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Category Coherence in Cross-Cultural Perspective

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Cognitive psychologists and cognitive anthropologists alike have been concerned with how the human mind divides entities in the world into categories. Cognitive psychologists have recently begun approaching this issue by asking a question long of interest to anthropologists: To what extent are the categories given by structure in the environment, and to what extent are they created through constructive processes on the part of the human categorizer? Despite this shared question, relatively little of the data available in the anthropological literature has become familiar to psychologists. Psychologists stand to benefit from greater acquaintance with this literature, since the cross-cultural studies have often addressed the relative roles of structure in the environment vs constructive processes by the observer more directly than psychological studies have. Furthermore, cross-cultural data provide a unique opportunity to separate culture-specific from universal aspects of categorization. This paper sketches positions on the nature of category formation that have been put forth in the psychological literature. It then reviews in detail four areas of anthropological research that are relevant to evaluating the psychological perspectives. The cross-cultural data provide substantial constraints for theories of category coherence. © 1995 Academic Press, Inc.

Which came first, the chicken or the egghead? This question, posed in the title of Bulmer's (1970) essay, captures a set of issues that has concerned cognitive anthropologists over the past three decades. The issues are these: Of all the countless possible ways of dividing entities in the world into categories, why do members of a culture use some groupings and not use others? What is it about the nature of the human mind and the way that it interacts with the nature of the world that gives rise to the categories that are used? In Bulmer's terms, which is more influential: the chicken (the objective facts of nature) or the egghead (the human intellect in its role as classifier)? These issues are central to cognitive anthropology's quest to understand the role of culture and environment in human thought.

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Cognitive psychologists during the same time period have also been concerned with understanding human categorization. As has often been observed, the world is filled with an incredible number and diversity of objects. If people treated each object as an isolated entity unrelated to any others, mental life would be chaotic (Smith & Medin, 1981). The ability to group objects into categories provides efficiency in communication and memory, and it underlies the ability to draw inferences about unseen properties of new objects. As such, it is among the most fundamental of cognitive processes, and it has become a central research topic for cognitive psychologists seeking to understand the basic architecture of the human mind.

Despite a common interest in classification, early psychological studies differed in emphasis from the anthropological explorations. Materials for the psychological studies were most often artificial categories consisting of geometric shapes (e.g., Bruner, Goodnow, & Austin, 1956), dot patterns (Posner & Keele, 1968, 1970), or other abstract forms (e.g., Neuman, 1974; Reed, 1972), and such studies focused on how these artificial categories were learned and mentally represented. While the stimuli reflected certain assumptions about possible structures of real-world categories (e.g., that all exemplars share a set of necessary and sufficient features, or that membership in a category is probabilistic), there was little investigation of the actual resemblance of these stimuli to real-world categories.

More recently, however, cognitive psychologists have recognized that artificial patterns may not accurately reflect the structure of real-world categories, and their use in laboratory studies may not elicit the same kind of responses that real-world categories do. Thus, the questions posed by Bulmer and other anthropologists have begun to be echoed in the questions asked by cognitive psychologists. What is the nature of real-world categories? What makes these categories coherent to us? How and why do we form the categories we do? These questions reflect a growing commitment by psychologists to understanding how cognitive processes operate in the complex environment of the world beyond the laboratory.

Psychologists and anthropologists are now asking similar questions, and they share the common goal of understanding how the human mind deals with the human environment. Nevertheless, there has been relatively little contact between the psychological investigations and the anthropological. This separation of the two enterprises may be especially unfortunate for psychologists for several reasons. For one, at this point, there have been more anthropological than psychological studies that directly address the roles of the environment and the mind in constructing categories. For another, anthropological studies provide data from a variety of different cultures speaking a variety of different languages, and in doing so they may be able to provide insights into universal versus culture-specific aspects of categorization that data from only one culture cannot. Finally, many anthropological studies have involved cultures with little or no contact with

Western science, and this fact further helps disentangle the universal from the culture-specific aspects of categorization. Psychological theorizing about category formation therefore stands to benefit from greater acquaintance with the anthropological literature.

I will first briefly lay out the major proposals that psychologists have made about how humans segment their world into categories. In the remainder of the paper, I will review anthropological literature that bears on the same issues, and I will draw out implications of the anthropological data for psychological theorizing. The data provide substantial constraints for theories of category coherence.

Anthropologists have studied classification in a variety of domains including plants and animals (ethnobiology), color, kinship, textiles, and household objects such as pots and bowls. The ethnobiological studies have addressed questions with the greatest direct correspondence to issues raised by psychologists and have been most systematic in their approach. Since studies on this topic provide the largest amount of relevant data, this review will focus on the domain of ethnobiology. I will address the question of generalizability from ethnobiology to other domains under General Discussion.

PROPOSALS FROM PSYCHOLOGY

Proposals from within psychology have varied in the relative weight they give to the environment versus the constructive processes on the part of the human categorizer in determining what categories get formed. The general trend might be summarized as saying that early work emphasized the role of the environment and more recent work emphasizes the role of the human. However, different lines of work within psychology have not necessarily all followed this trend. Furthermore, there are a number of distinct variants of these general tendencies, differing in the nature of the structure they attribute to the environment and/or the nature of the constructive processes they attribute to the categorizer.

Table 1 summarizes five identifiable variants. The columns represent possible contributions of the world to determining the categories that are formed: no structure, weak structure, or strong structure. The rows represent possible con-

TABLE 1
Possible Contributions of the Human Categorizer and of the World to Category Formation

Human contribution	World contribution		
	No structure	Weak structure	Strong structure
Perceptual		Weak chicken view	Strong chicken view
Perceptual and conceptual	Strong egghead view #1	Weak egghead view	Strong egghead view #2

tributions of the human categorizer: only relatively low-level perceptual processing of the input, or perceptual processing plus top-down conceptual processing as well. The bottom left corner, then, represents a minimum influence of structure in the world and a maximum influence of the mind of the categorizer; the top right corner represents the maximum influence of world structure and minimal influence of the human categorizer; and other cells represent intermediate positions. The top left corner is empty; no theorists take the implausible view that categories are formed with unstructured input and no constructive processes on the part of the categorizer.

Borrowing Bulmer's (1970) phrasing, I refer to views that emphasize the role of the environment as "chicken" views, and views that emphasize the role of the human categorizer as "egghead" views. I will first discuss the two most extreme views, and then I will describe other versions. This overview is not exhaustive, but rather illustrates the major positions that have been held.

The Strong Chicken View

Rosch and Mervis (1975) provided one of the first proposals within psychology about how humans come to mentally organize the entities in their environment. They noted that features in the world are not distributed randomly across entities, but instead tend to occur in clusters. For instance, the features "feathers," "wings," and "beaks" frequently occur together. Rosch and Mervis suggested that we group objects together that share such clusters of features; feathered, winged creatures with beaks therefore are grouped together and form our category "bird." Similarly, the features "has leaves, has roots, has bark, is tall" tend to co-occur, and things with these features will be grouped together into the category that is labeled "tree" and so on. Thus this proposal suggests that the environment is highly structured. As will be noted later, Rosch and Mervis also at points suggested a role for a conceptual influence on categories. The dominant message of their early work, however, was that the human categorizer forms categories by recognizing structure in the world.

A number of other authors have similarly emphasized the importance of property clusters in the environment in determining what groupings are perceived as categories, and they have provided empirical support for the ability to detect feature correlations in the environment (e.g., Billman, 1989; Billman, Heit, & Dorman, 1987; Malt & Smith, 1984; Medin, Altom, Edelson, & Freko, 1982; Younger, 1985, 1990; Younger & Mekos, 1992; see also Husaim & Cohen, 1981; Kemler Nelson, 1984; and Ward, Vela, & Hass, 1990). Recognition of correlations does, of course, imply a role for the human categorizer. However, these discussions, along with Rosch and Mervis's, generally do not refer to top-down influences such as expectations about property correlations or knowledge of causal connections among properties. Thus, this view limits the contribution of the human categorizer to relatively low-level perceptual or computational processes that are presumably universal and invariant.[1]

The primacy of the role of the environment has also been asserted or assumed in many studies on the "basic" or preferred level of categorization for an object. Rosch, Mervis, Gray, Johnson, and Boyes-Braem (1976), in proposing a basic level of categorization, argued that a middle level of abstraction would be preferred for categorization since categories at this level are the most differentiated: Category members would share many attributes in common while having relatively little featural overlap with members of contrasting categories. Subsequent discussions of the basic level have debated how best to formulate the attribute structure that leads to preference for the middle level (Corter & Gluck, 1992; Murphy, 1982; Jones, 1983), but these discussions and others have retained a strong focus on the idea of structured input as underlying basic level effects on order of acquisition, speed of categorization, preferred naming, etc. (see also Mervis & Crisafi, 1982; Murphy & Brownell, 1985; Murphy & Smith, 1982; Tversky, 1989; Tversky & Hemenway, 1984).

Finally, other authors have stressed the primacy of the environmental input from somewhat different perspectives. Anderson (1991) presents a view of categorization embedded in a general theory of cognition that strongly stresses the role of the environment. He argues that not only do categories reflect the structure of the environment, but "the mind has the structure it has because the world has the structure it has" (p. 428). This approach assumes a highly structured environment and explicitly discounts the possibility of major influences of higher cognitive processes on category formation. Smith and Heise (1992) argue for a view of the relation between perception and cognition in which perception is the driving force behind conceptualization. While acknowledging that conceptual knowledge can to a limited extent guide perceptual processing, they hold that perceptual data constrain conceptual constructions to a much greater extent than vice versa.

The Strong Egghead View #1

In contrast to these appeals to a structured environment, many psychologists have recently shifted toward a view placing a strong emphasis on the role of constructive processes brought to bear by the categorizer. Murphy and Medin (1985) noted that appeals to structure in the world as the basis of categories leave several questions unresolved. Central among them is what properties of objects "count" in determining whether the objects are seen as similar to one another

[1] This view does implicitly assume some selectivity in what sets of objects in the world receive recognition as named categories. All theorists would probably agree that not every perceptually discriminable grouping becomes a category. However, under the Strong Chicken view, the selection is presumably based on perceptual salience derived from the number of intercorrelated properties, strength of the property correlations involved, etc.

(and hence forming a coherent category), and how the properties that count are weighted in the similarity judgment. They argued that both the properties taken as relevant to judging similarity and the weight these features receive are determined by a person's prior knowledge, expectations, or "theories" about the world. In their view, theories provide a "glue" that holds concepts together. Murphy (1993), in discussing Anderson's (1991) paper, suggests that for categories such as animal categories, the connection between the concepts people have and the "objective" classification of the world by biology is not very strong, and that the objective categories as determined by biology do not determine conceptual structure. Under this view, then, category formation is taken to be heavily influenced by higher-level cognitive processes that direct the perception of the world.

This approach, in fact, downplays the possibility that any single or dominant structuring of the world exists independent of the human construction of it. Medin, Wattenmaker, and Hampson (1987) suggest that the categories normally used represent only a small subset of categories that could be formed. Their data also indicate that people may not perceive the presence of certain attribute structures in a stimulus set unless they have appropriate background knowledge that makes the structure interpretable. Wattenmaker, Dewey, Murphy, and Medin (1986) note that the environment can be partitioned in an infinite number of different ways, and they conclude that there is no structuring of attributes that can be identified as most natural or learnable independent of the knowledge that a person brings to bear in acquiring the category. Medin, Goldstone, and Gentner (1993) and Murphy (1993) also seem to assume that there are multiple possible interpretations of the world that would yield different sets of categories.

An extreme version of this view is represented by Barsalou (1983, 1985). Although he assumes that common taxonomic categories such as "bird" and "chair" may be heavily based on perception of attribute clusters, he notes that people also use many kinds of categories other than common taxonomic ones. Categories such as "things to take on a picnic" or "things to eat on a diet" may contain objects that have few attributes in common with one another (e.g., food, bug repellent, and a blanket are "things to take on a picnic"). Barsalou argues that these sets of objects function as a category, nevertheless, because the category members are all instrumental to achieving some goal. The things that are taken on a picnic are the things needed for a successful meal and a good time; the things to eat on a diet are the ones that have few calories, etc. These categories are thus not dictated primarily by the structure of the world. Rather, they are formed from entities that meet particular human goals or needs. If the goal or need did not exist, the category would not exist for the human perceiver. Murphy and Medin (1985), similarly, suggest that theories can impose coherence on a set of objects even when perceptual similarity among them is low.

It should be noted that these views do not suggest that top-down processes are the only processes that affect category formation. For instance, Murphy and

Medin (1985) refer to the possibility of built-in constraints on the perceptual system (see also Medin & Ortony, 1989) and to the idea that some categories can be picked out without invoking theories. They thus seem to assume the possibility of at least some structure in the environment and some limits on what objects can constitute a coherent category. At the same time, though, their emphasis on the flexibility of categorization and the importance of top-down processes, along with their lack of explicit formulation of the role of structure in the environment, makes these relatively strong statements of an egghead position.

In sum, one extreme position within the psychology literature attributes the existence of categories primarily to structure inherent in the environment, while the other extreme position assumes the primacy of higher-level cognitive processes. However, several other positions also exist.

The Strong Egghead View #2

The recent literature on conceptual development has shared, and has helped shape, the trend toward emphasizing the importance of conceptualization described in the preceding section. Keil (1989), Carey (1985), Gelman (1988), and Gelman (1990) have all characterized conceptual development as centrally involving the development of intuitive theories of different domains (e.g., biology, social roles), and they have shown that perceptual similarity alone is not enough to explain children's judgments of category membership and inferences about properties belonging to category members. Other authors have also highlighted the contribution of the child's conceptualization to category formation. For instance, Shipley (1993) argues that sets of perceptually similar objects become categories only through the projection of hypotheses about shared properties. Once these hypotheses have been projected, perceptually dissimilar objects that share the same properties may become category members. Mandler, Bauer, and McDonough (1991) argue that even very early groupings may not be perceptually based; children's categories may be based on primitive theories of a domain by as early as 16 months. Barrett, Abdi, Murphy, and Gallagher (1993) suggest that children's intuitive theories of a domain guide what features of a stimulus will be attended to and how relations between features are interpreted.

Despite this similarity with the Strong Egghead View #1, the perspective adopted in much of the developmental literature differs from that view in a significant way. The developmental literature shares with the Strong Chicken view a much more explicit premise that compelling structure does indeed exist in the world. The child's conceptual apparatus does not serve to flexibly create categories out of relatively nonstructured input; rather, the conceptualization is of structure that is present in the world. Keil (1989), for instance, argues against "promiscuous realism" (Dupré, 1981), in which there are indefinitely many similarity relations that can be used to create categories, and instead argues for a "causal homeostasis," or the presence of causal relations in the world that result in certain clusters of properties tending to occur together (Boyd, 1984, cited in Keil). He suggests that the categories mentally represented are heavily influenced by the construction of causal explanations for the property clusters; categories are formed around sets of properties for which causal explanations are generated. Carey (1985), Gelman (1988), Markman (1989), and Mandler et al. (1991), as well as Keil, assume the existence of different ontological kinds in the world; they take part of the child's task to be understanding the nature of these kinds. Other authors, while not referring to kinds per se, also assume that structure in the world provides the basis for the categories that the child forms (at least for categories labeled by concrete nouns, e.g., Landau, Smith, & Jones, 1988; Ward, Becker, Hass, & Vela, 1991).

This view, then, emphasizes categories as reflecting structure that exists in the world to a much greater extent than the positions represented in the first Strong Egghead view. However, like that view, it assumes that perceptual processes alone are not sufficient for the construction of categories. Categories are constructed only through the engagement of higher-level cognitive processes.

The Weak Chicken View

The work discussed in the preceding three sections has most often involved studies of natural categories such as "dog" and "chair." In cases where studies involve experimenter-generated categories, there has generally been an attempt to model the stimuli after natural categories. However, both the developmental and adult literature include traditions of research somewhat separate from those discussed above, in which the stimuli are artificial and there is less concern with the relation of the artificial stimuli to members of natural categories. Work in this tradition includes that in Estes (1986; Estes, Campbell, Hatsopolous, & Hurwitz, 1989), Hintzman (1986), Homa, Sterling, and Trepel (1981), Kemler (1982), Kruschke (1992), Medin and Schwanenflugel (1981), Medin and Shaffer (1978), Nosofsky (1988; 1991; Nosofsky, Clark, & Shin, 1989), Oakes, Madole, and Cohen (1991), and Smith (1989). This work is concerned mainly with investigating low-level processes such as memory retrieval, decision processes, and weighting of dimensions, and with developing mathematical models of these processes.

