CHAPTER 25

Culture, Categorization, and Reasoning

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Do people from different cultures have different categories and concepts? What aspects of the way a person thinks depend on the culture in which one grew up? In this chapter we review research on concepts and reasoning from a cultural perspective. It is tempting to plunge right into the literature, without saying much about the notion of culture itself, because, as many people believe, everyone has a pretty good idea about what culture is. To the contrary, we believe that a great deal hinges on how one conceptualizes culture, including challenging methodological and interpretive issues, and deep commitments to research strategies. Therefore, we plunge right away into different approaches to studying culture.

What is at stake is not so much determining which approaches to culture are correct and which are incorrect but rather what their strengths and weaknesses might be relative to the questions and issues one would like to address. First, there is an issue on which everyone who studies culture can agree. Given that much of the history of cognitive and social psychology has focused nearly exclusively on college students at major research universities, we really need to know the generalizability of these findings. Both the presence and absence of generality are informative. We think that *the* scandal of cognitive and social psychology is its narrow empirical base—it reflects either immense optimism with respect to universality or is too pessimistic about being taken seriously. In short, psychology needs cultural research to be legitimate.

The challenges arise when cultural differences are observed. Aside from jarring us out of our complacency, what more can we say? A central problem is that culture is not an independent variable, and cultural comparisons provide very little by way of experimental control. This is where different approaches to culture part company, strategically speaking. We now take a closer look, starting with intuitive approaches to culture.

APPROACHES TO STUDYING CULTURE

We begin with an important distinction: The question of how cultures should be studied is separable from the question of how to define cultures. Intuitively, one might define "culture" as the shared knowledge, values, beliefs, and practices among a group of people, typically living in geographical proximity, who share a

history, a language, and cultural identification. Although we think a definition of a culture in terms of history, proximity, language, and identification is useful and (if not too rigidly applied) perhaps even necessary, it does not follow that the cultural content of interest must be shared ideas and beliefs.

We see three problems with the intuitive view of culture and its focus on shared content. First, it prejudges the issue of what constitutes cultural content. If culture is shared and we encounter a tradition in which a diversity of ideas, values, and practices compete, are we to conclude that the tradition is not cultural because it is not consensual? Second, this view of culture is static, in that either cultural change is not a relevant object of study or is treated as (cultural) loss, or in some cases, extinction. Third, this approach may implicitly essentialize culture by conceptualizing it as an entity with systematic, law-like properties.

In this section we look at a number of approaches that in different ways endorse or reject this agenda for cultural research.

Culture as Norms and Rules

It is very natural to think that the cultural contents of interest must be shared to qualify as "cultural." Note, however, that this commitment undercuts the dynamic side of cultural processes. There might well be distinctive values, beliefs, and knowledge within a culture that nonetheless are not consensual. For example, a culture may have a set of beliefs and practices known only to a privileged group of people (e.g., healers, elders, ruling elite).

Some influential models of culture formation and evolution in biology and anthropology take a somewhat more liberal view of consensus. Based on group-level traits, they assume that cultures are integrated systems consisting of widely shared social "norms" ("rules," "theories," "grammars," "codes," "systems," "models," "worldviews," etc.) that maintain inheritable variation (Rappaport, 1999; Laland, Olding-Smee, & Feldman, 2000; Wilson, 2002). Some political scientists also tend to view cultures as socially "inherited habits" (Fukuyama, 1995), that is, as socially transmitted bundles of normative traits (Huntington, 1996; Axelrod, 1997).

The interest in inheritable variation loosens the restrictions on consensus and raises questions about the basis for variation. But here cognitive scientists are likely to be disappointed by the implicit assumption that the gist of cultural learning is the (automatic) absorption of norms and values from the surrounding culture (by processes no more complicated than imitation). We believe that these assumptions do not pay sufficient attention to the sorts of inferential and developmental cognitive processes that allow human beings to build and participate in cultural life.

Cultural Psychology

Studies in the area of "cultural psychology" have made important contributions to human understanding by showing that knowledge systems and associated ways of thinking previously assumed to be universal actually vary widely across the world (for a review, see Cohen, 2001). The lesson drawn is that "psychologists who choose not to do cross-cultural psychology may have chosen to be ethnographers instead" (Nisbett, Peng, Choi, & Norenzayan, 2001, p. 307). In brief, cultural psychology is succeeding in divesting academic psychology of implicit and ingrained ethnocentric biases.

Cultural psychology differs from the "norms and rules" approach in at least two distinct ways: (1) Cultural psychology has tended to focus on reducing cultural differences to differences in values along a small set of dimensions; and (2) cultural psychologists have claimed that these differences also mediate differences in cognitive processes. In short, culture affects not only what people think about but also how they think.

The area draws much of its inspiration from researchers such as Hofstede (1980) and Triandis (1995), who sought to characterize cultural differences in terms of a small number of relevant dimensions. The project is successful if converging evidence points to the same small set of dimensions. Examples of such dimensions that have received a lot of attention are individualism versus collectivism and egalitarian versus hierarchical social structure. Other researchers, such as Nisbett (2003), have used socio-historical analysis to analytically derive differences in worldviews or preferred modes of thought. Examples of these differences are analytic versus holistic and logic versus dialecticism. In short, Nisbett and his associates (2001) are suggesting that what they call cultural studies must include not only contents per se but also thinking processes that them-

selves may be differentially distributed across cultures.

The recent interest in cultural psychology (for a review and critique, see Oyserman et al., 2002, and associated commentaries) has produced a considerable array of intriguing findings. In our view, however, the field risks being inherently self-limiting, because it tends to focus on very abstract, superordinate-level contrasts. It is difficult to argue with success, but it is equally difficult to overcome the impression that the picture is somewhat oversimplified. Here is an analogy. Suppose we were trying to understand the object concepts associated with a language and culture. It would be possible to take a large sample of such concepts, develop some measure of similarity, and then do multidimensional scaling (MDS). We would probably be able to recover meaningful dimensions of similarity such as size, animacy, and affective valence. But knowing object concepts as we do, we would likely have the feeling that a great deal was missing. In the 1950s Osgood, Suci, and Tannenbaum (1957) undertook a project of this sort (using the so-called "semantic differential technique") and uncovered several abstract dimensions, such as valence (pleasantness vs. unpleasantness) and potency (active vs. passive). Although dimensions such as positive versus negative evaluation have been of some use in subsequent research (Niedenthal, Halberstadt, & Innes-Ker, 1999), no one would mistake this dimensional analysis with a theory of semantics and overall, the MDS approach has fallen into neglect.

A second limitation of cultural psychology is that when a hypothesized cultural difference is reported, it is not clear how explanation or interpretation can be extended beyond simple description. In some cases researchers have been able to exert some experimental control by priming tendencies to act individualistically versus collectively (e.g., Gardner, Gabriel, & Lee, 1999; Briley, Morris, & Simonson, 2000). These sorts of studies reinforce the dimensional analysis and potentially extend its scope (Oyserman & Lee, Chapter 10, this volume). There is always the risk, however, of circularity in analysis. If priming does not affect some candidate task measuring individualism versus collectivism, then perhaps the prime is ineffective or the task does not entail individualism and collectivism.

Perhaps we are guilty of prejudging the initial phase of a two-step project. A focus on within-culture variations in modes of thought might illuminate how different cultural institutions shape ways of thinking and vice versa (see Kitayama, Duffy, & Uchida, Chapter 6, this volume; Kitayama, Ishii, Imada, Takemura, & Ramaswamy, 2006).

Context and Situated Cognition

Alternative views of "cultural psychology" call into question the use of standard forms of experimental procedure as flawed on the grounds that they are biased in their focus on the individual mind/brain in isolation. Instead of considering cognitions to be embedded exclusively in individual minds, with "culture" as just one component of individual cognition, these theorists maintain that human cognitions should be properly situated in a cultural–historical context and "practical activity" (Cole, 1996; cf. Vygotsky, 1978). A related concern is that cultural cognitions may be better understood as "distributed cognitions" that cannot be described exclusively in terms of individual thought processes, but only as "emergent structures" that arise from irreducible levels of interactional complexity involving differential linking of individual minds in a given population (Hutchins, 1995). Cole (1996) argues that subjects and objects are not only directly connected but also indirectly connected through a medium comprising artifacts, which are simultaneously material and conceptual. One consequence of this view is an emphasis on studying cognition in context, where cognitive labor may be distributed across both individuals and artifacts (e.g., plumb lines or computers). Because context includes people's conceptions of artifacts, it is inherently relational.

We share some of these concerns raised by the situated view, such as difficulties with standard experimental procedures, including 2×2 designs with culture, in effect, treated as an independent variable (Atran, Medin, & Ross, 2005) and lack of concern with differential distributions of cognitions among minds within populations. We also agree that cultural notions are intimately tied to the study of development, and that one excellent research avenue involves looking at how cognition plays out in particular contexts.

But we find other aspects of the situated view somewhat problematic. First, it is not always clear when a proposal is to be read as a metaphor and when it is to be taken literally,

for example, the idea that cognition is "distributed" or even "stretched across mind, body, activity and setting" (Lave, 1988, p. 1). The focus on practical activity can be very useful, but to make activity the primary, or in some cases the sole unit of analysis, is to ignore individual cognitions.

The situated view and cultural psychology represent two end points on a continuum of scope and specificity. Cultural psychology aims to identify a small set of cognitive processes that (are thought to) operate very widely. In contrast, situationists are more impressed with the lack of transfer of cognitive skills across settings (e.g., Lave, 1988). The final view we discuss falls in the middle of this continuum.

Cultural Epidemiology

We endorse looking at cultures in terms of mental representations (and attendant behaviors) that are distributed across individuals in a population—what Sperber and others have called "cultural epidemiology."[1] This view focuses on the stabilizing role of cognitive structures in production and transmission of ideas (and attendant behaviors) that achieve widespread cultural distribution. These are not exclusively or even mainly shared as nearly identical mental representations across individual minds (Atran, 2001; Sperber, 1996). For example, imitation has strong limits: Given the multiple mappings between acts and mental representations of them (including their meaning), there is no guarantee of any sort of fidelity. Rather, much of the cultural transmission and stabilization of ideas (artifacts and behaviors) involves the communication of fragmentary bits of information that manage to trigger prior, rich inferential structures (Sperber & Hirschfeld, 2004).

We see two main limitations of the distributional view of culture: (1) Its focus on ideas may not give appropriate weight to the role of institutions, artifacts, and contexts; and (2) the notion of "idea" is underspecified in much the same way that the notion of a feature is underspecified in models of similarity (Murphy & Medin, 1985). Both limitations reflect the fact that the distributional view is stated at a fairly abstract level, so they are probably the same symptom. For instance, in an attempt to concretize the notion of "idea," one will likely find that ideas are not only influenced by institutions, artifacts, and contexts but also include key features of these phenomena in their representational makeup.

At the same time, the distributed view of culture has several important strengths. First, it directs attention to within-culture variation and processes of cultural transmission. Second, cultural differences are a beginning point for analyses, not an end point. Third, this view requires that cultural consensus be empirically demonstrated rather than simply presumed. Consequently, cultures are seen as a dynamic system in which different perspectives and ideas may be in competition. All of these factors are relevant to the methodological considerations to which we turn next.

METHODOLOGY FOR CULTURAL RESEARCH

It is our view that cultures can be effectively studied as causally distributed patterns of mental representations, their public expressions, and the resultant behaviors in given ecological contexts. We say "distributed" to emphasize that the distribution of ideas may be highly variable, and "causally" to make the point that whether and how representations are formed, transmitted, or transformed depends on particular contexts, as we elaborate below. People's mental representations interact with other people's mental representations to the extent that those representations can be physically transmitted in a public medium (language, dance, signs, artifacts, etc.). These public representations in turn are sequenced and channeled by ecological features of the external environment (including the social environment) that constrain psychophysical interactions between individuals (Sperber, 1996).

A significant departure from a culture as "shared norms and rules" perspective is that the variable distribution of ideas, which are themselves objects of study, and disagreement across observers, is treated as signal, not as noise. The distribution view avoids the limitations of considering "culture" a well-bounded system or cluster of practices and beliefs (see Brumann, 1999, and commentaries for examples), in favor of using a set of techniques for assessing groupwide patterns that statistically demonstrate cultural consensus or lack thereof. This proposal has the advantage that it avoids trying to define culture, focusing attention instead on the distribution of cultural representations.

In our work we have relied extensively on the cultural consensus model (CCM) of Romney, Weller, and Batchelder (1986), an important tool for analyzing commonalities and differences within and across cultural groups. The CCM has been an effective tool for cognitive anthropologists (e.g., Moore, Romney, Hsia, & Rush, 2000; Romney & Batchhelder, 1999; Romney, Brewer, & Batchelder, 1996). Consensus modeling permits recovery of graded patterns of variation within and between populations (down to the level of the individual and up to the level of combining cultural patterns to show "metacultural" interaction and consensus). Rather than locating "cultural analysis" at any one level, one can explore the existence of agreement patterns, linking them to environmental (social and physical) processes and phenomena.

Other researchers (e.g., Eid & Diener, 2001) have employed latent class analysis to identify subgroups. A limitation of latent class analysis not shared by the CCM is that fairly large sample sizes are needed to identify subgroups.

Accordingly, it is less useful to try to estimate population parameters for such norms and associated behaviors (especially when cultural studies consist of cross-national samples of college students) than to establish the pathways that determine how ideas (in our case, categories and concepts) affect reasoning and behaviors. For example, in some of our work we have identified cultural differences in approaches to nature but then have been able to link within-group variation in mental models with corresponding within-group variation in cross-group stereotyping (Medin, Ross, Cox, & Atran, 2006).This means that trying to establish a truly random sample may be much less useful than selecting a sample that is most likely to reveal some cultural processes of interest (this contrasting strategy is known as *purposive sampling*).

The Cultural Consensus Model

The CCM assumes that widely shared information is reflected by a high concordance among individuals. Estimation of individual competencies is derived from the pattern of interinformant agreement on the first factor of a principal component analysis (essentially factor analysis). A cultural consensus is found to the extent that the data overall conform to a single factor solution (the first latent root is large in relation to all other latent roots), and individual scores on the first factor are strongly positive. These competency scores should not be mistaken for scores of expertise. The cultural model provides a measure for culturally shared knowledge; hence, the levels of competencies measure the extent to which an individual shares what everyone else agrees upon. The CCM is not a theory of culture or of the cultural transmission of information, any more than analysis of variance is a theory of cognition. It is only a tool that can be used to evaluate such theories.

