

Zafimaniry: An Understanding of What Is Passed on from Parents to Children: A Cross-Cultural Investigation

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ABSTRACT

Children (aged 7 to 16 years) and adults from a remote Zafimaniry village in eastern Madagascar were probed for their intuitive understanding of the biological inheritance of bodily features. They were told a story about a baby adopted at birth, and were asked whether, when grown, he would be more likely to resemble his birth parents or his adoptive parents in bodily traits, beliefs, preferences, temperaments, and skills. In spite of the fact that the Zafimaniry, like other Southeast Asian and Malagasy peoples, profess explicit beliefs concerning the fixation of individuals' properties that are at variance with Western folkbiology, Zafimaniry adults responded as do American adults on the task. Zafimaniry children, however, did not respond as did the adults, nor did they respond as did the majority of American children. Rather, they responded in the manner most consistent with what would be predicted, for children as well as for adults, from the ethnographic literature. That is, they tended to judge that an adopted boy would resemble his adoptive rather than his birth parents on virtually all traits, including bodily traits. The implications of these findings for current debates within cognitive science and anthropology are discussed.

Research from many quarters supports the existence of *core knowledge* (Carey & Spelke 1996). Core knowledge has the following hypothesized properties: 1) its acquisition is supported by innate, domain specific, learning mechanisms; 2) it develops early, under conditions of wide variation in input; and 3) it remains constant throughout development.

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These three hypothesized properties have the consequence that core knowledge should be cross-culturally universal.

Evidence from human infants (and even non-human primates, see Hauser & Carey 1998) suggests that there are at least three domains of core knowledge: intuitive psychology, with intentional agent at its center (Gergely, Nadasdy, Gergely & Biro 1995; Gopnik & Meltzoff 1997; Johnson, Slaughter & Carey 1998); intuitive mechanics, with physical object at its center (Leslie 1994; Spelke, Phillips & Woodward 1995), and intuitive mathematics, with natural number at its center (Dehaene 1997; Wynn 1992). Those who are committed to the existence of core knowledge consider it still open whether intuitive biology, with animal or living thing at its center, is also a core domain of knowledge (for yes see Atran 1998; Keil 1992; and Wellman & Gelman 1992; for no see Carey 1985, 1995).

Some argue for core knowledge of intuitive biology on the basis of evidence for an early developing (by age 3 or 4 years), cross-culturally universal, essentialist construal of human and animal kinds, grounded in a folkbiological understanding of innate potential (Atran 1998; Gelman & Hirschfeld 1999; Gelman & Wellman 1991; Horobin 1997; Keil 1992; Rosengren, Gelman, Kalish & McCormick 1991; Springer 1999; Taylor 1996). According to these authors, some human and animal kinds (e.g., species, race, ethnicity, occupation) and some properties (e.g., language spoken, skin color, properties of internal organs) are considered to be fixed at birth and inherited from birth parents. (Any essential property, constant throughout the life cycle, will be fixed at birth. At issue here is biological inheritance.) Hirschfeld (1995, 1996) suggests that this system of thought contributes to cross-culturally universal construals of race.

An essentialist construal of human and animal kinds is logically independent of its grounding in a folkbiological understanding that essences are inherited from birth parents. Indeed, a great deal of convergent evidence suggests that it is not until the age of 6 or 7 years that a majority of American children have an intuitive understanding of the biological inheritance of properties or of kind. It is not until this age that most children reliably judge that offspring will resemble their birth parents in bodily characteristics and their adoptive parents in beliefs (Johnson & Solomon 1997; Morris 1998; Solomon, Johnson, Zaitchik & Carey 1996;

Springer 1996; Weissman & Kalish 1999). It is not until this age that most children judge that an animal which looks like a raccoon but has skunk parents and skunk babies is a skunk, not a raccoon (Keil 1989). And it is not until that age that most children reliably judge that offspring will have an unusual property (e.g., a pink rather than a red heart) if their parents were born with it, but not if their parents obtained it by accident (Solomon & Johnson 2000; Springer & Keil 1989). Indeed, Carey (1985, 1995) argues that the developing child's construction of a biological construal of inherited essences requires conceptual change, and thus is not part of core knowledge (see also Johnson & Carey 1998).

Here we focus on the putative cross-cultural universality of a folkbiological essentialism with respect to individual people's properties. Atran (1998) reviewed evidence for cross-cultural universality of certain aspects of species taxonomies and argued that the Itzaj Maya also have an essentialist construal of species kind. But Atran provided no direct evidence that the Itzaj Maya themselves have such an essentialist construal, let alone that they have a folkbiological understanding of the inheritance of physical properties or species kind (but see Atran, this volume, for evidence of an understanding that species kind is determined by birth). Jeyifous (1992) presented unschooled Yoruba children with the Keil (1989) transformation scenarios in which they are asked whether an animal from one species can be changed into an animal from another. She found that Yoruba children treat the task much as do American children, attaining adult intuitions around 7 or 8 years of age. However, younger Yoruba children, like younger American children, base their judgments of species kind on relatively superficial bodily and behavioral characteristics rather than on aspects of the individual animal's history, including its birth lineage.