Since work in this tradition does not discuss possible influences of higher-level, conceptual influences on categorization, in a sense it is similar to the Strong Chicken view. However, the focus of the work is quite different. There is more interest in the details of the lower-level perceptual and/or computational processes involved in categorization. At the same time, there is little explicit analysis of, or reference to, structure that exists in the real world. The first fact reflects an assumption that the lower-level processes are central to category formation. The second fact does not, however, reflect a stand against a possible influence of structure in the world on category formation. The artificial categories to be learned typically do not partition feature spaces randomly. Instead, they are constructed so that individual features and/or pairs of features have complete or partial predictive value for category membership. Although it is not always clear how the category structures chosen are related to the structure of natural categories, the use of these structures seems to indicate an implicit assumption that structured input is a typical learning situation. Furthermore, some studies specifically investigate the impact of different category structures on learning and performance (e.g., Estes, 1986; Medin & Schwanenflugel, 1981; Kruschke, 1992; Smith, 1989), suggesting a more explicit belief that input in the world is structured (see also Kemler Nelson, 1984, 1990). The approach in this tradition of research thus seems to represent a weaker version of the first chicken view: Lower-level processes are taken to be critical, but the artificial categories studied embody an assumption that structure is likely to be a contributing factor to category formation in the real world.

The Weak Egghead View

Finally, some work presents a weak version of an egghead position by suggesting that the categories formed are a product of an interaction between structure in the world and higher-level knowledge of the categorizer. In a review of categorization subsequent to their 1975 and 1976 papers discussed earlier, Mervis and Rosch (1981) noted that work in many areas has shown a pervasive influence of abstract and general knowledge on interpretation of input (e.g., Bartlett, 1932; Bransford, Barclay, & Franks, 1972), and they concluded that category knowledge must be integrated with such higher-order knowledge. Murphy and Wisniewski (1989) found that categories based on clusters of features consistent with people's prior experience were easier to learn than ones that violated their expectations, and they argued that expectations influenced the encoding of property correlations. Tanaka and Taylor (1991), investigating the influence of expertise on basic level categorization, found that bird and dog experts could categorize birds and dogs as fast at a low level of abstraction (e.g., "cardinal," "beagle") as non-experts could at a middle level of abstraction (e.g., "bird," "dog"). They concluded that knowledge interacts with structure in the world in determining ease of classification at any given level. Most recently, Wisniewski and Medin (1994) have argued that prior knowledge and perceived stimulus features mutually influence each other in concept learning.

Other papers that have stressed the importance of either the environment or the categorizer have also at times discussed or implied the likelihood of an interaction. For instance, despite a Strong Chicken orientation, Rosch et al. (1976) suggest that expertise as well as stimulus structure may influence location of the basic level. They note that their data suggest the basic level for biological entities such as trees may differ for their urban subjects versus more traditional rural populations. As discussed above, Wattenmaker et al. (1986) and Medin et al. (1987) argue that the world can be divided in an infinite number of different ways; however, the artificial categories that they use in the experiments seem to assume the presence of some structure in the world. Further, Medin and Wattenmaker (1987) suggest an ecological approach to category formation that assumes that perceptual processes have been shaped by the nature of the environment, and that the theories that give feature sets coherence are constrained by evolutionary processes. Such views seem to suggest that structure may exist in the world, but that it is not so powerfully present that lower-level perceptual processes operating on it alone determine what groupings of objects will be seen as coherent categories.

Summary and Conclusions

Early psychological proposals about how people segment the world into categories suggested the presence of structure in the world as the primary determinant of what objects would be grouped together and considered a coherent category. Influential subsequent proposals have stressed, instead, the contribution of knowledge or theories about the world that the human categorizer brings to the task of dividing up the world. One version of this approach suggests that virtually any set of entities can form a coherent category if the human categorizer brings the right conceptualization to bear. An alternative version is that higher-level conceptualization is necessary to form categories from existing structure. Concurrent with this newer emphasis, however, is work that continues to stress the role of the environment over the role of the categorizer; other work that makes only weak assumptions about the environment and focuses on lower-level perceptual processes; and still other work that allots both an important role.

Clearly, then, psychologists have not reached a consensus on the relative contributions of the environment versus the human categorizer in determining what categories exist. Given the available information in the psychological literature, it seems likely that some degree of interaction between top-down and bottom-up processes will exist under at least some circumstances. Much of the work representing the more extreme views has taken a Strong Chicken or Strong Egghead position as a presumption or perspective rather than as the subject of the inquiry per se; thus, the studies do not attempt to, and do not, in fact, provide evidence that *only* world structure or *only* human conceptualizations determine category formation. At the same time, they do provide separate evidence for the potential impact of structure and of conceptualizations. Furthermore, studies discussed under the Weak Egghead view provide some direct evidence for contributions from both within the same laboratory task. The difficult questions, then, are what role each plays in how categories are formed in the real world and whether the relative contributions of each vary as a function of important factors. Sources of information outside of psychological research may be valuable in shedding light on these issues.

ANTHROPOLOGICAL PERSPECTIVES

Positions that have been taken within anthropology about the relative contributions of the "chicken" and the "egghead" map roughly onto views held by psychologists, but with some significant divergences. In this section, I will briefly describe positions taken in the anthropological literature. Much of the rest of the paper will describe and evaluate the evidence that has been given in support of these views.

One early, extreme position took a view of traditional peoples as "primitive" thinkers who classify only to satisfy their basic bodily needs (Malinowski, 1954). While traditional cultures are no longer characterized as primitive, some researchers continue to emphasize the practical significance of classification of the natural world and to hold that to a significant extent, ethnobiological categories are based on utility of the category members to the culture in question (e.g., Hunn, 1982; Morris, 1983; Randall & Hunn, 1984; cf. Hays, 1982). Others in the symbolic anthropology tradition suggest that there is little or no natural order and that categories are entirely social constructs; a child must learn to impose order on natural disorder (e.g., Leach, 1964, 1976). To the extent, then, that classification is taken to be culture-specific and imposed on the input by the needs of a particular culture, these views imply that the contribution of structure in the world is minimal and the contribution of conceptualization by the human categorizer is central. These views might thus be thought of as versions of the Strong Egghead View #1 described earlier. They are distinct from the version described there, though, in that the role of the human is not necessarily one of bringing to bear sophisticated theories about causal relationships among properties, etc., but instead may be of one who understands the world in terms of what he or she can eat or otherwise use to meet the physical and social demands of survival.

Lévi-Strauss (1966) put forth a position viewed by anthropologists as constituting the opposite pole from Malinowski. He argued that humans have an inherent curiosity about the world around them and are driven to classify nature for purely intellectual reasons. This view has been taken as a strong contrast to Malinowski's view because of its portrayal of humans as curious about the world for its own sake instead of for purely utilitarian purposes (see Berlin, 1992; Boster & Johnson, 1989). Whether this position constitutes an extreme divergence from that of Malinowski in terms of the psychological positions is less clear. Lévi-Strauss' discussion ranges from examples of classification of nature corresponding to biological species to examples of classification involving myth and totemic roles. This discussion seems to imply both recognition of divisions given by nature and construction of divisions with social significance and thus implies an interplay between structure in the input and conceptualizations brought to bear by the human categorizer. To the extent that it does, this view seems to correspond best to the Weak Egghead View. It differs from the standard psychological Weak Egghead View somewhat, though, in that it suggests that input structure determines some categories and human conceptualization determines others, rather than both factors interacting in the construction of one set of categories.

An influential position that does provide a strong contrast to the Malinowskian view and constitutes a clear-cut case of the Strong Chicken View is that of Berlin (e.g., 1973, 1992; Berlin, Breedlove, & Raven, 1974). Berlin (1992) argues that humans need not be driven by a basic intellectual curiosity in order for the categories formed to be based on biological structure. Rather, they are constrained in their recognition of biological diversity by "nature's plan" (p. 8). He proposes that ". . . groups of plants and animals present themselves to the human observer as a series of discontinuities whose structure and content are seen by all human beings in essentially the same ways, perceptual givens . . ." (p. 9). Although aspects of social and cultural reality for a culture might be constructed, Berlin argues, "when human beings function as ethnobiologists . . . they do not construct order, they discern it" (p. 8).

Berlin's view, then, clearly gives structure in the input the major role in determining what categories are formed, and it suggests that only relatively low-level perceptual processes are needed to extract the structure and form categories. It thus corresponds quite closely to the Strong Chicken View as held by psychologists (and, in fact, Berlin's early work was influential in forming Rosch's [Rosch & Mervis, 1975; Rosch et al., 1976] Strong Chicken perspective). Although not always stated so explicitly by other authors, this perspective is largely shared in many reports on folk biological classification (e.g., Boster, 1987; Boster, Berlin, & O'Neill, 1986; Bulmer, 1970, 1979; Conklin, 1954, 1957; Hunn, 1975a, 1976; Waddy, 1988).

Finally, Atran (1987a, 1987b, 1990) takes a position relatively new to anthropology. Like Berlin, he argues for the existence of discontinuities in nature that are perceptually salient and that provide the input for the categories that are formed. However, to Atran, the mere perception of discontinuities is not sufficient to account for category formation. Instead, he argues, people bring to categorization a presumption that members of a given biological category share an underlying essence or nature; it is this presumption that allows them to form the categories. He suggests that "[p]resumptions of underlying nature impose constraints on the perceptual processor, which trigger the mapping of abstract and prior cognitive schema onto the world" (1987a, p. 150). In other words, higher cognitive processes are brought to bear in creating categories from the structured input that is available. This view is thus quite similar to the psychological view labeled the Strong Egghead View #2.

Summary and Conclusions

This overview illustrates that anthropologists have held as wide a range of views as psychologists have, with some differences in detail but many points of overlap. A large number of cross-cultural studies have provided data that speak to the validity of the various views. As for any complex phenomenon that raises complex theoretical issues, the data themselves are complex and occasionally contradictory. However, some central findings emerge as compelling across a range of cultures and a variety of methodologies. Other findings are provocative if not definitive. The focus of the remainder of the paper is an exploration of these findings.

As in psychological research, of course, in anthropology the broad question must be tackled in terms of specific, testable hypotheses. The literature addresses a variety of related questions relevant to understanding how people carve their world into categories. I will take up four specific issues that reflect major angles of attack in the literature: (1) To what extent does folk classification correspond to scientific classification? (2) To what extent is differentiation of a domain influenced by biological structure versus by utility to a culture? (3) To what extent are the categories that are formed "natural" and universal versus "artificial" and culture-specific? (4) Is there one level in classification systems that appears to be universally primary or most salient? I will elaborate on the relevance of each question to the broader issue as I take each up. After reviewing the evidence on each topic, I will discuss its implication for the relative contributions of structure in the world and of the human categorizer, and I will note the extent to which the data support or contradict the basic psychological perspectives laid out in the preceding section.

It should be noted that the vocabulary of anthropologists and psychologists for discussing these issues is not identical. In particular, what psychologists refer to as a "category" (that is, a set of objects grouped together by virtue of some degree of shared properties) is referred to as a "taxon" in the anthropological literature. The term "category" in the ethnobiological literature is used to refer to ranked classes of taxa (e.g., generics, specifics, life-forms, that is, taxa of differing degrees of inclusiveness having associated properties of nomenclature, contrast, etc., as described in the literature [see e.g., Berlin, 1992; Berlin, Breedlove, & Raven, 1973, and Section 4 below]). Throughout this paper, I will use "category" only in the psychologist's sense, and I will substitute category where anthropologists have used "taxon" in their writing. Also following standard psychological terminology, I will refer to the "level of abstraction" or "degree of inclusiveness" of a category rather than its "rank."

1. TO WHAT EXTENT DOES FOLK CLASSIFICATION CORRESPOND TO SCIENTIFIC CLASSIFICATION?

Scientific classification systems are aimed at capturing specifiable objective relationships among the objects being classified. In the case of plants and animals, biologists attempt to construct classifications that reflect phylogenetic (evolutionary) relatedness and/or current similarities among the objects being classified (e.g., Mayr, 1969; Simpson, 1961; Sokal & Sneath, 1963; Wiley, Siegel-Causey, Brooks, & Funk, 1991; see Hull, 1984; Ridley, 1985). Even if folk classifiers are as strongly driven to capture structure in the environment as biologists are, their categories cannot be expected to correspond fully to scientific classification because they lack the technology that is used to construct modern scientific classifications. However, many of the relationships among plants and animals confirmed by technology such as DNA analysis are also evident to the untrained eye on the basis of internal and external morphology, and indeed measures of overall similarity including those features of morphology play a partial or even a dominant role in some approaches to classification (e.g., Sokal & Crovello, 1984; Sokal & Sneath, 1963). If folk classification shows substantial correspondence to scientific classification, and does so cross-culturally, then this fact argues for a major and universal influence of structure in the world on category formation. On the other hand, if folk classifications show little correspondence to scientific classification, and if cultures differ from one another in the nature of the categories constructed, then the role of the environment would appear to be less and the role of constructive processes by the human categorizer must be greater.[2]

It should be noted that the different approaches to scientific classification do result in somewhat different assessments of the relatedness of organisms, raising questions about whether there is a single objective structure to the world that scientific classification captures. However, the anthropological papers generally do not specify the particular scientific classification scheme used for comparison, nor do they consider implications of the possible variation in scientific classification. For purposes of this section, I will follow the practice in the literature. The implications of variation in scientific classification will be addressed in the General Discussion.

It should also be noted that in one sense, it must be true that there is no single objective reality to the world, because organisms with different bodies and different sensory systems will perceive the attributes of objects differently. One animal may perceive flowers in shades of gray, another in terms of the spectrum

[2] A more direct measure of the universality of classification might be to compare different folk classification systems to each other. This strategy is not generally feasible for at least two reasons, though. First, data sufficient for direct comparisons are difficult to obtain. Developing a full picture of folk classification in any one culture requires years of work, and preparing descriptions of classification in two cultures adequate for comparison would be prohibitively time consuming. Some comparisons can be made based on sets of published data (e.g., Berlin et al., 1973). However, extensive reliance on such data, sometimes collected for other purposes and not containing all desirable information, can lead to serious interpretation problems (see, e.g., commentaries accompanying Brown, 1985, 1986). Second, different cultures generally will be located in different geographical locations. The cultures will therefore have different plants and animals in their environment, making direct comparisons of correspondence in classification impossible. The majority of studies therefore consist of detailed studies of the classification system of a single culture and the correspondence of that system to scientific classification. Comparing each culture's system to scientific classification separately, and then looking at whether different cultures have systems with similar degrees of correspondence to scientific classification, provides an indirect measure of the folk-to-folk similarity. This method also has the advantage of providing information about whether folk classifiers form categories that capture the same sort of resemblances that scientific categories do. Folk classification could be universal in nature and consistent of groupings such as "red things" or "edible things." Only comparison to scientific categories tells us to what extent the folk categories are like "falcon" and "oak."

visible to humans, and a third in terms of colors beyond the human visible spectrum. One animal may perceive a leaf or twig as a relatively rigid, weight-bearing object, and another may perceive it as flexible or fragile (e.g., Gibson, 1966; von Bertalanffy, 1968). However, for purposes here, only the world as perceived through the human body and human sensory system is relevant.

The evidence that has accumulated since the early debates shows a substantial correspondence between folk and scientific classification. I will take up the nature of the divergences that do exist in the next section. In this section, I will focus on data directly addressing and quantifying the extent of the correspondence.

Several early studies of folk classification noted somewhat informally the high degree of familiarity of traditional cultures with the botany or zoology of their environment and in some cases explicitly remarked on a high degree of correspondence between folk and scientific classification. Conklin (1954, 1957), for instance, described the extensive knowledge of both plants and animals by the Hanunóo of the Philippines, including over 1600 plants, and he suggested that there was noticeable overlap with scientific categories. Smith-Bowen (1954) noted the sophisticated plant knowledge of even young members of a West African traditional group. Rosaldo (1972) estimated that the Ilongot of the Philippines identify over 1000 different plants. Bulmer (1967) similarly remarked on the detailed and highly accurate zoological knowledge of the Kalam of New Guinea. Diamond (1966), in a brief report on the zoological knowledge of the Fore of New Guinea, noted that Fore identification of animals seemed to match scientific classification quite closely. In fact, the Fore accurately distinguished between bird species that the researcher found difficult to tell apart, and they correctly noted a taxonomic relationship between two birds that superficially gave the impression of being quite unrelated to each other.

