIALS FOR REASONING ABOUT CULTURAL AND GENETIC TRANSMISSION

S1. ALTERNATE FOLKBIOLOGICAL ACCOUNT, INTEGRATED WITH FOLKPSYCHOLOGY

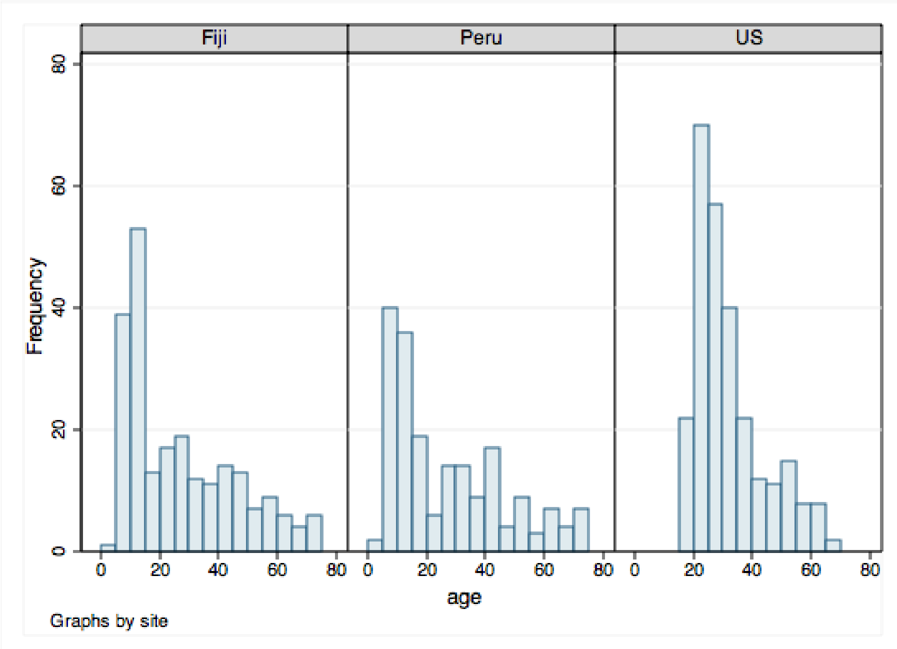
A potentially more plausible version of the folkbiological hypothesis is that the differentiated pattern emerges from a combination of folkbiology and Theory of Mind (ToM) mechanisms. The former would lead people to believe that morphological features are inherited prenatally (i.e., participants would respond with a "birth bias"), while (ToM) capacities would let people infer that the child in the vignette cannot acquire beliefs from dead birth parents. Relatedly, the differentiated pattern is consistent with claims that humans are innately predisposed to Cartesian dualist theories, having evolved separate systems for reasoning about physical objects (bodies) and social agents (their beliefs) (Bloom, 2004). We will refer to this hypothesis as "folkbiology plus ToM."

Though it is more plausible that the differentiated pattern emerges from ToM and folkbiology than from folkbiology alone, we believe this combination of heuristics would lead to incorrect predictions about beliefs under a wide range of circumstances. Folkbiological heuristics would track cues of genetic relatedness while ToM mechanisms would lead people to infer that beliefs could only be transmitted between individuals who know each other. However, people frequently adopt the cultural beliefs of unrelated individuals even when close kin are present (Boyd & Richerson, 1985; Harris, 1995) and the folkbiology plus ToM mechanism would not clearly lead people to make this prediction. For example, imitation of non-kin prestigious group members (Henrich and Henrich 2010; Henrich and Broesch 2011), or of peers when there is intergenerational change, would decouple the pathways of genetic and cultural transmission, even when kin are available to transmit their mental states.

The typical adoption scenario does not discriminate between this hypothesis and the folksociological account. However, we test for the differentiated pattern in the Migration Vignette condition where the birth parents raise the child in a new cultural context. Participants show a differentiated pattern in this condition as well. This means that "folkbiological plus ToM" abilities alone cannot account for participants' reduced prenatal transmission responses for beliefs, since the parents' mental states are accessible to the child as he grows up in the migration scenario. We believe this consistent differentiation of transmission pathways for morphological and belief traits is more consistent with the need to consider folksociological or structured learning mechanisms, even if folkbiological and folkpsychological ones are also involved.

S2. DEMOGRAPHIC DETAILS

Figure S1. Age distributions by site



S3. EXPERIMENTAL STIMULI AND METHODOLOGICAL DIFFERENCES BY SITE

The full text of the Vignette conditions can be seen in Table S1 and the set of traits used as questions is shown in Table S2. At two of the sites there are unequal numbers of responses per participant because 1) some participants online and in Puno did not complete all questions, either due to fatigue or unexpected interruptions, and 2) children in Puno were administered an abridged version with fewer questions (Table S2). Because trait question order was randomized, this should not have changed the distribution of questions asked, and we assume that those who dropped out prematurely are missing at random with respect to our hypotheses. Additionally, a slightly different, but overlapping, smaller set of traits was used in Yasawa. At that site the set of traits varied some between the Adoption and Migration vignettes. Where appropriate all statistical comparisons are made between the same subset of traits.

Table S1. Other Vignettes Conditions Text of Vignettes used in studies for 1) Puno, 2) Yasawa and 3) US samples.
1. Puno
Linguistic Group Adoption Condition
Many years ago a couple from Huatasani was moving from their home town Huatasani , where Quechua is spoken) to Inchupalla (where Aymara is spoken). On the way, almost reaching Inchupalla, their bus crashed and all the passengers died except this young couple's baby. Some Aymara people from Inchupalla were coming along the same path and found the baby and decided to adopt it. They named him Marco. They took the baby to Inchupalla and raised it with much love as if he were one of their other two sons. Now Marco is an adult, he married an Aymara woman there and had his own children.
Linguistic Group Migration Condition
Many years ago a Quechua couple from Huatasani was moving from their home town Huatasani (where Quechua is spoken) to Inchupalla (where Aymara is spoken). On the way, almost reaching Inchupalla, their bus crashed and all the passengers died except this young couple. They continued their trip to Inchupalla bought their house and stayed to live there. After some years they had a child Marco who was born in Inchupalla, played with other Inchupalla kids, and was raised there. Now Marco is an adult, he married an Aymara woman from Inchupalla and had his own children.
Regional Group Adoption Condition
Many years ago a couple from Huatasani was moving from their hometown Huatasani to Lima. On the way, almost reaching Lima, their bus crashed and all the passengers died except this young couple's baby. Some people from Lima were coming along the same path and found the baby and decided to adopt it. They named him Marco. They took the baby to Lima and raised it with much love as if he were one of their other two sons. Now Marco is an adult, he married a woman from Lima and had his own children.
Regional Group Migration Condition
Many years ago a couple from Huatasani was moving from their home town Huatasani to Lima. On the way almost reaching Lima, their bus crashed and all the passengers died except this young couple. They continued their trip to Lima bought their house and stayed to live there. After some years they had a child Marco who was born in Lima, played with other Lima kids, and was raised there. Now Marco is an adult, he married a woman from Lima and had his own children.
Ingroup Adoption Condition
Many years ago a couple from Huatasani was moving from their hometown Huatasani to Inchupalla. On the way, almost reaching Inchupalla, their bus crashed and all the passengers died except this young couple's baby. Some people from Huatasani were coming along the same path and found the baby and decided to adopt it. They named him Marco. They took the baby to their home in Huatasani and raised it with much love as if he were one of their other two sons. Now Marco is an adult, he married an Quechua woman there and had his own children.

2. Yasawa
Racial Group Adoption Condition
A long time ago, a young couple from Kadavu and their baby set sail in a tiny boat from one island to another. It is when they were close to the island during which time they begin to experience strong winds and very rough seas. The young mother was so sacred and terrified that she tied the baby to the bench right in the middle of the boat. Not for long a huge wave fills the boat with water and strong currents carry the young couples out to sea where they drowned. But it was a miracle that the boat neither sank nor capsized and the baby was still alive. After a while, the boat drifted ashore on an island and was found by an Indian couple. Then the couple named and took great care of the child as if the child were their own. The child was raised in the same manner in which their other two children were brought up and that is with love, compassion and understanding. The child became a responsible adult and later starts a family.
Racial Group Migration Condition
Some years ago, a young couple was traveling from one island to another with their newborn child in a small boat. Both the husband and wife were Indians from Viti Levu. As they neared their destination, the wind came up suddenly and the waves grew large. The boat ran aground on a reef and broke apart. The crew and the passengers were thrown into the rough seas. The couple were the only ones who survived. They drifted ashore on a beach alive but very exhausted. The next morning when the hurricane passed, some people from a nearby village, somewhere in the Yasawa islands, found the couple, gave them food and took care of them. The couple had lost all their belongings and was amazed by the love and hospitality of the Yasawans. With the villagers' approval, the couple decided to stay in the village for the rest of their lives. After some years they had a son. The boy's father survived by managing the village shop, while his son attended the local school with the rest of the kids in the village learning how to fish, farm, drink grog, and speak the village dialect. Later, still living in the village, the boy became an adult, married a local girl and had a child
Native Fijian Group Adoption Condition
A long time ago, a young couple from Kadavu and their baby set sail in a tiny boat from one island to another. It is when they were close to the island during which time they begin to experience strong winds and very rough seas. The young mother was so sacred and terrified that she tied the baby to the bench right in the middle of the boat. Not for long a huge wave fills the boat with water and strong currents carry the young couples out to sea where they drowned. But it was a miracle that the boat neither sank nor capsized and the baby was still alive. After a while, the boat drifted ashore on an island and was found by a couple from Yasawa. Then the couple named and took great care of the child as if the child were their own. The child was raised in the same manner in which their other two children were brought up and that is with love, compassion and understanding. The child became a responsible adult and later starts a family.
Native Fijian Group Migration Condition
Some years ago, a young couple was traveling from one island to another with their newborn child in a small boat. Both the husband and wife were Fijians from Kadavu. As they neared their destination, the wind came up suddenly and the waves grew large. The boat ran aground on a reef and broke apart. The crew and the passengers were thrown into the rough seas. The

couple were the only ones who survived. They drifted ashore on a beach alive but very exhausted. The next morning when the hurricane passed, some people from a nearby village found the couple, gave them food and took care of them. The couple lost all their belongings and were amazed by the love and hospitality of the Yasawans. With the villagers approval, the couple decided to stay in the village for the rest of their lives. After some years they had a son. The boy's father survived by managing the village shop, while his son attended the local school with the rest of the kids in the village learning how to fish, farm, drink grog, and speak the village dialect. Later, still living in the village, the boy became an adult, married a local girl and had a child.
Ingroup Adoption Condition
A long time ago, a young couple from Kadavu and their baby set sail in a tiny boat from one island to another. It is when they were close to the island during which time they begin to experience strong winds and very rough seas. The young mother was so sacred and terrified that she tied the baby to the bench right in the middle of the boat. Not for long a huge wave fills the boat with water and strong currents carry the young couples out to sea where they drowned. But it was a miracle that the boat neither sank nor capsized and the baby was still alive. After a while, the boat drifted ashore on an island and was found by a couple from Kadavu. Then the couple named and took great care of the child as if the child were their own. The child was raised in the same manner in which their other two children were brought up and that is with love, compassion and understanding. The child became a responsible adult and later starts a family.
3. US
Regional Group Adoption Condition
Some years ago, a young couple was traveling from one island to another with their newborn child in a small boat. Both the husband and wife were Fakians from Faka Island. As they neared their destination, the wind came up suddenly and the waves grew large. The wife was very frightened and tied her baby to a bench in the center of the boat. A moment later, a huge wave crashed over the boat and both the husband and wife were swept overboard and drowned. Amazingly, the boat righted itself, and the baby survived. Later that day the boat washed up on the coast. There it was found by a man and his wife who were Nonuans from Nonu Island. They brought the baby home and named him M. They raised M with affection and love, just like their other two children. M is now fully grown and married with his own children.
Regional Group Migration Condition
Many years ago, a young Fakian couple was traveling by ship from Faka, their homeland island to a new island, Atafu, where they planned to live. As they passed near Nonu island their ship was caught in a huge cyclone, hit a reef, and broke apart. Passengers and crew were thrown into the turbulent waters, and all perished, except for the young couple who washed up on the beach exhausted but alive. The next morning the cyclone had passed and the young couple were found by Nonuans from a nearby village who fed and cared for them. The young couple had lost all of their possessions in the shipwreck, and impressed with the kindness and generosity of the Nonuan villagers decided to live the rest of their lives in the village. After some time, the couple had a son named M, who grew up in the village, played with the village children, and looked just like the other village children. M is now fully grown and married to a

village girl and with his own children.
Ingroup Adoption Condition
Some years ago, a young couple was traveling from one island to another with their newborn child in a small boat. Both the husband and wife were Fakians from Faka Island. As they neared their destination, the wind came up suddenly and the waves grew large. The wife was very frightened and tied the baby to a bench in the center of the boat. A moment later, a huge wave crashed over the boat and both the husband and wife were swept overboard and drowned. Amazingly, the boat righted itself, and the baby survived. Later that day the boat washed up on the coast. There it was found by a man and his wife who were also Fakians from Faka Island. They brought the baby home and named him M. They raised M with affection and love, just like their other two children. M is now fully grown and married with his own children.