Of course, general agreement may be coupled with systematic disagreement, and the CCM is an effective tool for uncovering both shared and unshared knowledge. After the consensus parameters are estimated for each individual, the expected agreement between each pair of informants is generated (as the product of their respective consensus parameters). Next, the expected agreement matrix is subtracted from the raw agreement matrix to yield a matrix of deviations from expected agreement (cf. Hubert & Golledge, 1981). If raw and residual agreement are significantly associated, then a significant portion of residual agreement consists of deviations from the consensus. One can then explore other factors (e.g., cultural subgroups, social network distance) that might predict or explain the residual agreement. For example, Medin, Lynch, Coley, and Atran (1997) asked tree experts to sort local species of trees into groups and found a clear overall consensus, coupled with reliable residual agreement. They then examined second-factor scores and found that they correlated strongly with occupation (e.g., parks maintenance worker, taxonomist, landscaper). Subsequent comparisons revealed systematic differences in the basis for sorting across groups.

Logic and Strategy in Cross-Cultural Comparison

One reason that comparative research has been unpopular is that it is not always clear how to do it successfully. When one compares two groups and finds clear differences, interpretive problems quickly emerge. Which of the many ways in which the two groups differ are crucial? For example, López, Atran, Coley, Medin, and Smith (1997) found that U.S. undergraduates and Itza' Maya of Guatemala showed different patterns of responding on a category-

based inductive reasoning task involving mammals. Although this undermines the universality of the particular reasoning phenomenon, the two groups differed in myriad ways (age, education, literacy, livelihood, language, cosmology, etc.). Which of these differences matters? Practically speaking, it may be impossible to disentangle these various factors. Suppose we could control for age, education, literacy, and the like in comparing Itza' Maya and undergraduates. How do we decide which variables represent "culture" and should therefore not be controlled, and which variables do not, and should be controlled? The Itza' Maya practice agroforestry and also hunt and collect plants in the forest. Should these factors be controlled or are they part of Maya culture?

Now suppose that we control for every variable we can think of and still find differences. In this case, it seems that one is more or less forced to reify or essentialize culture; that is, the only explanation of the cultural difference involves appealing to some abstract notion of "culture." In short, it seems that we may be caught between two equally undesirable possibilities: (1) to end up with a notion of culture that solely has recourse to circular explanations of differences ("The Itza' are different because they are Itza' "); (2) to conclude that cultural comparisons just represent confounded experiments, and the notion of culture is not needed once proper experimental control is achieved.

Triangulation as a Research Strategy

There is no theoretically neutral way to define culture (see Atran et al., 2005). We have just suggested that the idea that culture is whatever is left when all potentially confounding variables are controlled is self-defeating. Granted, it is useful to control for variables that are clearly irrelevant to culture. But one must bear in mind that decisions about what is irrelevant are necessarily theory-based and commit one to a particular notion of culture.

Because (cultural) groups cannot be found that represent orthogonal combinations of variables, it may be impossible in principle to disentangle the various sources of variation among groups. The general idea of triangulation is to use observations from a third group to get at least modest leverage for understanding initial group differences. The third group should resemble the first group in some potentially important ways and the second group in other ways. If the third group performs like one of the groups and differently from the other group, then the variables shared by the third group and the group it mimics become candidates for critical variables.

To illustrate this strategy, consider again the findings of López et al. (1997). In that study, we compared Itza' Maya elders and University of Michigan undergraduates on categorization and reasoning involving local mammals (local to Petén and to Guatemala and Michigan, respectively). We told informants of a new disease that we know affects *coyotes* and *wolves*, and another new disease that affects *coyotes* and *cows*. Then we asked which disease is more likely to affect all mammals.

University of Michigan undergraduates overwhelmingly said the disease that coyotes and cows get is more likely to affect all mammals. They justified their answers by appealing to the dissimilarity of the two premises, or *diversity*; that is, they said that if some disease affects mammals as different as coyotes and cows, it is likely to affect all mammals. This reasoning strategy seems straightforward, and the Osherson, Smith, Wilkie, Lopez, and Shafir (1990) model for category-based reasoning predicts that people will prefer more diverse premises in drawing inductions to a category. What is surprising is that the Itza' Maya did not show a diversity effect. In some cases they were reliably *below* chance in picking the more diverse premises on these kinds of tests.

Why did the Itza' not use a diversity-based reasoning strategy? Obviously, there are any number of hypotheses one could conjure up. Perhaps the question was not asked quite the same way in Itza' Maya (back translation is no guarantee of equivalence), or perhaps formal education is a prerequisite for this form of abstract thought, or perhaps the Itza' have a very different conceptualization of disease. The answer just is not clear.

Here is where our triangulation strategy proved to be effective. In this case, the third group was U.S. tree experts who were asked to reason about novel tree diseases. They resembled both the Michigan undergraduates in many respects (language, formal education, etc.) and the Itza' with respect to having considerable domain knowledge. A typical diversity probe might be as follows: "White pine and weeping willows get one new disease and river birch and paper birch get another. Which

is more likely to affect all trees?" Using these kinds of probes, Proffitt, Coley, and Medin (2000) found that parks workers, like the Itza', showed reliably below chance diversity responding. As we elaborate later, both groups were employing a reasoning strategy that is sensible and coherent—it just does not show up in undergraduate reasoning, for reasons that we will soon make clear. For now, we simply note that the triangulation strategy pinpoints domain knowledge as a key variable in diversity responding (though, as we will see, this is not the whole story).

At first glance, it might appear that the triangulation strategy is just a 2×2 design with one cell missing. In our example, one factor might be *cultural group* and the other, *expertise*, with the missing cell being the Itza' Maya, who lack knowledge of biological kinds. But a 2×2 design presumes what the triangulation strategy is intended to discover, namely, which factors are crucial to group differences. So, in our case, *expertise* seems to be the main factor and the factor of *culture* is just a stand-in for the many ways the groups might differ, which may or may not be relevant for some specific task. The logic of triangulation implies compression of any number of possible 2×2 designs that together entail a host of possible explanations for group differences. Instead of 2^N controlled designs, each of which allows inference to a single factor, a carefully chosen third group deliberately confounds a number of variables. By carefully choosing a third group, C, that resembles both the first group, A, in a number of ways and the second group, B, in a number of other ways, one can assess the relative importance of the set of culturally confounded variables by which C differs from A versus C differs from B.

OVERVIEW OF CONCEPTS AND CATEGORIES

It is not easy to organize this review, because (mainstream) psychology has a different history and perspective than anthropology. Our compromise is to come at it both ways, noting the frequent parallels. We begin our overview with theories of concepts and categories that have arisen out of mainstream cognitive psychology, which has been more concerned with mental representations and abstract structural properties of categories than has anthropology. We then review research emanating from both anthropology and psychology that has investigated concepts and categorization across cultures.

In what follows, we use *concept* to refer to a mental representation, and *category* to refer to the set of entities or examples picked out by the concept. It is generally accepted that instances of a concept are organized into categories (Smith & Medin, 1981). Almost all theories about the structure of categories assume that, roughly speaking, similar things tend to belong to the same category and dissimilar things tend to be in different categories. For example, robins and sparrows both belong to the category *bird* and are more similar to each other than they are to squirrels or pumpkins. "Similarity" is a pretty vague term, but it is most commonly defined in terms of shared properties or attributes. Although alternative theories assume that concepts are structured in terms of shared properties, theories differ greatly in their organizational principles. The *classical view* assumes that concepts have defining features that act like criteria or rules for determining category membership. For example, a triangle is a closed geometric, three-sided form, with the sum of the interior angles equaling 180°. Each of these properties is necessary for an entity to be a triangle, and these properties together are sufficient to define a "triangle."

A fair amount of research has examined people's knowledge about object categories such as *bird*, *chair*, and *furniture*, and this evidence goes against the classical view. People not only fail to come up with defining features but also they do not necessarily agree with each other (or even with themselves when asked at different times) on whether something is an example of a category (Bellezza, 1984; McCloskey & Glucksberg, 1978). Philosophers and scientists also have worried about whether naturally occurring things such as plants and animals (so-called "natural kinds") have defining features. The current consensus is that most natural concepts do not fit the classical view.

The major alternative to the classical view, the *probabilistic view* (see Smith & Medin, 1981), argues that concepts are organized around properties that are characteristic or typical of category members, but, crucially, they need not be true of all members; that is, the features are only *probable*. For example, most people's concept of bird may include the properties of building nests, flying, and having hollow bones, even though not all birds have these properties (e.g., ostriches, penguins).The

probabilistic view has major implications for how we think about categories. First, if categories are organized around characteristic properties, some members may have more of these properties than other members. In this sense, some members may be better examples or more typical of a concept than others. For example, Rosch and Mervis (1975) found that the more frequently a category member's properties appeared within a category, the higher its rated *typicality* for that category. For instance, robins were rated to be very typical birds and penguins were rated as very atypical birds. A second implication is that category boundaries may be fuzzy. Nonmembers of a category may have almost as many characteristic properties of a category as do certain members. For example, whales have a lot of the characteristic properties of fish, yet they are mammals. Third, learning about a category cannot be equated with determining its defining features, because there may not be any (see, Murphy, 2002, for a general review).

Is typicality based only on central tendency? Although typicality effects are robust (and problematic for the classical view), other research shows that the underlying basis for typicality effects may vary with both the kind of category and the population being studied. Barsalou (1985) reported that the internal structure of taxonomic categories is based primarily on the central tendency (or the average member) of a category. In contrast, the internal structure of goal-derived categories, such as "things to wear in the snow," is determined by some ideal (or the best possible member) associated with the category. The best example of snow clothing, a down jacket, was not the example most like other category members; instead it was the example with the maximum value of the goal-related dimension of providing warmth.

One might think that ideals will only come into play when the category of interest lacks the natural similarity structure that characterizes common taxonomic categories, such as *bird*, *fish*, and *tree*. However, recent evidence undermines this idea. Lynch, Coley, and Medin (2000) found that, for tree experts (people who know a lot about trees, e.g., landscapers, parks workers and taxonomists), the internal structure of the category *tree* was organized around the positive ideal of height and the negative ideal of weediness. The best examples of *tree* were not trees of average height but trees of extraordinary height (and free of "weedy" characteristics, e.g., having weak limbs, growing where they are not wanted, and being susceptible to disease).

Other research is consistent with the idea that people who have considerable knowledge in a domain tend to base typicality judgments on ideals, and not on the number of typical features (Johnson, 2001). For instance, for Itza' Maya adults living in the rain forests of Guatemala the best example of bird is the wild turkey, which is culturally significant, prized for its meat, and strikingly beautiful (Bailenson, Shum, Atran, Medin, & Coley, 2002). The Lynch et al. (2000) finding that U.S. tree experts based typicality on ideals suggests that it is not just that the Itza' have a different notion of what typicality means. Burnett, Medin, Ross, and Blok (2005) also found that Native American and European American fishermen's typicality judgments were based on ideals, though those ideals differed somewhat across groups.

If categories are not represented in terms of definitions, what form do our mental representations take? One suggestion about how concepts are represented is known as the "family resemblance principle." The general idea is that category members resemble each other in the way that family members do. A simple summary representation for such a family resemblance structure would be an example that possessed all the characteristic features of a category. The best example is referred to as the *prototype*.

In a prototype model of categorization, a new example is classified by comparing the new item to the prototype. If the candidate example is similar enough to the prototype for a category, it is classified as a member of that category. More detailed analyses, however, show problems with prototypes as mental representations. Prototype theory implies that the only information abstracted from categories is the central tendency. A prototype representation discards information concerning category size, the variability of the examples, and correlations among attributes. The evidence suggests that people can use all three of these types of information (Estes, 1986; Flannagan, Fried, & Holyoak, 1986; Fried & Holyoak, 1984; Medin, Altom, Edelson, & Freko, 1982).

An alternative approach, which is also consistent with the probabilistic view, assumes that much more information about specific examples is preserved. This approach appropriately falls under the general heading of *exemplar*

theories. Exemplar models assume that people initially learn some examples of different concepts, then classify a new instance on the basis of how similar it is to the previously learned examples. The idea is that a new example reminds the person of similar, old examples and he or she assumes that similar items will belong to the same category. For example, suppose you are asked whether large birds are more or less likely to fly than small birds. You probably will answer "less likely," based on retrieving examples from memory and noting that the only nonflying birds you can think of are large (e.g., penguin, ostrich).

Quite a few experiments have contrasted the predictions of exemplar and prototype models. In head-to-head competition, exemplar models have been substantially more successful than prototype models (see Estes, 1994; Lamberts, 1995; Medin & Coley, 1998; Nosofsky, 1992; Nosofsky & Palmeri, 1997; Storms, De Boeck, & Ruts, 2000; Verbeeman, Vanoverberghe, Storms, & Ruts, 2001; Smits, Storms, Rosseel, & De Boeck, 2002; but for opposing views see Homa, 1984; Smith & Minda, 1998, 2000).

Why should exemplar models fare better than prototype models? One of the main functions of classification is to allow one to make inferences and predictions on the basis of partial information (see Anderson, 1990a, 1990b). Relative to prototype models, exemplar models tend to be conservative about discarding information that facilitates predictions. For instance, sensitivity to correlations of properties within a category enables finer predictions: From noting that a bird is large, one can predict that it cannot sing. In short, exemplar models support predictions and inferences better than do prototype models.

A number of researchers have argued that the organization of concepts is knowledge-based (rather than similarity-based) and driven by intuitive theories about the world (for a general review, see Carey, 1985; Keil, 1989; Murphy & Medin, 1985; Murphy, 2002). The idea that concepts might be knowledge- rather than similarity-based suggests a natural way in which concepts may change, namely, through the addition of new knowledge and theoretical principles. There is also good evidence that these theories help determine that abstract and observable features to which learners pay attention (Spalding & Ross, 2000; Wisniewski & Medin, 1994). The set of categories for mental disorders now differs from that 100 years ago, in part because our knowledge base has become more refined. Often knowledge of diseases develops from information about patterns of symptoms to a specification of underlying causes. For example, the advanced stages of syphilis were treated as a mental disorder until the causes and consequences of this venereal disease were better understood. Kim and Ahn (2002) have shown that clinical psychologists organize their knowledge of mental disorders in terms of the rich causal theories (and not the atheoretical diagnostic manual they are supposed to use) that guide their diagnostic classification and reasoning.