Other researchers subsequently provided more detailed assessments of the correspondence of folk and scientific classification. Berlin (1972, 1973, 1976; Berlin, Breedlove, & Raven, 1968, 1973, 1974) carried out extensive analyses of the folk classification systems of plants in two traditional cultures: the Tzeltal Maya of southern Mexico and the Aguaruna Jívaro of north central Peru. Although this work is known to psychologists mainly for its description of folk classification as hierarchical with a preferred level of abstraction (see Rosch et al., 1976), a second major aspect of the work directly addresses the correspondence of the folk to scientific categories. In Berlin's studies, the researchers and their field assistants collected large numbers of specimens of plants and presented them to informants for identification. Informants were also taken for walks in the region and asked to identify plants in their natural setting. Informants were simply cooperative members of the community whose knowledge of the plant life was similar to that of other members of the community. For his analysis of the correspondence of Tzeltal folk categories to scientific, Berlin (1973; Berlin et al., 1974) focused on "folk generic" categories. These are the smallest categories labeled by single words and are said to be the most common and salient categories in everyday contexts (see Berlin, 1992, and Section 4); they correspond to a large extent to what psychologists have come to call "basic level" categories (Rosch et al., 1976). Berlin calculated the percentage of folk generic categories that have a one-to-one correspondence to scientific species, that is, that are used by the Tzeltal to label the same plants that the species name is used for by a botanist. He found that 61% of the Tzeltal botanical terms corresponded directly to scientific species, and he concluded that the fundamental categories of the folk classification systems corresponded fairly closely to scientific classification.

A similar level of correspondence was found by Bulmer (1970) in a study of vertebrate animals named by the Kalam of New Guinea. He examined "terminal" categories or the most specific categories that a culture applies to specimens. The terminal categories are in some cases at the generic level, and in other cases they subdivide the generic category. (For example, "oak" might be the most specific category applied by urban Americans to a particular set of trees, whereas they might divide "maple" into "red maple" and "sugar maple." "Oak," "red maple," and "sugar maple" would therefore be the terminal categories for this culture). Bulmer found that about 60% of terminal categories corresponded closely with zoological species. Deviations appeared to be morphologically based; many cases involved lumping two morphologically similar forms, and some involved placing males and females showing high degrees of sexual dimorphism into separate categories. A somewhat less detailed analysis of Navaho insect classification (Morris, 1979, based on Wyman & Bailey, 1964) also shows a strong correspondence of Navaho generic categories to scientific families and suborders. Turner (1974) concluded that over half the generic plant categories used by three native Indian groups of British Columbia had a one-to-one correspondence to botanical species. While the level of correspondence demonstrated by these studies is not perfect, it does suggest recognition of many of the same groupings that scientific classification systems recognize.

Although Bulmer and Berlin found substantial levels of correspondence, Hunn (1977) argued that these studies were not sufficiently sensitive to demonstrate the full degree of correspondence. He noted that Bulmer's study and a similar one by Berlin, Breedlove, and Raven (1966), by looking only at terminal categories, missed cases where a correspondence exists between a folk category above the terminal one and a biological species. On the other hand, Berlin's (1973; Berlin et al., 1974) study examining the correspondence of folk generic categories to biological species could not assess all possible correspondences, either: In some cases, folk generic categories may correspond well to a scientific category that is above the species level. For instance, the folk English category "bat" corresponds perfectly to a scientific category that encompasses multiple species. In addition, by looking only at generics, Berlin missed cases of correspondence involving terminal categories more specific than the generics.

To address these problems, Hunn assessed the correspondence between folk categories at all levels and scientific categories at all levels (species, genus, family, etc.) for Tzeltal animals. He devised a measure to reflect correspondence of the folk to scientific categories in which dissimilarity between the two is measured by the number of levels in the scientific classification scheme that must be ascended to find the lowest common denominator for a folk category (that is, to find the smallest scientific category that encompasses all the members of the folk category. For instance, if a folk category contained all and only the rodents occurring in the region, this category would have a one-to-one correspondence or zero dissimilarity to the scientific order Rodentia. However, if the folk category also included moles and shrews, which belong to the scientific order of Insectivora, then one additional level in the scientific classification scheme must be ascended to encompass all the members of the folk category. The degree of dissimilarity in this case would be one.) With this analysis, Hunn found that less than 8% of the maximum dissimilarity possible by his measure existed. For birds, 79% of folk categories had a one-to-one correspondence with a scientific category at some level of abstraction; for mammals, 78% did. The majority of cases of non-one-to-one correspondence were at low levels of dissimilarity. Hunn concluded that the overall correspondence of folk categories to scientific is quite strong. This conclusion is supported by Waddy's (1988) application of Hunn's measure to plant and animal classification by Groote Eylandt (Australia) aborigines; she found levels of agreement similar to Hunn's.

Hunn's data also provided support for the claim that categories at the generic level correspond to divisions in the natural world that are so obvious they "cry out to be named" (Berlin, 1978, 1992), parallel to suggestions by scientific taxonomists about the salience of the biological genus (see Berlin, 1992). Hunn examined whether the degree of correspondence of folk to scientific classification differs depending on a category's level of abstraction, and he found that at all three levels examined, categories tended to have low degrees of dissimilarity as reflected in his measure. However, this tendency was most pronounced for the generic categories. For generic categories, 74% (228 out of 310) had the minimal degree of dissimilarity and an additional 17% had the next lowest degree of dissimilarity; thus, 91% fell into the lowest two possible degrees of dissimilarity. For subdivisions of generics (specific categories), 61% had the lowest degree of dissimilarity and 24% had the next lowest amount, so that 85% fell into the two lowest possible degrees of dissimilarity. For categories above the generic level, only 38% had the lowest degree possible and an additional 13% had the next lowest, for a total of only 51% falling into the lowest two possible degrees. These data support the idea that differences in the distinctiveness of groupings at different levels of abstraction causes differing degrees of correspondence.

Waddy's (1988) data (examining suprageneric and generic categories) likewise showed substantially higher levels of agreement for the generic categories. Similarly, Conklin (1954) remarked that the most inclusive Hanunóo plant categories showed far less correspondence to botanical divisions than did the more specific categories. The less quantitative analysis by Morris (1979) of Navaho ethnoentomology also supports this conclusion: Correspondence of the most general and most specific Navaho insect categories to biological categories was weak despite strong correspondence at the generic level.

Boster (Boster, 1987; Boster et al., 1986; see also Berlin, Boster, & O'Neill, 1981) has added further refinements to the assessment of folk and scientific correspondence. Boster et al. (1986) pointed out that earlier investigations made the simplifying assumption that all informants agree on the classification of a given specimen. However, they often do not; different informants will frequently give different classifications, and a single informant may give a different classification on different occasions. Boster et al. argued that this inconsistency can provide information about how folk classifications are constructed. Specimens that are perceived as similar to one another are most likely to be confused and therefore to yield inter- and intra-informant disagreement. To the extent that the folk pattern of similarity/confusion follows the biological relatedness of the specimens, the folk and the scientific systems can be said to be similar.

Boster et al. studied disagreement in bird identification by Aguaruna and Huambisa Jívaro of northern Peru. They asked informants to identify over 150 specimens of birds; a minimum of 20 informants responded to each specimen. The data consisted of the extent to which the members of each possible pair of specimens received the same identification response by informants. These data provide a measure of the extent to which the two birds are confused. Boster et al. found that the degree of confusion within pairs of specimens correlated positively with closeness in the scientific classification, as measured by the number of nodes that must be ascended to arrive at a category that encompasses both specimens. For passerines (songbirds), the correlation of confusion with taxonomic similarity for the Aguaruna informants was .39, and it was .41 for Huambisa informants. For non-passerines, the correlations were .62 for Aguaruna and .60 for Huambisa.

These correlations are substantial but far from perfect, especially for passerines. One influence on the level of correlation may be the fact that prepared specimens lack many cues to identity available in observations of live birds, including habitat, songs, diet, and other aspects of behavior (see also Berlin, 1992, pp. 229–230). As a result, this measure may have underestimated the correspondence between confusion and relatedness that would occur for live birds. Importantly, Boster et al. also noted that although the correlation was lower for passerines than for non-passerines, the difference in strength between the two is consistent with the idea that the confusions are a product of biological structure. Passerines are more recently evolved, with the two consequences that, first, members of the group have had less time to diverge from one another; and, second, intermediate forms are more likely to still be in existence. Objective discontinuities among songbirds are therefore generally considered to be less than discontinuities among non-passerines. If similarity and confusion within the folk system reflects perception of discontinuities in the structure of the input, then better agreement between folk and scientific classification for non-passerines is to be expected. The confusion data thus once again suggest a substantial, although not perfect, correspondence between folk and scientific classification.

Boster (1987) further established the cross-cultural generality of the preceding result by examining similarity judgments for a subset of his (Boster et al., 1986) South American bird sample by urban American students who had no familiarity with the South American birds. Boster found that the similarity judgments produced by the American students correlated significantly with relatedness in the scientific classification ($r = .46$ for passerines and $r = .91$ for non-passerines). They also correlated significantly with the relatedness perceived by the two groups of Jívaroans as measured by the confusion data given in Boster et al. (1986) ($r = .68$ and $r = .83$ for passerines; $r = .80$ for both groups of Jívaroans for non-passerines). Since the American students had no previous experience with these birds, this result suggests that the pattern of resemblance perceived by the Jívaroan informants does not depend on either knowledge of the birds or any particular culturally determined interpretation of their features. Instead, Boster suggests that a significant portion of the perceived pattern of resemblance is culture-independent and universal.

Boster and D'Andrade (1989) investigated one additional issue. Boster's previous work, and the work of others discussed above, argues that much of folk classification arises from perception of structure in the world rather than being a culture-dependent organization imposed on the world. Boster and D'Andrade suggest that this culture-independent character might arise in either of two ways. The first possibility allows perception to be variable, with the ultimate outcome nevertheless constrained by environmental structure: Different groups of informants may attend to radically different properties of the organisms, but all may arrive at similar classifications because many properties are correlated with one another. For instance, one informant might look at bird head shapes while another looks at bill shapes, but because these features will be correlated across birds, the two observers arrive at similar category cuts. The second possibility assumes not only the constraint of environmental structure but also universality of the perceptual processes involved in extracting that structure: Different groups of informants may share perceptual processes that are sufficient to cause them to look at the same sets of properties in arriving at classifications.

To discriminate between these possibilities, Boster and D'Andrade chose 16 features of birds used in Boster's previous experiments: 9 reflecting size/shape of body parts (beak, head, etc.) and 7 reflecting color of areas of the body (color of head, color of throat, etc.). They evaluated the extent to which each individual feature predicted the perceived similarity between birds through a two-part process. They first calculated the extent to which each pair of birds shared each individual feature and then, for each feature, correlated the calculated similarity of the birds on that feature with the judged similarity by the urban American, Aguaruna Jívaro, and Huambisa Jívaro informants. Two noteworthy patterns emerged. First, the three groups of informants showed substantial agreement in the features that were most important to their judgments of similarity. Agreement between each pair of groups ranged from $r = .52$ to $.90$ for non-passerines and $r = .62$ to $.93$ for passerines. Second, although the three informant groups agreed with each other as shown by these correlations, the features that were important for the passerines for the three groups were not the same as those important for the non-passerines. Agreement ranged from only $r = -.29$ to $r = .31$ between the two sets of birds.

Boster and D'Andrade argued that these two results, along with consideration of the particular features that were most important within each set of birds, indicate a universal strategy of looking for features that contrast within the sets of birds. A feature that is highly discriminative within one set of birds may show little variation within another set, causing informants to weight different features most heavily in the two sets. For instance, beak length may be a useful feature for discriminating among non-passerine birds, but because passerines tend to be more similar on this dimension, other features will instead become more relevant for the passerines. An alternative to Boster and d'Andrade's interpretation might be that different features are simply more salient in the two groups of birds. In either case, however, at the more general level, the results argue for the second of the two ways that the correspondence between folk and scientific taxonomies might arise: People from different cultures appear to share common perceptual strategies that they apply in extracting existing structure from the environment.

Summary and Conclusions

The data reviewed in this section indicate that there is a substantial, though by no means perfect, correspondence between the categories of plants and animals formed by a number of different non-Western cultures and those formed by Western scientists. Within the anthropological literature, these findings have provided a compelling argument against the idea that members of traditional cultures are "primitive thinkers" who classify nature in fundamentally different ways from members of industrialized societies (see, e.g., Berlin, 1992, p. 136; Bulmer, 1970). In demonstrating the similarity of classification in the various cultures to one another and to scientific classification, these findings further provide strong evidence against the idea of "promiscuous realism" (Dupré, 1981; see Keil, 1989), according to which the world can be segmented in any of a limitless number of different ways. The data support the importance of structure in the world in determining basic category cuts within the domain of plants and animals. At the same time, the fact that correspondence is greatest at one level of abstraction suggests that although presence of structure may be a strong influence on category formation at a middle level of abstraction, it may be less compelling for more abstract categories. Furthermore, because the correspondence between folk and scientific classification (and folk to folk in the Boster studies) is not perfect even at the middle level, the data also leave open the possibility of some variation imposed by the human categorizer even at the middle level.

Since structure in the world must, of course, be perceived by the human classifier in order to influence classification, the data also suggest that the human perceptual system makes perception of the existing structure universally available and salient. However, Boster and D'Andrade's (1989) data, which show that the features most central for classifying passerines differ from those most central for classifying non-passerines, further suggest that appealing to some set of features that are universally salient may not fully account for the use of structure in making category cuts. Instead, within a given domain, a subset of features may be selected as most useful and/or most prominent from among those that the perceptual system makes readily available.

2. TO WHAT EXTENT IS DIFFERENTIATION OF A DOMAIN INFLUENCED BY BIOLOGICAL STRUCTURE VERSUS UTILITY TO A CULTURE?

The studies discussed in the preceding section indicate that there is generally a strong correspondence of categories formed by folk classifiers to categories constructed by scientific taxonomists. However, it does not follow from this correspondence that every group of plants or animals identified by scientists is also recognized by folk classifiers. Folk classifiers may overlook some distinctions drawn by scientific classifiers. There are two potential reasons that scientific distinctions may be overlooked. One is that some differences between the groups of plants or animals are too small to be readily noticed by folk classifiers. The other is that folk classifiers focus on parts of a domain that are of greatest consequence to their culture, and they make finer discriminations in those parts of the domain on which they focus.

Distinguishing between these two possibilities has been of special concern to anthropologists because of the implications for the debate about whether folk classification is driven by a desire to understand the world for its own sake or by basic social and bodily needs. Evidence that differentiation is based on the nature of the input would support the first view, whereas evidence that recognition of groupings is driven primarily by usefulness of the groupings to the culture would support the second. From a psychological perspective, the difference between the two findings suggests a less drastic, but still noteworthy, difference in interpretation. Evidence that differentiation is driven by the structure of the input alone would provide support for the notion that structure in the world presents itself to categorizers in a way that is invariant across cultures. Evidence for an impact of utility would indicate, in contrast, that construction of categories from the structure present is influenced by attentional variation and differential feature weighting that may be culture-dependent.

A variety of relatively informal observations on differentiation in different cultures strongly suggests that utility does play a role in what categories are recognized. Diamond (1966) noted that although the Fore made fine distinctions among birds, they grouped all butterflies together under one category label despite many readily perceivable differences in appearance. Diamond argued that differentiating among birds, even those of less obvious value, helped the Fore to hunt those that they did value, whereas butterflies as a whole were of little value to the culture. Bulmer (1970) noted that the Kalam of New Guinea lump two or more biological species together under one folk name more often when the species involved are ones that are inedible or otherwise not used. Conklin (1957) noted that at least 90% of plant types distinguished by the Hanunóo of the Philippines were of practical or ritual significance, and he also (1954) suggested that the majority of recognized animal categories were as well. Hunn (1982) cited the Sahaptin Indians of the northwestern United States, who depend on fish as a staple food and who name 60% of the fish species that occur in their region, but only 25% of the birds (and he [1990] noted that they name few flowers, which have little use to them, despite their beauty). He also remarked that the Tzeltal Indians pay little attention to butterflies, but that 16 different categories of their larvae, which are culturally important as food, crop pests, etc., are recognized, and he pointed out examples from several other cultures of greater differentiation within those parts of a domain used for food (see also Posey, 1984). Conklin (1954) similarly noted that although the Hanunóo name many individual insect species, they do not differentiate among butterflies, which are harmless and economically insignificant. Ferns, likewise, are not as differentiated as more important plants.