Table S2. Traits by Kind
(see Table S3 for complete wording)

Identity	**Norms and Skills**	**Personality**
Child's ID	Health practices [1, 4]	Selfish[5]
Grandchild's ID	Has a small family [1, 4]	Quick to anger
	Knotting knowledge	Friendly[4]
Beliefs	Good fisherman[5]	Intelligent[5]
'Bats have x# of teeth'	Good sense of direction [1]	
Food taboo [1]	Beqa healing hand[2]	**Morphology**
Music preference [1]	'It is rude to stand above'[2]	Finger length [4]
'There are tigers in Africa' [1]	Birth Ritual[2]	Good eyesight[5]
'Eels are poisonous'[3]		Ear shape
		Liver size[5]

[1.] Not used in Yasawa. [2.] Only used in Yasawa Migration vignette. [3.] Not used in Puno or US
[4.] Not used with children in Puno. [5] Used in Yasawa, but not in Migration vignette.

Table S3. All Traits Used

Belief 1. shows the full wording. All other trait questions followed the same format.

Traits were used in all sites with the following exceptions:
a. Not used in Yasawa.
b. Only used in Yasawa migration vignette.
c. Not used in Puno or US
d. Not used with children in Puno.
e. Used in Yasawa, but not in Migration vignette.

Identity

1. Now that the child is grown, is the child an {Group A} or {Group B}?
2. Are his children {Group A} or {Group B}?

Beliefs

1. M's father (the man who sired M) believed that fruit bats had 32 teeth. The man who raised M, his adoptive father, believed that fruit bats had 28 teeth. Now that he is grown, do you think that the child believes that fruit bats have 32 teeth or 28 teeth? *('bat' replaced with 'toad' in Puno).*
2. believed eating pregnant tufted deer is a delicacy
   like most people, thought it was immoral to eat pregnant deer [a]
3. did not care much for percussion music
   really enjoyed percussion music [a]
4. believed that there were tigers in Africa
   thought that there were no tigers in Africa [a]
5. believes that the eel is poisonous when eaten as most people think so
   does not necessarily believe that the eel is poisonous when eaten [c]
6. believed that Beqans cannot heal by touching burned skin
   believe this to be true and that they can heal.[b]
7. believed that it is not rude if one sits on a high chair while others are sitting on the floor
   believe this to be rude [b]
8. believed that when there is a new born baby, they must sacrifice a chicken
   did not believe in this practice [b]

Norms and Skills

1. avoided getting ill by eating a nutritious diet to keep his immune system healthy
   avoided getting ill by avoiding other people who seemed sick [a, d]
2. wanted a family with three children
   wished to have a much larger family [a, d]
3. knew how to tie about the same number of knots as most people
   knew how to tie an exceptionally large number of knots
4. was a good fisherman
   was not a good fisherman [e]
5. had a really good sense of direction
   had an average sense of direction [a]

Personality	
1.	was like most people, sometimes helpful and sometimes selfish
	was exceptionally helpful and altruistic [e]
2.	became angry easily
	was slow to anger
3.	was outgoing
	was shy [d]
4.	was exceptionally intelligent
	is of normal intelligence [e]
Morphology	
1.	had a third finger that was longer than his index finger
	had an index finger that is longer than his third finger [d]
2.	had very good eyesight and can see distant objects much better than most people
	had normal eyesight [e]
3.	had pointed ears
	had rounded ears
4.	had a normal sized liver
	had a very large liver [e]

Table S4. Changes to vignette between Adoption and Migration Vignettes.
The Migration condition makes the birth parents responsible for vertical cultural influences and increases the salience of horizontal influences from peers.

	Adoption Vignette	Migration Vignette
Birth parents' influences	1. Prenatal	1. Prenatal 2. Cultural Vertical
Others' influences	2. Cultural Vertical 3. Implied Cultural Horizontal	3. Cultural Horizontal

S4. ALTERNATE ANALYSES

This section includes analyses that are 1) alternatives to the random effects models and 2) use categorical age as a predictor.

S4.1 DO PEOPLE DIFFERENTIATE BETWEEN THE CULTURAL AND PRENATAL TRANSMISSION OF TRAITS?

S4.1.1 INDIVIDUAL LEVEL SCORES

It is possible that aggregate patterns obscure between-individual variation. For example, while the population as a whole may not show a differentiated pattern, some individuals might. To assess this possibility we assigned people codes given their reasoning pattern. Separate binomial tests were run for each participant in order to assign these codes since participants at different sites, and in different conditions, were asked different numbers of questions.

In order to assign *differentiated* pattern codes we restricted our analysis to responses on belief and morphological traits. If the joint probability of having the target individual's number of birth parent ascriptions or *higher* on the morphological traits *and* their number of birth parent ascriptions or *lower* on the belief traits by chance alone was lower than 0.05, then the participant was assigned a *differentiated* code.

If the participant did not show a *differentiated* pattern then we determined whether they had a *birth* or *adoptive bias*, using the whole set of responses to non-identity traits in this analysis. If a participant predominantly answered that the child will resemble his adoptive parent regardless of traits he was coded as having an *adoptive bias* (if these responses were more than expected by chance alone at the p=0.05 level). If the participant overwhelmingly chose a birth parent resemblance then he was coded as having a *birth bias*. If the participant did not show any of these patterns he was assigned a *mixed* code.

Next we ran 2nd order binomial tests to determine whether there were more individuals showing a particular pattern than would be expected from chance alone. Bear in mind that assuming individuals are coin flippers it is statistically more unlikely to be assigned a *differentiated* pattern than a *mixed* pattern so that even if fewer than a quarter of respondents show a *differentiated* pattern this may be significantly more than expected by chance in the 2nd order binomial test.

We analyze the distribution of patterns for children (≤ 13 years old) and adults (≥18 years old) separately. We chose this age cut-off for children to parallel that used by Astuti, Carey and Solomon on a similar task (2004), and the 18 year cut off for adults to match the age range of the US sample. Unfortunately, we do not have enough adolescents in the intermediate age range to analyze them separately.

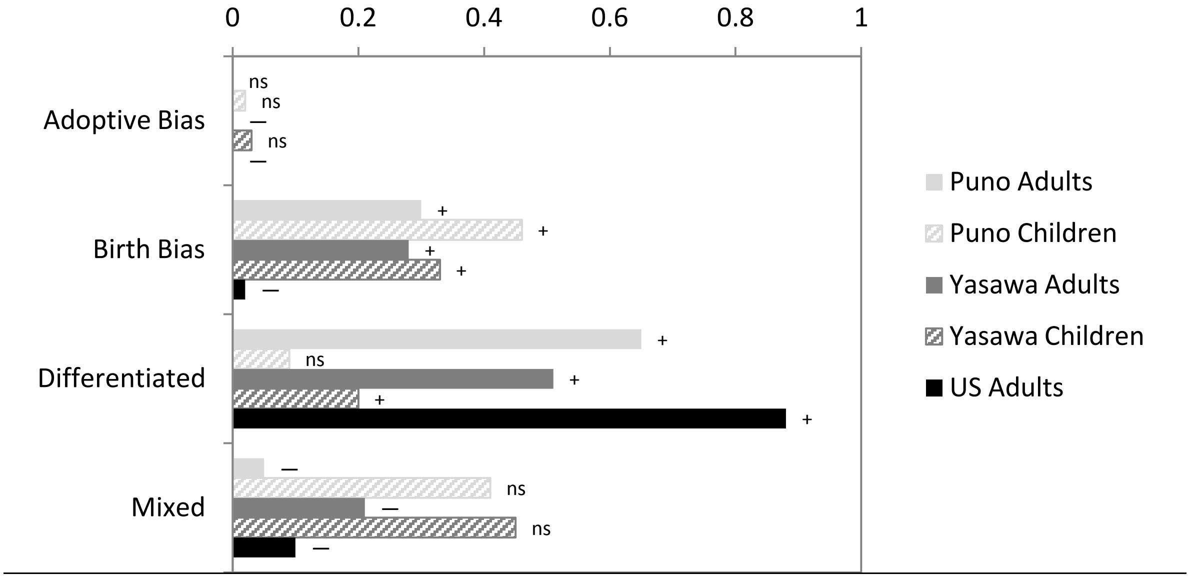
Table S5 and Figure S2 show that for all age and site categories except Peruvian children, the *differentiated* pattern is more common than expected by chance. For all age and site categories except for American adults, the birth bias is also more common than expected by chance alone.
These patterns parallel those discussed in the main text, and provide a robustness check.

Table S5. Trait transmission reasoning patterns distribution by Site and Age – Adoption Condition.

All participants in the Adoption Condition are assigned to having an Adoptive bias, a Birth bias, a Differentiated pattern, or a Mixed pattern. Adults (≥18 years old) are presented on top and children (≤ 13 years old) are represented on the bottom of the table. The top portion of each table represents the proportion of participants showing each pattern, and the bottom represents the participant count for each cell. Signs in parentheses represent the results of 2nd order binomial tests such that there are more people assigned to cells with a (+) than would be expected by chance alone (at p=0.05 cutoff values), and there are fewer people represented in the (–) cells than would be expected by chance alone.

		Adoptive	Birth Bias	Differentiated	Mixed
Adults	**Proportion**				
	Yasawa	0 (–)	0.28 (+)	0.51 (+)	0.21 (–)
	Puno	0	0.30 (+)	0.65 (+)	0.05 (–)
	US	0 (–)	0.02 (–)	0.88 (+)	0.1 (–)
	Number				
	Yasawa	0 (–)	17(+)	31 (+)	13 (–)
	Puno	0	6 (+)	13 (+)	1 (–)
	US	1(–)	3 (–)	175 (+)	20 (–)
Children	**Proportion**				
	Yasawa	0.03	0.33 (+)	0.20 (+)	0.45
	Puno	0.02	0.46 (+)	0.09	0.41
	Number				
	Yasawa	1	13 (+)	8 (+)	18
	Puno	1	25 (+)	5	22

Figure S2. Proportion of individuals per Site and Age category with each trait transmission reasoning patterns – Adoption Condition.
The signs reflect the results of 2nd order binomial tests for proportion of individuals with each reasoning pattern. A (+) indicates this pattern was observed more often than would be expected by chance alone (at *p*=0.05 cutoff values), and a (–) indicates fewer individuals showing this pattern than would be expected by chance alone.