FOLKBIOLOGY AND NATURAL KINDS ACROSS CULTURES

Perhaps one of the most natural questions to ask about concepts is whether people in different cultures have different ones. Concepts are the building blocks of thought, and at the heart of this question is whether people in different cultures think differently. Usually this question is tied up with the question of whether and how language influences thought (see Gentner & Goldin-Meadow, 2003, for a series of reviews and comments on this issue, which we do not cover separately here). Of course, if thought processes of two cultural groups were radically incommensurable, one would quickly realize there dramatic differences but be at something of a loss to explain them. The fact that one part of learning a foreign language involves finding out what term or word is used to refer to *bird*, *fish*, *chair*, *Tuesday*, or *mother* suggests that comparable concepts and categories are in play.

Folkbiology

Research in the domain of living kinds has allowed a natural comparison of concepts across cultures. Perhaps the most striking result is the strong cross-cultural agreement in categorizing plants and animals. Consider an ethnobiologist undertaking the study of folkbiology in some new culture. The project could hardly get under way before he or she asks what living kinds are found in that culture, what terms exist in the language referring to living kinds, and what the relation is between those terms and what is there (the issue of reference). How does one describe what living kinds exist in some cultural context? A reasonable starting point is

to use scientific taxonomy as a reference or standard. For example, one might ask whether every kind that science recognizes as a distinct species has a distinct name (Diamond & Bishop, 1999). Upon finding that many kinds do not have distinct names, it is natural for one to ask what principles determine whether or not a species has a distinct name (Berlin, 1992). For example, naming could be driven by relevance to humans (utility), perceptual discontinuities, or even size (Hunn, 1999).

Scientific taxonomy is, of course, a hierarchical taxonomy and, as such, provides both a standard and a heuristic for asking other questions about universal aspects of folktaxonomies. Two important analytic points are involved here: First, although the particular kinds of plants and animals to be found may vary across cultures, the abstract structure in terms of species, genus, family, order, class, division, and kingdom will be represented. Consequently, scientific taxonomy provides something of a conceptual grid for cross-cultural comparisons. The second, related point is that scientific taxonomy allows one to establish corresponding ranks, such that it becomes meaningful to state that *oak* is at the same level or rank as *trout*. This does not mean that they are psychologically at the same rank, but it does provide a basis for asking questions, such as whether some culture differentiates mammals more than fish. As it turns out, ethnobiologists have found that folk ranks and folktaxonomies only roughly approximate scientific taxonomies (Hunn, 1975). By *roughly*, we mean that the correlation between scientific taxonomic distance of species (i.e., the number of nodes that must be traversed to connect species x and species y) and folktaxonomic distance is about .75. On the one hand, this may be seen as quite high but on the other, this accounts for only about 50% of the variance.

Folkbiology is a field blessed with many intriguing and important issues that lend themselves to an analysis in terms of culture and cognition. Let us turn to a few of them.

Are Folkbiological Categories Recognized or Constructed?: Egghead versus Utilitarian Perspectives

A basic issue within ethnobiology concerns whether categories are recognized or constructed (see Malt, 1995; Brown, 1995). One view—known within ethnobiology as the "intellectualist view"—is that the structure of kinds in nature comprises "chunks" that more or less impose themselves on minds (at least on minds with a perceptual system like ours). This position is reinforced by the finding that folk categories often correspond to scientific species or genera and by quite strong cross-cultural agreement in folktaxonomic systems (e.g., Atran, 1990; Berlin, 1992; though Atran interprets agreement in terms of universal properties of mind rather than the structure of nature alone).

The alternative, or "utilitarian," view is that folktaxonomic systems are influenced by goals, theories, and belief systems, and that they may be culture-dependent constructions (Hunn, 1982; Ellen, 1993). For instance, Hunn (1982) noted that the Tzeltal peoples do not differentiate as finely among butterflies as they do among butterfly larvae, because the larvae are important for food and are also crop pests. Berlin (1978) found that Aguaruna and Tzeltal peoples formed generic categories for plants that were of no utility to them, yet further division into more specific categories was made for plants that were considered useful. In short, the role of utility seems to vary with taxonomic rank. The intellectualist view appears to be fairly accurate at the rank of folk generics (e.g., dog, pine, trout), and the utilitarian view holds more sway at the level of folk species (e.g., poodle, white pine, brook trout) and variety (e.g., toy poodle, Western white pine).

Other, intermediate positions hold that the intellectualist and utilitarian views are not necessarily mutually exclusive. For example, their relative influence may depend on factors such as rank in the hierarchy (Bulmer, 1970): Cultures may differ more in the structure and use of categories such as *tree* or *bird* (corresponding roughly to class in scientific taxonomy) than they do for *oak* or *robin* (corresponding roughly to the generic or species level).

A final twist on this issue arises from studies that have included informants from groups with less intimate contact with nature. Consider the research conducted by López et al. (1997). When comparing folkbiological taxonomies, López et al. found that Americans and Itza' were more or less equally competent in their classification of mammals, as judged by the correlation between sorting distance and formal taxonomic distance. Furthermore, classification in both groups was largely based on the morphology and behaviors of the mammals. However, relative to the American undergraduates, the Itza' were more likely to differ-

entiate among smaller mammals, were less likely to group mammals together in large groups, gave greater weight to ecological considerations, and gave less weight to size and domesticity. Indeed, for the undergraduates, most of the variance in sorting could be accounted for on the basis of size alone. In other words the undergraduates had a somewhat impoverished knowledge of mammals relative to that of the Itza'.

In related work, Bailenson et al. (2002) asked U.S. experts, U.S. novices (college students) and Itza' Maya to sort pictures of U.S. and Guatemalan birds into groups. They found that the Itza' sorting correlation with scientific taxonomy for U.S. birds was actually higher than the correlation of the U.S. novice sorting for U.S. birds, again suggesting that the U.S. college students had somewhat impoverished knowledge of birds (for more data and discussion of the cognitive consequences of impoverished contact with the biological world, see Johnson & Mervis, 1998; Medin & Atran, 2004).

Does Nature Have Joints?

THE BASIC LEVEL

An important observation about categories is that people are not confused about which label to use when asked about an object. For example, a person looking at a four-legged furry animal that had just fetched a ball would more likely call it a *dog* than an *animal* or a *poodle*. This intermediate level of abstraction, which seems to provide the label that we would use as a default, is called the *basic level*, and it appears to be especially salient and psychologically privileged. For example, basic-level concepts are the first to be learned, the natural level at which objects are named, and the highest level in which the instances all share the same parts and overall shape (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). The basic level resides at a middle level of abstraction. More abstract categories (e.g., animal) are called *superordinates*, and more specific categories (e.g., golden retriever) are called *subordinates*. Berlin (1992) found that among traditional societies, the basic level for plant and animal categories seems to correspond to the folk-generic level (e.g., *maple*, *trout*). Berlin calls these categories "beacons on the landscape of biological reality" (p. 53). Consistent with this claim, the genus level is the rank where cross-cultural agreement in categorization is maximized.

Although traditional ethnobiological studies point to the folk-generic level as privileged, Rosch et al. (1976) found that for American undergraduates, the basic level seemed to correspond to the more abstract life-form level (e.g., *tree*, *fish*). One way of reconciling these two claims is to again argue that American undergraduates do not have the requisite experience with biological kinds to develop what would otherwise be a universal appreciation of the genus level. Some cross-cultural studies have directly addressed this issue.

Coley, Medin, and Atran (1997) have examined whether the cultural differences in the privileged or basic level in taxonomic classification correspond to cultural differences in the privileged level for folkbiological induction. A level is defined as privileged if inferences to this level are significantly stronger than inferences to the immediate superordinate level, but no stronger than inferences to a subordinate level (if there is a subordinate level). The former task may measure consequences of experience, and the latter may assess expectations rather than knowledge about categories. Coley et al. told American undergraduates and the Itza' elders that an unfamiliar property was characteristic of all members of a particular category, and asked how likely this was to be true of members of a more general category. If the basic level is the level above which information is lost, and below which little information is gained (Rosch et al., 1976), then the privileged level for induction should be the basic level. Based on Berlin's (1992) and Rosch et al.'s (1976) research, Coley et al. (1997) predicted that the privileged level for induction should be the folk-generic level for the Itza' and the life-form level for the American undergraduates.

Coley et al. (1997) found that the privileged level for inductive inferences was the folk-generic level for both groups of participants; that is, the strongest inductions were made from the folk-generic level to the life-form level, relative to all other inductions. Thus, there is a dissociation of knowledge and expectations in Americans' folkbiological categories. In spite of the fact that undergraduates may have little specific knowledge about the sparrow, trout, or oak, expectations about the informativeness of categories serve to maximize inductive inferences at the folk-generic taxonomic level. Indeed, Coley, Hayes, Lawson, and Maloney (2004) found that for living

kinds, inductions are influenced more by expected informativeness (measured by collecting ratings of perceived similarity among category members at different levels) than by specific knowledge of the concepts themselves (measured by asking participants to list known features for concepts at different hierarchical levels).

CULTURE VERSUS EXPERTISE

There is evidence that as one becomes more expert in an area, what was previously the subordinate level becomes the basic level. For example, *dog* might be a basic-level category for most people, but *poodle* might be a basic-level category for dog trainers (Tanaka & Taylor, 1991; see also Johnson & Mervis, 1997, 1998). This difference in expertise accounts for some of the discrepancies between Berlin's (1992) findings and those of Rosch et al. (1976). One might argue, however, that expertise and culture are not totally dissociable, because as López et al. (1997) argued, knowledge is part of culture (see also Wolff, Medin, & Pankratz, 1999). Furthermore, differences in expertise do not preclude the potentiality for other "cultural" influences to play a role in categorization and reasoning.

An example in which group differences could be attributed to differences in culture, over and above differences in expertise, comes from research by Medin, Ross, Atran, Burnett, and Blok (2002). They examined categorization of freshwater fish among the Menominee and majority-culture European Americans in north-central Wisconsin. Both groups live in an area of Wisconsin with many rivers, lakes, and streams, and both groups have extensive knowledge about the fish that live in those waters. In addition, both groups fish similar species and use similar practices (e.g., fly-fishing, ice fishing). Given these similarities, it is possible to predict that these two groups would share similar conceptualizations of fish.

However, Medin et al. (2002) found differences between Menominee and majority-culture fishermen in categorization of freshwater fish. Importantly, these individuals had high levels of expertise about fish, and expertise did not differ between groups. Nevertheless, these groups exhibited differences in certain tasks. For instance, Medin et al. asked majority-culture and Menominee fish experts to sort name cards of 44 species of local fish into categories, then examined cross-group similarities and differences. Although a combined analysis showed an overall consensus, Menominee participants exhibited higher within-group than between-group consensus. Majority-culture fish experts showed no greater within- than across-group residual agreement. This analysis suggests that the two groups share a common model but that Menominee experts have an additional basis of organization.

Other analyses reinforce these group differences. Multidimensional scaling of majority-culture sorts yield two-dimensional solutions that correlate with size and desirability. Menominee sorting required an additional dimension corresponding to ecological relations (shared habitat). Majority-culture fishermen were more likely than the Menominee fishermen to give taxonomic or morphological justifications for their sortings (62 vs. 33%, respectively), and the Menominee fishermen were more likely than the majority-culture fishermen to give ecological justifications for their sortings (40 vs. 6%, respectively). These data indicate that levels of expertise (knowledge of a domain) and kinds of experience (practice and goals) cannot fully account for how individuals categorize living things. Later experiments showed that these cultural differences were differences in knowledge organization rather than knowledge per se. For example, a speeded fish–fish interaction task showed large cultural differences (Menominee experts reported more relations, more reciprocal relations, and more relations involving immature fish) that disappeared when the pace of the task was relaxed.

The same difference in cultural orientation was obtained for a group of less expert Menominee and majority-culture fishermen. Based on these findings, Medin et al. (2002) suggested that both experts and nonexperts exhibit a high degree of consensus with respect to fish in their area, but that these groups diverge in a culture-specific way: a difference in the salience of ecological relations as a basis for knowledge organization.

What Do We Know about Categorization as a Basis for Folkbiological Reasoning?

INDUCTIVE REASONING

One primary function of concepts is that they support *reasoning*. One does not need to store every fact and possibility if inferences can be

derived from information that is stored. From the knowledge that all animals breathe, that reptiles are animals, and that rattlesnakes are reptiles, one may reason (deductively) that rattlesnakes must also breathe, even though one may never have directly stored that fact. Indeed, Medin et al. (1997) found that for parks personnel and tree taxonomists who sorted based on morphological properties, the sorting data were a good predictor of performance on reasoning tasks. And as mentioned earlier, López et al. (1997), who investigated taxonomic classification of mammals and similarity, typicality, and diversity effects among Itza' and U.S. college participants, found that although both the Itza' and the U.S. students exhibited similarity and typicality effects when making inductions, only the U.S. students exhibited a diversity effect.

Why are the Itza' not showing taxonomic diversity effects in reasoning? The short answer appears to be that "diversity" is an abstract reasoning strategy that tends to be used by experts only when more concrete causal/ecological reasoning fails. Other work shows that Itza' Maya, U.S. bird experts, most U.S. tree experts, and European American and Native American fish experts do not show diversity effects in reasoning (Bailenson et al., 2002; Burnett et al., 2005; Proffitt et al., 2000). Instead, causal/ecological reasoning dominates. What knowledge seems to provide is flexibility, in the form of a variety of strategies that allow the reasoner to project different properties in different ways. In evidence of this flexibility, Shafto and Coley (2003) found that whereas fishermen projected diseases according to food chain relations among marine animals, they projected more abstract or ambiguous properties like "a property called sarca" among the same animals according to similarity or taxonomic relatedness, as did domain novices.

There is also suggestive evidence of cultural differences among college students in reasoning. For example, Choi, Smith, and Nisbett (1999) found that diversity effects involving specific conclusions (rather than a superordinate category) were weaker among Korean college students than among U.S. college students, at least for biological stimuli. Choi et al. attributed this effect to U.S. students' tendency to think more in terms of categories. They suggested that the fact that both groups show specific diversity effects for social categories reflects the interdependent social orientation of Korean students.

SUMMARY

The results on inductive reasoning echo the findings on categories and concepts: Performance is strongly influenced by domain knowledge, and results with U.S. undergraduates do not generalize very well to other populations.

Is Reasoning from Folkbiological Categories Similarity Based or Theory Based?

Especially within cognitive psychology, folkbiology is an appealing domain from the contending standpoints of both similarity- and theory-based views of categorization and category-based reasoning. On the one hand, our perceptual system is surely an adaptation to the natural world, and if similarity-based models are going to succeed anywhere, it should be here. On the other hand, the biological world is apparently a world of fairly stable clusters of complex features, whose remarkable endurance in the face of constant change presumably owes to naturally occurring causal patterns. Understanding causal patterns in the world is a primary goal of theory-driven knowledge in science, and the history of science is coterminous with trying to understand biological causality in particular. If theory-based knowledge were to develop anywhere outside of science—in other cultures, or in everyday thinking—it should be here.