Additional analyses suggest, however, that differentiation is not based only on utility. These analyses reveal what appears to be a joint influence of structure in the world and special attention due to utility.

Berlin (1978; Berlin et al., 1974) divided Aguaruna and Tzeltal generic plant categories according to four degrees of relative cultural significance: cultivated, protected but not cultivated, useful but not deliberately protected, and of no known cultural use. He found that for both cultures, although the largest number of generic categories fell into the three groupings with some cultural significance, fully one-third of the recognized categories were of plants with no known uses. Thus, he argued, it would be incorrect to suggest that at the generic level, the Aguaruna and Tzeltal classify only those plants that have cultural value. Hunn (1975c) made a similar observation about Tzeltal animals: Although the Tenejapa Tzeltal are agriculturalists and hunt only as an occasional pastime, they name nearly as many animals as plants. They label 158 categories of birds, although most are of no known cultural significance. Kesby (1979) noted that the great majority of animals named by the Rangi of Tanzania have no particular significance to them.

Although these observations suggest that not all generic categories named are culturally significant, Berlin also found that differentiation of the generic categories into more specific categories showed a clear relationship to utility. Eighty-one percent of Aguaruna generics that were further subdivided fell into one of the three categories of culturally important plants. Similarly, 76% of the Tzeltal polytypic generics fall into one of these three categories. Furthermore, the likelihood of division of the generic into specifics is related to the level of cultural significance: For the Aguaruna, 40% of all cultivated plants are further divided, while 31% of protected plants are, and only 19% of those not protected but with some value are. The same general pattern is true for the Tzeltal plant classification scheme. Data from two additional cultures showed the same pattern (Berlin, 1992).

Geoghegan (1976) provided a detailed analysis that gives strong evidence for a dual influence of structure in the world and cultural significance. He pointed out that in scientific taxonomies, there is a well-understood relationship between the size of biological genera (that is, the number of species included in a genus) and their frequency. There are a large number of biological genera that contain one or only a few species, and a smaller number of genera that contain many species. The precise relationship between genus size and frequency has been described in a formula developed by Yule (1924). Geoghegan argued that if folk classification closely reflects the structure present in the biological world, the distribution in folk classifications should also be accurately described by Yule's (1924) equation.[3]

Geoghegan's analysis of the distribution in folk classification systems made two important points. First, he found that, for botanical data from two cultures (from Berlin and colleagues' studies of the Tzeltal of Mexico and the Aguaruna of Peru), the distribution of subdivisions of folk genera conformed well to Yule's prediction, with curves closely resembling those from biological taxonomies. Zoological data from the Tzeltal (from Hunn, 1973) also showed this relationship. Since folk recognition of the existence of sub-categories follows the same pattern as recognition by scientists, these data support the idea that differentiation of the folk genera is related to observation of structure in the world.

Second, he found that when the folk botanical categories were divided according to Berlin's analysis of cultural significance, the total amount of polytypy varied with significance (as shown in Berlin's analysis), but the statistical distribution (i.e., the shape of the curve) involved was similar for each grouping. This outcome held true for both the Aguaruna and Tzeltal data. This finding suggests that although the extent of recognition of subcategories is influenced by cultural importance, the potential for recognizing subcategories is constrained by the occurrence of discontinuities inherent in the input.

[3] Geoghegan uses Yule's approximation to the original, apparently somewhat cumbersome formulation. Yule's approximation as given by Geoghegan is $f_n = f_1 n^{-k}$, where f_n is the proportion of genera of size n (having n species), f_1 is the proportion of monotypic genera, and k is a constant.

Berlin (1992) more recently compared the pattern of differentiation in a number of additional cultures to the pattern found in scientific classification systems. Using a formalism related to the one used by Geoghegan, he found patterns of differentiation similar to one another and similar to the scientific classifications across six linguistically unrelated folk botanical systems and eight folk zoological systems. This outcome again provides strong support for a component of differentiation that is constrained by the structure of the input.

Berlin also noted a constant ratio of monotypic folk genera (that is, genera that are not differentiated into species) to polytypic folk genera (that is, genera that are differentiated into two or more species) across a total of 20 cultures from different parts of the world. There were, however, consistently more monotypic generics in the folk systems than in scientific systems. The constant ratio itself is suggestive of some universal processes influencing differentiation. The higher proportion of monotypic generics in folk systems, Berlin suggested, may be due to less close scrutiny by folk classifiers than by scientists.

Finally, Berlin (1992) also cited a number of other studies (e.g., Turner, 1974; Whistler, 1976; Fowler, 1972; Waddy, 1988; Hunn, 1990) that have found little differentiation of generics into specifics in cultures based on foraging rather than agriculture (see also Brown, 1985, 1986; Waddy, 1982). Berlin speculated that this pattern reflects more careful attention to small differences between plants by people engaged in plant domestication. This view is consistent with observations by Berlin (1992) and Boster (1985, based on Boster, 1980) that members of a culture who are less familiar with a domain (e.g., forest birds for women; manioc plants for men) may make fewer or less accurate specific level classifications compared to those whose main occupation (e.g., hunting vs cultivation) encompasses that domain. Although Berlin interprets such findings as favoring differentiation due to an attention shift rather than due to utility of the finer divisions per se (cf. Brown, 1985, 1986), it is not clear that there is a major difference between the positions from a psychological perspective. In either case, they suggest that differentiation is to some degree influenced by the human categorizer rather than fully determined by the structure of the input.

The analyses by Berlin and by Geoghegan just described deal with the differentiation of generic categories into more specific categories. Many of the more casual reports do not make clear what level of categories is being referred to. However, level of abstraction is potentially a major variable. As noted earlier, it has been claimed that the groupings in nature that give rise to generic categories are highly perceptually salient, whereas groupings at other levels of abstraction are less so. If so, recognition of the generic categories themselves should be less susceptible to cultural influences than recognition of finer divisions of these categories. Berlin (1978, p. 19) has suggested that "... the native folk biologist apparently recognizes *generic* taxa 'because they are there' and recognizes *specific* ... taxa 'because it is culturally important to do so.' "

Despite the clear prediction, there is little evidence directly speaking to the possibility that recognition of generics is relatively immune to utility. Of the studies just reviewed, only Berlin's (1978; Berlin et al., 1974) analysis addressed the cultural significance of the generic categories themselves. However, the direction of causality involved in the fact that two-thirds of Tzeltal and Aguaruna botanical generics had some cultural significance is unclear. The high degree of use does not necessarily mean that these categories were recognized because of their usefulness; on the contrary, uses for different generics may gradually be developed once they are recognized. Turner (1987) notes that members of general plant categories that are given more specific names by two native Indian groups of British Columbia are those that are very common or distinctive and/or of cultural significance, suggesting that physical distinctiveness and cultural use may go hand in hand. Berlin (1992) suggests a better evaluation of the issue that is possible in principle, but for which insufficient data exist to fully carry out. He notes that scientific genera vary in their degree of phylogenetic distance from one another and hence in morphological distinctiveness, and that this fact can be used to make a strong prediction about recognition of generic categories if recognition is based on structure in the input. Those scientific genera that are most biologically distinct from others in a given location should be most likely to receive recognition as categories (see also Hunn, 1977). Berlin presents a small amount of evidence consistent with this prediction: For bird genera in three cultures (Tzeltal, Huambisa, and Kalam), the majority of biologically most distinctive genera receive recognition as folk generics. However, he does not present data to establish whether recognition in the folk system decreases for less biologically distinctive genera (though see Berlin et al., 1981, for suggestive evidence). He notes that a full-scale evaluation of the prediction would require both a complete scientific and a complete ethnographic inventory of a local flora or fauna for more cultures than are currently available.

Although these various analyses do show a correspondence between the cultural utility of part of a domain and the extent of its differentiation, some authors have urged caution in accepting the conclusion that utility per se is the causal factor driving the observed pattern. They have raised the possibility that the pattern arises at least in part through an objective factor of the extent to which distinguishable variants of a genus exist within the geographic area of the culture. Berlin (1978) argued against this interpretation by pointing out that biologists recognize as many species within the culturally less important generics as within the important ones in the Tzeltal plants he studied. However, his observation does not establish that the species divisions were as perceptually obvious for the culturally less important categories as for the others.

Other researchers have noted information consistent with the alternative interpretation. Bulmer (1970) argued that high cultural significance of a species may produce high genetic diversity within it. In particular, he noted that controlled human propagation can yield multiple strains of a single species that will look distinct and hence be named as separate folk specifics in the absence of knowledge of genetics. (One familiar example is corn: It is grown in yellow, white, blue, and multicolored varieties, but all are the same biological species.) Bulmer concluded that greater taxonomic differentiation for culturally significant plants may be due to greater objective differentiation. Geoghegan (1976) noted that some evidence, although sketchy, suggests that cultures that have developed agriculture more recently have fewer generic categories with a high degree of differentiation into specific categories (see also Brown, 1985, 1986). These cultures may not pay less attention to plants, but rather they have spent fewer years developing new plant varieties exhibiting objective differences. As a result, they have fewer objective discontinuities available to label. The same argument would apply to Berlin's (1992) interpretation of the comparison between foragers and agriculturalists. The cultures that cultivate plants may have more or greater objective discontinuities present, rather than undergoing a shift in their level of attention to detail.

Summary and Conclusions

A number of authors have argued for an influence of utility on the degree of differentiation in folk taxonomies. Evidence has also been provided for an influence of degree of biological differentiation on folk differentiation. Berlin's (1992) and Geoghegan's (1976) analyses provide strong evidence for the correspondence of folk differentiation to differentiation recognized in the biological classifications. The evidence that utility also influences differentiation of the taxonomies is itself consistent enough over a variety of different types of studies that the phenomenon must be taken seriously. Interpretation of the phenomenon is somewhat unclear because of the questions raised about possible changes in objective differentiation as a result of cultivation (and domestication of animals). However, the relatively casual early remarks suggesting a relation between use and differentiation for non-domesticated animals such as butterflies vs larvae support at least some influence of utility per se. Berlin's and Boster's observations that amount of differentiation may vary across members of a culture as a function of their degree of involvement with a domain also argues for a contribution by the human categorizer.

The evidence on all counts just mentioned concerns mainly differentiation of folk generics into specific categories. Although it has been suggested that recognition of folk generics themselves will be relatively immune from an influence of utility, evidence on this point is sketchy at best.

The findings together support a view that points toward an influence of objective structure in the world on the categories that are formed. To the extent that utility is influential, though, they also suggest the possibility of an important influence of the perceptual level contribution: Attention shifts may cause similarities (and differences) to be detected and categories formed that would not be under other circumstances. Thus the influence of structure alone is not so strong that it fully determines what categories will get formed. The results have nothing to say about the possible influence of conceptualization beyond that it must respect to some large extent the structure given by nature, so they do not discriminate between positions assuming only a perceptual contribution versus those emphasizing the conceptual contribution in addition to perceptual.

3. TO WHAT EXTENT ARE THE CATEGORIES FORMED "NATURAL" AND UNIVERSAL VERSUS "ARTIFICIAL" AND CULTURE-SPECIFIC?

The studies discussed in Section 1 document a strong overall correspondence between folk and scientific classification. At the same time, though, all of the studies find that this correspondence is not perfect. As noted earlier, perfect correspondence is not to be expected because scientific classification makes use of technology not available to folk classifiers. However, divergences might also arise by differences in the principles that are applied in making the basic category cuts. The goals and needs of folk categorizers in constructing categories are not necessarily the same as those of the scientific taxonomist, and this difference might be reflected in the categories formed.

As just discussed in Section 2, it is possible that the use a culture makes of various entities will influence what categories the culture recognizes. Utility might have a more profound influence than simply directing attention, though: It might cause qualitative differences in the nature of the categories formed. For instance, folk classifiers might weight one feature (such as size) more heavily than scientific classifiers would, or they might include features that scientific classifiers would not consider relevant for classification (such as edibility). They might also form categories based on a single criterion related to the use of the category members, rather than categories based on multiple features.

Another possible influence on category cuts is the existence of religious or social beliefs that associate various plants and animals with categories other than those dictated by structure in the world. There is no doubt that plants and animals have important symbolic values that differ from culture to culture (e.g., Lévi-Strauss, 1966; Bulmer, 1978; Bulmer, Menzies, & Parker, 1975; Tambiah, 1969). In some cultures, these associations are elaborated to the extent that they have sometimes been seen as constituting a system unto itself, separate from the basic recognition of plants and animals (see Waddy, 1988, for discussion; see also Posey, 1984; Walker, 1992). Of specific interest for the issues here is not whether such associations or systems exist, but whether the groupings of plants and animals that correspond to a large extent to those formed by scientists are also influenced by these associations. That is, does the structure of the world make itself so evident that in most everyday contexts it overrides any such possible influence, or do cultural constructions inextricably influence a classification system that is otherwise based on biological properties of the plants and animals?

The implications for possible effects of utilitarian, symbolic, or mythical considerations are straightforward. As just hinted above, a view in which categories are constructed mainly by recognizing strong structure that exists in the world would predict little or no effect of these other considerations. This prediction holds both under the possibility that only bottom-up perceptual processes are involved in extracting structure and forming categories, and under the possibility that conceptualization is central but consists of understanding the structure given by nature. If evidence for possible effects of utilitarian, symbolic, or mythic considerations exists, then this evidence would constitute support primarily for a view in which categories are formed through some interaction of structure in the input and conceptualizations that may be independent of that structure. If such influences were, in fact, found to be the primary determinant of classification, the outcome would argue against any major influence of structure in the world. However, the findings from Sections 1 and 2 indicate that such major divergence from scientific categories does not exist.

Intertwined with the question of possible culture-specific influences on category formation is the question of the structure of the categories per se. A distinction can be drawn between folk categories that are "natural," "general purpose," or "inductive" and categories that are "artificial," "special purpose," or "deductive" (e.g., Atran, 1990; Berlin et al., 1966; Brown, 1984; Bulmer, 1970; Hunn, 1977). Categories that are "natural" are defined as those based on multiple characteristics, none of which is foremost. Such categories are considered to capture more of the variation that is present in the world, and they are also taken in biological classification to be the natural system of classification. Categories considered to be "artificial" are those based on one or a small number of salient characteristics which may be chosen because of some special purpose that classification along this dimension serves. Modern scientific classification is generally not of this sort. To the extent that folk categories are "natural" categories, they will tend to correspond well to scientific categories; conversely, to the extent that they are "artificial," they will tend to diverge from the scientific categories. Consideration of the "natural" versus "artificial" nature of the categories will be taken up at points along with consideration of the specific influences on category formation.

Generic Categories

As noted earlier, folk generic categories have been said to be most strongly given by the structure of the world; they reflect salient clusters of attributes separated from other clusters by substantial gaps. As such, they may be considered "natural" or general purpose categories (Berlin, 1992; Hunn, 1977). Thus they should show relatively little evidence of cultural influences on the groupings that are formed.

Hunn's (1977) analysis of the correspondence of Tzeltal folk zoological categories to biological categories suggests that culture-specific influences must be minor at best at the generic level, because the dissimilarity between folk and biological categories was quite low at this level (see Section 1). His description of the divergences that exist indicate that the most common divergences consist of either lumping together two related scientific species or genera, or splitting one species on the basis of factors such as life stage or sex (see also Turner, 1974). These divergences appear to be based on morphological, behavioral, or ecological considerations, though not aspects of these considerations that scientific taxonomists consider relevant. A small number of categories may be based in part on the property "domestic" (e.g., domestic ducks are split from wild ducks). Although this could be interpreted as a utilitarian/cultural factor, at the same time, it reflects a major behavioral/ecological difference between the two sets of ducks, and it is not clear that there is reason to interpret it differently from the use of behavioral and ecological properties in making other divisions.