Furthermore, there is a large anthropological literature on kinship systems that puts the hypothesis of cross-cultural universality of folkbiological essentialism, based on innate potential, in doubt. In questioning whether all kinship systems are predicated on biological relationships, many anthropologists have come to believe that not all cultures consider birth to be privileged in the mechanisms by which people acquire the properties they do, and that not all cultures construe human kinds essentially.

Anthropological Background

Kinship studies have traditionally been thought of as at the core of anthropology. The most common reason given to explain that fact is that kinship systems articulate social structure in traditional societies and remain an important element of all forms of social organization. Kinship is thus often seen as the “natural” anchor on which diverse social systems are grafted. Such an argument requires that what is meant by kinship be, at its core at least, the same everywhere. However, such a theory is now very much in question. An important arena of recent anthropological debate concerns precisely the question of just how deep are cultural differences in kinship systems. These debates focus on a challenge to the many suggestions by the classical authors of anthropology that the constitutive elements of the elementary family, or at the very least the mother-child relationship, are seen to be the same by all human beings and are therefore, in their fundamental aspects, not culturally negotiable.

The debate over variation in kinship systems was taken as central to the discipline of anthropology because it was assumed that the nature/nurture controversy was at its core. Thus, the question was always how much the natural world or how much culture constrained people’s understandings. The possibility that there might be cognitive constraints on how nature was perceived was simply not considered. On the whole, earlier anthropologists implicitly took for granted that parent/child relationships were the building blocks of all kinship systems, and that, apart from discussions over the extent to which the relationship between fathers and children was understood (which was only thought to be a problem for a very few, very primitive societies), they assumed that the parental link was always understood in the same way. Of course, anthropologists were fascinated by differences in the patterns of kinship. For example, they discussed ad nauseam the fact that in some cultures members of descent groups are recruited patrilineally, whereas in others they are recruited matrilineally. But these differences were attributed to a cultural choice between links to fathers and links to mothers and not to a different conceptualization of what it was to be a parent or a child. This, it was taken for granted, was always the same. This implicit assumption united very different anthropological traditions, the British social anthropology of Radcliffe-Brown (1924), the American cultural anthropology of Murdock (1949), and

the French structuralism of Lévi-Strauss (1949). These traditions probably also made converging assumptions about what was thought to be the cause of such universality, though this was rarely discussed directly. It seems that the various authors simply assumed the link of parent to child was a fact about human biology and that, therefore, this was how all peoples had always seen it to be.

It was only in the 1960's that this faith in a cross-culturally universal understanding of the basic biological relation between parent and child was first contested. The most familiar criticisms are the challenges of Needham (1971) and Schneider (1986). Although different in tenor, they share two elements. Firstly, they pointed out that the biological facts do not "speak for themselves" but can quite reasonably be understood in a variety of ways, and secondly, they argued that different cultures do indeed understand them differently. They suggested that there is no such thing as kinship cross-culturally since the various systems which have been baptised by this name, although ostensibly involving ideas about procreation, actually evoke fundamentally incompatible representations. The grand comparative enterprises of kinship systems which so much concerned their predecessors were merely examples of people adding apples and pears. Needham and Schneider characterized the implicit argument of the earlier anthropologists as being based on a fallacy concerning folkbiology. For kinship to be comparable across different cultures it must be based on the same folk understanding of the relation of parent to children. But, because there exists a wide, perhaps infinite, range of different spins that are placed on nature by different cultures, folkbiologies of the relation between parents and children are fundamentally different and incommensurable. The earlier writers had not seen this because they had simply assumed that the folkbiology of the exotic peoples they had studied would be consistent with the folkscientific understanding of biology of the West.

Needham (1971) and Schneider (1986) argued that the anthropological record illustrated very different representations of kinship. The kind of cultural variation that they suggested might exist was that resemblances between parents and children might be believed to be due to such things as that they might have eaten similar food, lived in similar environments, been under the influence of the same supernatural beings, and so on. They suggested that the different cultural explanations involved different

mixtures of these elements. In some cultures, one of these elements might also happen to correspond to a (western) biological notion of the relation of parents to children, but the argument was that each culture has its own recipe for combining these elements and it would simply be a misrepresentation to forget this.

One of the most radical examples of a different cultural explanation of the relation of parents to children is that found in the ethnography of Southeast Asia and Madagascar. The point made by a number of authors — Fox (1987) for the Indonesian world, and Astuti (1995a, b), Bloch (1993), Lambek (1994), Middleton (1995), Ravolomanga (1991), and Southall (1988) for Madagascar — has been that, while in European and African systems, birth and parenthood seem to be the determinant factor in creating fundamental kinship identities, in South East Asia and Madagascar, birth is more like, as these people say, “the launching of a ship”. Where that ship will go will be determined later by other factors such as choice, association and environment. Kinship affiliation will be settled only late in life, and settled definitely perhaps only some considerable time after death.