From the perspective of similarity, there are evident patterns of covariation for biologically related attributes (e.g., toothless, two-legged beings generally have wings, feathers, and can fly). Perhaps most people in the world are aware of these covariations without necessarily understanding their causal origins or interrelations, such as the role of feathers in flight. In other words, there could be quite a bit of biologically relevant data stored but not theoretically assimilated.

Nevertheless, people in different cultures acknowledge, and often try to better understand, at least some of the causal interrelations among covariant biological attributes (Gelman, 2003). These include irreversible patterns of biological growth (maturation) the apparent constancy of covariant morphological, anatomical, and behavioral patterns across generations (reproduction and inheritance); the success of mutually constraining actions of interrelated attributes in maintaining life (bodily function); and the breakdown of interrelated bodily functions (illness and death).

Suppose, as ethnobiologists generally agree, that people everywhere witness certain covariant biological patterns (roughly corresponding to perceptually salient species or genera) but interpret the causal relationships underlying these patterns in different ways. This might suggest that similarity based reasoning precedes theoretically based reasoning, at least in the biological domain. This was a message of developmental studies in the 1980s (Carey, 1985; Inagaki & Sugiyama, 1988; Keil & Batterman, 1984). More recent studies have lowered the age at which children are thought to reason causally about biological kinds. But the origins of causal reasoning in folkbiology remain a matter of controversy.

This controversy hinges on two related questions: (1) What is the earliest age at which children can be said to have a theory of biology? and (2) Does biological thought constitute a distinct domain? Not surprisingly, the answer to these questions depends on how one defines the terms.

THEORY AND DOMAIN

A number of researchers have argued that even very young children's categorization and reasoning is guided by certain skeletal principles (Gelman, 2002) or a framework theory and a unifying concept of an underlying essence that makes things the sorts of things that they are (Gelman, 2003; Gelman & Hirschfield, 1999; Hirschfeld & Gelman, 1994; Medin & Atran, 2004).

FRAMEWORK THEORIES

Susan Carey (1982, 1985) has shown that children's biological theories guide their conceptual development. In one study, 6-year-old children rated a toy monkey as more similar to people than to a worm, but they also judged the worm to be more likely than the toy monkey to have a spleen (a spleen was described as "a green thing inside people"). Although worms may be less similar to people than are toy monkeys, they are more similar in some respects, namely, common biological functions. And Carey's work shows that children's biological theories help them determine which respects are relevant. Thus, the 6-year-old children's rudimentary biological knowledge influences the structure of their concept of animal (see also Au & Romo, 1999; Coley, 1995; Keil, 1989; Simons & Keil, 1995; for other studies on the development of biological knowledge, see Hatano and Inagaki, 1999; Inagaki & Hatano, 2002; see Gelman, 2003, for comprehensive reviews).

DOMAIN SPECIFICITY

A number of researchers, especially in the area of cognitive development, have suggested that cognition is organized in terms of distinct domains, each characterized by (usually) innate constraints or skeletal principles of development. For example, naive psychology (theories about people), naive biology (theories about livings things), and naive physics (theories about the physical world) may constitute distinct domains with somewhat different principles of conceptual development (see Hirschfeld & Gelman, 1994, for examples).

Although is it difficult to define a domain precisely, the notion of domain specificity has served to organize a great deal of research on conceptual development. For example, there has been a strong focus on the question of whether and when young children distinguish between psychology and biology. Carey (1985) argued that young children understand biological concepts in terms of a naive psychology in which human beings are the prototypical psychological entity. She suggested that only later on do children reorganize their knowledge into a less anthropocentric, biological form in which human beings are simply one animal among many. It is possible, however, that these results were driven by the relatively impoverished experience that children from large cities may have with nature. Rural European American and rural Native American children do not show this anthropocentric pattern (Ross, Medin, Coley, & Atran, 2003). In any event Carey's (1985) claims have sparked a great deal of research, and the current consensus is that young children do have biologically specific theories, though they may differ in content and degree of elaboration from those of adults (for extensive reviews, see Gelman, 2003; Inagaki & Hatano, 2002; Keil, 1989). Some of this research involves children's understanding of *essences*, a topic to which we next turn.

PSYCHOLOGICAL ESSENTIALISM

One way of integrating similarity and explanation is through psychological essentialism (Gelman, Coley, & Gottfried, 1994; Keil,

1989; Medin & Ortony, 1989). The main ideas are as follows: People act as if things (e.g., objects) have essences or underlying natures that make them the thing that they are. Essentialism is an idea present in many cultures (e.g., Atran, 1990; Walker, 1992). For biological categories in our culture, people often identify essence with genetic structure. The essence constrains or generates properties of organisms that may vary in their centrality. For example, people in our culture believe that the categories *male* and *female* are genetically determined, but to pick out someone as male or female we rely on characteristics such as hair length, height, facial hair, and clothing that represent a mixture of secondary sexual characteristics and cultural conventions. Although these characteristics are less reliable than genetic evidence, they are far from arbitrary. Not only do they have some validity in a statistical sense but also they are tied to our biological and cultural conceptions of male and female.

Why should people act as if things have essences? Possibly the reason is that it may be a good strategy for learning about the world; that is, our perceptual and conceptual systems appear to have evolved such that the essentialist heuristic is very often correct (Atran, 1990; Medin & Wattenmaker, 1987; Shepard, 1987). Classifying on the basis of similarity will be relatively effective much of the time, but that similarity will yield to knowledge of deeper principles. Gelman and Wellman (1991) showed that even young children seem to use notions of essence in reasoning about biological kinds (see also Gelman & Hirschfeld, 1999). Susan Gelman has systematically traced the development of essentialism and its role in conceptual and linguistic development (see Gelman, 2003, for a review).

The third experiment by Gelman and Wellman (1991) provides an example of a method for examining children's beliefs about nature versus nurture in biology. Children were told a story about a baby who, shortly after birth, was taken away from the birth parent to live with animals of a different species (a between-species manipulation). Importantly, the children were told that the baby never saw another animal of its mother's species again. Once children heard the story, they were asked whether the baby would have a particular property possessed by the birth parent or a particular property possessed by the adoptive parent when it was all grown up. Some of the properties were behavioral (e.g., a horse's neigh and a tiger's roar) and some of the properties were physical (e.g., kangaroos have a pouch and goats do not have a pouch). All of the properties were "known" in that they were category-typical properties about which the children would already have had some knowledge. Results showed that 4- and 5-year-old children exhibited a birth bias (i.e., they were more likely to say that the baby had the same property as the birth parent rather than the adoptive parent) for both behavioral and physical properties.

This initial study has sparked a number of other investigations, some driven by methodological issues and others aimed at testing the cross-cultural universality of a birth bias in children's reasoning. The upshot is quite strong support for a widespread birth bias in young children, even though adults' patterns of reasoning diverge across studies (e.g., Astuti, Solomon, Carey, Ingold, & Miller, 2004; Atran et al., 2001; Sousa, Atran, & Medin, 2002; Waxman, Medin, & Ross, in press).

We have presented only one theory and one interpretation of the data from the adoption properties paradigm. It would be misleading to imply that there is any strong consensus on essentialism. For example, as some researchers argue the key is that people are sensitive to causal relations, and that the notion of an essence is not needed (e.g., Rehder & Hastie, 2001; Rips, 2001; Strevens, 2000; see Ahn et al., 2001, for counterarguments).

Summary

Although it is hard to summarize across vast literatures, our impression is that the more categories are grounded by real-world contingencies, the greater the cross-cultural agreement in categorization. For example, in the domain of biology, the most relevant and informative rank corresponds to the scientific level of genus (and in most local contexts to species), and cross-cultural agreement is also the most unequivocal at this level (e.g., Berlin, 1992; Malt, 1995).

Cross-cultural studies of people's biology have influenced cognitive theories of concept and categories in at least two distinct ways. One is that undergraduates at major U.S. universities are often the "odd group out," and "standard" results do not hold up well to cross-cultural scrutiny (see Medin & Atran,

2004, for a summary). The other is that extensive experience with the same biological kinds (involving the same activities and goals) does not guarantee convergence with respect to conceptions of living kinds. In particular it appears that cultural groups differ substantially in their understandings of relations among kinds or, in other words, in their folkecology.

Another way to state this generalization is to note that shared categories need not imply shared meanings. For example, Atran et al. (2002) studied Itza' Maya and Ladino agroculturalists in Guatemala and noted that the Ladino term for the forest (*tierra agarrada de nadie*) translates into "the land guarded by no one," contrasting sharply with the Itza' Maya tendency to refer to the forest as *kiwotoch*, which translates as "our home." Guess which group has more sustainable practices? The point is that a major source of cultural differences is not in fixing reference but rather in meanings, which may guide attitudes and behaviors. We now turn to a second critically important domain, social reasoning.

SOCIAL CATEGORIES AND CULTURE

The ability to categorize individuals into social categories is fundamental to interpreting and predicting the behavior of others. Indeed, given the complexity of human cultural life, the competencies underlying social categorization are among the most important human reasoning capacities. Therefore, it is not surprising that these competencies are grounded in our species' evolutionary past and are among the earliest discriminations human infants make. Many species, including most nonhuman primates, inhabit complex social environments in which the capacity to identify and classify conspecifics is paramount. Chimpanzee social relationships, for example, require the capacity to distinguish other chimps with respect to sex, age grade, kin relation, residential group, as well as position in status hierarchies (de Waal, 1998). Given how deeply rooted these distinctions are in human natural history, we should not be surprised to find that human *infants* display precocious sensitivity to the age (Brooks & Lewis, 1976), gender (Miller, 1983), language spoken (Mehler et al., 1988), and even race (Kelly, Quinn, & Slater, 2005) of other humans in their environment.

Intriguingly, despite the evident universal dimensions of the capacity for social discrimination and ultimately categorization, the degree to which social categories are contingent aspects of culture is striking. Anthropologists, comparative sociologists, and historians have documented extraordinary differences in the way peoples partition and reason about the social world. Even those classifications that otherwise seem grounded in natural "fact" vary dramatically across cultures. Consider the classification of kinfolk. On the one hand, as anyone who has witnessed a young child acquire language knows, kinterms such as *Mama* and *Papa* are invariably among the first words produced and understood (Hirschfeld, 1989). On the other hand, and perhaps less familiar to many readers, the classification of kin, at least to the anthropologist, is the preternaturally varying system of cultural categorization. Particularly for speakers of English, kinship categories represent the cultural recognition of relations of procreation and affiliation, and more or less accurately map them linguistically (Goodenough, 1955). All "full" siblings are biologically equally close relations, first cousins are somewhat less so, second cousins, even less so, and so on. Yet the thrust of kinship studies—which *was* largely what anthropologists studied during much of the 20th century—has been the demonstration that understanding consanguinity requires an understanding of the specificities of cultural tradition, not the universals of human procreation (Schneider, 1980).

As an illustration, consider the system of kin classification of the Batak of highland Sumatra, with whom one of us (LH) worked. Kin categories not only identify relations of consanguinity but also specify what these relations *mean*. In the case of the Batak system, kin categories pick out proscriptive marriage partners (in fact, this system, found throughout much of southeast Asia, has figured in one of anthropology's most influential debates [Leach, 1970; Lévi-Strauss, 1949]). In contrast to the American system, in which marriage between first cousins is generally avoided, among the Batak, kin classified as parallel cousins (the child of a parent's same-sex sibling; e.g., the father's brother's child) are in the same category as one's siblings. Accordingly, marriage between them is prohibited. On the other hand, cross-cousins (the child of a parent's opposite-sex sibling; e.g., the mother's brother's daughter) are

preferred marriage partners. Blatantly, these contrasting classifications do not reflect relations of biological proximity; parallel and cross cousins are equally close biologically.

The classification of kinfolk, of course, is not the only system of "natural" categories that vary across cultures. Even "givens" such as "sex" (*not* gender) vary intriguingly across cultural traditions, as Laqueur (1990) demonstrated in his history of the shift from a one-sex system to the modern two-sex system. The notion of *child*, on the one hand, is evidently a universal (e.g., infants are able to discriminate between children and adults, *and* to distinguish both from midgets), but it is also widely recognized as a cultural construction (Ariès famously [1962] argued that children were not recognized as a distinct category of being prior to the 15th century). As with most categories, a particular pattern of partitioning a domain is linked to a particular pattern of reasoning about the domain as well. In contemporary U.S. society, for example, children are typically not considered capable to cross a busy street without supervision, whereas 8-year-olds are preferred caregivers for infants in much of the world (Morelli, Rogoff, & Angelillo, 2003).

As with many systems of categorization, the study of social categories therefore involves a tension between attention to their universal psychological bases and to the considerable cultural variation that mark them. Our goal in this section is to address this tension directly, and in doing so, we take an approach that is distinct from many other chapters in this volume. Among other things, we do not pretend to present a balanced or comprehensive review of existing work on culture and social categorization. Rather we suggest, following Sperber (1996), that much cultural variation in cognition is best explained by identifying the factors that shape the distribution of cognitive representations within a given population. This approach does not assume, or even favor, identifying either the boundaries or key features (symbols, meanings, propositions, regimes of truth, etc.) of a particular culture. Sperber's epidemiological theory does not oblige us to distinguish between cultural and other forms of knowledge but simply requires that we identify the factors underlying the (more or less) stable, recurring distribution of representation in a particular population. Nor, in this view, is it assumed that all linked cultural phenomena can be mapped on the same population (i.e., have identical distributions) or that the same factors underlie the distribution of different cultural phenomena within the same cultural tradition. In brief, culture is more or less a sort of thing, not a unique level of variation.

Sperber's (1996) approach does not discount cultural variation. Rather, it holds that cultural variation can in significant measure be explained as the outcome of the operation of invariant cognitive processes. Specifically, Sperber argues that variation in the distribution of many cultural phenomena is governed by evolved and modular, domain-specific cognitive competencies that render some representations "catchier"—hence, more widely and stably distributed—than others. It is not that these cognitive competencies are dedicated to producing cultural phenomena—that they were evolved to output cultural phenomena. Rather, culturally varying representations are produced by these competencies and are exploited for cultural purposes. Sperber gives as an example the widely varying and culturally important elaborations of human faces found in virtually all cultures. Ranging from special-purpose makeup to sculpture to masks to gargoyles, the ubiquity *and* variation in the cultural elaboration of faces rest on an evolved and robust capacity to identify and remember human faces, even from degraded and/or programmatic representations (e.g., a circle with two dot and a dash). Plausibly evolved to track individual persons and their actions, the special *psychological* salience of human faces makes them excellent objects of cultural variation, if *excellent* in this context means "widely and stably distributed."