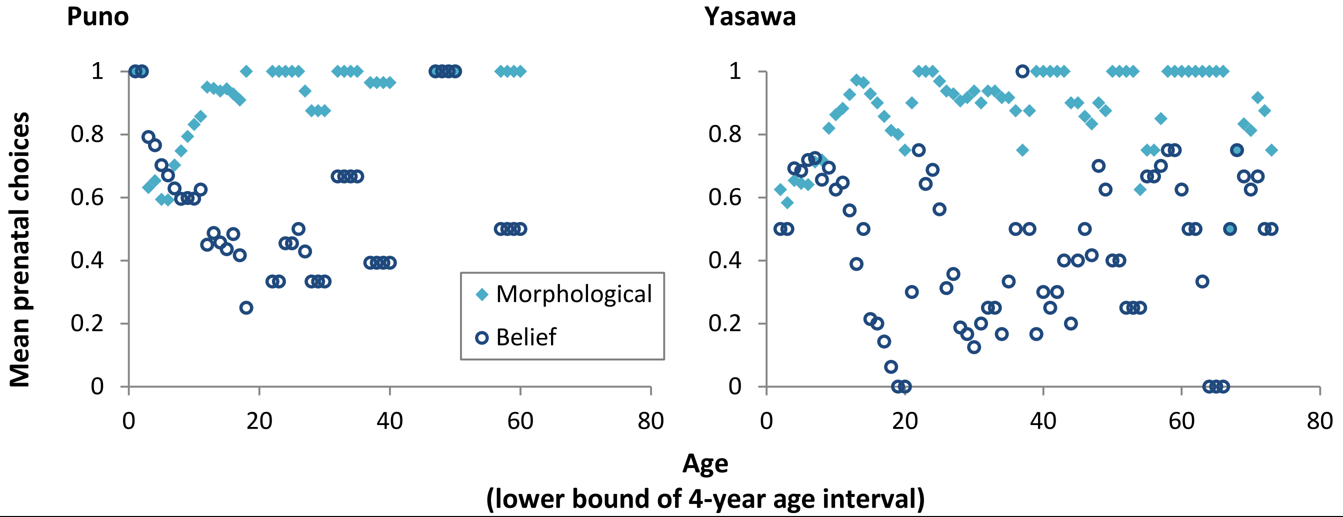
S4.1.2 DESCRIPTIVE STATISTICS AND RUNNING MEANS

In this section we attempt to visualize distributions of "like birth parent" choices as a function of age using other categorical age cut offs (Table S6) and by plotting running averages of "like birth parent" choices in 4-year age bands (Figure S3). They broadly confirm the patterns shown by the random effects models using Socialization Index as a predictor instead.

Table S6. Percent of questions answered as prenatal transmission in Adoption vignette, by trait type and age category. Number of questions represented shown in parentheses.

	3-5	6-10	11-15	16-20	21-75	total
Puno						
morph	100 (7)	67.48 (123)	88 (50)	92.86 (28)	96.61 (59)	81.27 (267)
belief	100 (8)	63.46 (156)	57.14 (56)	48.39 (31)	46.67 (60)	58.52 (311)
Yasawa						
morph	62.5 (16)	69.32 (88)	90 (80)	85.71 (28)	92.27 (220)	85.65 (432)
belief	50 (8)	70.45 (44)	57.5 (40)	14.29 (14)	41.82 (110)	49.07 (216)
US						
morph	(0)	(0)	(0)	90.91 (88)	86.9 (664)	87.43 (756)
belief	(0)	(0)	(0)	4.55 (87.9)	4.67 (663.8)	4.63 (755.9)

Figure S3. Running averages of prenatal transmission choices in 4 year age bands in Adoption vignette, by trait type and site.



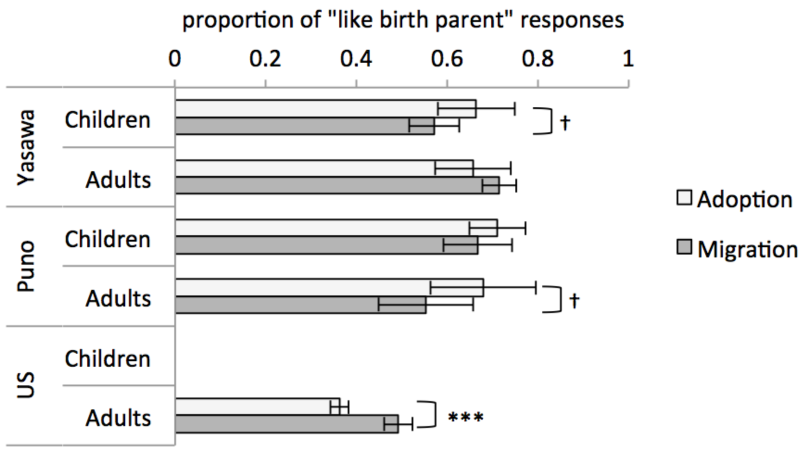
S4.2. DO PEOPLE DIFFERENTIATE BETWEEN PARENTAL AND NON-PARENTAL CULTURAL INFLUENCES?

For this analysis we compared people's reasoning across all non-identity traits in the Migration and the Adoption condition to assess the importance of parental social influences. We calculated a score for each individual that was the proportion of non-identity traits on which they chose "like the birth parent." Only questions that were both used in the Migration and the Adoption vignettes were used to calculate this score (see Table S2). Furthermore, we exclude the Ingroup Adoption condition responses from analysis since these are not comparable to the Ingroup Migration condition.

The results of this analysis show that only American adults strongly expect that parents will socially influence their children in the Migration vignette (Figure S4). In other words, they make significantly more "like birth parent" ascriptions in the Migration vignette than in the Adoption vignette. In the latter condition the birth parents are only responsible for pre-natal influences on their child. The effect for Yasawa adults is in the same direction but not significant, and for all other groups the result is in the opposite direction. This suggest that in Yasawa and Puno participants are less convinced about the relative importance of vertical transmission, at least in a social context where parents are migrants and thus members of a cultural minority in the group. This suggest that the "nurture assumption" may be particularly unusual feature of Westerners or Americans.

Figure S4. Proportion of each individual's responses that were "like the birth parent" – By Vignette Condition.

Analysis is restricted to non-identity traits. Children are at most 13 years of age, and Adults are at least 18. Results of paired t-tests are coded as *** p<0.001, † p<0.1.



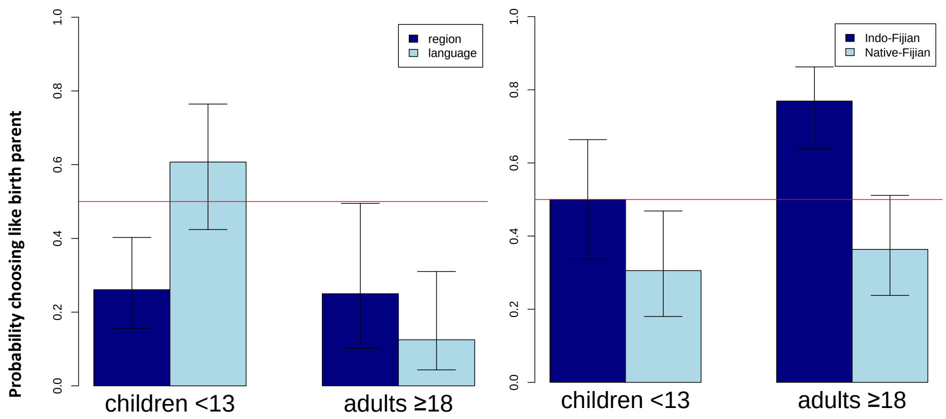
S4.3 HOW DO PEOPLE THINK ETHNIC GROUP IDENTITY IS INHERITED?

S4.3.1 BINARY AGE SPLIT

For this analysis we restrict ourselves to the 1st generation identity responses in the Adoption condition. We divide participants into the less than 13 and 18 and over age categories. The Regional Group condition in Puno and the Indo-Fijian one in Yasawa reflect lower mobility and more morphological marked ethnic boundaries.It is worth emphasizing that the children in Puno and Yasawa look pretty similar (Figure S5). They have relatively low rates of prenatal ascriptions for the Regional and Native Fijian group conditions, and higher rates for the Language and Indo-Fijian group conditions. However, the adults show totally different patterns across the sites, relfecting different developmental changes – adults in Yasawa show an exaggeration of the the children's pattern, while the bias disappears among adults in Puno who choose pre-natal transmission for neither group.

Figure S5. Probability of choosing "like birth parent" identity, generation 1. Adoption Condition By Age Category and Group condition
For (a) Puno using limited sample and (b) Yasawa. Bars are 95% CIs. Dark blue bars represent the low mobility boundaries, and the light blue ones represent high mobility social boundaries.

a) Puno **b) Yasawa**



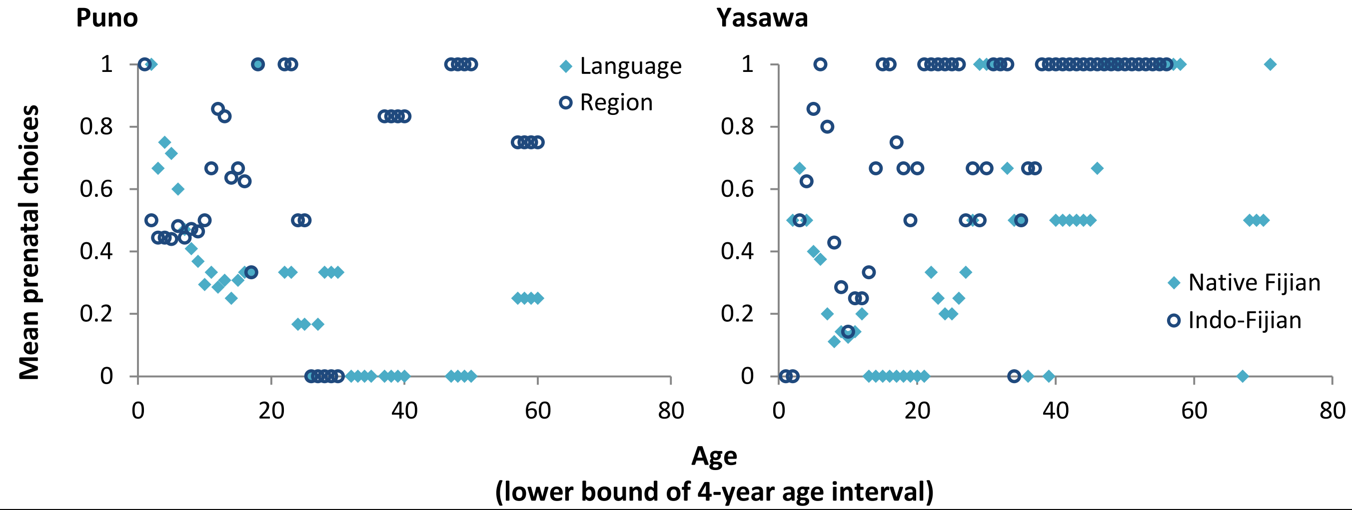
S4.3.2 DESCRIPTIVE STATISTICS AND RUNNING MEANS

In this section we attempt to visualize distributions of "like birth parent" choices of 1st generation identity questions as a function of age using other categorical age cut offs (Table S7) and by plotting running averages of "like birth parent" choices in 4-year age bands (Figure S6). They broadly confirm the patterns shown by the random effects models using Socialization Index as a predictor.