Accompanying such a view of kinship in these places is the idea that the person, even in bodily characteristics, is continually being made and remade by the kind of things which the individual will learn and practice and through intercourse with the persons with which the individual associates through life. This malleability has struck most modern anthropologists of Madagascar and they have often noted the fact that Malagasy will often tell you such things as that their bone structure is such “because they are fishermen”, or that they used to belong to a particular ethnic group, but that, since they have given up the typical activities of that group, they have lost that affiliation, or that their children have whiter skin because they spent a lot of time associating with a French missionary. This malleability due to environment is particularly evident in the case of children who are spoken of as soft and not yet “finished”.

On Some Relations between the Psychological and the Anthropological Debates

The debate in psychology over what are innately supported aspects of a framework theory of biology, especially over whether an understanding of

biological inheritance is such an aspect, has direct relevance to the current debate in anthropology over the universality of the basic building blocks of systems of kinship. In turn, the anthropological claim of fundamental cultural variation over such matters is obviously a challenge to some of the claims of the psychological literature. However, it is striking how little the practitioners of the two subjects have attempted to put their theoretical proposals together. Many anthropologists who believe that they have demonstrated that culture can construct the world in different ways seem to forget that there might be regularities in representations caused by constraints originating in the nature of the human brain, and they also seem not to consider how their traditional methods of research might mislead them. Many psychologists, on the other hand, seem content to make universalist claims on the basis of studies carried out in only one culture, or in different but closely related cultures, and they seem not to consider some of the methodological difficulties of fieldwork. Clearly there is a need for psychological questions about how it is that a naive understanding of biological inheritance is acquired to be addressed through cross-cultural research with peoples whose explicitly articulated beliefs on the subject would appear to be very different from those of the West. It is also necessary for anthropologists to check their claims of cultural relativity by using methods which will satisfy skeptics in other disciplines.

The methods of anthropology and the methods of the experimental study of cognitive development are strikingly different. Anthropologists interested in folk-understandings of biological inheritance might observe relevant behaviors and seek explicit explanations for them, and might conduct open-ended ethnographic interviews with native informants (e.g., do pregnant women seek certain experiences and avoid others, and do they explain this behavior in terms of their effects on the child to come?). In contrast, a developmental psychologist studying young children might look at patterns of forced-choice judgments designed to tap implicit knowledge. For example, a variety of researchers have presented young children with adoption stories and asked whether infants born to one couple would, when grown, come to resemble their birth parents or their adoptive parents on a variety of properties (e.g., Hirschfeld 1996; Solomon et al. 1996; Springer 1996; Weissman & Kalish 1999). At least by age 6 or 7 years, and perhaps earlier, most American children provide differentiated responses,

judging that an adopted child will resemble its birth parents on bodily traits such as hair color or properties of internal organs, and will resemble its adoptive parents on beliefs, preferences, temperaments, and skills. Thus, at least implicitly, young American children recognize that distinct causal processes are involved in the fixing of bodily traits, on the one hand, and psychological traits, on the other.

It is possible that the different conclusions which anthropologists and cognitive psychologists seem to be proposing might simply be due to their different methods. If that were so, it would mean that the conflict in findings is illusory, but also, and perhaps more interestingly, that the two disciplines tap different but co-existent types of knowledge, both of which must be taken into account when we want to characterize what people know.

The present study is the first cross-cultural exploration using the developmental methods developed to tap intuitive beliefs about how individuals come to have the particular properties they do (see also Astuti 2000, and Mahalingam 1998). We study children and adults who belong to the cultural area which is often characterized as Southeast Asian: the Zafimaniry of Madagascar. Ethnographic work shows that the Zafimaniry believe that children come to resemble their parents, in great part, because of the house they grew up in, the environment in which they live, and the people with whom they have interacted (Bloch 1993). The existence of a theory of the acquisition of features that is so different from that of the West offers a test case for the questions which both anthropologists and psychologists seem often to have avoided.

The explicit, articulated, beliefs of the Zafimaniry concerning how individuals come to have the properties they do are at variance with the putatively cross-culturally universal folkbiological theory of inheritance, which is acquired by American children at least by ages 6 or 7. To explore whether Zafimaniry children and adults share the intuitive understanding tapped by the methods used by developmental psychologists, the procedures of Solomon et al. (1996) were adapted for use in Madagascar. If an essentialist construal of individual people is part of core knowledge, and either includes or leads to the early construction of a folkbiological understanding of inheritance of properties from birth parents, then we would expect the judgments of the Zafimaniry participants to

reveal the same differentiated patterns as those observed among American participants. If, in contrast, an understanding of biological inheritance is a cultural construction, as the anthropological literature suggests, then, because the explicit Zafimaniry belief system is so different from that in the West, we would also expect the patterns of judgments of both children and adult Zafimaniry to differ from those obtained in the West.

Method

Participants. The study was carried out in a remote mountain village in the Zafimaniry area of Madagascar where the basis of livelihood is shifting cultivation and occasional wage work. The population is close culturally to the Betsileo and Merina people of the central plateau. The research was conducted entirely in the local Malagasy dialect by Maurice Bloch, who has been working in the region for more than twenty years and is well-known to the villagers. The 7 adults who participated in the study were all over 16 years of age, the 11 older children were between 11- and 15-years-old, the 14 younger children were between 7- and 10-years-old. Children under 6-years of age were not tested because the researcher found them to be very shy and he reasoned that they were not likely provide meaningful responses. The village is in a relatively isolated location and the children tested were, to all practical purposes, unschooled (Bloch 1984).