A number of other researchers, while not evaluating the fit of generic categories to scientific in as much detail as Hunn (1977), have described generic categories (sometimes under different labels) in various cultures. These descriptions are consistent with the characterization of generic categories as perceptually salient and based on multiple morphological, behavioral, and ecological features (e.g., Bulmer, 1970; Bulmer et al., 1975; Headland, 1983; Hunn, 1977; Posey, 1984; Taylor, 1990; Turner, 1974). The issue of divergences from classification based on these features has generally received little attention, presumably reflecting little noteworthy divergence. Because such influences have been considered noteworthy for supra-generic categories (see below), the absence of similar reports for generics, along with the close correspondence of these categories to scientific categories, suggests that they are not major influences for generics.

One exception to this general agreement is Hunn (1982), who suggests that although "core" generic categories are "natural," general-purpose ones, others at the periphery of the generic level are artificial. In particular, he suggests that there are categories that contrast with natural generic categories but that group together plants or animals whose main shared property is that they are not included in other generic categories within their life-form. These are "residual" categories and their names may be glossed as "just flowers," "just grass," etc. (see also Hays, 1979; Hunn, 1976, 1977, 1990). They typically encompass organisms that have no particular value to the culture and so are not named separately. According to Hunn, these categories are similar to the English category "weed."

Presumably, which particular organisms are named in this residual way is culture-specific, since the plants or animals that do not receive enough attention to be named separately will vary from culture to culture. Thus Hunn's observation might argue for a subset of generic categories that are not dictated largely by structure in the world. However, it is not clear that such groupings should be treated as equivalent to other generic categories. Berlin (1992) suggests, following Taylor (1990) and Waddy (1988), that the sets of organisms given such names should not be thought of as categories at all, but instead as residue that do not constitute categories. That is, there is simply incomplete partitioning of the observed world. Some things are recognized but not put into any category.

For purposes of the present discussion, it would be circular to eliminate these groupings from consideration simply because they are not similar to the more usual generic categories. However, there is a further reason to question whether the groupings described by Hunn should be considered categories for our purposes. Whereas the English category "weed" does support inductive inferences such as a tendency to spread fast, to displace desired plants, and to be unattractive, the groupings that Hunn describes do not necessarily share any properties other than being insufficiently valued to be named distinctively. Indeed, Hunn (1990) states that residual categories are defined by the absence of any perceptual unity, in contrast to the other categories in the same domain. One of Waddy's (1988) informants suggested that members of residual categories could be seen as "friends of" various named generic categories rather than being grouped together. On these bases, Berlin's analysis of them as unnamed residuals rather than as generic categories seems most appropriate.

Specific and Varietal Categories

Generic categories are sometimes divided further into categories referred to as specific categories. Specific categories typically have a two-part name comprised of a modifier plus a generic category name (e.g., "white pine," "tree snake"); the modifier usually picks out some morphological, behavioral, or ecological feature relevant to distinguishing the category members from members of contrasting categories within the same generic category (e.g., "red pine," "water snake") (see Berlin, 1992). Relative to the generic groupings, divisions at the specific level are thought to be less perceptually obvious, and classification into these divisions is assumed to require closer scrutiny.

Despite these differences from generic categories, there is no suggestion that specific categories differ to any great degree in the extent of influence of factors other than morphological (and behavioral or ecological). Hunn's analysis of the correspondence of Tzeltal animal categories to scientific categories showed that correspondence at the specific level was almost as high as at the generic level. This fact suggests that there is relatively little influence on these categories other than those reflecting biological structure. Discussions of the nature of specific categories indicate a general consensus that specific categories are heavily based on the presence of one or a small number of morphological characteristics (e.g., Berlin et al., 1974; Berlin, 1992; Hunn, 1977). The distinguishing characteristic(s) would include the one mentioned in the name, but might also include others (e.g., the Tzeltal folk species translated as "white pokeberry" and "red pokeberry" differ from one another not only in flower color but also in stem and leaf color; Berlin, 1992).

In relatively rare cases, specific categories may be further subdivided into varietals. The presence of varietals is associated with a high degree of human cultivation (Berlin, 1992), which presumably yields distinguishable variations of otherwise highly similar plants. Hunn (1977) considers varietal categories to be less objectively given by notable discontinuities than are categories at other levels, including specific categories. He considers them to be distinguished by a single characteristic and to share all other characteristics (see also Bulmer, 1970). In contrast, Berlin (1992; Berlin et al., 1973) does not consider them qualitatively different from specific categories and refers to them as being based on one or more distinguishing characteristics. Regardless of whether distinguishing characteristics are limited to one or not, there appears to be a consensus that these categories are based on contrasting physical characteristics reflected in varietal names such as "gray harvest mouse" and "red harvest mouse." By Hunn's analysis, these are special purpose or artificial categories; nevertheless, he gives no indication that the distinctions drawn have a motivation other than recognition of physical and/or behavioral–ecological properties of the organisms. Thus, these categories, like specifics, appear to be based on biological structure.

The actual evidence for these conclusions about the nature of specific and varietal categories, and the evidence for the similar conclusions about generic categories, is often not directly referred to in research reports. Rather, the particular characteristics that distinguish members of one category from members of others are discussed as a given (see, e.g., Berlin, 1992, p. 104). The evidence for these characteristics appears to consist of statements made by informants when asked to name and describe various flora or fauna, along with observation by the researcher of differences between plants or animals that have been identified by informants as members of contrasting categories. As is evident from the psychological literature on categorization, people do not necessarily have full introspective access to the bases for their categorization decisions (e.g., Malt, 1994; Malt & Johnson, 1992; Taylor, 1990, p. 45 alludes to this problem as do Berlin et al., 1974, p. 154, and Bulmer & Tyler, 1968, p. 353). If people did have such access, there would be much less controversy within psychology over the details of category representations. However, there is no reason to doubt that the features reported constitute some significant portion of the features relevant to classification. Further, the high degree of correspondence of folk categories at this level to scientific categories provides some independent validation of the nature of the distinguishing characteristics. As will be seen in the discussion of supra-generic categories below, major divergences from morphologically based categories are readily seen in a lack of correspondence to scientific categories, and in stories provided by informants in explaining the basis for category membership. Thus there seems to be little reason to question the conclusions drawn about the nature of the generic and subgeneric categories as a fairly general level of description.

Supra-generic Categories

Unnamed groupings above the level of generics are sometimes evident. (In a sorting task, for example, informants might place various waterfowl together, even if their language does not have a name for this group.) Although these "covert" categories have been discussed by various investigators (e.g., Berlin et al., 1968; Hays, 1976; Hunn, 1977; Taylor, 1990), I will restrict discussion here to named categories since these have been the categories of most interest to psychologists.

Although many languages do not have terms designating categories as broad as "plant" and "animal" (see Brown, 1984), researchers have noted many cultures that name highly inclusive categories of plants and animals. These categories show definite similarities across the cultures but, at the same time, diverge in notable ways from the most closely comparable scientific classifications. Highly inclusive categories were apparent to early ethnobiologists as well as to more recent investigators. For example, Conklin (1954) noted that Hanunóo plants were divided into three general categories based on stem habits: woody, vinelike, and herbaceous. Diamond (1966), in his study of the Fore of New Guinea, identified nine categories of animals that the Fore called by "big names" (in contrast to the members of these categories, which they called by "small names"). The nine categories contained groupings such as small flightless mammals (most rodents and the smallest marsupials); large flightless mammals (most marsupials, the echidna, and giant rats); bats; and frogs. Similarly, Bulmer (1967), in his study of the Kalam of New Guinea, identified 20 most inclusive categories of animals, consisting of groupings such as flying birds and bats; dogs; pigs; larger marsupials and rodents; frogs and small marsupials and rodents. Bright and Bright (1965) studied a number of Indian groups of northwestern California speaking diverse languages and reported terms for highly inclusive groupings such as quadruped mammal; fish; snake; and bird (especially small bird). Later researchers applied more explicit criteria for determining what groupings to consider to be generic categories vs "life-form" categories (a level of abstraction above generic categories) and reported smaller numbers of life-form categories that nevertheless were similar in nature to those described earlier. For instance, Berlin et al. (1973, 1974) reported that the Tzeltal Indians had four major life-form categories into which they sorted at least 75% of all plants, the four being trees, vines, grasses, and broad-leafed herbaceous shrubs. Hunn (1977) identified two terms for inclusive animal categories used by the Tzeltal: a category that included all animals classified as birds in scientific taxonomies, and a category that included all mammals with the exception of human beings, bats, and possibly armadillos. Other Tzeltal inclusive animal groupings are recognized but not explicitly named. Morris (1979) describes Navaho animal life-forms as including crawling animals versus flying animals. Brown (see Brown, 1977, 1979; 1984; Brown & Witowski, 1982) reviews evidence for the existence of life-form categories in a range of other cultures, and Berlin (1992) provides a summary of documentation of life-form categories, along with examples of the categories, from a large number of studies.

It is clear that these categories do not correspond closely to scientific categories. For instance, some groupings include both birds and bats; others might include marsupials with rodents. Botanical categories such as "tree" include species from diverse scientific families, some of which have closer relatives in the categories labeled "bush" or "grass." Thus these highly inclusive categories often cross-cut the more inclusive scientific categories. In agreement with this observation, Hunn's (1977) evaluation of the correspondence of Tzeltal animal categories to scientific categories found that only 50% of the supra-generic animal categories had either the first or second lowest amount of dissimilarity to scientific categories, in contrast to 91% for folk generic categories.

What causes these groupings, then? One explanation is that the groupings are based on universal, perceptual features, but that at this level the features do not correspond well to those used by scientific classifiers. Brown (1977, 1979, 1984) proposed that there are a small number of life-forms that are potentially universally recognized on the basis of morphology (although, depending on its state of evolution, a particular language may or may not include terms for all of these; Brown's proposal actually centers around a particular evolutionary sequence for entry of the terms into a language). For plants, the universal categories include tree, grass or grerb (grass + herb), bush, and vine. For animals, they consist of fish, bird, snake, mammal, and wug (worm + bug). In contrast to generics, these folk categories do not always correspond well to scientific classification because the aspects of form that are salient at this level may not be those that are most predictive of scientific classification. For example, shape and size are important attributes in distinguishing trees from shrubs and both from vines, but these attributes are not necessarily indicative of the genetic relationship among plants (as, indeed, the folk categories "tree," "shrub," and "vine" in English do not correspond to any categories of scientific botany.) Brown's survey of 188 languages for plant categories and 144 languages for animal categories supported the similarity of life-form categories cross-culturally.

Although some of Brown's sources and the details of his arguments have been called into question (see commentaries accompanying Brown, 1985, 1986; see also Berlin, 1992; Randall & Hunn, 1984), other researchers have shared the perspective that life-form categories are based on morphology and are likely to be similar cross-culturally. Conklin (1954) described Hanunóo general plant categories as based on their vegetative characteristics. Bulmer (1970) remarked that although the Kalam inclusive categories are not natural in terms of their relationship to biological taxonomies, they are natural in their logical nature: Their members possess many attributes in common including both those of morphology and cultural relationships to humans. Berlin initially considered life-form categories to be like generic categories except in their degree of inclusiveness; he (1973) described them as "the broadest, most encompassing classification of organisms into groups that are apparently easily recognized on the basis of numerous gross morphological characteristics." More recently, Berlin (1992) has suggested that the categories are heavily based on morphology and reflect objective discontinuities in nature as generics do, but that the morphological characters on which they are based are many fewer in number than those that establish generic categories.

Atran (1985) likewise considers life-form categories to be morphologically based, although he argues that they differ somewhat from generics in the nature of the morphological features selected. He interprets the particular attributes used at this level as dimensions that are more anthropocentrically determined than the attributes used in making generic divisions. These dimensions are ones that humans find especially salient. Thus, for instance, trees and bushes form separate groups because they reflect sizes of being taller than a human and shorter than a human respectively. Atran also (1987a, 1990) suggests that life-forms differ somewhat from generics in that they partition the world into categories with opposing features. The opposition may be along a single dimension (e.g., size, or mode of locomotion; that is, small vs medium vs large or flying vs walking vs crawling), or they may partition simultaneously along several dimensions. In contrast, the features that identify one generic need not have any particular relationship to the features that identify another generic; it is enough that they do not have the identical set of features. These differences in structure, though, do not mean that life-forms are not natural categories nor that they are cultural-specific. He argues (e.g., 1985) that life-forms are universal and orderly in nature.

There are several sources of challenge to this assessment of life-form categories, however, leading to the alternative answer that life-form categories are influenced by cultural constructions. One source of challenge is evidence that culture-specific factors such as mythical relationships among animals may influence the groupings that get formed. Bulmer (1967) suggested that natural discontinuities, although playing a central role in formation of life-form categories, still do not fully explain the way that these categories are derived by the Kalam. He explored why the cassowary (an ostrich-like bird) is not classified as a bird by the Kalam and found that it has a mythical relationship to humans in which it is kin (sister or cousin). He also (1978) noted that ritual-based aversion to some animals may inhibit accurate observation and hence indirectly influence where they are placed in a classification scheme (see also Bulmer et al., 1975). In a similar vein, Tambiah (1969) examined the animal classification system of a northeastern Thai village in which a category that translates roughly as "bird" excludes crows and vultures. This exclusion appears to be due to the crow's and the vulture's feeding habit of scavenging, which sets them apart from other birds. They are designated as inedible by the villagers, whereas all animals that are included in the bird category are edible. Other inclusive categories in this classification system also appeared to be heavily influenced by their role in the culture apart from form; forest animals, for instance, divide into those that are counterparts of domestic animals and those of the deep forest that are credited with extraordinary properties. Morris (1979) noted that some divergences of Navaho insect classification from correspondence to scientific families are due to the ritual significance of the insects. Finally, many of the cultures studied do not include humans in their category that encompasses most or all other mammals (e.g., Hunn, 1977; Kesby, 1979, p. 44; Posey, 1984), despite perceived human morphological similarities to the other mammals. Hunn (1977) notes that the Tzeltal do appreciate the similarity between humans and monkeys, but they separate humans from the other mammals on the basis of their belief that humans have souls and other animals do not. Observations such as these suggest that there may be culture-specific influences on categorization at the life-form level.

A second argument against viewing life-forms as morphologically based is given by Hunn (1982), Randall (1987), and Randall and Hunn (1984). They argue that the categories in different cultures that have been loosely translated into English as "tree," "vine," "shrub," etc., are not nearly as universal as Brown (1977, 1979, 1984) suggested and do not necessarily all share a common basis. Instead of being defined mainly by morphology, the categories in each culture are also heavily influenced by the utility of particular entities to that culture. For instance, the word translated as "tree" used by the Samal of the Philippines is more accurately glossed "burnables." Although many of the plants included under this name are ones that speakers of English would call "tree," they also include some that are relatively short and are multistemmed but make good firewood. At the same time, they exclude some that are similar to others within the category in form, but that have trunks not good for burning (e.g., palms) or that are normally used for other purposes (e.g., fruit trees) (see also Turner, 1987). Similarly, the Samal term that translates roughly as "mammal" is centered on those that are edible, and the term used by the Sahaptin Indians that translates roughly as "fish" focuses on those aquatic forms that are typically caught and eaten. Hunn (1977) considered life-form categories to be "artificial" or "special purpose" categories since, according to this analysis, they are based on features selected by a culture from a larger set of potential features (though later, he [1987] suggested that some life-forms are natural and reflect natural discontinuities while others are artificial).

Finally, Berlin (1992) notes that not only Randall and Hunn (1984) but a number of other authors as well (e.g., Hays, 1974; Brunel, 1974; Pennoyer, 1975) have observed that plant species of high cultural importance are commonly excluded from membership in the botanical life-forms categories. This fact suggests a deviation from morphologically based groupings based on a plant's utility.