Table S7. Percent of identity generation 1 questions answered as prenatal transmission in Adoption condition, by Group Condition and age category. Number of questions represented shown in parentheses.

	3-5	6-10	11-15	16-20	21-75	total
Puno						
region	50 (2)	44.19 (43)	68.75 (16)	62.5 (8)	68 (25)	56.38 (94)
language	100 (2)	44.44 (18)	30.77 (13)	33.33 (9)	11.54 (26)	29.41 (68)
Yasawa						
Indo-Fijian	(0)	87.5 (8)	22.22 (9)	100 (3)	85 (20)	69.05 (42)
Native Fijian	50 (2)	27.27 (11)	14.29 (7)	(0)	50 (18)	35 (40)

Figure S6. Running averages of prenatal transmission generation 1 identity choices in 4 year age bands in Adoption vignette, by Group condition and site.



S5. DERIVING THE BEST FIT SOCIALIZATION INDEX (SI)

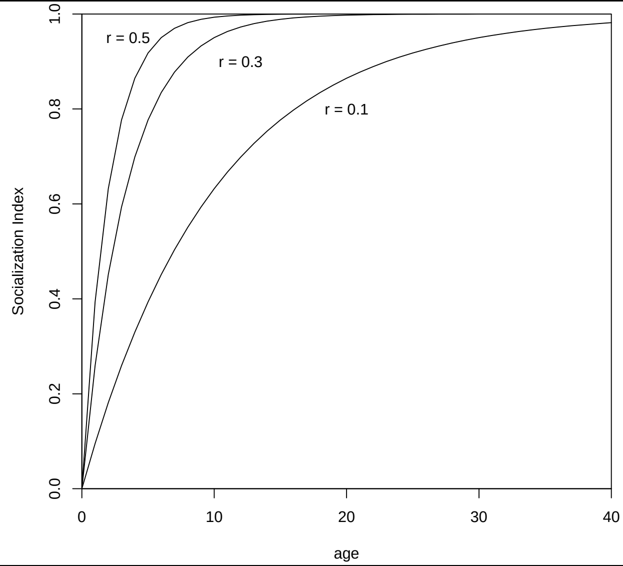
For the purposes of this paper we are not interested in changes in later adulthood that are likely to reflect historical changes rather than cognitive development. Therefore, we develop a Socialization Index (SI) which is simply a negative exponential function of raw age. The negative exponential function is asymptotic and so collapses all variation at higher values of age.

However, we have little *a priori* reason to expect a particular negative exponential function since we know relatively little about this developmental trajectory. For this reason we compare models with varying negative exponential functions and choose the best fit one as determined by the lowest AIC score. We test the SI's derived from the following function:

$$SI = 1 - e^{-r*age}$$

for values of *r* ranging from 0.1 to 0.5 in 0.01 unit increments. The higher *r* is, the faster the developmental trajectory. We chose this lower bound on *r* to ensure that adult variation is largely collapsed and not driving the effect. For example, at the lower bound of *r*=0.1 we expect that by 20 years of age, participants are 86% as likely as the oldest individual of responding affirmatively. Figure S7 illustrates trajectories for several values of *r.* We restrict the SI functions to ones where all age variation translates to 1 unit of change in SI – namely where the coefficient of *e* is equal to 1.

Figure S7. Illustration of various Socialization Indices as a function of varying *r*, rates of change. From left to right r=0.5, 0.3 and 0.1



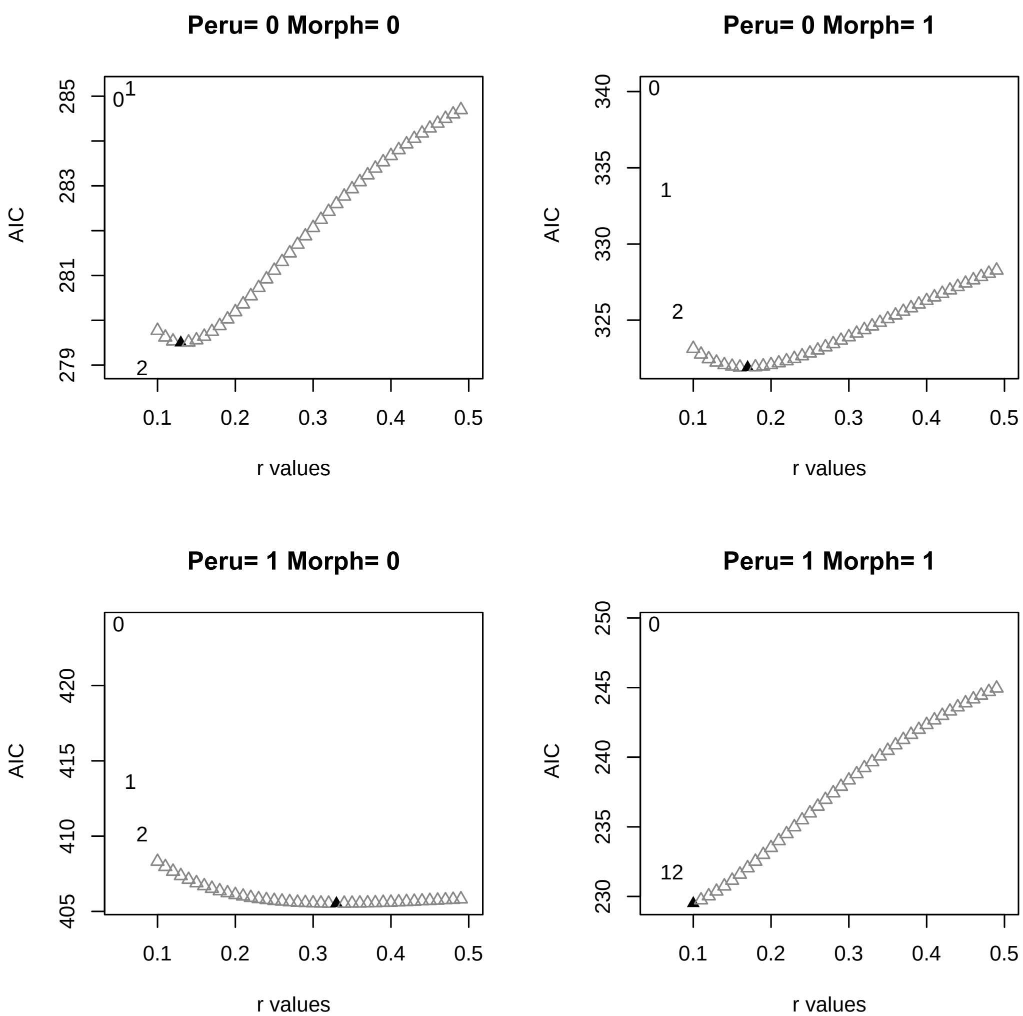
We also compare AIC scores of three different models of age; a baseline model without age as a predictor, a model with a linear raw age term, and a model with age and age squared as predictors. AIC's for these alternate models are shown as 0, 1, and 2, respectively, in Figure S6 alongside AICs for various SI's as a function of values of r. While in some cases linear or squared age terms fit the data better, we still report SIs in the main models because we do not wish to capture changes in adulthood. Table S8 shows the r-values for the SI with the minimum AIC scores for each model at each site. It also shows the "half-way" age for the given r-value. This is the age at which children are expected to be half-way between their "initial belief" and the adult belief – i.e. age at which SI=0.5. Low values may be due to faster socialization or beliefs that are more similar between 5 year olds and adults. Given this vast diversity of best-fit SIs, we take the average of these r-values (0.2) for ease of comparison to make our Socialization Index for all future models. For a robustness check using other r-values see Table S15.

Table S8. Best fit Socialization index. r-value with minimum AIC for each model and corresponding ½ way age, by site.

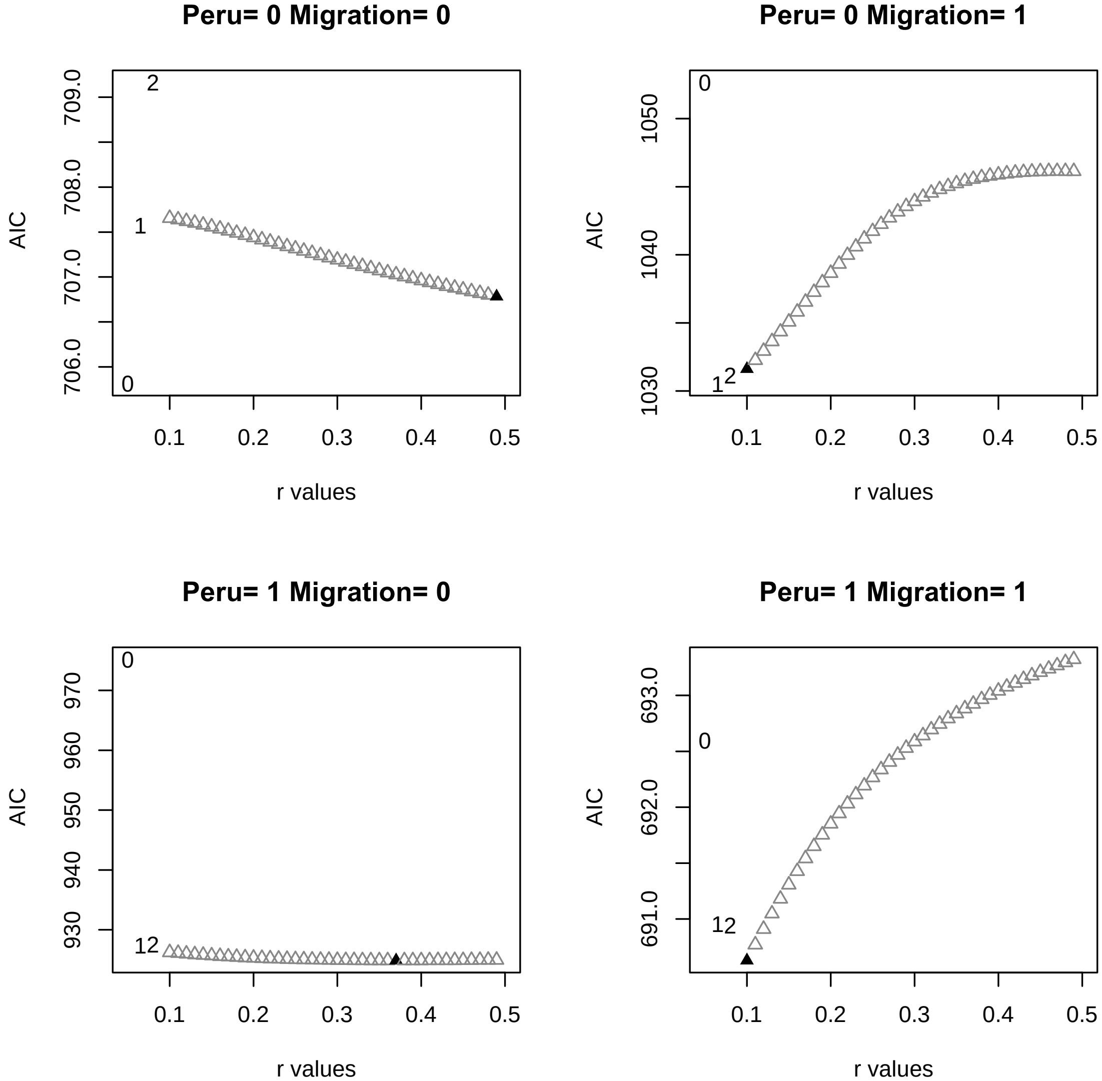
	Peru		**Fiji**	
	r	**½ way age**	**r**	**½ way age**
Beliefs	0.13	5.33	0.33	2.10
Morphology	0.17	4.08	0.1	6.93
Adoption	0.49	1.41	0.37	1.87
Migration	0.1	6.93	0.1	6.93
Non-racial	0.1	6.93	0.14	4.95
Racial	0.1	6.93	0.27	2.57

Figure S8. AIC scores for various models of age predicting ID responses. Triangles indicate AIC scores for models using Socialization Indices with varying r-values in the negative exponential function. The numeric markers denote AIC scores for a baseline model with different orders of age terms; without predictors (0), a model with a linear age term as a predictor (1) and a model with a linear and squared age terms (2). The position around r=0.05 for these is arbitrary and is just meant to allow easy comparison. The SI with the lowest AIC score is filled in black. Section a) shows the results for the development of beliefs about Morphological and Belief traits in the Adoption condition, b) for non-ID traits in the Migration versus Adoption condition, and c) for 1st generation Identity in the Racial versus Non-racial Group conditions.