Procedure. The study was a variation on the Solomon et al. (1996) adoption task, and in broad outline the designs are the same. Participants were told the following story about a child born to one couple and raised by another:

There was a doctor couple who lived in a big town and did not have any children. Here is the picture of the house of the doctor. One day when they were going for a walk in the countryside they saw a numerous group of children playing together. They were the children of a peasant couple. The doctor couple went to the house of the peasant couple and they asked them if they would be willing to give them a child to bring up. There was a newborn child in the peasant house and the peasant said to the doctor couple that they could bring him/her up. Here is the picture of the peasant house. The doctor couple took the child and loved him as though it was their own child and they blessed him. The child loved the doctor couple too. And now the child is grown up and he still lives in the house of the doctor couple. Now

there are a few things I would like to ask you about this story (see Appendix for the Malagasy original).

The participants were then asked a series of questions in which the birth parents were described as having one of a pair of features (e.g., straight hair) and the adoptive parents were described as having the other feature (e.g., curly hair). The participants then judged which parent the child would be more likely to resemble on that feature. As in Solomon et al., the 14 feature pairs were divided among 5 types of traits: 4 bodily traits, 2 beliefs, 3 preferences, 3 skills, and 2 temperaments (see Table 1). Participants were encouraged to explain their responses.

Transferring the test to Madagascar involved not only translating the stories and questions of Solomon et al. (1996), but also changing aspects of the story and test items to make them more culturally appropriate for the Zafimaniry. The story was modified so that the families were that of an urban doctor (doctor means any medical person with some sort of training) and that of a poor rural peasant, thereby introducing elements concerning class and the rural/urban contrast that were not present in the American study. The notion of adoption in the western sense does not exist in rural Madagascar though a procedure rather like western adoption occurs in sophisticated urban contexts. A kind of fostering/adoption is

Table 1

Feature pairs used in story, in order in which they were presented

Trait type	Adoptive parent	Birth parent
1. preference	likes oranges	likes pineapples
2. bodily	skin whitish	skin darkish
3. temperament	smooth and calm	angers easily
4. skill	does not know how to plat mats	knows how to plat mats
5. belief	there are birds under water	there aren't birds under water
6. bodily	tallish	shortish
7. preference	likes dogs	likes cats
8. belief	there are little worms in teeth	there aren't little worms in teeth
9. skill	bad at elementary math	good at elementary math
10. temperament	not cheerful	cheerful
11. bodily	lightish red blood	darkish red blood
12. preference	does not like songs on the radio	likes songs on the radio
13. bodily	curly hair	straight hair
14. skill	bad speechmaker	good speechmaker

however common in rural areas, but this transfer of children normally occurs between close relatives and is never final. This is called *Mitaiza*, which means literally “to bring up”. Normally an arrangement such as the one above is only considered if the couples are related, though perhaps quite distantly. In this story the class difference is used in part to make the story credible but also to distance the biological and adoptive parents maximally.

Some of the features pairs used in Solomon et al. (1996) were also changed. As the Zafimaniry were not assumed to be familiar with traffic lights, skunks, western ovens, baseball, pickles, movies, and the like, the traits included such beliefs as believing that there are birds living under water or that little worms live in people’s teeth (both of which some Zafimaniry believe to be possible) or such preferences as liking the songs on the radio or such skills as knowing how to plat mats. Despite these differences between the American and the Malagasy versions of the task, the rationales behind the tasks remain the same: The adoption stories allow the biological and social notions of parenthood to be disentangled, and the traits allow participants the opportunity to reveal an understanding that family resemblances on different sorts of traits (such as on bodily traits and beliefs) are driven by different sorts of causal processes.

Results

Judgment patterns

The participants were characterized according to their individual judgment patterns. As in Solomon et al. (1996), the Differentiated pattern, the pattern most consistent with the explicit folkbiological understanding in the West, is defined according to the participant’s judgments concerning bodily traits and beliefs, because it is these two types of traits for which distinct causal mechanisms most clearly underlie their acquisition (i.e., offspring are taken to resemble their birth parents on bodily traits due to biological inheritance, and they are taken to resemble their adoptive parents on beliefs due to learning). The other traits — temperaments, preferences, and skills — were included for exploratory purposes, although, as noted above, American participants providing differentiated judgments tend to judge these traits as they do beliefs; the offspring will resemble the adoptive parent.