Several responses to these suggestions of deviation from morphologically based categories have been made. Atran (1987a) points out that cases such as the Kalam omission of cassowary from the "bird" category may be based on perceptual factors at least as much as cultural, since the cassowary's flightlessness and unusual size and shape set it apart from other birds. Although the separation of cassowary from other birds does not correspond to a scientific division, it nonetheless may be made on the basis of morphological features salient to the

Kalam (and, in fact, Bulmer, 1978, 1979, points out that animals that are salient either by being behaviorally or physically anomalous or by being highly typical of their category tend to be those that are ritually marked, suggesting that perception of an animal's relation to its category may precede its acquisition of mystical or ritual significance). Likewise, the omission of corn (a plant of high cultural value) from a category including other grasses may be based on its distinctive form (Atran, 1985). Atran (1990), Brown (1992), and Berlin (1992) all agree that Randall and Hunn did not distinguish well between those categories that are indeed function-based categories (such as "edible fruits") and those that are true life-forms; they argue that the presence of classifications based on utility that may cross-cut morphologically based categories in no way undermines the claim that there is a primary classification system not based on utility. As Atran (1985, p. 303) also notes, Randall and Hunn's observation that a category including trees is centered around ones with burnable wood does not logically imply that "burnable" is the meaning of the category term, but only that burnable trees are the prototype for the category.[4]

None of these responses, however, fully explains away the possible influence of cultural factors such as exclusion of humans from the mammal category or exclusion of perceptually similar but culturally important plants from botanical life-forms. At this point, the safest conclusion seems to be that many life-form categories are explainable primarily on the basis of morphology, though the aspects of morphology salient at this level do not closely match those used by scientists. An influence of culture, in the form of utility and/or other social constructions, does seem to exist within the categories reasonably taken to be life-forms, although some purely function-based categories may better be considered part of cross-cutting classifications that are more culture-specific.

Summary and Conclusions

The potential influence of cultural constructions on membership in folk categories has received less systematic investigation than the issues described in Sections 1 and 2. However, the available evidence suggests that folk generic categories and those below the generic level may be relatively immune to culture-specific influences beyond those influencing differentiation as discussed in Section 2. This conclusion is based primarily on the close correspondence of such categories to scientific categories, and on the consistent lack of noted divergences in the literature as contrasted with discussions of supra-generic categories. For

[4] This point is consistent with Barsalou's (1985) finding that for American college student subjects, for the category "bird," the typicality of category members was significantly related to their likeableness and their judged frequency of occurrence, not only the extent to which they shared properties with other members of the category. There is little reason to think that categories such as "bird" are utility-based for urban Americans; nevertheless, factors related to interactions with them appear to influence what members are considered most typical.

life-form categories, in particular, it is clear that divergence from scientific categories is great and that there is more potential for culture-specific influences. While some claims for culture-specific influences may be reinterpreted as classification based on universal morphological, behavioral, or ecological considerations other than the ones used in scientific classification, some culture-specific influences most likely do exist and influence membership in these categories. Overall, then, the evidence supports the idea that categories at the generic level and below are strongly given by the structure of the world, with relatively little other influence. In contrast, categories above this level may also be influenced by observed structure, but the role of conceptualization is larger and interacts to a greater extent with input from the world.

4. IS THERE ONE LEVEL IN CLASSIFICATION SYSTEMS THAT IS UNIVERSALLY PRIMARY OR MOST SALIENT?

As discussed earlier, much psychological research on the "basic level" of categorization has assumed that although a given object can be categorized at a number of different levels of abstraction, there is one level that has a special status as primary or most basic because of the structure of the environment. Categories at this level are taken to be ones whose members share many properties in common with one another while at the same time being substantially dissimilar to members of contrasting categories. However, aside from Rosch et al.'s (1976) seminal work with natural categories, most psychological work on the basic level has been carried out using artificial categories. These categories are typically devised such that the proposed feature distribution is present; thus the research assumes the structure of the input rather than testing it (e.g., Murphy & Smith, 1982; Mervis & Crisafi, 1982). Furthermore, Rosch et al.'s subject population was restricted to American college students from largely urban backgrounds. It may be, therefore, that Rosch et al.'s result was peculiar to urban Americans, or even to some aspect of the methodology.

Suggestions very similar to Rosch's have been made within the anthropological literature using a slightly different vocabulary: Both Berlin (1992) and Hunn (1977) discuss at some length the existence of categories that are highly distinctive by virtue of having both a high degree of internal homogeneity and being separated from other categories by large gaps or discontinuities in the distribution of features. (In fact, Rosch et al.'s suggestion was based in part on an early version of Berlin's proposal [Berlin et al., 1973]). In contrast to the psychological work, of course, the evidence contributing to this view comes exclusively from consideration of natural categories. In addition, the evidence is drawn from studies of categories in a number of different cultures. The cross-cultural literature therefore provides an opportunity to look for evidence either for or against the generality of Rosch et al.'s suggestion.

It is possible that cultures differ from one another in the level of abstraction that is most salient to them. As noted earlier, Rosch et al. (1976) did find that for biological categories such as trees, their college student subjects seemed to have a basic level that was above the generic level reported by Berlin et al. (1973, 1974). Some cultures might even not have any one level that stands out. In either case, a strong influence of the human categorizer would be implicated. Even if members of a culture generally show similarity in the level that is most salient, it might also be the case that the level that is primary for any individual member of the culture can shift as a function of the person's level of knowledge in a particular domain (Dougherty, 1978; Rosch et al., 1976; Tanaka & Taylor, 1991; Lin, Murphy, & Shoben, 1994). If so, this outcome would also argue for a top-down influence that interacts with the structure of the environment. To the extent that the evidence supports the universal existence of one level of abstraction as most salient, the outcome would provide support for a major role of structure in the environment. To the extent that cultures differ in whether there is a preferred level, and to the extent that the preferred level within a culture differs as a function of the knowledge brought to bear by different individuals, the importance of a conceptual contribution by the categorizer would be supported.

Notably, there is little by way of systematic evidence for the repeated assertion that there are larger between-category discontinuities and greater within-category homogeneity at one level of abstraction than at others. Evidence for this assertion seems to come primarily from the impressions of researchers based on informal comparison of categories at different levels of abstraction, and from their observations of the amount of scrutiny that their informants give to specimens in classifying them at different levels of abstraction. Also taken as evidence for the proposed feature distribution are similar statements made by biologists about the nature of the biological genus relative to other levels of scientific taxonomies (e.g., Bartlett, 1940, cited in Berlin, 1992). However, other, more independent observations are available that are consistent with the existence of such categories. The evidence suggests that there is one level of classification that is particularly salient within individual cultures, and that this most salient level is at the same level of abstraction cross-culturally.

As discussed in earlier sections, ethnobiological knowledge has most often been described in terms of a set of hierarchically related categories. One level, the "generic" level, has been defined in the past by Berlin (e.g., Berlin et al., 1973, 1974; Berlin, 1992) as the level of greatest psychological salience. For purposes of the present discussion, though, defining the generic level in terms of psychological salience would be circular, because the issue being addressed is in part whether such a level exists. Generic categories are sometimes defined as the smallest groupings that can be easily perceived on the basis of gross morphological and behavioral characteristics (e.g., Berlin, 1973, 1978) and are said to be recognized as a "gestalt" of these characteristics as opposed to through scrutiny of individual features (e.g., Berlin, 1992; Hunn, 1975b). Unfortunately, like the related claim about gaps and homogeneity, this definition accords well with intuition but has received little systematic evaluation. For present purposes, then, the generic level will be taken to be the level consisting of the smallest groupings labeled by a primary lexeme (defined below). Categories at the specific level further divide these, and categories at supra-generic levels group together two or more generic categories.

The first question to address is whether folk classification systems do, in fact, tend to have one level that is more salient than the other levels. One type of evidence for the existence of a particularly salient level is the structure of names given to categories at different levels of abstraction. Berlin (1992; Berlin, 1973; Berlin et al., 1973, 1974; see also Berlin, 1976) has argued that there is substantial cross-cultural regularity in how categories at different levels of abstraction are named. Categories of a high degree of inclusiveness, such as "tree" and "herb," as well as categories at the next lower level of inclusiveness, such as "oak" and "redbud," are consistently named with primary lexemes. Primary lexemes are most often single words. When they consist of two (or more) words (such as "poison oak" or "baby's breath"), they either do not include within their name the name of an immediate superordinate category (e.g., the name "poison oak" does not refer to a type of oak, just as the name "redbud" does not specify the superordinate category to which redbuds belong), and or they contrast with other categories that do not specify the superordinate (e.g., tulip tree contrasts with oak and maple). Categories at lower levels of abstraction are consistently given names with a different sort of structure. These categories almost always are given two-word names consisting of the name of an immediate superordinate, preceded by a modifier (e.g., pine warbler), and they contrast with other categories that also include the same superordinate in their name (e.g., palm warbler, Canada warbler). Although the most detailed evidence for this naming pattern comes from Berlin et al.'s (1974) examination of Tzeltal botanical classification, Berlin et al.'s (1973) review of a wide range of other folk classification systems (including groups in diverse regions such as the Philippines, New Guinea, and China) supports the cross-cultural regularity of the naming pattern. Subsequent investigations have also found this pattern (e.g., Hunn's 1977 study of Tzeltal zoological classification; cf. Headland, 1983, for one possible exception). Because both highly inclusive categories, such as "tree" and "vine," and immediate divisions of those categories, such as "oak" and "maple," have similar name structure, the naming pattern does not differentiate these two levels in terms of salience. It does, however, suggest that both are cross-culturally more salient than the finer divisions below them.

Another indicator of a salient level is the numerosity of named categories at different levels of abstraction. By virtue of the nature of a biological classification system, there are always a smaller number of biologically distinct categories at any given level of abstraction than at any level below it. In contrast, in the folk systems, categories that are the smallest groupings to have primary lexeme names (such as "oak" and "maple") are the most numerous of the categories that exist for a given culture, although they are typically not at the lowest level of abstraction of the folk system. This point is made explicitly by Berlin (1992; Berlin et al., 1973) and is reflected in data provided by other authors (e.g., Hays, 1983; Hunn, 1977; Posey, 1984). Berlin notes that folk classification systems of small-scale tropical horticulturists can have up to 500 to 600 generic plant names. Since many generic categories are not further subdivided, the number of sub-generic categories is only a fraction of that of generics, and this pattern is highly regular cross-culturally (see Section 2). Furthermore, since the more abstract levels of the folk system place several generics into a single more inclusive category, the number of categories above the generic level is also consistently substantially smaller than the number of generics. Languages typically have no more than eight life-form terms; some languages have only a few or even none of these terms; and many have no terms at all corresponding to the plant and animal kingdoms per se (Berlin, 1972, 1992; Brown, 1984). This pattern clearly indicates that there is one level in folk classifications of the smallest grouping to be labeled with a primary lexeme, that constitutes the largest part of the vocabulary for referring to plants and animals.

Related to the preceding point is the observation that these same terms appear to be the earliest to enter the ethnobiological lexicon of a language (Berlin 1972; Berlin et al., 1973; Brown, 1986). As just noted, many languages have few or no terms for categories that group together two or more of the categories labeled in this way, and similarly, few or none that subdivide these, but none is known to lack names consisting of primary lexemes for categories at an intermediate level of abstraction. This observation, to an even greater degree than the preceding one, suggests that there is one level that is especially salient to a given culture, and that this is true cross-culturally.

The observation that the smallest categories labeled by a primary lexeme are often not further subdivided is in itself evidence for the salience of those categories. Finer discriminations than those given by the generic category terms occur for only about 20% of generics (Berlin, 1992), and are associated with greater cultural importance. Even this degree of division occurs primarily within agricultural societies (see Section 2). These facts suggest that discriminations finer than those required for categorization at the generic level, although possible, are not salient in the absence of greater than average attention. In contrast, the fact that life-forms are standardly divided into a large number of generic categories, even when not associated with great cultural importance (see Section 2) argues for the salience of the generic groupings without special circumstances.

One study of the acquisition of botanical terminology has sometimes been used to suggest that generic terms are the first learned by young children. Stross (1973) took 25 Tzeltal children separately along a trail, eliciting names for 209 different plants along the trail. Stross reported on a number of aspects of the children's responses, among them that children often knew the generic name for a plant even if they did not know the specific and varietal name, and that they would give a generic name before giving a specific or varietal name even when these finer discriminations were known. Although some authors (e.g., Berlin et al., 1973; Berlin 1992, p. 63; Dougherty, 1978) have used these results to argue that generic names are the first learned and most salient for children, this conclusion is not necessarily dictated by Stross's report. One problem is that the children he studied were from 4 to 13 years old, well past the point of learning their first words. The data do not, therefore, directly address what terms they might have acquired as their first words. A related problem is that his report indicates that although the children knew many generic names, they also knew and sometimes used supra-generic terms as well; in fact, they would often respond with a supra-generic name if they did not know a generic name. Thus it is not clear which they learned first or most easily. What is clear from this report, though, is that generic terms were quite numerous in the early vocabularies of the children studied and were far more common and learned earlier than names of greater specificity. Again, they suggest that generic categories are at least more salient than those involving finer discriminations. This sort of study of acquisition has been carried out on only one culture, however, so the generality of the finding is not established. More cross-cultural data on children's earliest vocabulary are necessary to establish both the generality of the finding and whether generic terms are truly the first learned.

Finally, although not as systematically documented in the research reports, investigators have reported that generic names are those most easily and commonly elicited from informants (Berlin et al., 1973; Headland, 1983; Taylor, 1990). The typical response to questions of "what is that?" is a generic name, though occasionally generic names are not given if an informant believes a researcher lacks the knowledge to appreciate them (Berlin, 1992). This observation indicates again that the generic level is taken to be the most useful and natural level for communicating.

The evidence just discussed, taken as a whole, argues that individual folk classification systems have a level that is primary. Since similar patterns have been found in all cultures studied, the finding appears to be a general one. Although this observation is consistent with the idea that structure in the environment provides a salient level, it does not establish that the same level is the salient one cross-culturally. If the salient level were at different levels of abstraction for different cultures, this fact would argue against the structured environment interpretation and for an interpretation in which the establishment of a most salient level is determined by culture-specific conceptualization.[5]

[5] This interpretation assumes that the cultures in question have environments that are similar in how features are distributed across the organisms present (so that any difference in preferred level is not due to objective differences in the size of gaps between feature clusters at different levels). This equivalence assumption is probably reasonable for any culture living in a moderately or very rich environment. In each such environment, there are likely to be a number of organisms present from

Two pieces of evidence indicate that the most salient level is at the same level across different cultures. First and foremost is the fact that studies of folk classification consistently describe the smallest categories labeled with a primary lexeme as corresponding roughly to scientific genera (which, in most cases, are coextensive with single species since frequently only one species of a genus is present in a given local environment; Atran, 1987a; Berlin, 1992). This correspondence holds true across a wide range of cultures speaking unrelated languages (e.g., Berlin, 1973; Berlin et al., 1974; Bulmer & Tyler, 1968; Diamond, 1966; Hunn, 1977, 1990; Turner, 1974; Waddy, 1988). A secondary and related point supporting the idea that the most salient level is the same level cross-culturally derives from the fact that, as noted earlier, cultures have either no terms above the folk generic level or a relatively small number. Given that the folk generic level corresponds roughly to the scientific genus level, this means that there are no cultures having a large vocabulary of terms for categories corresponding to scientific categories above the level of the genus. Similarly, no cultures are reported to have vocabularies of subgeneric terms near in size to those of generic terms; this means that there are no cultures having a large vocabulary of terms corresponding to scientific categories below the level of the genus. If the most salient level were variable and culture-dependent, one would expect to see some cultures with the bulk of their vocabulary naming categories at higher levels of abstraction, and other cultures with the bulk of their vocabulary naming more specific categories. Taken together, these pieces of evidence constitute strong support for the idea that the most salient level for cultures is at a similar level for all of them. This outcome in turn suggests that there is a substantial contribution of structure in the environment to the most salient level.