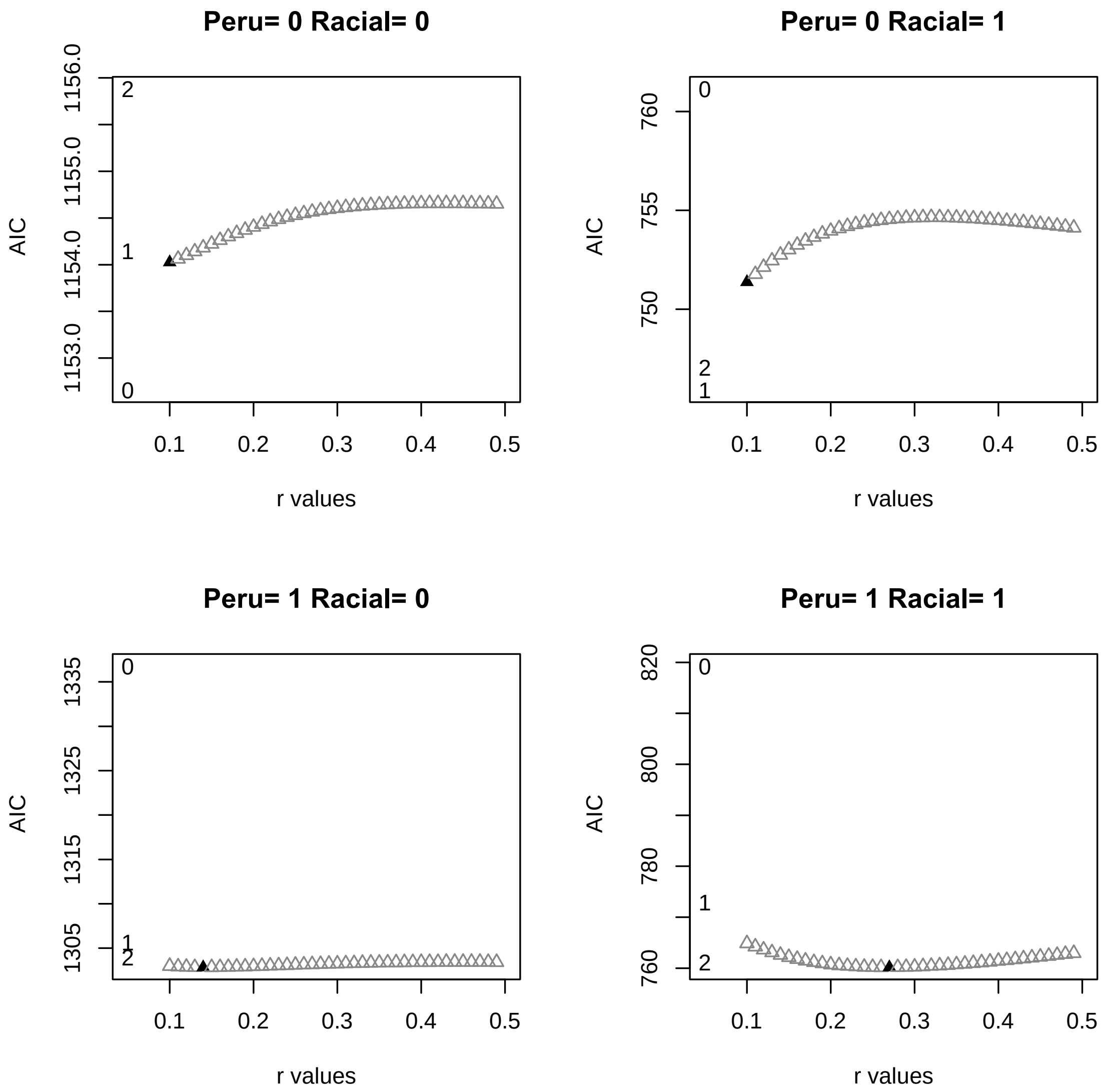
a)



b)


Peru= 0 Migration= 0
AIC
706.0
707.0
708.0
709.0
2
1
0
0.1
0.2
0.3
0.4
0.5
r values
Peru= 0 Migration= 1
AIC
1030
1040
1050
0
12
0.1
0.2
0.3
0.4
0.5
r values
Peru= 1 Migration= 0
AIC
930
940
950
960
970
0
12
0.1
0.2
0.3
0.4
0.5
r values
Peru= 1 Migration= 1
AIC
691.0
692.0
693.0
0
12
0.1
0.2
0.3
0.4
0.5
r values

c)


Peru= 0 Racial= 0
Peru= 0 Racial= 1
Peru= 1 Racial= 0
Peru= 1 Racial= 1
AIC
r values
0.1
0.2
0.3
0.4
0.5
1153.0
1154.0
1155.0
1156.0
750
755
760
1305
1315
1325
1335
760
780
800
820
0
1
2

S6. MODEL COMPARISONS

Our data analysis is based on the model-fitting approach (Wagenmakers & Farrell, 2004; Wagenmakers & Waldorp, 2006). We pit different logistic regression models against each other to see which ones explain best whether or not participants choose that "the child is like the birth parent" for each site. This tells us which predictors are more associated with prenatal transmission folk beliefs. Different models correspond to the different hypotheses, but discriminating between some hypotheses requires examining effects within a given model. We report the logit regression coefficients, their corresponding standard errors and significance values *as well as* corrected Akaike Information Criteria (AICc) scores and Akaike weights for each model (Anderson, 2008). AICc's are a function of the probability that the data would be observed given the model, and of the number of predictors in the model. The model with the lowest AICc score maximizes the probability of the data given the model while penalizing overfitting resulting from multiple predictors. Akaike weights may be easier to interpret. They vary between 0 and 1 and tell us the relative likelihood that a given model provides the best fit among the ones being tested.

Tables S9-S14 provide the full models compared to address each of our questions for each site using the Socialization Index we derived previously in section S5. Table S15 provides a robustness check by comparing the same models from Tables S9-S13 for the Puno and Yasawa samples, but using the extreme values of the Socialization Index (SI) that we tested above (r=0.1 and r=0.5). This analysis shows that the results from Puno are the same regardless of which of these three SI we use. Additionally, regardless of which SI we use, the choice of pre-natal transmission is best explained at each site by trait kind, SI and their interaction, in the Adoption condition. The remaining Yasawa results are less stable however. The majority of the discrepancies between models with r=0.1 and r=0.5 in Yasawa result from the worse fits of models with SI's in them when the development rate is assumed to be very fast or when it assumes that there is little difference between children and adult beliefs (r=0.5). Only with respect to 2nd generation identities in Yasawa does increasing r to 0.5 improve the fit of a model with SI, suggesting a fast development rate for these beliefs.

The overall pattern from this robustness check suggests that generally more moderate developmental rates fit the data better. Additionally, larger developmental changes that happen throughout various stages of childhood – such as the development of the differentiated pattern – are detectable regardless of the SI we use.

Table S9. Relative fit of models predicting "similar to birth parent". Adoption Condition

Random effects logistic regression models predicting probability of choosing "like the birth parent" in Adoption Condition. Predictors include Trait Type (dummy coded as 1 for morphological traits, and 0 for belief traits), Socialization Index (a negative exponential transform of real age), and the interaction of SI and Trait Type.

	Puno					Yasawa					US				
	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight
Model 1				708.07	<.001				748.49	<.001				2090.55	<.001
constant	0.89	0.13	<.005			1.10	0.12	<.005			-0.16	0.05	<.005		
Model 2				670.65	<.001				644.74	<.001				861.08	0.37
Trait type	1.26	0.21	<.005			2.12	0.23	<.005			4.96	0.20	<.005		
constant	0.40	0.16	0.01			-0.04	0.17	0.81			-3.03	0.17	<.005		
Model 3				710.09	<.001				747.96	<.001				2092.27	<.001
SI	-0.11	1.26	0.93			1.67	1.03	0.11			-3.24	6.01	0.59		
constant	0.99	1.11	0.38			-0.45	0.96	0.64			3.06	5.96	0.61		
Model 4				672.59	<.001				644.39	<.001				862.13	0.22
Trait type	1.26	0.21	<.005			2.12	0.23	<.005			4.97	0.21	<.005		
SI	-0.41	1.37	0.77			2.07	1.33	0.12			-10.71	11.04	0.33		
constant	0.76	1.21	0.53			-1.96	1.25	0.12			7.61	10.96	0.49		
Model 5				629.18	1.00				606.45	1.00				860.90	0.41
Trait type	-11.92	2.17	<.005			-9.63	1.98	<.005			28.15	1.85	-3.01		
SI	-6.45	1.92	<.005			-5.31	1.93	0.01			21.40	23.83	0.37		
SI X Trait type	15.27	2.53	<.005			12.90	2.18	<.005			-47.48	28.30	0.09		
constant	6.10	1.71	<.005			4.89	1.80	0.01			-24.29	23.69	0.31		

Table S10. Relative fit of models predicting "similar to birth parent". Migration Condition

Random effects logistic regression models predicting probability of choosing "like the birth parent" in Migration Condition. Predictors include Trait Type (dummy coded as 1 for morphological traits, and 0 for belief traits), Socialization Index (a negative exponential transform of real age), and the interaction of SI and Trait Type.

	Puno					Yasawa					US				
	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight
Model 1				341.08	0.02				947.15	<.001				868.55	<.001
constant	0.68	0.17	0.00			0.36	0.08	<.005			0.06	0.08	0.47		
Model 2				338.92	0.06				855.78	0.11				686.18	0.66
Trait type	0.56	0.27	0.04			1.81	0.21	<.005			2.40	0.20	0.00		
constant	0.44	0.21	0.03			-0.15	0.11	0.17			-1.12	0.14	0.00		
Model 3				341.63	0.02				944.23	<.001				870.55	<.001
SI	-1.64	1.34	0.22			1.90	0.86	0.03			1.22	10.35	0.91		
constant	2.10	1.17	0.07			-1.42	0.80	0.08			-1.15	10.28	0.91		
Model 4				339.27	0.05				852.84	0.49				688.18	0.24
Trait type	0.57	0.27	0.04			1.81	0.21	<.005			2.40	0.20	0.00		
SI	-1.78	1.36	0.19			2.25	1.01	0.03			1.72	13.02	0.90		
constant	1.96	1.18	0.10			-2.25	0.95	0.02			-2.83	12.93	0.83		
Model 5				333.51	0.86				853.21	0.40				690.05	0.10
Trait type	-5.01	2.04	0.01			-0.48	1.78	0.79			12.36	24.86	0.62		
SI	-4.73	1.83	0.01			1.52	1.13	0.18			6.55	17.86	0.71		
SI X Trait type	6.46	2.35	0.01			2.48	1.93	0.20			-10.03	25.03	0.69		
constant	4.51	1.60	0.01			-1.57	1.06	0.14			-7.62	17.74	0.67		

Table S11. Relative fit of models predicting "similar to birth parent" responses as a function of Vignette Condition.
Random effects logistic regression models predicting probability of choosing "like the birth parent" across all non-identity traits that are constant across Vignette conditions. Predictors include Vignette Condition (dummy coded as 1 for Migration Condition, and 0 for Adoption Condition), Socialization Index (a negative exponential transform of age), and their interaction.