We propose that parallel, domain-specific processes underlie cultural variation in some social categories. Humans, we suggest, are endowed with a psychological module—elsewhere Hirschfeld (1996) has referred to it as "naive sociology"—that governs the development of the capacity to reason about others' actions by virtue of their membership in social groups. Although the competency for naive sociology may be innately prepared, elaborations of its output vary substantially across cultures. Indeed, our proposal is that social categories are central to virtually all systems that regulate and organize human behavior *precisely because* these systems are so easy to learn and remember, and they are so easy to learn and remember because they are grounded in a universal, cognitive competency.

To understand better the nature and scope of the modular competence for naive sociology, it is useful to identify and contrast it with another evolved, domain-specific capacity for understanding the behavior of others. In addition to reasoning about people with respect to memberships in groups, humans readily account for the actions of others as a function of other unseen mental states and dispositions. In previous research, the two capacities have typically been studied independently, giving the impression that they may represent distinct phenomena. But as Hamilton and his colleagues argue, group-based reasoning in fact relies on the same cognitive mechanisms and processes as person perception (Crawford, Sherman, & Hamilton, 2002; Hamilton & Sherman, 1996). To the contrary, we argue that each of these capacities is based in a distinct evolved, modular device. Theory of mind (ToM)—the capacity to interpret and predict another's actions on the basis of unseen mental states—appears to be a species-specific capacity (Povinelli & Bering, 2002; Tomasello, Call, & Hare, 2003). Frith and Frith (2003; Gallagher & Frith, 2003) provide evidence that ToM involves a special-purpose neurocognitive module. Although culture is likely to elaborate, highlight, or place them in the background, clearly these attributions of intentional states have an innate basis.

Reasoning about individual persons involves both attributions of transient mental states (Johnny stole a cookie from the cookie jar because he *believed* that cookies were in the cookie jar, and he *believed* that consuming them would satisfy his *desire* to sate his hunger) or enduring dispositions and traits (Johnny stole a cookie from the cookie jar because he is an intrinsically *dishonest* person). Conventional psychological wisdom about both transient mental states, particularly emotions, and dispositions and traits has been challenged during the last two decades (as several chapters in this volume attest) by anthropologists (Lutz, 1988) and cultural psychologists (Markus & Kityama, 1991). It is important to distinguish, at least in this context, between how peoples *talk* about motivation to act and how such motivation is actually psychologically achieved. Johnny may say that he believes in ghosts, when in fact he does not believe that sentient creatures can pass through solid objects (Atran, 2002; Barrett & Keil, 1996; Boyer, 2001), and at the group level, Johnny might say that the Nuer believe in ghosts. But the Nuer do not actually believe anything, only individual Nuer form beliefs—in particular, Johnny-the-Nuer's beliefs about what the Nuer supposedly believe (Sperber, 1996).

Even though cultures vary widely in the degree to which attributions of mental states and attributions of dispositions and traits are engaged, the cognitive processes that make such attributions possible vary little across cultures. Experience also does not significantly alter the individual's capacity to make either kind of attribution. For example, living in a cultural environment that disprefers attributions of dispositions and traits in favor of more interdependent representations of self does not reduce the individual's *capacity* for such attributions (Nisbett, 2003). Similarly, being reared in a more communal cultural environment does not reduce the individual's capacity, if not proclivity, to interpret behavior in terms of private, individually experienced mental states (Avis & Harris, 1991).

Our concern here is the human capacity to use group membership in interpreting and predicting the actions of others (Berreby, 2005; Furth, 1996; Hirschfeld, 1989; Jackendoff, 1992). Membership in social groups serves to identify both the *kind* of person an individual is and the *roles* the individual may assume. It also *explains* behavior as a function of group affiliation. The hypothesis that this sort of explanation is the result of the operation of a modular cognitive competency is supported by several lines of research. The first concerns the range of variation in *types* of social categories encountered. Despite considerable variation in their elaborations, surprisingly few dimensions of social difference predominate in all cultures and across all historical epochs: sex/gender, age, kinship, language spoken, and race/ethnicity. Each of these social dimensions, across a broad range of cultures, is seen as having a particular essence that governs the development and behavior of the organism (Gelman, 2003; Haslam, Rothchild, & Ernst, 2000; Hirschfeld, 1996; Mahalingham, 1998). As we observed earlier, the ability to classify people over these types of categories emerges quite early, in some important respects during infancy (for gender, see Miller, 1983; for age, see Brooks & Lewis, 1976; for language spoken, see Mehler et al., 1988). This kind of robust development, in which cultural experience appears to have limited effect, is a hallmark of a modular competence.

A second line of supporting evidence comes from considerable research on stereotyping. A number of studies have now demonstrated that many stereotypes are based in nonconscious, automatic processes (e.g., similarity judgments, categorization formation, within- and between-category biases [Greenwald & Banaji, 1995; Hilton & von Hippel, 1996], among other strategies of category-based reasoning under uncertainty). Relevant to this discussion is work demonstrating that even quite young children are subject to subtle social biases. Children, like adults, show ingroup favoritism even when membership is based on trivial commonalities (Nesdale & Flesser, 2001). Recent studies have demonstrated the early emergence of a susceptibility to stereotype threat (Ambady, Shih, & Kim, 2001), strikingly at an age when racial and ethnic stereotypes play virtually no role in shaping children's behavior. Imaging studies suggest that the perception of and reasoning about race and racial stereotypes may involve unique patterns of neural activation (Eberhardt, 2005; Hart et al., 2000; Phelps et al., 2000; Richeson et al., 2003; Wheeler & Fiske, 2005).

These findings aside, most work on stereotypes in social psychology would not be thought to support the domain-specific competency hypothesis we propose. Indeed, according to a long-standing view in social psychology, social categorization differs from other object categories only to the degree that social categories are object categories whose target stimuli are people (Hamilton & Trolier, 1986). A developmental corollary is the widely held claim that stereotypes arise through a process of social learning: Children are exposed to stereotypes, particularly those expressed by important adult models such as parents and teachers, and as a result, come to hold them (e.g., Powslishta, Sen, Serbin, Poulin-Dubois, & Eichstedt, 2001).

Social learning presupposes social modeling, particularly modeling of attitudes and practices by parents, teachers, and other significant persons in the child's environment. "As the twig is bent, so grows the tree" goes the old saw. Yet several studies show that children's racial and ethnic biases are not reliably associated with the beliefs and attitudes of parents or peers. This is the case even when children believe that their attitudes correspond to those of parents and peers, and even when parents intervene to shape directly their children's racial and ethnic attitudes (Aboud & Doyle, 1996). These findings are inconsistent with the view of social development, according to which young children's early understanding of social categories is tethered to surface differences in appearance. Young children, according to this view, grasp neither racial nor gender constancy, instead believing that superficial and reversible changes in skin color actually change an individual's racial identity or that superficial aspects of appearance such as hair length or gendered clothing determine one's gender. Finally, according to this model, it is only as children mature that their understanding becomes more adult-like (e.g., grasping the notions of racial and gender constant, and eventually coming to understand both as functions of a person's biological constitution/heritage). For example, Aboud and Skerry (1983) found that when Canadian 5-year-olds were shown pictures of a familiar Anglo child dressed in traditional Eskimo clothing, most agreed that the child had become Eskimo. Semaj (1980) found a similar pattern of reasoning when he asked young children whether a child's race would change if he wore a blond wig and light makeup; they also judged that the child's race would change.

Our proposal predicts a different pattern of development: Even early representations of social groups are theory-like and untethered to perceptual appearance. Thus, like the modular competencies for folkbiology, ToM, naive physics, and numerosity, a competence for naive sociology predicts that children develop largely on their own more adult-like knowledge of social groups, and form more adult-like representations of them. Hirschfeld (1996) speculated that children may have found Aboud and Skerry's (1983) and Semaj's (1980) transformation tasks difficult, because the changes were both implausibly abrupt and difficult to integrate with gradual changes typical of biological processes. To rule out this possibility, Hirschfeld (1996) asked preschoolers whether racial and other corporeal properties could change in the familiar context of transformations that occur over one's lifespan and over generations. When asked which property would remain unchanged as a person grew up (hair and skin color vs. clothing style and color), even 3-year-olds judged that racial properties were more constant than sartorial ones. More strikingly, when asked which property would remain unchanged as a person grew up (hair and skin color vs. body build), 4-year-

olds judged that racial properties were more constant than body build. The same pattern of judgment was obtained when Hirschfeld asked which properties would remain constant between a parent and his or her child (i.e., if a heavyset parent was black he was more likely to have a thin, black child than a heavyset white one).

Similar results were found when Hirschfeld (1996) asked preschoolers whether a child would develop racial properties matching her birth parents or those of her adopted parents. Hirschfeld's studied the judgments of North American and Northern European children; however, the same theory-like understanding of race has been documented by Giménez and Harris (2002) among Spanish preschoolers, by Astuti et al. (2004) in their work with 6-year-olds in Madagascar, and by Mahalingham (1998) in his study of South Asian preadolescents.

Modular competencies also appear to channel children's attention to specific kinds of things (e.g., with folkbiology, nonhuman living organisms, or with naive physics, the relationship between the movements of objects). In domains, such as naive sociology, in which cultural input evidently plays a significant role, the modular competence specifies that membership in essentialized groups is particularly informative, it does not specify whether the essentialized group is a race, as in contemporary North America, or caste, as in contemporary South Asia; the relevant entities are inferred from cultural information rather than given by the environment. A crucial task for the child is to determine which sources of cultural knowledge are likely to provide the most relevant information. In conventional social learning theory, it is assumed that parents and teachers are the best sources of information. As observed earlier, however, this does not appear to be the case with racial information. On reflection, this is hardly surprising: If children are to develop culturally meaningful understanding, they should look to culturally meaningful sources of information. Relying on very local sources—say, a particular family tradition or a particular teacher's image of the world—risks forming beliefs that may be marginal to the dominant cultural traditions. If, however, the child attends to representations in the larger community, then her knowledge is more likely in line with the broader contours of the cultural tradition in which she participates. The issue is essentially one of sampling. In the case of the young child, it means attending to—privileging—less frequently encountered sources over more frequently encountered, local ones.

As an illustration, consider the development of accent. Young children of non-native speakers do not develop the accents of their parents. They develop normative speech patterns, often not well modeled by their parent (Harris, 1998; Hirschfeld, 1996). Presumably this occurs because the local source of linguistic information is discounted relative to less local, and less frequently encountered, sources. Somehow the child knows to sample the broader speech community in language learning. If our proposal is correct, then we would expect to find examples of this sampling bias in the development of social categories, particularly in reasoning based on social category membership. In support of this claim, Hirschfeld (1996) conducted a study examining the development of the "one drop of blood rule," the culturally specific expectation that a person with any traceable black ancestor is black. Children's interpretation of racial admixture was not found to be shaped by race, as social learning theory would predict. By age 12, children living in a predominantly white city judged that a child with one black parent would have phenotypically black features. Black 12-year-olds living in a community with a large minority population, in contrast, judged that a child with one black and one white parent would look mixed. The crucial case was the white children living in the community with a large minority population. Like black 12-year-olds from the same community, the white children judged that the mixed-race couple would have a child that looked mixed. In short, children's reasoning about race was more influenced by community—the cultural environment—in which they lived than by their race/ethnicity.

In summary, social reasoning makes use of a variety of skills and competencies, but there is emerging evidence that key competencies are invariant across cultures and are likely to be in part innate. In the domain of reasoning about individual persons, attributions of mental states and traits are likely to be grounded in one innate module, whereas in the domain of reasoning about individual persons as members of groups, there seems to be an innate preparedness to detect group memberships and use them as the basis for social inference. Cultures are likely to exploit such innate compe-

tencies, advantaging cultural representations whose stability and recurrence are enhanced by them. Cultural variation and universal psychological processes are not opposing explanations but are instead functions of the same human cognitive architecture.

OTHER ISSUES TO CONSIDER

The following section addresses additional methodological issues that should be considered when conducting research on culture, categorization, and reasoning. Included in the discussion of these issues is a brief introduction to other kinds of concepts (e.g., non-natural kinds, emotions) not covered earlier in this chapter. Reference to these kinds of concepts is included in this chapter for completeness, but readers interested in a more comprehensive review should refer to the literature cited in this section and beyond.

Task Sensitivity

When searching for cultural differences, it is important to consider whether the task being used is sensitive enough or appropriate for finding cultural differences. For instance, replicating earlier work by Chiu (1972) and Nisbett and colleagues (2001), Unsworth, Sears, and Pexman (2005) found that Chinese adults are more likely to group both natural and non-natural kinds together if they share a relationship (e.g., a car and a tire), and that Canadian adults might be more likely to group natural and non-natural kinds together if they belong to the same category (e.g., a car and a bus). However, cultural differences in categorization were not observed in a timed categorization task, although differences in response latencies were analogous with the differences in categorization found in the previous experiment. The authors interpreted the results as suggesting that differences in categorization styles are associated with differences in semantic activation, but, importantly, they noted that the results also suggest that the nature of the categorization task may determine the extent to which these cultural differences are observed. Interestingly, Medin et al. (2002) found the opposite pattern to that found by Unsworth et al. (2005), such that cultural differences were observed in a speeded task but disappeared in an unspeeded task (this study is described in more detail in an earlier section of this chapter). Medin et al. (2002) suggested that the cultural differences observed were due to differences in "habits of the mind" that are more easily observed in a speeded task. If such an explanation is correct, then it is unclear why the opposite pattern was found by Unsworth et al. (2005). This inconsistency would be interesting to follow up in future research. Importantly, though, both studies reveal the importance of considering whether the task is sensitive enough to detect cultural differences. Such considerations could impact the kinds of conclusions drawn about the variability of particular aspects of cognition across cultural communities.

Elaboration of Concepts

Yet another issue to bear in mind is whether an investigation of cultural differences is "deep enough," that is, whether the myriad ways in which concepts can differ across communities have been explored. Two areas of research that could benefit from further analysis include the studies of emotion concepts and of artifact concepts.

A number of researchers have investigated the extent to which emotion concepts vary across cultural communities (e.g., Boster, 2005; Ekman, 1972; Izard & Buechler, 1980; Johnstone & Scherer, 2000; Kim & Hupka, 2002; Lutz, 1988; Markus & Kitayama, 1991; Páez & Vergara, 1995; Romney, Moore, & Rusch, 1997; Rosaldo, 1984; Russell, 1991; Scherer & Wallbott, 1994; P. B. Smith & Bond, 1993; Wierzbicka, 1992).