At the same time that cultures as a whole show a general agreement on the most salient level, however, there is also some evidence supporting the idea that for any given individual, the salience of a particular level of abstraction may vary to some degree as a function of the individual's degree of knowledge about the domain. Boster (1980, cited in Berlin, 1992; see also Boster, 1985) found that among the Aguaruna, the members of the community responsible for cultivating manioc tended to refer to manioc plants by specific rather than generic names, whereas other members of the community used the generic label as expected. Berlin (1992) noted that Aguaruna women, who spend less time in the forest than

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different biological phyla and classes that would fall into different life-forms; a number of different genera of each of those; and, for at least some of the genera, two or more different species. In some particularly harsh environments, such as in deserts or the Arctic circle, the plant and/or animal life may be sparse enough that a somewhat different feature distribution would exist. In that case, the feature distribution may indeed influence what level is most salient. For example, suppose that in some hypothetical desert, the only non-human animals present were camels and beetles, with several highly similar biological genera of each represented. In that case, the life-forms of camel and beetle might be as salient as the folk generics, since there is so little diversity within the life forms. However, none of the cultures discussed inhabit this sort of environment.

men, may fail to differentiate among members of some scientific genera of forest birds which men do name distinctively. Dougherty (1978) observed that urban American children, in contrast to the Tzeltal children studied by Stross, appear to learn supra-generic distinctions among plants first and may never learn more than about a dozen folk generic distinctions. These observations are consistent with the suggestion in the psychological literature that urban Americans may in general classify biological entities at a higher level of abstraction than members of traditional cultures do, but that expertise in any subdomain (or simple familiarity, such as with domestic cats and dogs) may cause the preferred level in that subdomain to shift downward (Rosch et al., 1976; Tanaka & Taylor, 1991).

Berlin (1992) interprets these latter findings to mean that the psychological salience of a category varies with its importance to the culture (or individual). According to his interpretation, psychological salience is not unambiguously associated with categories at a particular level of abstraction. Rather, variables such as the numerosity or structure of the category names do not really reflect psychological salience at all; they are independent indicators of a particular taxonomic "rank" or level of abstraction. A slightly different interpretation, though, is that the nomenclatural and other indicators of primacy discussed above reflect the psychological salience to the majority of members of the culture, while the naming behavior of any one individual may reflect a shift from the general level of salience for that particular individual, brought about by a level of knowledge that differs from that of most members of the culture. (In some cases, of course, the culture as a whole may experience a shift in the average degree of individual knowledge about a domain, e.g., the urban American "devolving" botanical knowledge [Dougherty, 1978; Berlin, 1992]. In such cases, nomenclature and other indirect indicators of salience may undergo a slow shift that lags somewhat behind the actual shift in salience for members of the culture).

Berlin's interpretation does raise the important point, however, that once various indicators of salience diverge from each other, the meaning of "most salient level" becomes less clear. It is possible that while the level most useful for purposes of communication shifts, the level at which groupings are perceptually most distinctive stays the same or shifts relatively less. Tanaka and Taylor (1991), cited above, found that although American experts on birds and dogs were able to classify animals in their area of expertise as fast at a lower level of abstraction as at the middle level preferred by non-experts, their speed at the lower level did not actually exceed their speed at the other level. Similarly, Lin et al. (1994) found that providing subjects with extra practice differentiating category members at lower levels improved the speed with which they could be classified, but the speed never exceeded the speed for the middle level. If the preferred level for talking about a domain can shift with expertise but ease of identification at a low level cannot surpass ease at a middle level, this fact would indicate that there is a limit on the extent to which knowledge can change the perceived distinctiveness of groupings at different levels of abstraction. The limit would presumably be due to the size of gaps between feature clusters at different levels of abstraction. The available cross-cultural data unfortunately do not provide the information needed to evaluate ease of classification as distinct from the preferred level for communication.

Summary and Conclusions

The cross-cultural evidence on the existence of one primary, most salient level of classification given by the environment suggests that there is, in fact, one level that tends to be most salient cross-culturally. However, what little evidence exists on the influence of expertise seems to indicate that the most salient level, at least for purposes of communication, may shift somewhat as a function of different degrees of knowledge. To the extent that the level does shift, this evidence argues against the idea that structure in the environment is strong enough to yield one fixed level of abstraction at which groupings of objects are always most noteworthy, and it suggests that there is some flexibility brought about by a contribution of the human categorizer. This suggestion is consistent with a small amount of evidence from psychological studies indicating that some effect of expertise on perceptual salience can be seen. At the same time, though, the psychological studies also suggest that there may be a limit on the extent to which categories at different levels can become most perceptually distinctive, and they are consistent with the possibility that shifts in preferred level may be primarily for purposes of communication. Thus the available data again argue for a substantial contribution of a structured environment, with some evidence that structure interacts with a contribution of the human categorizer.

The available data do not indicate whether the human contribution, to the extent that it exists, is something that should be viewed as a higher-level, conceptual contribution, or whether it can be characterized fully in terms of lower-level processes such as shifts in attention and perceptual learning. It is possible that both are involved: Changes in how dimensions are weighted may be the immediate cause of a change in the salience of groupings at a particular level, but those changes in weighting may be driven by more abstract conceptual learning.

GENERAL DISCUSSION

Summary of Findings and Conclusions

The studies reviewed here provide a number of central findings along with some less definitive but suggestive findings. Together these point to several conclusions about the role of structure in the environment versus conceptualizations in category formation. They also highlight the contribution of cross-cultural research to resolving this issue.

Environment vs conceptualization. Several findings argue for the idea that there is structure in the environment that is perceived in a universal fashion by human categorizers. One of the most striking and important findings is that of the close correspondence of folk biological categories to scientific categories. This correspondence is illustrated in most detail by Hunn (1977) for Tzeltal folk zoological categories, but it is clearly noted for many other unrelated cultures as well. The finding of close correspondence, and of cross-cultural regularity in this correspondence, argues strongly against the possibility that folk biological categories are constructed in an unconstrained fashion from unstructured input. Instead, the nature and contents of the categories seem to be heavily influenced by the presence of structure in the input. This conclusion is bolstered by the finding that both urban Americans and traditional Jívaroans from Peru perceive similar patterns of resemblance among a set of South American birds (familiar to the Jívaroans and unfamiliar to the Americans) and rely on similar features to sort the birds into groups.

A second strong piece of evidence for the role of structured input is the correspondence noted by both Berlin (1992) and Geoghegan (1976) between the differentiation of scientific genera into scientific species and the differentiation of folk generic categories into folk specifics. The fact that the frequency distribution of folk specifics closely follows that of scientific species and is also regular cross-culturally argues again that folk classifiers in different cultures, operating without communication across cultures or with scientific theorists, all perceive the same fundamental structure in the input.

A further finding consistent with a major role for structure in the environment is that at least some, and possibly most, folk generic categories appear to be recognized independent of their cultural value or role, and some folk specifics are also so recognized. This observation, in conjunction with the observation that generic and specific categories appear to be based heavily on morphological and behavioral/ecological characteristics, suggests that one dominant set of features makes themselves obvious to all human observers as the basis for categories. Finally, the fact that there are categories at one level of abstraction cross-culturally that share similar properties of nomenclature, numerical dominance within the classification system, and frequency of use, supports the idea that some categories are salient to all observers.

Taken alone, these findings might suggest that a structured environment is sufficient to explain the formation of folk biological categories: Strong clusters of features exist in the world, and the human categorizer need only apply basic perceptual processes to extract these feature clusters and form categories. However, other findings suggest more complexity in the formation of categories.

Two related findings suggesting more complexity are, first, that the correspondence between folk and scientific categories varies depending on level of abstraction, and second, that factors other than morphological and behavioral/ecological features may influence classification at some levels of abstraction. In particular, correspondence is strongest at the generic level, and, in fact, is fairly weak at supra-generic levels. Consistent with this observation, it is also at the supra-generic levels that culture-specific influences appear to have the most potential impact on classification. To some extent, discrepancies between folk and scientific categories at supra-generic levels may be explained by the idea that morphological and behavioral/ecological characteristics are still the primary characteristics used, but that the particular characteristics salient to folk classifiers at this level differ from those used by scientific classifiers. At the same time, though, there is some evidence that more top-down conceptualizations such as mystical and religious beliefs may influence categorization at these higher levels of abstraction. In either case, this observation suggests that there is not a single pattern of resemblance for more abstract ("life-form") categories that makes itself obvious to folk and scientific categorizers alike. To the extent that there is not, this suggests that for category formation at higher levels of abstraction, conceptualization may interact with weak to moderate structure provided by the environment.

An additional consideration is the fairly strong indication that utility to a culture does influence the recognition of folk specific categories to some degree; there appears to be greater differentiation in parts of a domain that are of greater interest to a culture. Although there is less systematic evidence concerning recognition of generic categories, there is some suggestion that the utility may also influence recognition of generics, though probably to a lesser degree. Some of the greater recognition of useful specifics may arise because of greater objective differentiation of domesticated plants and animals. However, relatively informal reports suggest that utility also influences recognition of species that are not domesticated. Although a potential influence of utility does not directly implicate top-down, conceptual, processes, it does argue against the sufficiency of structure in the input to account for category formation and in favor of at least a view in which low-level processes such as attention are variable and may themselves be influenced by more top-down factors. This position is also strengthened by the observation that differentiation of generics into specifics (and even of life-forms into generics) may differ to some extent across cultures or across individual members of a culture as a function of the importance or familiarity of a domain to the culture or to individuals.

Finally, there is some indication that degree of expertise in a domain can influence the most salient level of abstraction in a classification system, with greater expertise possibly causing a lower level to become more salient or at least equally salient to the level above it. To the extent that the expertise effect exists, it again implicates a contribution of the human categorizer consisting of an attention shift that may be directed by more top-down processes.

In sum, taken together, the findings reviewed in this paper argue against the extreme perspective that there is little structure in the input and the particular categories formed are heavily determined by constructive processes on the part of the human categorizer. Instead, the categories formed seem to be strongly influenced by regularities in the input that are recognized by the categorizer. This fact alone would argue that perception of strongly structured input might fully account for category formation, and it is also compatible with, though does not in itself provide evidence for, the possibility that strongly structured input plus conceptualizations yield category formation. The fact that the impact of regularity in the input is most pronounced at the generic level, though, with a greater potential role for constructive processes at higher and lower levels of abstraction, argues that a view in which structure in the input is moderate rather than strong would be needed to account for category formation at all levels of abstraction. This view is also necessary to accommodate the possibility that the preferred level of classification in a domain may be influenced to some extent by degree of expertise in that domain.

The contribution of cross-cultural investigations. The conclusions just discussed demonstrate three primary benefits from considering anthropological investigations of classification. First, the cross-cultural data allow us to sort out aspects of category formation that may be cultural constructions, and hence have variable conceptual contributions, from aspects shared cross-culturally by virtue of universality in the nature of the input and/or ways that humans perceive and interact with them. The cross-cultural approach is a central feature of anthropological research and is virtually nonexistent within psychological investigation.

Second, the study of natural categories rather than artificial ones, while not exclusively associated with anthropology, is a hallmark of anthropological investigations. In contrast, the number of psychological studies examining the structure of natural categories is relatively small compared to studies using stimuli invented by the investigator. Although psychologists have learned a great deal about how people deal with various types of artificial stimuli that make available different amounts of structure in the input and encourage different amounts of constructive processes, these studies cannot reveal what sort of structure exists in the world and how strong its influence on category formation might be.

Finally, psychological studies with artificial stimuli, outside of those specifically on the "basic level," typically have not considered the potential influence of different levels of abstraction on the nature of the categories formed. As a result of the anthropological emphasis on studying naturally occurring categories, the potential for important differences among categories at different levels of abstraction is made clear.

Universal Structure or Universal Minds?

The above discussion argues that structure in the environment has a substantial influence on folk categories. This argument is based in part on the observation of cross-cultural regularities in the nature of ethnobiological categories. One might ask, however, whether cross-cultural similarity necessarily points to the influence of a structured environment, or whether it might mean, instead, that conceptualizations are heavily constrained such that universal category structures arise. Among linguists, observation of universals such as the presence of linguistic units referring to objects, actions, and events is often taken as evidence for the innateness of such linguistic categories (e.g., Chomsky, 1968, 1988; Greenberg, 1966; Jackendoff, 1983; Langacker, 1973; Pinker, 1989), not for an influence of world structure on individual language users. In contrast, observation of universals has been used here and throughout the anthropological literature to argue for an influence of structure in the environment.

While there is little doubt that fundamental perceptual and cognitive abilities allowing categories to be formed are shared cross-culturally, several points argue against the stronger position that the categories themselves are given by highly constrained or innate conceptualizations in the same way that the concepts of object, action, event, etc. might be. With 500–600 generic terms for plant categories alone common in a single small-scale agricultural society (Berlin, 1992), there are undoubtedly thousands of different plant and animal categories recognized across the world's cultures. It is highly implausible that such a vast number of individual categories, of which any culture instantiates only a subset, are innate. Furthermore, many cultivated plants have been developed only within recent history and so have not been present long enough to influence the evolutionary history of the human mind. A more plausible idea might be that the smaller number of more abstract plant and animal categories are innate. However, these are the ones that are most variable across cultures (see Section 3), and that are poorly represented or not represented at all in some languages (see Sections 3 and 4). Such categories are not good candidates for having innate status. Thus the level of innate constraints on the categories formed, it seems, must remain at the more general level of the perceptual and cognitive processes that operate on input from the world. Although these processes may, indeed, be strongly shaped by the history of human evolution in the environment (see, e.g., Medin & Wattenmaker, 1987; Shepard, 1984), the processes must be general enough and flexible enough to permit categories with a wide variety of structures to be formed (including the variable life-form categories as well as the more limited specific categories, categories such as ''weed'' and ''pet,'' well-defined categories such as ''prime number,'' and others such as artifact and social categories, discussed below). Given that this is so, it seems that a significant source of constraint on the cross-cultural regularity of the form of folk biological categories must be structure in the input from which they are formed.

Limitations of the Available Data

Although I have drawn a number of conclusions from the anthropological research, it is useful to consider what sorts of information these investigations do not provide about category formation, either by virtue of insufficient data or by virtue of their nature.

As far as data limitations, there are a number of places where additional data are needed in order to draw firmer conclusions. Several of them concern claims about the primacy of the generic level. First, as noted earlier, there have been many statements about the existence of maximal between-category gaps and minimal within-category variation at the generic level, but there has been little systematic investigation of the claim. Further support for this idea is needed. Similarly, there is a frequent assertion that generic categories are the smallest groups easily perceived on the basis of gross morphological and behavioral/ecological characteristics. Support for this assertion is also mainly based on intuition and needs to be substantiated. In addition, more data on the primary vocabulary used by members of traditional cultures for talking among themselves, rather than to researchers, would help establish whether the generic level really is most salient in communication. As noted earlier, it would also be revealing to have more careful investigation of the level of abstraction of the earliest and primary vocabulary used by children in traditional cultures, in order to see if the generic level is also the primary level for language and concept learning. Finally, to fully evaluate to what extent the most perceptually salient level is fixed by structure in the environment versus is flexibly determined by the categorizer, it would be valuable to have on-line tests of the level at which classification is quickest and most accurate across cultures and across individuals with varying degrees of expertise in a domain. On-line data may be difficult or impossible to collect from people unaccustomed to computer technology, however, leaving people with varying degrees of expertise within industrialized societies the only viable study population.

Two related issues about the extent to which culture-specific concerns influence category membership need further attention. First, the role of utility to a culture in recognition of both specific and generic categories is not fully resolved. Additional work is needed to establish, for specifics, to what extent greater differentiation for useful species is due to greater objective differences among those species, and for generics, whether utility is, in fact, systematically related to recognition. Second, further disentanglement of the relationship between classification and symbolic/religious associations is needed to establish whether divergences from scientific classification in life forms are due to unusual morphological characteristics, with special cultural status following, or whether the cultural status is the causal factor in the classification.

Two other sorts of investigations would also help establish the extent to which category formation follows structure in the input. Following Berlin's (1992) suggestion, in order to evaluate the claim that biological facts will predict the recognition of generic categories, it would be useful to lay out the scientific relationships among the plants or animals of a region and examine whether those groups or individual species that are most biologically isolated from neighboring groups of plants or animals are the ones most likely to receive recognition as a folk category. As Berlin notes, such an enterprise would be difficult because it depends on having available a full cataloging of the species likely to be encountered in a given environment. Another convincing piece of evidence for the impact of structure on formation of generic categories would be to locate cultures having similar plants and animals yet different means of subsistence and different sets of religious and other cultural beliefs, and to look at whether their categories are the same. To the extent that distinct cultures arrive at similar classifications, of course, a substantial role of structure in the environment is supported. Unfortunately, as noted earlier, making such a comparison may be nearly impossible, because communities in different geographical locations will typically have different plants and animals in their environment. An approximation to this sort of comparison might be to examine classification by, for instance, members of the Spanish vs Indian cultures within the settlement of Tenejapa, which Hunn (1977) describes as maintaining separate languages and lifestyles. However, it cannot be expected in this case that the cultures are entirely separate and uninfluenced by one another.