Table 2

Number of participants from village who showed each judgment pattern, by age in years

	7-10	11-15	16+
Differentiated	1	2	4
Adoptive parent bias	8	5	0
Birth parent bias	0	0	1
Mixed	5	4	2

The *Differentiated* pattern was here defined as the pattern in which the little boy was judged to resemble his birth parents on 3 or 4 of the 4 bodily traits and on neither of the 2 beliefs. A participant had a probability of .08 of showing such a pattern by chance. As in Solomon et al. (1996), those participants who did not provide Differentiated patterns showed *Adoptive bias* patterns, *Birth bias* patterns, or *Mixed* patterns. Those showing an Adoptive bias pattern judged the boy to resemble his adoptive parents on 11 or more of the 14 traits. This is the pattern most consistent with explicitly articulated Zafimaniry beliefs about how an individual's traits are fixed. Those showing a Birth bias judged the boy to resemble his birth parents on 11 or more of the 14 traits. A participant had a chance probability of .02 of producing either an Adoptive or Birth bias pattern of judgment. Finally, patterns that fell into none of the above types were categorized as Mixed. The number of participants at each age who produced each pattern of judgment is shown in Table 2.

The first striking finding is that 4 of the 7 Zafimaniry adults produced a Differentiated judgment pattern. Just as do American adults, they judged the boy to resemble his birth parents on most or all of the bodily features and on none of the beliefs. The strength of this finding is partly masked by the individual pattern analysis reported in Table 2. All of the adults, even the one who showed a Birth bias and the two who showed Mixed patterns, judged the boy to resemble the birth parent on a greater proportion of the bodily traits than beliefs (the adults who did not show a Differentiated pattern judged the boy to resemble his birth parents on an average of 50 percent of the bodily traits and only 17 percent of the beliefs). Thus, despite the cultural weight the Zafimaniry place on nurture and lifetime events in determining an individual's properties, most adults would appear to understand that resemblance on bodily features, but not beliefs, is

mediated by causal processes associated with birth. They would appear to understand biological inheritance.

In contrast, very few of the Zafimaniry children showed the Differentiated pattern: only 1 of the 14 younger children and only 2 of the 11 older children. Rather, Zafimaniry children's judgment patterns tended to be that predicated on the explicit Zafimaniry belief system concerning how individuals come to have their particular properties. The modal judgment pattern for the children was the Adoptive parent pattern, shown by 57% of the younger children and 45% of the older ones. No children provided a Birth bias pattern, and the remaining children gave Mixed responses. Furthermore, of the children who did not show a Differentiated pattern, only about 32 percent of the bodily traits were judged to be like those of the birth parent as compared with 23 percent of the beliefs. Most of the children did not appear to be close to making the categorical distinction between the inheritance of different kinds of traits, though some of the children undoubtedly were in the process of constructing just such an understanding.

As is the case with American participants, the Zafimaniry judged skills, preferences, and temperaments much as they did beliefs (see Table 3). For those Zafimaniry who had shown either a Birth or Adoptive bias pattern this was an expected finding, for, by definition, these participants had judged either that the boy would resemble his birth parents on virtually none of the traits or on virtually all of the traits. It had also been expected that the Zafimaniry showing the Mixed pattern would judge the skills, preferences, and temperaments as they did the beliefs and bodily traits (and indeed, roughly 50% of all traits were judged to be like those of the birth parents), for overall their judgments did not systematically associate one kind of trait with a particular parent but appeared instead to reflect a variety of strategies. Most interestingly, all 7 Zafimaniry with Differentiated patterns, children and adults alike, were more likely to judge that the boy would resemble his adoptive parents in skills, temperaments, and preferences, just as they do with beliefs but not bodily traits. Even though the Differentiated pattern is defined according to judgments on beliefs and bodily traits alone, American and Zafimaniry children and adults who give Differentiated responses make the same kinds of judgments on preferences, skills, and temperaments. This convergence

Table 3

Percentage of features of each type judged to be like that of birth parent, collapsing across age

Judgment pattern	Trait type				
	Bodily	Beliefs	Preferences	Skills	Temperaments
Differentiated (n = 7)	90	0	20	5	14
Adoptive parent bias (n = 13)	12	4	5	8	0
Birth parent bias (n = 1)	100	50	67	100	100
Mixed (n = 11)	45	41	45	58	41

lends credence to the conclusion that the Differentiated pattern reveals similar understanding across the two cultures, a conclusion bolstered by an analysis of participants' explicit justifications for their judgments.

Justifications

Participants were encouraged to explain their responses. Their justifications provide further information concerning their reasoning in this task. Following Solomon et al. (1996), explanations were coded as *Birth-origin*, *Nurture*, *Teleological*, *Like Birth Parent*, *Like Adoptive Parent*, and *Other*. Birth-origin explanations explicitly invoked the fact that the peasant couple gave birth to the boy and so contrasted with the adoptive couple, or implicitly appealed to birth as the origin of the trait. Examples include, "because he was born to the peasant," or "because he got the blood from the peasant." Nurture explanations referred to the parents' social role or to a specific teaching or learning mechanism. Examples include, "because he was taught," and "because the doctor is the one who brought him up." Teleological explanations invoked the truth or greater desirability of one of the features. Here the participant is not reasoning in terms of family resemblance, but simply stating that the boy would acquire the more desirable trait, leaving the mechanism unstated. Examples include, "because there really are birds who live under water," or "because pineapples taste better." Like Birth Parent and Like Adoptive Parent explanations explicitly restate which parent the boy would resemble, but do not fill in any details of the mechanism. Any explanation not fitting into one of the above categories was coded Other. The explanations were independently coded by two experimenters (GS and SC) who were blind