Research about emotion concepts and culture has primarily focused on the extent to which emotions are biologically determined, and therefore universal (e.g., Ekman, 1972; Izard & Buechlar, 1980), or socially constructed, and therefore culturally relative (e.g., Lutz, 1985, 1987, 1988; Rosaldo, 1980, 1984). Although some researchers argue in favor of one or the other of these two extremes, most researchers adopt a kind of hybrid theory, in which they believe that some components of emotions, such as certain physiological responses (e.g., facial expressions, the release of particular hormones) may be experienced universally, but that the way particular emotions are displayed and the kinds of emotion categories people form may be culturally specific.

The kinds of similarities and differences researchers might examine include (1) whether

an emotion is lexicalized or not; (2) the degree of correspondence of lexicalized emotion terms across cultures; and (3) whether there are differences in rules about expressions of emotions and conceptualizations about whether the resulting behaviors are voluntary or not (e.g., running amok).

It is well-known that there is substantial cultural variability in lexicons of emotion. Thus, many cultures have at least several emotion words that correspond to basic emotions such as joy, anger, sadness, fear, and disgust, but some cultures have only a few words for these emotions (Russell, 1991). Nevertheless, when words for basic emotions are present, there is an impressive cross-cultural similarity in the meanings of these words. For example, Scherer and Wallbott (1994) asked participants in 37 countries across five continents to complete questionnaires about seven different emotions (joy, anger, fear, sadness, disgust, shame, and guilt). Participants first recalled experiences in which they felt each emotion and were then asked specific questions about those emotional experiences. Results revealed that the seven emotions differed substantially from each other, and that geographical and sociocultural differences were observed, but such differences were much smaller than the overall differences between the emotions themselves. A similar conclusion was obtained by Kim and Hupka (2002), who compared Koreans and Americans, and Romney et al. (1997), who tested perceived similarities of English and Japanese emotion terms.

However, Boster (2005) has pointed out that such research often involves an attempt to match semantic meanings of emotion terms using methods such as back-translation, and that such methodology can be problematic in assessing cross-cultural variation. In particular, translation methods often occur before data collection, so it is not surprising to see cross-cultural agreement elicited by terms that have been chosen specifically because they correspond to each other across languages. Furthermore, although other research may not rely on translation as a first step (see Russell, 1983, 1989), such research often involves similarity judgments on only a couple of shallow dimensions (e.g., evaluation [positive, negative], arousal) that may not capture deep semantic structure and might therefore fail to capture important semantic variations across cultures. To examine emotion concepts at a deeper level of analysis, future research might include an investigation into whether some cultural groups elaborate a subset of emotional concepts (e.g., those associated with guilt in Japan) more than others, or whether expressions of particular emotions vary with respect to social roles in some cultural groups more than in others. One useful approach for future research might be to conduct ethnographic studies to generate further predictions about where cultural differences might exist and to obtain a more comprehensive understanding about the nature of particular cultural differences.

Studies examining culture and the concepts of artifacts have led to conclusions similar to those made for cultural differences in emotion concepts, namely, that differences in naming practices can sometimes be much more pronounced than conceptual differences. For instance, Malt, Sloman, Gennari, Shi, and Wang (1999) asked English-, Chinese-, and Spanish-speaking adults to categorize nonnatural kinds (60 different bottles and jars) explicitly on the basis of different kinds of similarity, and after several types of analyses, concluded that there were no cultural differences in these similarity-based sorts. Importantly, Malt et al. noted that there is little agreement about the most relevant features for artifact categorization, so separate sorts were based on similarity of physical qualities (e.g., what it looks like, what it is made of), similarity of function (e.g., how it is used), and "overall" similarity. None of these sorts produced cultural differences. However, Malt et al. did find substantial differences in naming patterns for these objects (whether the item is named a bottle, a jar, or a container, etc.), suggesting that the relationship between similarity and naming of these artifacts is not very straightforward. Further research should examine whether cultural differences in categorizing the objects emerge if categorization is based on other dimensions (contextual relevance of particular bottles, etc.; conceptual elaboration of particular bottles) and whether these different types of sorts map more directly onto naming patterns in the different communities. Again, ethnography would be a useful tool in this regard.

Attribution of Differences

Once cultural differences have been found, it is important to consider whether the differences can really be attributed to differences in the

concept or process of interest, or whether there is an alternative explanation for the results. For example, Norenzayan, Smith, Jun Kim, and Nisbett (2002) argued that East Asians were less likely than European Americans to abandon intuitive reasoning (i.e., reasoning based on experience and information from the senses) in favor of formal reasoning (i.e., reasoning based on rules and formal logic), and although some of their findings are compelling, other results must be considered with caution. In Experiments 1 and 2 they found cross-cultural differences in categorization and conceptual structure, and in Experiments 3 and 4, cross-cultural differences in deductive reasoning. However, the cultural differences observed in Experiment 4 are not attributable to differences in deductive reasoning or even to intuitive or formal reasoning more generally. We shall soon see why.

In the fourth experiment, Norenzayan et al. (2002) examined cultural differences in deductive reasoning by giving Korean and U.S. college students valid and invalid arguments that were either abstract or concrete; for the concrete problems, the conclusions were either believable (consistent with real-world knowledge) or unbelievable (inconsistent with real-world knowledge). The groups did not differ on the abstract problems, but Norenzayan et al. found that Koreans were less likely than were U.S. college students to endorse concrete arguments with unbelievable conclusions. They concluded that the Koreans' reliance on intuitive reasoning led to less accurate responses in this task.

The Norenzayan et al. (2002) results are not unambiguous, in that they do not separate response biases (i.e., the tendency to be more or less liberal when deciding to accept an argument as valid) from the ability to distinguish between valid and invalid arguments. In fact, Unsworth and Medin (2005) showed that Korean participants overall were much less likely to accept an argument as valid, and that cultural differences in reasoning disappeared when response biases were taken into consideration. The reason for the cultural difference in response bias or criterion setting is unclear, and this particular finding would be interesting to examine more closely in its own right. Furthermore, future research specific to deductive reasoning might profit by narrowing the examination to a domain in which specific cultural differences might be expected (e.g., Menominee deductive reasoning in the domain of biology, or Chinese deductive reasoning in the domain of social relationships).

SUMMARY AND CONCLUSIONS

We are very much in the position of describing a moving target. The intersection of culture, categorization, and reasoning currently is receiving a great deal of attention, and new empirical findings appear almost daily. This field of research has largely overcome its ugly beginnings, in which cognitive tasks developed in Western countries were transported wholesale to other cultures, and contexts and any differences noted were interpreted as deficits (see Cole & Scribner, 1974, for a review). We say "largely" because cultural research needs to be constantly vigilant about "home court assumptions" that get in the way of our understanding other cultures. We see room for both broad contrasts based on a few dimensions of difference and very specific examinations of single cultural groups. But to yield powerful generalizations, the broad contrasts will have to be coupled with careful ethnography and sociohistorical analyses. We have tried to show that a serious concern with the fine-grained, typically narrative specificity of ethnographic and historical investigations does not mean abandoning psychology's powerful theories and methods, honed in laboratory studies. Social scientists have long been skeptical of the "anthropological veto," the claim that since it does not happen like that in Pago Pago, one has got it wrong (see Bloch, Solomon, & Carey, 2001, for a nice example of the tension between experimental probes and ethnographic observation). It is uncontroversial that cognition, no matter how widely a *task* may be distributed, is something that happens in individual minds. It is no more controversial that individual minds inhabit complex cultural environments—indeed, that the mind's evolution was profoundly shaped by complex cultural circumstances. Categorization and reasoning simply cannot be understood without taking into account both the mind and the environment that supports it.

In the same vein, we believe that it is impossible for studies of single cultures to be theoretically neutral. Therefore, the promise for this field lies on middle ground, where both within- and between-culture similarities and differ-

ences are recruited in the service of understanding how culture affects thought. As we have seen, triangulation can be an effective strategy for understanding both within-culture differences and across-cultural similarities. In addition, the CCM has proven to be a useful tool in the service understanding variation. In ongoing work in Guatemala and among cultural groups in Wisconsin, we are collecting social network data along with cognitive measures to see whether similarities in values and beliefs can be linked to social network proximities. If so, we may be in a position to observe cultural processes at work.

Finally, it is also worth pointing out that attending to complex cultural environments does not require *cross*-cultural research. In other words, research that is sensitive to cultural processes does not necessarily require observations of *differences* or comparisons *between* cultural communities to be meaningful and interesting. Simply directing attention towards any community not typically represented in psychological research will help to inform our understanding of cognitive and psychosocial phenomena in new and exciting ways. Given the overwhelming focus of cognitive research on U.S. college students, it behooves us to do meaningful ethnography, apply consensus analysis, and employ converging measures, with the goal of understanding the nature and dynamics of their culture.

NOTE

1. The notion of "cultural epidemiology" has two distinct traditions: one focused on the relatively high-fidelity "reproduction" and patterning of cultural (including psychological) traits within and across human populations, and the other focused on the ways cognitive structures "generate" and chain together ideas, artifacts, and behaviors within and across human populations. Jacques Monod (1971), the Nobel Prize–winning biologist, was the first to use the concept of "culture as contagion"—although more as metaphor than theory. Cavalli-Sforza and Feldman (1981) were pioneers in working out a theory in which culture is conceptualized as distributed through a population; however, no microscale cognitive processes or structures were modeled or considered, only macroscale social psychological traits. Lumsden and Wilson (1981) explicitly advocated a theory of culture as distributed mental representations, but the combination of a high degree of mathematical sophistication and a rudimentary awareness of basic conceptual structures failed to spawn any further serious research along their lines.

Two more fully developed epidemiological approaches soon emerged. Boyd and Richerson (1985) were able to show how biases in transmission, such as prestige or conformism, could help to explain the spread and stabilization of macrosocial psychological traits among populations. Sperber (1985) provided the first theoretical blueprint for how individual-level microcognitive structures (as opposed to invocation of imitation or other cultural reproduction processes) could account for cultural transmission and stabilization. Until now, there has been little fruitful interaction between these two traditions (see Laland & Brown, 2002; Henrich & Boyd, 2002). We believe that these two "epidemiological" traditions are compatible, and our empirical example suggests that they can be mutually informative.

REFERENCES

Aboud, F. E., & Doyle, A.-B. (1996). Parental and peer influences on children's racial attitudes [Special Issue]. *International Journal of Intercultural Relations*, *20*(3–4), 371–383.

Aboud, F. E., & Skerry, S. A. (1983). Self and ethnic concepts in relation to ethnic constancy. *Canadian Journal of Behavioural Science*, *15*, 14–26.

Ahn, W., Kalish, C., Gelman, S. A., Medin, D. L., Luhmann, C., Atran, S., et al. (2001). Why essences are essential in the psychology of concepts. *Cognition*, *82*, 59–69.

Ambady, N., Shih, M., & Kim, A. (2001). Stereotype susceptibility in children: Effects of identity activation on quantitative performance. Psychological Science, *12*(5), 385–390.

Anderson, J. R. (1990a). *Cognitive psychology and its implications* (3rd ed.). New York: Freeman.

Anderson, J. R. (1990b). *The adaptive character of thought*. Hillsdale, NJ: Erlbaum.

Ariès, P. (1962). Centuries of childhood: A social history of family life. New York: Knopf.

Astuti, R., Solomon, G. A., & Carey, S. (2004). Constraints on conceptual development: A case study of the acquisition of folkbiological and folksociological knowledge in Madagascar. In W. A. Collins (Ed.), *Monographs of the Society for Research in Child Development* (pp. 1–135). Oxford, UK: Blackwell.

Astuti, R., Solomon, G. E. A., Carey, S., Ingold, T., & Miller, P. H. (2004). Constraints on conceptual development: A case study of the acquisition of folkbiological and folksociological knowledge in Madagascar. Boston, MA: Blackwell.

Atran, S. (1990). *Cognitive foundations of natural history*. Cambridge, UK: Cambridge University Press.

Atran, S. (2001). The trouble with memes: Inference versus imitation in cultural evolution. *Human Nature*, *12*, 351–381.

Atran, S. (2002). In gods we trust: The evolutionary landscape of religion. Oxford, UK: Oxford University Press.

Atran, S., Medin, D., Lynch, E., Vapnarsky, V., Ucan Ek', E., & Sousa, P. (2001). Folkbiology doesn't come from folkpsychology: Evidence from Yukatek Maya in cross-cultural perspective. *Journal of Cognition and Culture*, *1*, 3–42.

Atran, S., Medin, D., & Ross, N. (2005). The cultural mind: Environmental decision making and cultural modeling within and across populations. *Psychological Review*, *112*, 744–776.

Atran, S., Medin, D., Ross, N., Lynch, E., Vapnarsky, V., Ucan Ek', E., et al. (2002). Folkecology, cultural epidemiology, and the spirit of the commons: A garden experiment in that Maya Lowlands, 1991–2001. *Current Anthropology*, *43*, 421–450.

Au, T. K., & Romo, L. F. (1999). Mechanical causality in children's "folkbiology." In D. L. Medin & S. Atran (Eds.), *Folkbiology* (pp. 355–401). Cambridge, MA: MIT Press.

Avis, J., & Harris, P. L. (1991). Belief-desire reasoning among Baka children: Evidence for a universal conception of mind. *Child Development*, *62*(3), 460–467.

Au, T. K., Romo, L. F., & DeWitt, J. E. (1999). Considering children's folkbiology in health education. In M. Siegal & C. Peterson (Eds.), *Children's understanding of biology and health* (pp. 209–234). London: Cambridge University Press.

Axelrod, R. (1997). Advancing the art of simulation. *Complexity*, *3*, 193–199.

Bailenson, J., Shum, M., Atran, S., Medin, D., & Coley, J. (2002). A bird's eye view: Biological categorization and reasoning within and across cultures. *Cognition*, *84*, 1–53.

Barrett, J. L., & Keil, F. C. (1996). Conceptualizing a nonnatural entity: Anthropomorphism in God concepts. *Cognitive Psychology*, *31*(3), 219–247.

Barsalou, L. W. (1985). Ideals, central tendency, and frequency of instantiation as determinants of graded structure in categories. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *11*, 629–654.

Bellezza, F. S. (1984). Reliability of retrieval from semantic memory: Noun meanings. *Bulletin of the Psychonomic Society*, *22*, 377–380.