	Puno					Yasawa					US				
	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight
Model 1				1618.06	0.08				1762.28	0.14				3848.28	<.001
constant	0.77	0.09	0.00			0.70	0.08	0.00			-0.31	0.04	0.00		
Model 2				1617.63	0.10				1764.16	0.05				3807.36	0.57
Migration condition	-0.29	0.18	0.12			-0.05	0.15	0.72			0.52	0.08	0.00		
constant	0.89	0.12	0.00			0.73	0.12	0.00			-0.55	0.05	0.00		
Model 3				1615.54	0.27				1759.75	0.48				3850.24	<.001
SI	-1.71	0.80	0.03			1.52	0.71	0.03			1.00	5.10	0.85		
constant	2.26	0.70	0.00			-0.71	0.66	0.28			-1.30	5.06	0.80		
Model 4				1614.72	0.41				1761.47	0.20				3809.36	0.21
Migration condition	-0.30	0.18	0.09			-0.08	0.15	0.59			0.52	0.08	0.00		
SI	-1.76	0.79	0.03			1.55	0.71	0.03			-0.36	4.60	0.94		
constant	2.43	0.70	0.00			-0.69	0.66	0.29			-0.20	4.57	0.97		
Model 5				1616.73	0.15				1762.39	0.13				3809.22	0.22
Migration condition	-0.41	1.38	0.77			-1.44	1.31	0.27			-13.01	9.24	0.16		
SI	-1.82	1.09	0.10			0.76	1.04	0.46			-6.05	5.99	0.31		
SI X Migration condition	0.12	1.57	0.94			1.48	1.42	0.30			13.64	9.30	0.14		
constant	2.48	0.97	0.01			0.03	0.95	0.98			5.44	5.94	0.36		

Table S12. Relative fit of models predicting "original group" identity responses as a function of Group Condition – 1st generation question.
Logistic regression models predicting probability of choosing "like the biological parent" for identity questions in the Adoption Condition. Random effects models were used for Peru to control for repeat responses per participant. Possible predictors include Group condition (dummy coded as 1 for racial/low mobility groups, and 0 for higher mobility groups), SI (a negative exponentia transform of age), and their interaction.

	Puno					Yasawa					US				
	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight
Model 1				227.07	<.001				115.53	0.01				239.76	0.73
constant	-0.20	0.16	0.21			0.10	0.22	0.66			-0.74	0.16	0.00		
Model 2				217.31	0.01				107.92	0.38					
Group condition	1.16	0.49	0.02			1.42	0.47	0.00							
constant	-0.90	0.37	0.02			-0.62	0.33	0.06							
Model 3				228.16	<.001				115.17	0.01				241.78	0.27
SI	-1.56	1.57	0.32			3.27	2.13	0.13			18.02	-0.12	0.91		
constant	1.20	1.42	0.40			-2.90	1.97	0.14			17.90	0.08	0.94		
Model 4				219.32	0.00				107.94	0.37					
Group condition	1.12	0.50	0.03			1.42	0.48	0.00							
SI	-0.52	1.67	0.76			3.23	2.25	0.15							
constant	-0.41	1.60	0.80			-3.57	2.10	0.09							
Model 5				208.32	0.99				108.86	0.24					
Group condition	-11.80	4.39	0.01			-3.17	4.04	0.43							
SI	-10.63	4.13	0.01			0.64	3.07	0.84							
SI X Group condition	14.49	5.08	0.00			5.02	4.41	0.25							
constant	8.71	3.65	0.02			-1.20	2.81	0.67							

Table S13. Relative fit of models predicting "original group" identity responses as a function of Group Condition – 2nd generation question.

Logistic regression models predicting probability of choosing "like the biological parent" for identity questions in the Adoption Condition. Random effects models were used for Peru to control for repeat responses per participant. Possible predictors include Group condition (dummy coded as 1 for racial/low mobility groups, and 0 for higher mobility groups), SI (a negative exponential transform of age), and their interaction.

	Puno					Yasawa					US				
	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight
Model 1				128.33	<.001				115.68	0.03				188.93	0.67
constant	-3.26	1.12	<.005			-0.05	0.22	0.83			-1.41	0.18	<.005		
Model 2				130.38	<.001				109.35	0.60					
Group condition	-0.10	0.73	0.89			1.32	0.47	0.01							
constant	-3.22	1.23	0.01			-0.73	0.34	0.03							
Model 3				97.86	0.02				117.55	0.01				190.35	0.33
SI	-15	5.7	0.01			-0.99	2.05	0.63			23.75	23.75	0.45		
constant	11	4.3	0.01			0.86	1.89	0.65			23.60	23.60	0.41		
Model 4				94.74	0.10				111.01	0.26					
Group condition	-1.4	0.6	0.03			1.35	0.47	<.005							
SI	-17	3.6	<.005			-1.53	2.19	0.49							
constant	13.7	3.2	0.00			0.65	2.00	0.75							
Model 5				90.33	0.88				112.91	0.10					
Group condition	-24	12	0.04			-0.84	3.94	0.83							
SI	-38	13	<.005			-2.69	3.02	0.37							
SI X Group condition	26.3	14	0.06			2.40	4.30	0.58							
constant	31.8	11	0.01			1.70	2.74	0.54							

Table S14. Relative fit of models predicting "original group" identity responses as a function of Group Condition using limited sample* from Puno. – Identity questions.

Random effects logistic regression models predicting probability of choosing "like the biological parent" for identity questions in the Adoption Condition. Possible predictors include Group condition (dummy coded as 1 for racial/low mobility groups, and 0 for higher mobility groups), Age (transformed as a negative exponential of real age -i.e. SI), and their interaction.

**A note on the limited sample: In Puno, at the end of the task, we asked participants to make identity judgments for the alternate conditions to which they were not randomly assigned. So for example, if someone was randomly assigned to the Language Group & Migration Condition, we went through the standard protocol and then told them the Regional Migration, Language Adoption, and Regional Adoption vignettes, asking them to make identity judgments for each. The following analysis is done on the limited sample of responses, that is from the identity judgements in the conditions to which the participant was originally randomly assigned.*

	1st generation					2nd generation				
	logit	SE	p	AICc	AICc weight	logit	SE	p	AICc	AICc weight
Model 1				70.11	0.403				58.78	<.001
constant	-0.32	0.29	0.26			-1.02	0.32	0.002		
Model 2				72.28	0.136				57.37	<.001
Group condition	0.03	0.57	0.96			-1.26	0.69	0.07		
constant	-0.34	0.41	0.42			-0.44	0.43	0.30		
Model 3				71.05	0.252				42.03	0.008
Age	-3.03	2.77	0.27			-17.79	5.62	0.002		
constant	2.33	2.43	0.34			14.01	4.68	0.003		
Model 4				73.30	0.082				33.03	0.712
Group condition	-0.07	0.59	0.91			-3.68	1.41	0.01		
Age	-3.08	2.81	0.27			-30.08	10.36	0.004		
constant	2.41	2.53	0.34			25.93	9.00	0.004		
Model 5				72.43	0.126				34.90	0.28
Group condition	-9.56	5.66	0.09			-16.11	18.36	0.38		
Age	-9.70	5.22	0.06			-38.16	18.13	0.04		
Age X Group condition	10.83	6.40	0.09			15.11	21.91	0.49		
constant	8.28	4.66	0.08			32.92	15.65	0.04		

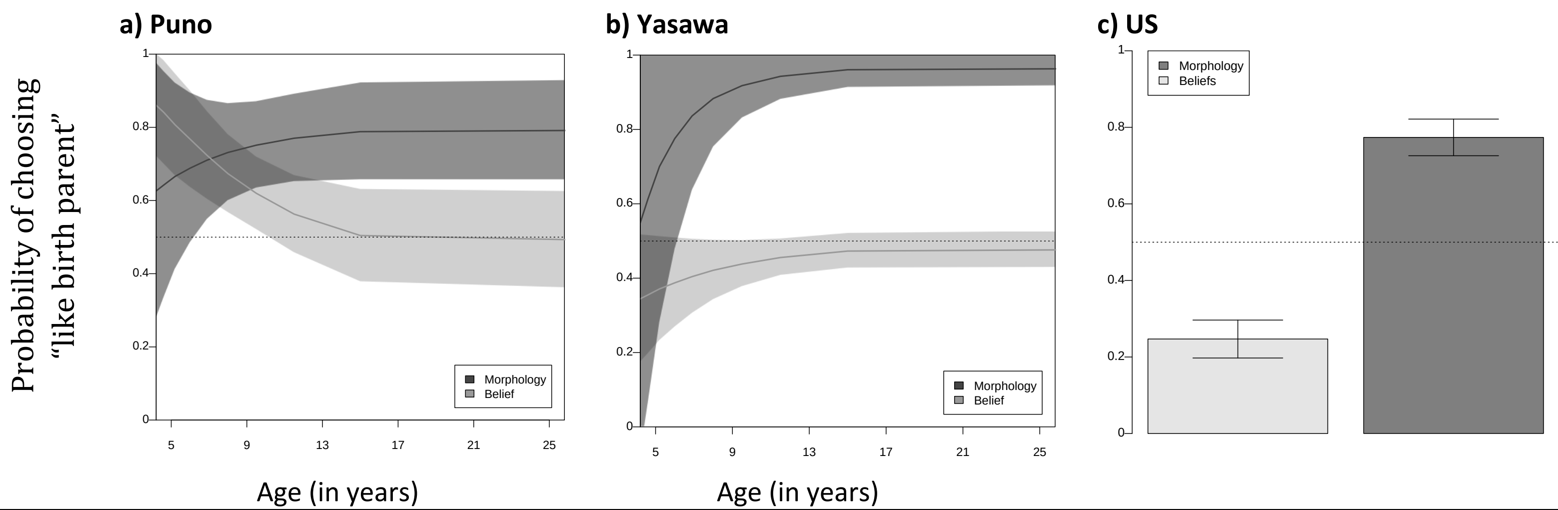
Table S15. Model comparison with alternate Socialization Indices. AIC weights are shown, the largest in bold. SI's with r=0.1 and r=0.5 are compared. Best fit models from the main results where r=0.2 are noted in left most column (P for Puno, and Y for Yasawa)

		Puno		Yasawa	
Model	**Variables**	**r=0.1**	**r=0.5**	**r=0.1**	**r=0.5**
Differentiation - Adoption (Table S7)					
1	none	<.001	<.001	<.001	<.001
2	Trait	<.001	<.001	<.001	<.001
3	SI	<.001	<.001	<.001	<.001
4	Trait + SI	<.001	<.001	<.001	<.001
5 (P,Y)	Trait X SI	**1**	**1**	**1**	**1**
Differentiation - Migration (Table S8)					
1	none	0.008	0.084	<.001	<.001
2	Trait	0.024	0.251	0.01	**0.559**
3	SI	0.01	0.041	<.001	<.001
4 (Y)	Trait + SI	0.034	0.128	0.127	0.316
5 (P)	Trait X SI	**0.924**	**0.497**	**0.863**	0.124
Vignette Condition (Table S9)					
1	none	0.083	0.118	0.037	**0.484**
2	Mig. Cond.	0.103	0.147	0.015	0.19
3 (Y)	SI	0.282	0.219	**0.412**	0.194
4 (P)	Mig. + SI	**0.379**	**0.361**	0.175	0.076
5	Mig. X SI	0.152	0.156	0.361	0.056
Group Condition - Generation 1 ID (Table S10)					
1	none	<.001	<.001	0.003	0.009
2 (Y)	Group Cond.	0.006	0.082	0.124	**0.407**
3	SI	<.001	<.001	0.014	0.005
4 (Y)	Grp. + SI	0.002	0.036	**0.557**	0.221
5 (P)	Grp. X SI	**0.991**	**0.881**	0.303	0.358
Group Condition - Generation 2 ID (Table S11)					
1	none	<.001	<.001	0.024	0.015
2 (Y)	Group Cond.	<.001	<.001	**0.608**	0.386
3	SI	0.036	0.004	0.009	0.013
4	Grp. + SI	0.203	0.006	0.224	**0.427**
5 (P)	Grp. X SI	**0.761**	**0.99**	0.134	0.157

S7. REASONING ABOUT MORPHOLOGICAL AND BELIEF TRAITS IN THE MIGRATION CONDITION.