Table 4a

Percentage of 7- to 15-year-olds who made explanation of given type at least once, by judgment pattern

Pattern group	Explanation type					
	B	N	T	LB	LA	X
Differentiated (n = 3)	67	100	0	67	67	0
Adoptive parent bias (n = 14)	0	43	21	43	50	7
Birth parent bias (n = 0)	–	–	–	–	–	–
Mixed (n = 8)	0	0	38	50	25	13

Table 4b

Percentage of adults who made explanation of given type at least once, by judgment pattern

Pattern group	Explanation type					
	B	N	T	LB	LA	X
Differentiated (n = 3)	100	67	33	100	67	0
Adoptive parent bias (n = 0)	–	–	–	–	–	–
Birth parent bias (n = 1)	0	0	0	100	100	0
Mixed (n = 2)	0	0	50	100	50	100

Key to explanation abbreviations: B = Birth-origin; N = Nurture; T = Teleological; LB = Like Birth parent; LA = Like Adoptive parent; X = Other.

to which participant had produced each one. Intercoder reliability was 95 percent. Disagreements were resolved over drinks.

Tables 4a and 4b show the percentage of participants in each judgment pattern who made explanations of each type at least once. Children and adults are presented separately, making it clear that the differences between those participants with Differentiated patterns and others hold in both age groups. One adult (a Differentiated pattern) was not asked for explanations and so is not included in Table 4.

The justifications given by the Differentiated participants confirm that they had invoked causal mechanisms to explain family resemblance on bodily traits that are distinct from those invoked for the other types of traits. Eighty-four percent of the Differentiated children and adults appealed to Birth-Origin explanations at least once in justifying their judgments. Only one of the participants with other judgment patterns ever did so, an adult with a Birth bias pattern. Furthermore, all of the Zafimaniry who

showed the Differentiated pattern used the Birth-Origin justifications only to explain why the boy would resemble his birth parent on bodily traits, and not to explain resemblance on any other kind of trait. The adult with the Birth bias pattern used Birth-origin justifications to explain why the boy would resemble his birth parent both on a bodily trait and on a temperament (i.e., angers easily).

Similarly, 84% of the Differentiated children and adults appealed to Nurture explanations at least once in justifying their judgments. Moreover, these Differentiated participants only gave Nurture justifications to explain why the boy would resemble his adoptive parent in beliefs, temperaments, preferences, or skills, never to explain resemblance on bodily traits. By contrast, only six (24 percent) of the participants who did not show the Differentiated pattern ever gave Nurture explanations, and all six had shown Adoptive bias judgment patterns. Yet, it is striking that even for these participants who favored resemblance to the adopting doctor, the Nurture justifications were only given to explain resemblance on beliefs, temperaments, preferences, or skills. Contrary to the ethnographic literature, the Zafimaniry participants, whether or not they had demonstrated an understanding of biological inheritance, did not appeal to Nurture explanations to explain how the boy would acquire such bodily features as skin or blood color.

Teleological explanations were provided by 8 participants, distributed widely over age and judgment pattern. All of the teleological justifications, which appeal to the truth, the intrinsic preferability, or the desirability of a feature, were only given for beliefs, preferences, temperaments, or skills, and never for bodily traits. This result suggests that these justifications were implicit Nurture explanations, that the boy would end up acquiring the skills, beliefs, and preferences of the culture. It further suggests that though many of the participants may not have constructed an understanding of biological inheritance, they understand that the kinds of factors implicated in the acquisition of beliefs, skills, and preferences are not also factors in the acquisition of bodily traits.

Finally, a large number of the justifications were not informative. Participants in all judgment patterns often said that the boy would have some property because he would be like the peasant (the birth parent) or because he would be like the doctor (the adoptive parent, or “bringer

up” as one would say in Malagasy). These *Like Birth Parent* and *Like Adoptive Parent* justifications may implicitly reflect appeals to distinct causal mechanisms for fixing traits, or they may simply be restatements of the resemblance judgments or general appeals to family resemblance without any underlying causal process in mind. In support of the latter possibility, we note that 50 percent of the participants who showed Non-Differentiated judgment patterns appealed to Like Birth Parent justifications for bodily traits, but that 29 percent used the same justification for the other traits as well. Similarly, 33 percent of the Non-Differentiated participants appealed to Like Adoptive Parent justifications for bodily traits, and 54 percent did so as well for the other traits. Finally, the uncodable *Other* explanations were given rarely, once each by only 4 of the participants.

The Differentiated pattern, justified by explicit appeals to Birth-Origin and Nurture explanations and by Teleological explanations offered only non-bodily traits, reflects an understanding of the biological inheritance of bodily features, in contrast to environmental forces or learning processes that cause other types of traits. The Adoptive parent bias pattern may have two different sources: Such a judgment pattern could reflect a participant’s belief that specific post-birth environmental factors are responsible for the creation of most of a person’s properties, or the pattern could simply reflect the two-step reasoning that a boy will resemble his parents and that the relevant parents are those who bring the child up. The justifications suggest both sources were operative, although specific Nurture explanations were never given for bodily traits. Similarly, the Birth parent bias pattern may reflect beliefs in the biological inheritance of most of a person’s properties, or simply that a child will resemble his parents and the biological father and mother are the relevant parents. The adult who produced the sole Birth-bias pattern was likely engaging in at least some of the former type of reasoning, given that he produced explicit Birth-Origins justifications for both a bodily trait and a temperament. Finally, Mixed patterns reflect a pattern of reasoning not organized around the contrast between family types.