In addition to these gaps in the existing data, there is also one critical inherent limitation on the data that have been collected to date. Psychologists are ultimately interested in concepts, that is, the mental representation that underlies the observed categories, and they have used a variety of measures to uncover different aspects of the mental representations. Anthropologists, on the other hand, have focused primarily on analysis of the categories, that is, the sets of objects that are treated as equivalent and given a common name. As a result, the information provided by anthropologists about the nature of the underlying concepts is more limited. In particular, data on the basis for various classifications consist primarily of researchers' and informants' verbalizable intuitions on the matter. However, introspective reports do not necessarily reveal the full content of the underlying concept. Statements of the "identification procedure" for a plant or animal (Miller & Johnson-Laird, 1976; Smith & Medin, 1981) may not capture other, less easily verbalized, aspects of knowledge that are important to category membership. Keil (1989), for instance, suggests that even fairly young (urban American) children hold beliefs about the relevance of parentage and internal structure to category membership for animals, and they take these factors into account in addition to more readily named morphological features when making category decisions (see also Carey, 1985). In line with such suggestions, Atran (1987b) has argued that implicit assumptions about the existence of an underlying essence are also necessary to the formation of folk categories in traditional cultures. Such beliefs will not typically be revealed in the absence of testing situations specifically designed to probe for them.

Furthermore, beliefs of this sort, even when verbalized, may not fully capture the factors that influence category membership. Malt (1994) has argued that for at least one natural kind category, "water," the beliefs about chemical composition that both researchers and urban American subjects typically hold about what determines whether a liquid is water are not sufficient to explain membership in the category. Instead, factors such as the source of the liquid and the use it is put to seem to influence whether it is considered to be water. Thus, although informants in the anthropological studies do not typically mention function as their basis for plant or animal classification, morphological structure and the potential uses of an organism will tend to be correlated (Hunn, 1982; Randall & Hunn, 1984), and the reports cannot provide conclusive evidence against the possibility that non-verbalized functional considerations influence category membership. By the same token, other factors not yet discovered may potentially play some role in category formation as well.

These considerations mean, essentially, that the sorts of information given in reports by informants and researchers can be taken to reveal part, but not necessarily all, of the relevant knowledge and processes involved in determining folk category formation and classification of individual specimens. The reports given typically reveal the perception of morphological and behavioral/ecological characteristics associated with groupings. However, they cannot fully indicate to what extent other factors including ones such as beliefs in an underlying essence, which are more conceptual and top-down, might also be part of the underlying concepts and critical to the formation of the groupings. The problem with taking such reports to be definitive has been noted to some extent by Atran (1985), Bulmer (1979), and Hunn (1979) in pointing out that, for instance, it is not clear whether, in cases like the Kalam exclusion of the cassowary from the category "bird," the myth reported as explanation for exclusion is itself the underlying reason for exclusion, or whether the anomalous physical features or place in the classification was the original reason, which then led to the development of an associated myth (see also Berlin et al., 1974, p. 154; Bulmer & Tyler, 1968, p. 353; and Taylor, 1990, p. 45). Little has been done at this point, though, to provide a means of resolving such issues. For this reason, it is impossible on the basis of the data currently available to know whether bottom-up perceptual processes operating on structure in the environment are sufficient to account for the most perceptually salient categories, or whether for even those cases some larger contribution of the human categorizer must be present.

What Do the Data Suggest about the Role of Top-Down, Constructive Processes in Folk Biological Category Formation?

Taking into account the limitations just noted above, the available data can nevertheless offer some constraints on the possible role of top-down, constructive processes in the formation of folk biological categories. The most general constraint, already discussed, is stated most easily in negative terms: Top-down influences are not alone the basis for folk biological categories, nor are the categories infinitely malleable and molded by highly variable conceptualizations. Within this general constraint, other, more specific constraints are also suggested.

First, the data suggest that top-down processes may have a role through directing selective attention, which helps determine what groupings within generic categories get recognized as specific categories. In particular, the goals and interests of a culture or individual may direct greater or lesser attention to certain domains, yielding finer discrimination of features within the domains receiving more attention. Finer discrimination may result in the formation of more categories within those domains and possibly a shift in the most salient level of abstraction for those domains.

Second, mainly for more abstract categories where property clusters are less strong and involve fewer properties, there may be culture-specific beliefs in the form of myths and other associations that influence in what category some entity gets placed. To some extent, the beliefs may act to influence what features are salient. Further, though, the particular beliefs may endow additional features on a plant or animal that are considered in classification along with the standard morphological and behavioral/ecological features. For instance, if a plant is considered to have magical properties not shared by other plants of similar morphology, this discrepant feature may cause it to be perceived as sufficiently unlike the other plants that it will be excluded from membership in the same category.

Third, as just discussed, there may be general conceptions that underlie and are necessary for all category formation (or at least for categories of living things), including assumptions about parentage, similarity of unseen parts, or some unspecified shared "essence" among category members. Although the available anthropological data do not speak to this possibility, the data reviewed in this paper are compatible with such an interpretation. Walker (1992) carried out an exploratory study based on Keil's (1989) experiments with Americans, using Yoruba of western Nigeria as subjects. She found suggestive evidence for some general conceptions about the basis for category membership similar to those of Keil's subjects, though others of the beliefs expressed appeared to be more culture-specific. More investigation of the role and nature of beliefs about category membership is clearly needed.

Finally, Boster and D'Andrade's (1989) research showing that members of different cultures perceive similar patterns of resemblance among birds suggests a complex interaction between environmental constraints and top-down constraints on the selection of features relevant to classification. Their study revealed that members of different cultures shared common strategies for picking out contrastive features in different domains: Subjects used different features to discriminate among the passerine than among the non-passerine birds, but subjects from different cultures made similar choices of features for the two subdomains. This finding is highly compatible with Medin, Goldstone, and Gentner's (1993; see also Goldstone, 1994) argument that the context of a comparison may provide a major constraint on the features taken to be relevant to the similarity of any two objects. The comparisons to be made may, themselves, provide a stable context against which relevant features are extracted. To the extent that this is true, selection of features may be said to be constrained by the nature of the input. However, the selection process itself may draw upon some implicit beliefs or theories about what sorts of features are relevant to discriminations within a domain. For instance, the idea that beak size or shape should be heavily weighted in judging bird resemblance, and that color may be relevant but somewhat less so, may rest on underlying concepts of what features are important adaptations to different habitats, and on beliefs about the importance of habitat differences in deciding what birds are related to one another. At the same time, there appears to be a strong environmental constraint on the development of such theories, if indeed theories guide feature selection, since members of cultures with drastically different levels of experience in the domain chose similar sets of features for the different bird groups. Relatively minimal exposure to birds appears to be sufficient for the development of common beliefs about what features are relevant to discriminations. Thus conceptualizations may guide the perception of resemblance, but the conceptualizations themselves may have been strongly constrained by the nature of the input (see Smith & Heise, 1992, for arguments that perception constrains conceptualizations in this way).

Is There Really an Objective Structure to the World?

The discussion up to this point has proceeded as if there is one objective structure to the world, explicitly sought and identified by scientific classifiers, and implicitly serving as the basis for categories formed by folk classifiers. However, this way of talking about structure is an oversimplification of the nature of scientific classification. There are a number of different and distinct schools of thought about how botanical and zoological classification should be carried out and about what sorts of relationships the classification schemes should capture. In one major approach, phenetics, classifications attempt to capture resemblances among organisms and are based heavily on overall morphological and behavioral similarity. In another approach, cladistics, classifications attempt to capture evolutionary relationships and are based on evidence of relatedness given by shared derived characters (see, e.g., Hull, 1984; Mayr, 1969; Ridley, 1985; Simpson, 1961; Sober, 1984, 1988; Sokal & Sneath, 1963; Wiley, Siegel-Causey, Brooks, & Funk, 1991).

Notably, the different approaches yield classifications that differ somewhat from one another. While the classifications produced through different methods overlap to a large degree, there are also cases where the placement of an organism or group of organisms in the classification changes substantially depending on the method being used. Furthermore, advances in technology under any given approach can change the analysis of relatedness among the organisms (e.g., Ridley, 1985; Salzman, 1993; Stevens, 1994). Given that this is so, what is the implication for claims that folk classification is strongly influenced by objective structure in the world?

One interpretation of these observations is that there is no objective reality to the world; classification is inherently a constructive process that reflects the goals, interests, and knowledge of the classifier (e.g., Lakoff, 1987). An alternative interpretation, though, is that the different scientific classification schemes emphasize different, but related, aspects of reality. Evolutionary relationships are one aspect of reality, and similarity of form is another. Which aspect a particular classification system emphasizes is without doubt attributable to choices made by the classifiers reflecting their goals and interests (e.g., Ridley, 1985; Stevens, 1994). To the extent that these goals and interests, along with the state of knowledge at the time, are influential, the classifications constructed must be said to reflect a contribution of top-down, constructive processes rather than reflecting only structure in the world.

However, importantly, the goals and interests involved in all modern scientific classification are those of people explicitly aiming to create general-purpose, "natural" classifications based on multiple characteristics of the organisms involved, and in particular reflecting clusters of co-occurring features (e.g., Ridley, 1985). They are not classifications based on single characteristics or special-purpose classifications reflecting, e.g., utility of the organisms for food or medicine, or their role in religious beliefs. In essence, the scientific classification systems are aimed at capturing biologically meaningful relationships of the organisms to one another, not culturally determined relationships of the organisms to humans. To the extent that folk classification matches scientific and does so cross-culturally, this observation suggests that folk classifiers perceive the same sorts of "natural" relationships among organisms as do scientific classifiers, and that this perception is relatively universal and culture-independent. This sort of relationship between folk and scientific classification can be thought of as a "conceptual" correspondence (Bulmer, 1970) that holds even in cases where actual category membership does not match perfectly.

If folk classification has a conceptual correspondence to scientific but cannot logically be expected to correspond closely to all versions of scientific classification systems, where does this observation leave the claim that folk classification is heavily constrained by structure in the world? Although there may be no single classification that can be constructed given all the information available to modern science, in fact, folk classifiers have a much more limited set of information on which to base their classifications than scientists do. Folk classifiers are limited to considering those characteristics apparent without the aid of microscopes or genetic analysis or other equipment beyond their own sensory apparatus. Thus alternatives to the classifications suggested by readily perceived morphology, such as those based on DNA or RNA evidence, are not part of the possibilities available to them. Folk classifiers are also limited to considering those organisms that appear within the environment they inhabit. Because it is common for only a single species in a given genus to exist in a particular habitat (e.g., Atran, 1987a; Berlin, 1992; Turner, 1974), the input that folk classifiers experience may exaggerate the extent of gaps between clusters of properties relative to that experienced by scientists. Together, these facts suggest that the groupings perceptually available to folk classifiers may be relatively unambiguous. Thus folk classification is most likely more heavily constrained by structure in the input than scientific classification is, and is less likely to be subject to competing goals of classification within the constraint of "natural" systems (such as those involved in the phenetics versus cladistics controversy). In sum, while there may be no single objective classification system that is favored and used by all scientific classifiers, this fact does not argue against the possibility that folk classification is heavily constrained by structure inherent in the input observed.

To What Extent Do Findings from Folk Biological Categories Generalize to Other Sorts of Categories?

Up to this point, the discussion has focused entirely on biological categories, since it is these categories that anthropological research has addressed in most detail. Theories of categorization, of course, are ultimately intended to account for other sorts of categories as well, and the psychological literature has often addressed artifact categories in particular. To what extent do the cross-cultural findings on biological categories also inform theories of how artifact categories and other categories are created?

Unfortunately, relatively little is known about whether property clusters exist in the world for artifact categories as strongly as they appear to for (at least genus level) biological categories. In contrast to the case for biological categories, there is no comprehensive and systematic scientific inventory of artifacts and their degree of relatedness to one another. Some evidence suggests that clusters do exist. Rosch and Mervis (1975) used four artifact categories in their study of family resemblances and found that typical category members shared substantial numbers of properties with other category members and shared few properties with members of contrasting categories. In addition, Malt and Smith (1984) found significant pairwise correlations between properties within each of two artifact categories. However, whether these clusters are stronger or weaker, or perceptually more obvious or less obvious, than clusters of features for biological entities, is unknown.

There is some reason to think that potential groups of artifacts may be somewhat less strongly separated from one another by gaps in a feature distribution than are biological groups. Because artifacts are made by humans, and can be made in essentially endless variation, the features that they possess may vary more continuously, even if there is some degree of clustering. For instance, there may be many artifacts that share certain standard chair properties, and many others that share certain standard stool properties, but there are also at least some artifacts in most people's experience that have properties intermediate between the two. Several studies of container classification suggest that although the prototype for categories such as "bowl," "vase," "bottle," and "jar" may be clear-cut, there is substantial fuzziness in the boundaries of these categories (Kempton, 1981; Labov, 1973; Malt, 1993). In addition, roughly equivalent artifact terms in different languages do not always encompass the same set of artifacts. For instance, the rough equivalent of "sofa" in mandarin Chinese is centered on objects similar to American sofas, but it also encompasses large, stuffed seats for only one person. This fact suggests that there is no single compelling gap separating the two categories. Finally, as noted earlier, the perception of gaps in the feature distribution for animals is most likely heightened by the fact that any given geographical region will typically contain only one or a small number of the members of a given biological genus. It is not clear whether there is any equivalent effect at work for artifacts. Although an individual person might only own or use one variant of a given artifact, that same person may come into contact with a large number of other variants owned by others (or that are present in stores, on TV, etc.).

These observations suggest that there may be more room for top-down influences in separating artifacts into categories. However, the existing research does not establish to what extent separation is truly due to variation in conceptualization versus due to relatively arbitrary convention based on history, manufacturer's naming choice, etc. (see Malt, 1993). Here as for biological categories, research with artificial stimuli demonstrating the impact of top-down processes does not by itself reveal the answer, since it is unclear whether the structure of the artificial stimuli reflects that provided by the world. To better understand how much property distributions overlap among artifact categories, studies along the lines of Labov (1973), Kempton (1981), and Malt (1993) of the range of category membership for pairs of contrasting categories (e.g., "bottle" and "jar," "sofa" and "chair") are needed for larger numbers of artifact categories.

There are, of course, many other sorts of categories that people name and use besides biological and artifact categories. Among these are kin categories and other categories of people (e.g., professions, social class, personality types), categories of emotions, and categories of biological entities that appear to cross-cut the basic biological classifications discussed in this paper (e.g., pet, weed, firewood, enemy, flower, fruit, berry, vegetable). For instance, Waddy (1988) suggests that plants and animals enter into three separate systems of conceptual classification for Groote Eylandt Australian aborigines and possibly for many other cultures: biological, food, and totemic classification. Each of these plays an important cultural role. Even less is known for these than for artifact categories about what sort of structure in the world may serve as input to the categories, and about how much of a contribution conceptualization might make. However, it is unlikely that category formation for all the different types of categories is identical. Some of the categories (e.g., mother) may be heavily perceptually given (e.g., by virtue of the salience of birth and nursing), while others (e.g., uncle) may be much less perceptually given and dependent in part for recognition on culture-specific social construction. Categories such as weed, pet, and enemy may not be perceptually obvious at all, but yet might be universally constructed (or nearly so) due to universal tendencies in the way that humans interact with their world. Still other categories (e.g., queen, king, martyr) may exist only in some cultures depending on the structure of the society.

Conclusion

There can be no doubt that there is a strong and universal human urge to group entities in the world into categories. Some groupings may stand out given only the world and the human perceptual system, others may stand out given those plus universal human interactions with the world, and still others may stand out only given a particular system of knowledge and/or particular goals, needs, and interests. The chicken, or objective facts of nature, appears to dominate in cases when the world as filtered through the human perceptual system presents itself in discrete chunks. Such cases include biological categories at a middle level of abstraction. The egghead, or human intellect in its role as classifier, becomes more important when nature and perception do not by themselves deliver the world prepackaged into obvious chunks. Such cases include biological categories at higher, and to some extent lower, levels of abstraction, and potentially many common categories in other domains.

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