The differentiated pattern persists in the Migration vignette. It is muted in the Migration vignette relative to the Adoption condition in Puno and the US, but exaggerated in Yasawa (Figure S9).

Figure S9. Predicted probability of choosing prenatal transmission by Trait Types – Migration condition.
For (a) Puno, (b) Yasawa, and (c) US from random effects logistic regression models. For the US sample, predicted probabilities are calculated at the mean age of the participants as all were over 18 years old.
Shaded regions represent the 95% confidence intervals for the model predictions. Models were fit using the full range of the Socialization Index as a predictor, but age is plotted for ease of interpretation. A restricted adult age range is plotted below to improve resolution.



S8. RAW PROPORTIONS OF ADULT RESPONSES BY SITE AND QUESTION

Figure S10. Proportion of adults choosing "similar to birth parent" for each trait, by site. – Adoption Condition. Note: not all traits were used at each site.

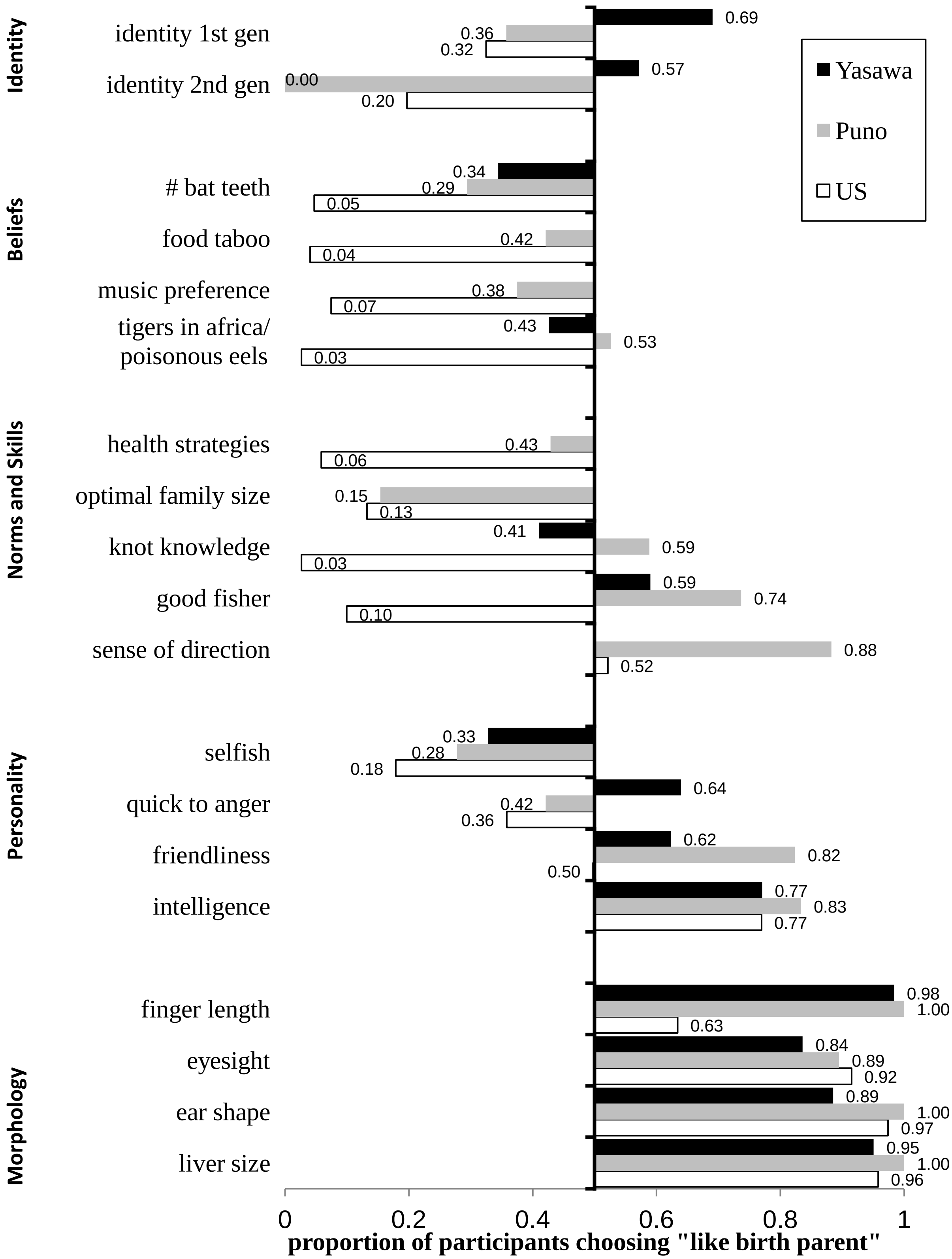
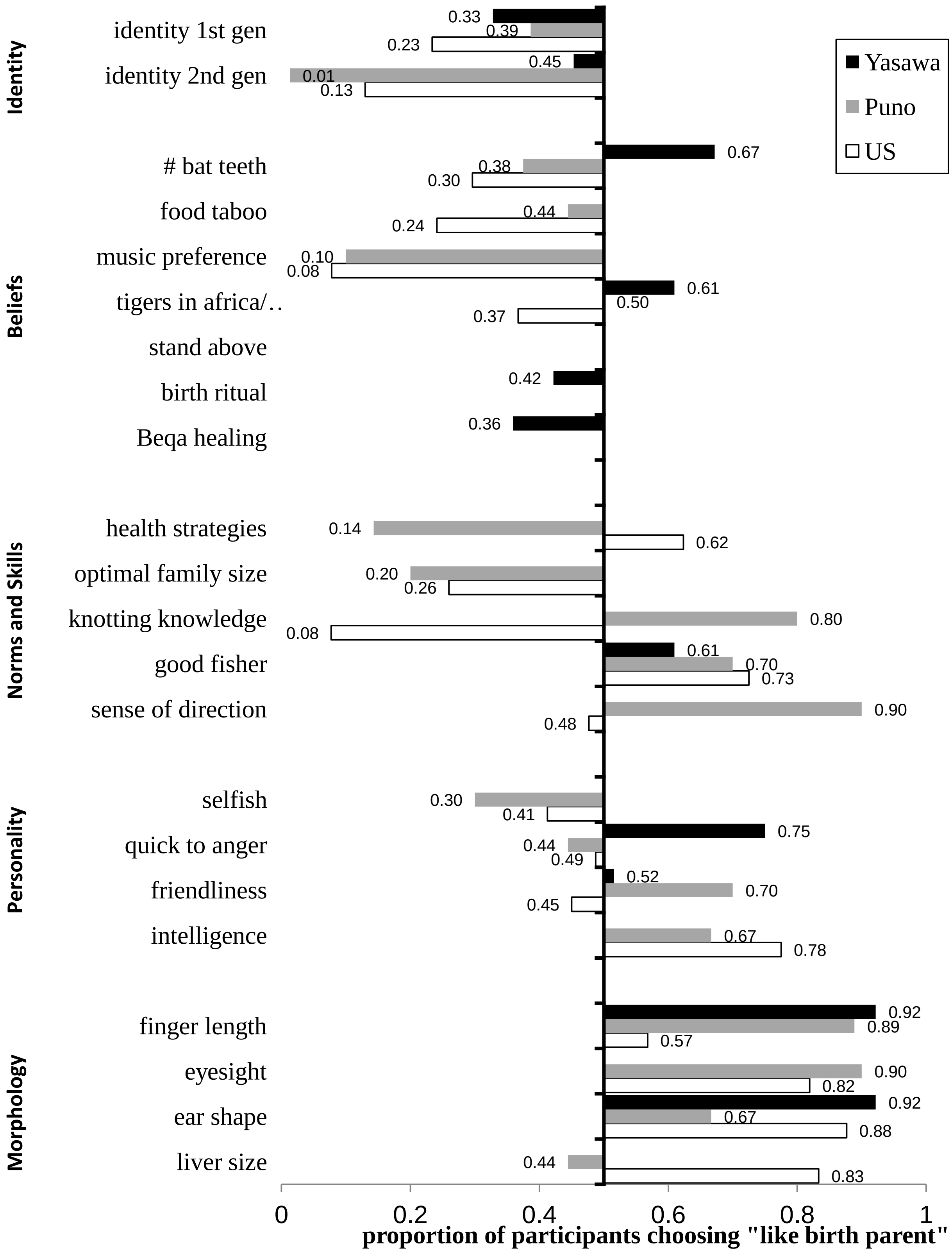


Figure S11. Proportion of adults choosing "similar to birth parent" for each trait, by site. – Migration Condition. Note: not all traits were used at each site.



S9. MIGRATION CONDITION INTERACTIONS WITH TRAIT TYPE

It is possible that participants believe some kinds of traits are more likely to be horizontally transmitted than others. For example, people might reason that morphological traits will be under pre-natal influence whether or not a biological parent raises a child, but that beliefs are more likely to be socially learned from peers. In other words, we might expect that the Vignette condition (Migration versus Adoption) will not affect pre-natal ascription rates regarding morphological traits. Furthermore, the Migration condition might reduce "like birth parent" ascriptions regarding beliefs if people believe horizontal transmission is important, or increase "like birth parent" ascriptions of beliefs if people believe vertical transmission is important.

In order to test this, we ran models with two-way interactions between Vignette condition and Trait type (belief versus morphological) by age category (<13 and ≥18) rather than SI for ease of interpretation. Contrary to our expectations of stability, both in the Puno and US samples participants decreased their "like birth parent ascriptions" of morphological traits in the Migration condition (Figure S12). In other words, priming peer influences in the new social setting made fewer people reason that a child would resemble his birth parents with respect to morphological traits. With respect to pure belief traits both Yasawa and US adults show an expectation of vertical transmission, while children in Yasawa act as if they expect horizontal transmission to swamp the effects of having a birth parent still alive in the Migration condition. The Puno samples show no marked differences in reasoning about pure beliefs between the two Vignette conditions. Table S16 shows the size of the interaction effects by site and age category. All of the interaction effects among adults are significantly negative, meaning that the Migration condition was *less* likely to promote birth parent (vertical transmission) ascriptions of morphological than of belief traits.