Conclusions

The ethnographic literature on Southeast Asia in general, and the Zafimaniry in particular, describes articulated beliefs about how an individual

person's properties are fixed. The present study was designed to elicit patterns of judgment reflecting implicit understandings of biological inheritance. The pattern of judgments most consistent with the ethnographic literature is one in which an adopted boy is said to resemble his adoptive parent rather than his birth parent on most traits, and in which such judgments are justified by Nurture or Teleological explanations. The study yielded two important results: First, not a single Zafimaniry adult participant provided data consistent with what would have been predicted from the ethnographic literature alone. Rather, more than half performed as would American adults on this task. Another judged that the boy would resemble his birth parent on almost all traits, and the remaining two gave Mixed responses. These data reveal an intuitive understanding of the fixation of bodily traits by a process that implicates innate potential and the fixation of the other traits by a process that implicates learning and social factors.

The second important result is that Zafimaniry children, between ages 7 and 15, were different from the Zafimaniry adults. Only a few provided Differentiated patterns, and most of the others showed little sign of distinguishing the processes through which bodily features and beliefs are fixed. Rather, their modal response pattern, the Adoptive bias pattern, was that predicted by the ethnographic literature.

Despite the Zafimaniry's consistent, explicitly articulated beliefs concerning a person's malleability during development, over half of the adult participants (and even some of the children) displayed the Differentiated judgment pattern that reveals typical Western folkbiological understanding. It seems likely that the conflict between the picture of Zafimaniry beliefs about parent/child resemblance that derives from ethnographic research and the picture that derives from the present study reflect differences in methodology. The conflict is real, and is seen within individual informants. One of the adults who produced a Differentiated response pattern in the peasant/doctor scenario also assured one of us (MB), in another context, that because on a previous visit to the village he had ridden in a car with a pregnant woman, the woman's child, now a 2-year-old, looked like him, was white like him, and walked like him. Further research is needed to systematically explore the meaning of this conflict. It seems likely that different modes of explanation coexist. The symbolic function of each mode

of explanation and the contexts in which each is elicited remain to be elucidated. But what seems clear, subject to confirmation by further research, is that the explicit Southeast Asian anti-essentialist picture of people as in the process of becoming all their lives is not incompatible with a folkbiological understanding of the inheritance of certain properties from one's birth parents.

In many ways this study should be seen as a pilot study. Only one version of the story was given to all participants, and the sample sizes, especially of adults, were small. However, subsequent work by Astuti (2000) on the Vezo of Madagascar provides striking converging data to those reported here. The Vezo make similar statements to the Zafimaniry concerning the malleable nature of young children and the role of practice in fixing physical and non-physical properties of an individual. Yet, in a slightly different version of a similar adoption story, 78% of 31 Vezo adults provided Differentiated responses.

Astuti also confirmed that most children (ages 6 to 13) did not provide Differentiated responses, as only 12% of 40 children did so. However, in one way, Astuti's results differ from ours. Whereas the Zafimaniry children were likely to show adoptive biases, the Vezo children were more likely to show birth biases (30%) than adoptive biases (18%). Both patterns were statistically systematic; that is, Zafimaniry children provided more Adoptive Bias patterns than would be expected by chance and the Vezo children provided more Birth Bias patterns than would be expected by chance. We have no explanation for the different patterns of responses. Perhaps the Zafimaniry cultural story of the lifelong process of "becoming," or "hardening" one's personal characteristics, more saliently supports an adoptive bias. Alternatively, the difference may be due to the fact that the Zafimaniry are even more isolated from Western culture than are the Vezo.

Whereas the present data may be of surprise to anthropologists who believe that folkbiological understanding of the consequences of the fundamental parent/child relationship displays radical cross-cultural variation, they also hold no comfort for those who believe that an understanding of biological inheritance is part of core knowledge. Apparently, the folkbiological theory of inheritance of properties revealed by adoption and switched-at-birth scenarios does not develop early and spontaneously un-

der widely different conditions of input. In this study, most Zafimaniry children below age 16 did not display it, a result confirmed by Astuti's (2000) Vezo sample. This is in marked contrast with American children, who provide Differentiated responses by ages 6 or 7 in versions of these experiments as close to the present one as we could manage. Further research is needed to explore several possible factors that might contribute to the striking differences between Zafimaniry children and American children. For example, Zafimaniry children are largely unschooled, and thus may be less likely than American children to respond to the pragmatic demands of the structure of this task (Cole & Scribner 1974). If so, then less demanding versions of the present task (e.g., Springer 1996; Hirschfeld 1996; Solomon 1996) may reveal earlier understanding among Zafimaniry children. It is also likely that the Zafimaniry children's responses reflected the influence of the explicit Zafimaniry beliefs about how people come to have whatever traits they do. It is striking that Zafimaniry children never produced Birth bias patterns, even though these are common among American and Vezo children in the process of working out a differentiated account of the fixation of individual people's traits (Solomon et al. 1996).