Berlin, B. (1978). Ethnobiological classification. In E. Rosch & B. B. Lloyd (Eds.), *Cognition and categorization* (pp. 9–26). Hillsdale, NJ: Erlbaum.

Berlin, B. (1992). *Ethnobiological classification*. Princeton, NJ: Princeton University Press.

Berreby, D. (2005). *Us and them: Understanding your tribal mind*. New York: Little, Brown.

Bloch, M., Solomon, G., & Carey, S. (2001). Zafimaniry: An understanding of what is passed on from parents to children. A cross-cultural investigation. *Journal of Cognition and Culture*, *1*(1), 43–68.

Boster, J. (2005). Emotion categories across languages. In H. Cohen & C. Lefebvre (Eds.), *Handbook of categorization in cognitive science* (pp. 188–223). London: Elsevier Science.

Boyd, R., & Richerson, P. J. (1985). *Culture and the evolutionary process*. Chicago: The University of Chicago Press.

Boyer, P. (2001). *Religion explained: The human instincts that fashion gods, spirits and ancestors*. London: Heinemann.

Briley, D., Morris, M., & Simonson, I. (2000). Reasons as carriers of culture: Dynamic versus dispositional models of cultural influence on decision making. *Journal of Consumer Research*, *27*, 157–178.

Brooks, J., & Lewis, M. (1976). Infants' responses to strangers: Midget, adult, and child. *Child Development*, *47(2), 323–332.*

Brown, C. (1995). Lexical acculturation and ethnobiology: Utilitarianism and intellectualism. *Journal of Linguistic Anthropology 5*, 51–64.

Brumann, C. (1999). Why a successful concept should not be discarded. *Current Anthropology*, *40*, S1–S14.

Bulmer, R. (1970). Which came first, the chicken or the egg-head? In J. Pouillon & P. Maranda (Eds.), *Echanges et communications: Mèlanges offerts [daggerdbl] Claude Lèvi-Strauss*. The Hague: Mouton.

Bulmer, R. (1974). Folk biology in the New Guinea Highlands. *Social Science Information*, *13*, 9–28.

Burnett, R., Medin, D., Ross, N., & Blok, S. (2005). Ideal is typical. *Canadian Journal of Psychology*, *59*, 3–10.

Burnett, R., Medin, D., Ross, N. O., & Block S. V. (2005). Ideal is typical. *Canadian Journal of Psychology*, *59*, 3–10.

Carey, S. (1982). Semantic development: The state of the art. In E. Wanner & L. R. Gleitman (Eds.), *Language acquisition: The state of the art*. Cambridge, UK: Cambridge University Press.

Carey, S. (1985). *Conceptual change in childhood*. Cambridge, MA: Bradford Books.

Cavalli-Sforza, L. L., & Feldman, M. W. (1981). *Cultural transmission and evolution: A quantitative approach*. Princeton, NJ: Princeton University Press.

Chiu, L. (1972). A cross-cultural comparison of cognitive styles in Chinese and American children. *International Journal of Psychology*, *7*, 235–242.

Choi, I., Nisbett, R., & Smith, E. (1999). Culture, category salience, and inductive reasoning. *Cognition*, *65*, 15–32.

Cohen, D. (2001). Cultural variation: Considerations and implications. *Psychological Bulletin*, *127*, 451–471.

Cole, M. (1996). *Cultural psychology*. Cambridge, MA: Harvard University Press.

Cole, M., & Scribner, S. (1974). *Culture and thought: A psychological introduction*. New York: Wiley.

Coley, J. D. (1995). Emerging differentiation of folkbiology and folkpsychology: Attributions of biological and psychological properties to living things. *Child Development*, *66*, 1856–1874.

Coley, J. D., Hayes, B., Lawson, C., & Moloney, M. (2004). Knowledge, expectations, and inductive inferences within conceptual hierarchies. *Cognition*, *90*, 217–253.

Coley, J., Medin, D., & Atran, S. (1997). Does rank have its privilege?: Inductive inferences in folkbiological taxonomies. *Cognition*, *64*, 73–112.

Crawford, M. T., Sherman, S. J., & Hamilton, D. L. (2002). Perceived entitativity, stereotype formation, and the interchangeability of group members. *Journal of Personality and Social Psychology*, *83*, 1076–1094.

de Waal, F. B. M. (1998). *Chimpanzee politics: Power and sex among apes* (Rev. ed.). Baltimore: Johns Hopkins University Press.

Diamond, J., & Bishop, K. (1999). Ethno-ornithology of the Ketengban people. In D. L. Medin & S. Atran (Eds.), *Folkbiology* (pp. 17–46). Cambridge, MA: MIT Press.

Eberhardt, J. L. (2005). Imaging race. *American Psychologist*, *60*(2), 181–190.

Eid, M., & Diener, E. (2001). Norms for experiencing emotions in different cultures: Inter- and intranational differences. *Journal of Personality and Social Psychology*, *81*, 869–885.

Ekman, P. (1972). Universals and cultural differences in facial expressions of emotion. In J. Cole (Ed.), *Nebraska Symposium on Motivation 1971* (Vol. 19, pp. 207–283). Lincoln: University of Nebraska Press.

Ellen, R. (1993). *The cultural relations of classification*. Cambridge, UK: Cambridge University Press.

Estes, W. K. (1986). Array models for category learning. *Cognitive Psychology*, *18*, 500–549.

Estes, W. K. (1994). *Classification and cognition*. New York: Oxford University Press.

Flannagan, M. J., Fried, L. S., & Holyoak, K. J. (1986). Distributional expectations and the induction of category structure. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *12*, 241–256.

Fried, L. S., & Holyoak, K. J. (1984). Induction of category distributions: A framework for classification learning. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *10*, 234–257.

Frith, U., & Frith, C. (2003). Development and neurphysiology of mentalizing. *Philosophical Transactions of the Royal Society of London*, *358*, 459–473.

Fukuyama, F. (1995). *Trust*. New York: Free Press.

Furth, H. (1996). *Desire for society: Children's knowledge as social imagination*. New York: Plenum Press.

Gardner, W., Gabriel, S., & Lee, A. (1999). "I" value freedom but "we" value relationships: Self-construal priming mirrors cultural differences in judgment. *Psychological Science*, *10*, 321–326.

Gallagher, H. L., & Frith, C. D. (2003). Functional imagine of "theory of mind." *Trends in Cognitive Sciences*, *7*(2), 77–83.

Gelman, R. (2002). Cognitive development. In H. Pashler & D. L. Medin (Eds.), *Stevens' handbook of experimental psychology, third edition* (Vol. 2, pp. 533–559). New York: Wiley.

Gelman, S. A. (2003). *The essential child: Origins of essentialism in everyday thought*. Oxford, UK: Oxford University Press.

Gelman, S. A., Coley, J. D., & Gottfried, G. M. (1994). Essentialist beliefs in children: The acquisition of concepts and theories. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Mapping the mind* (pp. 341–367). Cambridge, UK: Cambridge University Press.

Gelman, S., & Hirschfeld, L. (1999). How biological is essentialism? In D. Medin & S. Atran (Eds.), *Folkbiology* (pp. 403–446). Cambridge, MA: MIT Press.

Gelman, S., & Wellman, H. (1991). Insides and essences. *Cognition*, *38*, 213–244.

Gentner, D., & Goldin-Meadow, S. (Eds.). (2003). *Language in mind: Advances in the study of language and thought*. Cambridge, MA: MIT Press.

Giménez, M., & Harris, P. L. (2002). Understanding constraints on inheritance: Evidence for biological thinking in early childhood. *British Journal of Developmental Psychology*, *20*(3), 307–324.

Goodenough, W. (1955) Componential analysis and the study of meaning. *Language*, *32*, 185–216.

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review*, *102*, 4–27.

Hamilton, D. L., & Sherman, S. J. (1996). Perceiving persons and groups. *Psychological Review*, *103*, 336–355.

Hamilton, D. L., & Trolier, T. K. (1986). Stereotypes and stereotyping: An overview of the cognitive approach. In J. Dovidio & S. Gaertner (Eds.), *Prejudice, discrimination, and racism* (pp. 127–163). Orlando, FL: Academic Press.

Harris, J. R. (1998). *The nurture assumption: Why children turn out the way they do*. New York: Free Press.

Hart, A. J., Whalen, P. J., Shin, L. M., McInerney, S. C., Fischer, H., & Rauch, S. L. (2000). Differential response in the human amygdala to racial outgroup vs. ingroup face stimuli. *Neuroreport*, *11*, 2351–2355.

Haslam, N., Rothschild, L., & Ernst, D. (2000). Essentialist beliefs about social categories. *British Journal of Social Psychology*, *39*(1), 113–127.

Hatano, G., & Inagaki, K. (1999). A developmental perspective on informal biology. In D. L. Medin & S. Atran (Eds.), *Folkbiology* (pp. 321–354). Cambridge, MA: MIT Press.

Henrich, J., & Boyd, R. (2002). On modeling cognition and culture: Why replicators are not necessary for cultural evolution. *Journal of Cognition and Culture*, *2*, 87–112.

Heyman, G. D., & Gelman, S. A. (2000). Preschool children's use of trait labels to make inductive inferences. *Journal of Experimental Child Psychology*, *77*(1), 1–19.

Heyman, G. D., & Gelman, S. A. (2000). Beliefs about the origins of human psychological traits. *Developmental Psychology*, *36*(5), 663–678.

Hilton, J. L., & von Hippel, W. (1996). Stereotypes. *Annual Review of Psychology*, *47*, 237–271.

Hirschfeld, L. A. (1989). Rethinking the acquisition of kinship terms. *International Journal of Behavioral Development*, *12*, 541–568.

Hirschfeld, L. A. (1995). Do children have a theory of race? *Cognition, 54*, 209–252.

Hirschfeld, L. A. (1996). *Race in the making*. Cambridge, MA: MIT Press.

Hirschfeld, L. A., & Gelman, S. A. (Eds.). (1994). *Mapping the mind: Domain specificity in cognition and culture*. New York: Cambridge University Press.

Hofstede, G. (1980). *Culture's consequences: International differences in work-related values*. Beverly Hills, CA: Sage.

Homa, D. (1984). On the nature of categories. In G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 18, pp. 49–94). San Diego, CA: Academic Press.

Hubert, L., & Golledge, R. (1981). A heuristic method for the comparison of related structures. *Journal of Mathematical Psychology, 23*, 214–226.

Hunn, E. S. (1975). A measure of the degree of correspondence of folk to scientific biological classification. *American Ethnologist, 2*, 309–327.

Hunn, E. S. (1982). The utilitarian factor in folk biological classification. *American Anthropologist, 84*, 830–847.

Hunn, E. S. (1999). Size as limiting the recognition of biodiversity in folkbiological classifications: One of four factors governing the cultural recognition of biological taxa. In D. L. Medin & S. Atran (Eds.), *Folkbiology* (pp. 47–70). Cambridge, MA: MIT Press.

Huntington, S. (1996). *The clash of civilizations and the remaking of the world order*. New York: Simon & Schuster.

Hutchins, E. (1995). *Cognition in the wild*. Cambridge, MA: MIT Press.

Inagaki, K., & Hatano, G. (2002). *Young children's naive thinking about the biological world*. New York: Psychology Press.

Inagaki, K., & Sugiyama, K. (1988). Attributing human characteristics: Developmental changes in over- and under-attribution. *Cognitive Development, 3*, 55–70.

Izard, C. E., & Buechler, S. (1980). Aspects of consciousness and personality in terms of differential emotions theory. In R. Plutchik & H. Kellerman (Eds.), *Emotion, theory, research, and experience: Vol. I. Theories of emotion* (pp. 165–181). New York: Academic Press.

Jackendoff, R. (1992). *Language of the mind: Essays on mental representation*. Cambridge, MA: MIT Press.

Johnson, K. E. (2001). Determinants of typicality throughout the continuum of expertise. *Memory and Cognition, 29*, 1036–1050.

Johnson, K., & Mervis, C. (1997). Effects of varying levels of expertise on the basic level of categorization. *Journal of Experimental Psychology: General, 126*, 248–277.

Johnson, K. E., & Mervis, C. B. (1998). Impact of intuitive theories on feature recruitment throughout the continuum of expertise. *Memory and Cognition, 26*, 382–401.

Johnstone, T., & Scherer, K. R. (2000). Vocal communication of emotion. In M. Lewis & J. M. Haviland-Jones (Eds.), *Handbook of emotions* (pp. 220–235). New York: Guilford Press.

Keil, F. (1989). *Concepts, kinds, and cognitive development*. Cambridge MA: MIT Press.

Keil, F. C., & Batterman, N. (1984). A characteristic-to-defining shift in the development of word meaning. *Journal of Verbal Learning and Verbal Behavior, 23*, 221–236.

Kelly, Quinn, & Slater (2005). Three-month-olds, but not newborns, prefer own-race faces. *Developmental Science, 8*(6), F31–F36.

Kim, H. J., & Hupka, R. B. (2002). Comparison of associative meaning of the concepts of anger, envy, fear, and jealousy between English and Korean. *Cross-Cultural Research, 36*, 229–255.

Kim, N. S., & Ahn, W. (2002). Clinical psychologists' theory-based representations of mental disorders predict their diagnostic reasoning and memory. *Journal of Experimental Psychology: General, 131*, 451–476.

Kitayama, S., Ishii, K., Imada, T., Takemura, K., & Ramaswamy, J. (2006). Voluntary settlement and the spirit of independence: Evidence from Japan's "Northern Frontier." *Journal of Personality and Social Psychology, 91*, 369–384.

Laland, K. N., & Brown, G. R. (2002). *Sense and nonsense: Evolutionary perspectives on human behavior*. Oxford, UK: Oxford University Press.

Laland, K., Olding-Smee, F. J., & Feldman, M. (2000). Niche construction, biological evolution and cultural change. *Behavioral and Brain Sciences, 23*, 131–146.

Laqueur, T. (1990). *Making sex: Body and gender from the Greeks to Freud*. Cambridge, MA: Harvard University Press.

Lamberts, K. (1995). Categorization under time pressure. *Journal of Experimental Psychology: General, 124*, 161–180.

Lave, J. (1988). *Cognition in practice*. Cambridge, UK: Cambridge University Press.

Leach, E. R. (1970). *Political systems of Highland Burma: A study of Kachin social structure*. London: Athlone Press.

Lèvi-Strauss, C. (1949). *Les structures elementaires de la parenté*. Paris: Presses Universitaires de France.

López, A., Atran, S., Coley, J., Medin, D., & Smith, E. (1997). The tree of life: Universals of folk-biological taxonomies and inductions. *Cognitive Psychology, 32*, 251–295.