Figure S12. Effect of Vignette Condition by Trait type interactions. Figures show predicted probabilities of choosing "like birth parent" ascriptions from random effects models using Trait type, Vignette condition and their interaction as predictors. Models were run separately for children (<13) and adults (≥18). 95% CI shown.

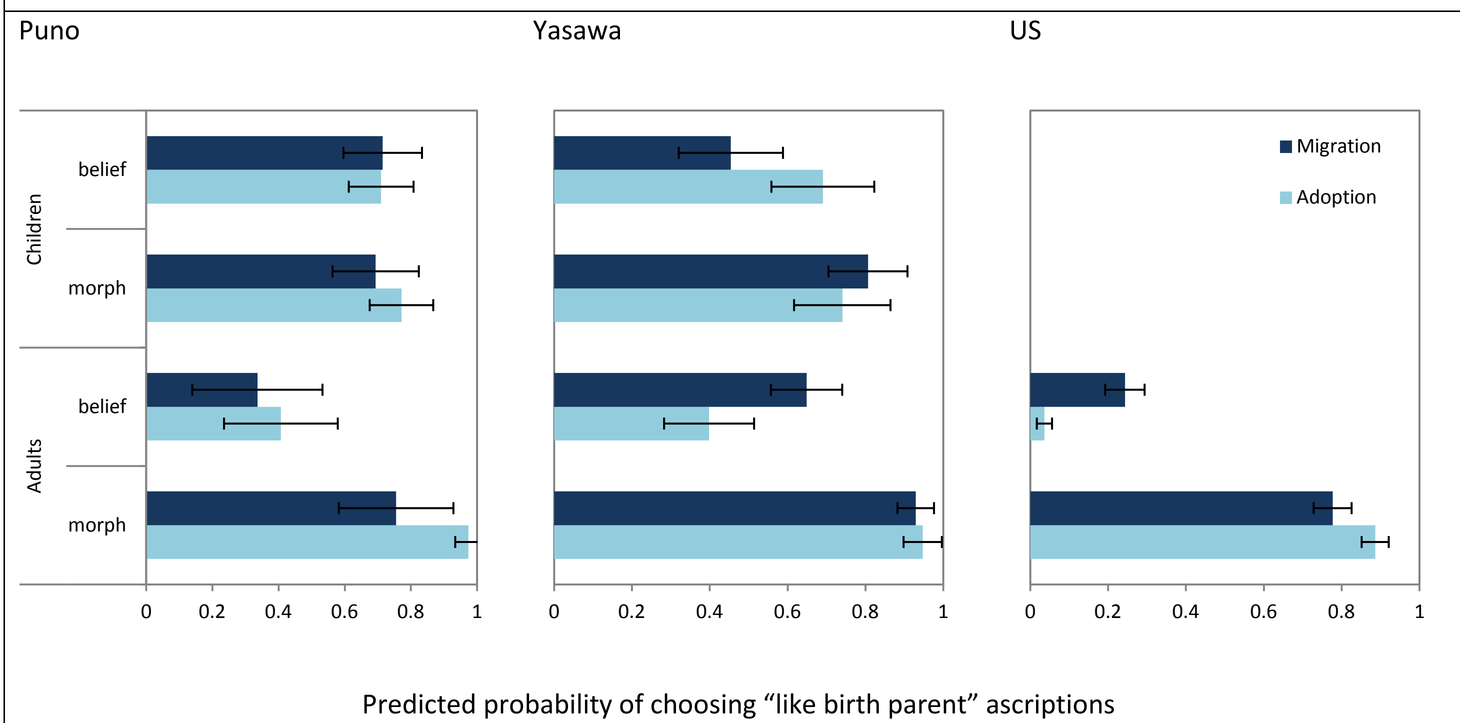


Table S16. Interaction effects between Vignette condition and Trait type by site and age category. From random effects logistic regression models with Migration condition and morphological trait dummy coded as 1.				
site	age	Logit coef.	SE	p
Puno	≥18	-2.19	.98	0.03
	<13	-.42	.47	0.37
Yasawa	≥18	-1.34	.66	0.04
	<13	1.37	.57	0.02
US	≥18	-2.94	.37	<0.001

S10. 2ND GENERATION IDENTITY QUESTION

There are two identity questions and we consider the 2nd generation one here – namely, once the target child grows up, marries a woman from the adoptive group and they have a child, what will their child's identity be? The grandchild in this story is less likely to have the "original group" identity than the child (1st generation) is for at least three possible reasons: 1) He is temporally removed from "original group" ancestors, 2) he has one parent – the mother – who is a member of the "new group", and 3) he is implied to have been born in the "new group", whereas the 1st generation target was born in the "original group". Choosing original group identity means choosing the identity of the biological paternal grandparents in the 2nd generation question.

Responses to the second generation question generally replicate the results from the first generation question. The best-fit models are the same as the ones for the first generation question (Table S10). However, there are some notable differences in the shapes of the logistic regression models (Figure S13). Puneño adults' prenatal transmission response rates in both Group conditions fall to equivalently low levels for the 2nd generation question. Again, we believe this is because the 2nd generation target child is no longer born in the "original group" (i.e. the paternal biological grandparent's homeland) so that the new birthplace and residence now constitute his regional identity.

Young children continue to choose the "original" identity more often for the Linguistic Group condition, despite a counterintuitive increase overall in "original" group choices in the 2nd generation. It is not until age 8 that children's prenatal transmission responses drop to chance levels, suggesting a greater reticence to adopt the adult concept of identity as socially transmitted for language groups than for regional groups.

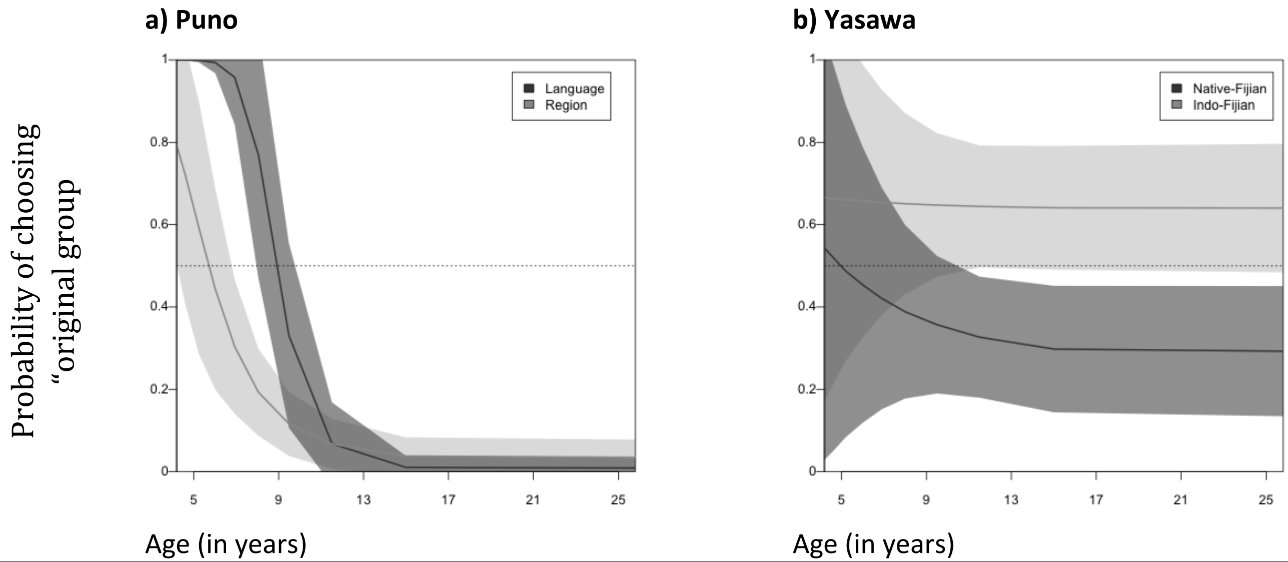
In Yasawa, the patterns replicate the first generation results. Adults show only slightly reduced levels of prenatal transmission choices for both groups relative to the first generation and maintain higher rates of "prenatal transmission" choices in the Racial Group condition relative to the Native Fijian Regional Group condition. Again, children demonstrate no strong priors with respect to either group.

This data suggests that people rely on structured learning mechanisms that allow the development of cross-culturally diverse folk beliefs about identity inheritance. However, Puneño children's commitment to "prenatal transmission" responses for linguistic categories, even when they are at odds with adults' folk beliefs, suggests that a folksociological heuristic of ethnolinguistic groups as inter-generationally stable may have evolved from folkbiological heuristics and may still be evident early in development (Gil-White, 2001).

Figure S13. Probability of choosing "original group" identity in Adoption Condition By Age and Site – 2st generation.

For (a) Puno and (b) Yasawa random effects logistic regression models predicting the probability of choosing "like the birth parent" as a function of 'age' and 'Group Condition' are shown.

The 95% confidence intervals for the models are estimated using the Delta-method of standard error estimation. Participants ranged from children four years old to adults in their 70's. Models were fit using the Socialization Index rather than Age as a predictor, but Age is plotted for ease of interpretation. Models were fit to the entire dataset using the full age range at each site, however a restricted age range in years is plotted below to improve resolution. The 95% confidence intervals for non-racial/high mobility groups are shown in dark grey, and racial/low mobility group conditions are in light grey.



S11. EVIDENCE THAT ADULTS IN PUNO ARE NOT BIOLOGIZING REGIONAL IDENTITY.

While adults in Puno show a "birth bias" for the Regional Group condition, we suspect this is because they think birthplace – *not* prenatal inheritance – is relevant to regional identities and because the child in the vignette is described as being born in his biological parent's village. Adults do not show a "birth bias" for language identity because they think that neither birthplace, nor prenatal transmission, affects this group membership.

In a separate experiment we confirmed this explanation by running two versions of the Migration vignette with adults in Puno, manipulating only where the child was born – either the parents migrated shortly before, or shortly after the child was born. The birthplace of the child had a huge effect on "like birth parent" choices for regional identity (OR = 13.8, SE=9.1, p <0.0001). When the child was born in the parents' homeland region, participants ascribed him his birth parents' regional identity 61% of the time. However, when the child was born in the new group participants said he shared his birth parents' regional identity only 10% of the time. Birthplace did not affect linguistic group identity in this follow-up study.

S12. EMPIRICAL LIMITATIONS OF THE CURRENT STUDY

Our data have limitations common to cross-cultural and evolutionary projects. First, it is possible that the traits chosen for the questions connoted different concepts in different settings (e.g., being a good fisherman could imply rod and line fishing to the US participants and thus require less physical prowess compared to that required for net fishing in Puno, and spear fishing in Yasawa). However, we doubt this can explain the overall patterns given that we asked about various traits precisely to avoid such concerns. Second, we chose locally appropriate, and therefore diverse, Group conditions. This diminishes our ability to differentiate cross-cultural variation in beliefs from universal human beliefs about specific kinds of groups.

Finally, developmental data are not always informative about the evolved nature of conceptual primitives. When children's responses differ from adults' it suggests that they have yet to be fully socialized and that the differences reflect innate biases. But a failure to show a difference between children and adults' reasoning does not mean that children did not have cognitive biases either in line with, or earlier in development at odds with, adults' folk beliefs. We did not test participants younger than 4 or 5 years of age, and given the method probably could not do so. Furthermore, a late, but reliably developing pattern does not imply that the conceptual structures are not innate (e.g., consider adaptations that should only develop after sexual maturity).

S13. BIBLIOGRAPHY

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