These results bear directly on Hirschfeld's (1995, 1996) claims for a cross-culturally universal, early developing, essentialist construal of race, grounded in a theory of innate potential. The bodily property of skin color, a stand-in for race in Hirschfeld's own switched-at-birth and adoption scenario, was one of the four bodily properties probed in this study. Among non-Differentiated children (88 percent of the sample), the boy was no more considered to resemble his birth parent in skin color than his adoptive parent. As noted in our introduction, essentialist construals of race, ethnicity, species kind, and individuals' properties are logically distinct from their being grounded in folkbiological understanding of inheritance. The present study is consistent with other evidence (Carey 1995; Solomon 1996) that such folkbiological understanding is acquired slowly during childhood, and may even require conceptual change.

Given that Zafimaniry adults display the differentiated understanding of biological inheritance tapped in this task, why are Zafimaniry children so slow to develop it? Why do the Zafimaniry children differ so much from the Zafimaniry adults? One possibility is that the Zafimaniry adults, at least some of them, had the benefit of much better schooling than do current

Zafimaniry students, given the deterioration of the Malagasy economy. As suggested above, better schooling helps a participant analyze the relevant contrasts in the task (in this case, two types of families, two types of traits). Or, more directly, the western folkbiological understanding might have been taught in school. If the difference between Zafimaniry children and adults is due to better schooling of the latter, then totally unschooled adults from this culture should not display differentiated understanding on such tasks. Further research could explore this possibility. Consistent with this type of explanation for the difference between Zafimaniry children and adults in the present study is the observation that Zafimaniry children are not expected to declare their solutions to intellectual problems — indeed, they are openly ridiculed if they hold forth about serious matters — they may have been less apt to engage the adoptive/biological problem we put to them and instead may have interpreted the task superficially and so fallen back on the ready-made explanations provided for them by their culture. We have no evidence that this is in fact the case, but simply note it as a logical possibility.

A second possibility is that, because of the existence of such ready-made and culturally significant explanations for how an individual's properties are determined, children are less apt to try to seek out alternative explanations. They are less apt to find themselves in the kind of explanatory quandary that has been implicated as a major factor motivating conceptual change and the construction of new frameworks of understanding (Bromberger 1992; Kuhn 1977; Solomon & Johnson, *in press*). Despite the likelihood that Zafimaniry children have far more occasions to witness sex and birth in animals as well as in humans, they need not have recognized the kinds of distinctions and covariations that would undermine the culturally-provided theory. Indeed, the bias against seeking out or even recognizing disconfirming evidence is a well-documented, almost certainly universal, phenomenon (Wason & Johnson-Laird 1972). If the construction of an intuitive theory of biological inheritance requires conceptual change, such conceptual change must await relevant input and motivation. Zafimaniry adults have constructed such a folkbiological theory. We can only speculate as to what the motivation and input might be that would lead Zafimaniry adults and not

children to engage in conceptual change; perhaps it is not until parenthood that one naturally wonders why a child looks the way it does.

Why, then, does the construction of a differentiated intuitive biological theory of inheritance occur so early in American children? First, American children are not faced with an explicit belief system at variance with this construal. Second, American adults' explicit folkbiological understanding of how each individual's properties are fixed is consistent with the Differentiated pattern probed in this scenario. And third, the distinction between biological and adoptive families is salient in American culture, and even in young children's experience. Thus, even if the construction of an intuitive biological theory of inheritance requires conceptual change, by age 6 or 7 it is not unlikely that American children will have encountered the input and motivation needed to achieve it.

The results from the Zafimaniry, at the very least, highlight the dangers of psychological generalizations based on data from a single culture and of anthropological generalizations which assume that the "knowledge" of a particular group of people can be accessed unproblematically through what is said in the type of contexts which normally satisfy ethnographers.

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Appendix. Adoption story (Malagasy version)

Nisy mpivady mpitsabo izay mitoetra any an-tanan-dehibe tsy manan-janaka Ity ny sarin-tranon'ireo mpitsabo. Nefa maniry mafy ny hitaiza ankizy. Indray andro raha sendra nitsangatsangana tany ambanivohitra izy ireo dia nahita ankizy maro nilalao. Izay mpambody ny ray amandrenin'ireo ankizy ireo. Nandeha tany an tranony izy mivady mba hifampidinika aminy, fa manam-pikasana ny hitaiza ny iray amin'ireo ankizy ireo. Nisy zaza voa teraka tao ka io zaza io no nomen'ireo mpambody ho taizan'ireto mpitsabo. Ity ny sarin-tranon'ireo mpambody. Io ny sarin'ilay zaza. Nonome toky izy ireo fa hotiaviny toy ny zaany io zaza io, ka nitsodrano ilay zaza izy ireo. Amin'izao fotoana izao dia efa lehibe io zaza io, izay mbola mipetraka ao amin'ireo mpitsabo. Misy zavatra manintona anao tao amin'io angano io.

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