Lumsden, C. J., & Wilson, E. O. (1981). *Genes, mind, and culture: The coevolutionary process*. Cambridge, MA: Harvard University Press.

Lutz, C. (1985). Ethnopsychology compared to what? Explaining behavior and consciousness among the Ifaluk. In G. White & J. Kirkpatrick (Eds.), *Person, self, and experience: Exploring Pacific ethnopsychologies* (pp. 35–79). Berkeley: University of California Press.

Lutz, C. (1987). Goals, events, and understanding in Ifaluk emotion theory. In D. Holland & N. Quinn

(Eds.), *Cultural models in language and thought* (pp. 290–312). Cambridge, UK: Cambridge University Press.

Lutz, C. (1988). *Unnatural emotions: Everyday sentiments on a Micronesian atoll and their challenge to Western theory.* Chicago: University of Chicago Press.

Lynch, E., Coley, J., & Medin, D. (2000). Tall is typical: Central tendency, ideal dimensions and graded category structure among tree experts and novices. *Memory and Cognition, 28,* 41–50.

Mahalingam, R. (1998). Essentialism, power and representation of caste: A developmental study. *Dissertation Abstracts International, 60*(2-B).

Malt, B. (1995). Category coherence in cross-cultural perspective. *Cognitive Psychology, 29,* 85–148.

Malt, B. C., Sloman, S. A., Gennari, S., Shi, M., & Wang, Y. (1999). Knowing versus naming: Similarity and the linguistic categorization of artifacts. *Journal of Memory and Language, 40,* 230–262.

Markus, H., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98,* 224–253.

McCloskey, M., & Glucksberg, S. (1978). Natural categories: Well-defined or fuzzy-sets? *Memory and Cognition, 6,* 462—472.

Medin, D., & Atran, S. (2004). The native mind: Biological categorization and reasoning in development and across cultures. *Psychological Review, 111,* 960–983.

Medin, D., Lynch, E., Coley, J., & Atran, S. (1997). Categorization and reasoning among tree experts: Do all roads lead to Rome? *Cognitive Psychology, 32,* 49–96.

Medin, D., & Ortony, A. (1989). Psychological essentialism. In S. Vosniadou & A. Ortony (Eds.), *Similarity and analogical reasoning* (pp. 179–195). New York: Cambridge University Press.

Medin, D., Ross, N., Atran, S., Burnett, R., & Blok, S. (2002). Categorization and reasoning in relation to culture and expertise. In B. Ross (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 41, pp. 1–38). New York: Academic Press.

Medin, D. L., Altom, M. W., Edelson, S. M., & Freko, D. (1982). Correlated symptoms and simulated medical classification. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 8,* 37–50.

Medin, D. L., & Coley, J. D. (1998). Concepts and categorization. In J. Hochberg & J. E. Cutting (Eds.), *Handbook of perception and cognition: Perception and cognition at century's end* (2nd ed., pp. 403–440). San Diego: Academic Press.

Medin, D. L., Ross, N. O., Cox, D. G., & Atran, S. (in press). Why folkbiology matters: Resource conflict despite shared goals and values. *Human Ecology.*

Medin, D. L., & Wattenmaker, W. D. (1987). Family resemblance, conceptual cohesiveness and category construction. *Cognitive Psychology, 19,* 242–279.

Mehler, J., Jusczyk, P., Lambertz, G., Halsted, N., Bertoncini, J., & Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. *Cognition, 29,* 143–178.

Miller, C. L. (1983). Developmental changes in male/female voice classification by infants. *Infant Behavior and Development, 6*(3), 313–330.

Monod, J. (1971). *Chance and necessity: An essay on the natural philosophy of modern biology.* New York: Knopf.

Moore, C., Romney, A. K., Hsia, T., & Rush, C. (2000). The universality of the semantic structure of emotion terms. *American Anthropologist, 101,* 530–546.

Morelli, G. A., Rogoff, B., & Angelillo, C. (2003). Cultural variation in young children's access to work or involvement in specialised child-focused activities. *International Journal of Behavioral Development, 27*(3), 264–274.

Murphy, G. L. (2002). *The big book of concepts.* Cambridge, MA: MIT Press.

Murphy, G. L., & Medin, D. L. (1985). The role of theories in conceptual coherence. *Psychological Review, 92,* 289–316.

Nesdale, D., & Flesser, D. (2001). Social identity and the development of children's group attitudes. *Child Development, 72*(2), 506–517.

Niedenthal, P. M., Halberstadt, J. B., & Innes-Ker, A. H. (1999). Emotional response categorization. *Psychological Review, 106,* 337–361.

Nisbett, R., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review, 108,* 291–310.

Nisbett, R. E. (2003). *The geography of thought: How Asians and westerners think differently—and why.* New York: Free Press.

Norenzayan, A., Smith, E. E., Kim, B. J., & Nisbett, R. E. (2002). Cultural preferences for formal versus intuitive reasoning. *Cognitive Science, 26,* 653–684.

Nosofsky, R. M. (1992). Exemplar-based approach to relating categorization, identification, and recognition. In F. G. Ashby (Ed.), *Multidimensional models of perception and cognition* (pp. 363–393). Hillsdale, NJ: Erlbaum.

Nosofsky, R. M., & Palmeri, T. J. (1997). An exemplar-based random walk model of speeded classification. *Psychological Review, 104,* 266–300.

Ocherson, D. N., Smith, E. E., Wilkie, O., Lopez, A., & Shafir, E. (1990). Category-based induction. *Psychological Review, 97,* 185–200.

Osgood, C. E., Suci, G. J., Tannenbaum, P. H. (1957). *The measurement of meaning.* Urbana: University of Illinois Press.

Oyserman, D., Coon, H. M., & Kemmelmeier, M. (2002). Rethinking individualism and collectivism: Evaluation of theoretical assumptions and meta-analyses. *Psychological Bulletin, 128*(1), 3–72.

Páez, D., & Vergara, A. (1995). Cultural differences in emotional knowledge. In J. A. Russell, J. M. Fernandez-Dols, A. S. R. Manstead, & J. C. Wellencamp (Eds.), *Everyday conceptions of emo-*

tion: An introduction to the psychology, anthropology, and linguistics of emotion (pp. 415–434). Boston: Kluwer.

Phelps, E. A., O'Connor, K. J., Cunningham, W. A., Funayama, E. S., Gatenby, J. C., Gore, J. C., et al. (2000). Performance on indirect measures of race evaluation predicts amygdala activation. *Journal of Cognitive Neuroscience, 12*, 729–738.

Povinelli, D. J., & Bering, J. M. (2002). The mentality of apes revisited. *Current Directions in Psychological Science, 11*(4), 115–119.

Powslishta, K. K., Sen, M. G., Serbin, L. A., Poulin-Dubois, D., & Eichstedt, J. A. (2001). From infancy to middle childhood: The role of cognitive and social factors in becoming gendered. In R. K. Unger (Ed.), *Handbook of the psychology of women and gender* (pp. 116–132). New York: Wiley.

Proffitt, J., Coley, J., & Medin, D. (2000). Expertise and category-based induction. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*, 811–828.

Rappaport, R. (1999). *Ritual and religion in the making of humanity*. Cambridge, UK: Cambridge University Press.

Rehder, B., & Hastie, R. (2001). Causal knowledge and categories: The effects of causal beliefs on categorization, induction, and similarity. *Journal of Experimental Psychology: General, 130*, 323–360.

Richeson, J. A., Baird, A. A., Gordon, H. L., Heatherton, T. F., Wyland, C. L., Trawalter, S., et al. (2003). An fMRI investigation of the impact of interracial contact on executive function. *Nature Neuroscience, 6*, 1323–1328.

Rips, L. (2001). Necessity and natural categories. *Psychological Bulletin, 127*, 827–852.

Romney, A. K., & Batchelder, W. (1999). Cultural consensus theory. In R. Wilson & F. Keil (Eds.), *The MIT encyclopedia of the cognitive sciences* (pp. 208–209). Cambridge, MA: MIT Press.

Romney, A. K., Brewer, D. D., & Batchelder, W. H. (1996). The relation between typicality and semantic similarity structure. *Journal of Quantitative Anthropology, 6*, 1–14.

Romney, A. K., Moore, C. C., & Rusch, C. D. (1997). Cultural universals: Measuring the semantic structure of emotion terms in English and Japanese. *Proceedings of the National Academy of Sciences USA, 94*, 5489–5494.

Romney, A. K., Weller, S., & Batchelder, W. (1986). Culture as consensus: A theory of culture and informant accuracy. *American Anthropologist, 88*, 313–338.

Rosaldo, M. (1980). *Knowledge and passion: Ilongot notions of self and social life*. Cambridge, UK: Cambridge University Press.

Rosaldo, R. (1984). Grief and a headhunter's rage: On the cultural force of emotions. In E. Brunner & S. Plattner (Eds.), *Text, play, and story: The construction and reconstruction of the self and society* (pp. 178–195). Washington, DC: American Ethnological Society.

Rosch, E., & Mervis, C. B. (1975). Family resemblance: Studies in the internal structure of categories. *Cognitive Psychology, 7*, 573–605.

Rosch, E., Mervis, C., Grey, W., Johnson, D., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology, 8*, 382–439.

Ross, N., Medin, D., Coley, J. D., & Atran, S. (2002). Cultural and experiential differences in the development of folkbiological induction. *Cognitive Development, 18*, 25–47.

Russell, J. A. (1983). Pancultural aspects of the human conceptual organization of emotions. *Journal of Personality and Social Psychology, 45*, 1281–1288.

Russell, J. A. (1989). Measures of emotion. In R. Plutchik & H. Kellerman (Eds.), *Emotion: Theory, research, and experience* (Vol. 4, pp. 83–111). New York: Academic Press.

Russell, J. A. (1991). Culture and the categorization of emotion. *Psychological Bulletin, 110*, 426–450.

Scheffler, H. W., & Lounsbury, F. G. (1971). A study in structural semantics: The Siriono kinship system. Englewood Cliffs, NJ: Prentice Hall.

Scherer, K. R., & Wallbott, H. G. (1994). Evidence for universality and cultural variation of differential emotion response patterning. *Journal of Personality and Social Psychology, 66*, 310–328.

Schneider, D. (1980). *American kinship: A cultural account*. Chicago: University of Chicago Press.

Semaj, M. B. (1980). The development of racial evaluation and preference: A cognitive approach. *Journal of Black Psychology, 6*, 59–79.

Shafto, P., & Coley, J. D. (2003). Development of categorization and reasoning in the natural world: Novices to experts, naive similarity to ecological knowledge. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 29*, 641–649.

Shepard, R. N. (1987). Toward a universal law of generalization for psychological science. *Science, 237*, 1317–1323.

Simons, D. J., & Keil, F. C. (1995). An abstract to concrete shift in the development of biological thought: The insides story. *Cognition, 56*, 129–163.

Smith, E., & Medin, D. (1981). *Categories and concepts*. Cambridge, MA: Harvard University Press.

Smith, J. D., & Minda, J. P. (1998). Prototypes in the mist: The early epochs of category learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24*, 1411–1436.

Smith, J. D., & Minda, J. P. (2000). Thirty categorization results in search of a model. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*, 3–27.

Smith, P. B., & Bond, M. H. (1993). *Social psychology across cultures*. New York: Harvester Wheatsheaf.

Smits, T., Storms, G., Rosseel, Y., & De Boeck, P. (2002). Fruits and vegetables categorized: An application of the generalized context model. *Psychonomic Bulletin and Review, 9*, 836–844.

Sousa, P., Atran, S., & Medin, D. (2002). Essentialism and folkbiology: Further evidence from Brazil. *Journal of Cognition and Culture*, *2*, 195–223.

Spalding, T. L., & Ross, B. H. (2000). Concept learning and feature interpretation. *Memory and Cognition*, *28*, 439–451.

Sperber, D. (1985). Anthropology and psychology: Toward and epidemiology of representations. *Man*, *20*, 73–89.

Sperber, D. (1996). *Explaining culture*. Oxford, UK: Blackwell.

Sperber, D., & Hirschfeld, L. (2004). The cognitive foundations of cultural stability and diversity. *Trends in Cognitive Sciences*, *8*(1), 40–46.

Storms, G., De Boeck, P., & Ruts, W. (2000). Prototype and exemplar based information in natural language categories. *Journal of Memory and Language*, *42*, 51–73.

Strevens, M. (2000). The naive aspect of essentialist theories. *Cognition*, *74*, 149–175.

Tanaka, J., & Taylor, M. (1991). Object categories and expertise: Is the basic level in the eye of the beholder? *Cognitive Psychology*, *23*, 457–482.

Tomasello, M., Call, J., & Hare, B. (2003). Chimpanzees understand psychological states—the question is which ones and to what extent. *Trends in Cognitive Sciences*, *7*(4), 153–156.

Triandis, H. (1995). *Individualism and collectivism*. Boulder, CO: Westview Press.

Unsworth, S. J., & Medin, D. L. (2005). Cross-cultural differences in belief bias with deductive reasoning? *Cognitive Science*, *29*, 525–529.

Unsworth, S. J., Sears, C. R., & Pexman, P. M. (2005). Cultural influences on categorization processes. *Journal of Cross-Cultural Psychology*, *36*, 662–688.

Verbeemen, T., Vanoverberghe, V., Storms, G., & Ruts, W. (2001). Contrast categories in natural language concepts. *Journal of Memory and Language*, *44*, 1–26.

Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Walker, S. J. (1992). Supernatural beliefs, natural kinds and conceptual structure. *Memory and Cognition*, *20*, 655–662.

Waxman, S. R., Medin, D. L., & Ross, N. (in press). Folkbiological reasoning from a cross-cultural developmental perspective: Early essentialist notions are shaped by cultural beliefs. *Developmental Psychology*.

Wheeler, M. E., & Fiske, S. T. (2005). Controlling racial prejudice and stereotyping: Social cognitive goals affect amygdala and stereotype activation. *Psychological Science*, *16*, 56–63.

Wierzbicka, A. (1992). *Semantics, culture, and cognition: Universal human concepts in culture-specific configurations*. Oxford, UK: Oxford University Press.

Wilson, D. S. (2002). *Darwin's cathedral*. Chicago: University of Chicago Press.

Wisniewski, E., & Medin, D. (1994). On the interaction of theory and data in concept learning. *Cognitive Science*, *18*, 221–281.

Wolff, P., Medin, D., & Pankratz, C. (1999). Evolution and devolution of folkbiological knowledge. *Cognition*, *73*, 177–204.