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Naming the animals that come to mind: Effects of culture and experience on category fluency

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Abstract

This article considers the semantic structure of the animal category from a cross-cultural developmental perspective. Children and adults from three North American communities (urban majority-culture, rural majority-culture, and rural Native American) were prompted to generate animal names, and the resulting lists were analyzed for their underlying dimensionality and for the typicality or salience of specific animal names. The semantic structure of the animal category appeared to be consistent across cultural groups, but the relative salience of animal kinds varied as a function of culture and first-hand experience with the natural world. These results provide evidence of a shared representation of animals across disparate cultures but also indicate a role for culture in shaping animal concepts.

KEYWORDS: categorization, development, cross culture, Native-American, folkbiology, name generation

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Introduction

Universals and cultural specifics in folkbiology

A robust finding in the folkbiological research is that across the world's cultures, individuals categorize and name animals (as well as plants) in fundamentally similar ways (e.g. Berlin, Breedlove, & Raven, 1973; Atran, 1990; Berlin, 1992; Malt, 1995; Coley, Medin, & Atran, 1997). But there is also evidence for cross-cultural variability in the peoples' naming and representations within the animal domain. One dimension of variation is related to exposure. Apparently, a poverty of exposure to living kinds, such as that associated with urban contexts, coupled with diminished cultural support for learning about nature (Wolff, Medin &Pankratz, 1999) has important consequences for biological reasoning (Medin & Atran, 2004). Recent evidence reveals that urban children show different patterns of reasoning about biological phenomena (including more anthropocentric reasoning and less ecological reasoning) than their rural counter-parts (Ross, Medin, Coley & Atran, 2003; Waxman & Medin, 2007). Another dimension of variation is related to cultural construals of the natural world. Recent evidence reveals that even among children raised in rural settings, patterns of biological reasoning vary as a function of their cultural communities. Ross et al (2003) reported that rural Native-American children displayed ecological reasoning several years earlier than rural European-American children, echoing corresponding differences among Native-American and European-American adults (Medin, Ross & Cox, 2006; Bang,

Medin & Atran, 2007).

The present paper is concerned with how children and adults from three distinct populations (urban, rural European-American[1], rural Native-American) conceptualize animals. This question has many facets and the study reported here represents just one of them. Our goal is to uncover the ways in which individuals from each of these communities organize the entities within the animal kingdom. We approach this question from a developmental perspective, asking children and adults from each population to name the animals that come to mind spontaneously in a free-listing name generation task.

The free-listing task

To study the effects of cultural and experiential factors in the organization of animal kinds, we make use of a free-listing task, also known as *category fluency*. This task has long been used as an index of memory structure and retrieval processes (e.g., Deese, 1965). Participants are asked to name members of some specified category as they come to mind (e.g., "Name all the animals you can think of"). The simplicity of this task makes it especially well-suited for an investigation involving young children, as well as adults, from a range of cultural communities. We first briefly review the most relevant subset of that work and then turn to the rationale for our comparative focus.

Researchers using the free-listing task have identified two principal dimensions that organize children's representations of the animal category: *domesticity* and *exoticism*, or jointly, characteristic habitat (Storm, 1980; Lucariello, Kyratzis, & Nelson, 1992; Crowe & Prescott, 2003). Storm (1980) used a hierarchical clustering technique to analyze animal free-listing data. She reported that children showed identifiable clusters

corresponding to farm animals (e.g., cow, horse, pig), city animals (e.g., dog, cat, mouse) and exotic animals (e.g., lion, elephant, giraffe). More recent replications (Lucariello, Kyratzis, & Nelson, 1992; Crowe & Prescott, 2003) provide additional support for these clusters. In addition, although evidence from these studies reveal that older children were more likely than younger children to name non-mammals, children at all ages clustered by habitat.

The free-listing task plainly underdetermines category structure, since many kinds of structure (based, for instance, on different respects of similarity and association) are collapsed under the retrieval prompt to "Name any animal you can think of." Although free-listing may be a rather blunt assay of semantic structure, it is, in principle, sensitive to experiences with animals (insofar as they shape our semantic network)-- trips to the zoo, walks in the park, camping trips, story books and favorite TV shows—in ways that more specific tests of semantic structure (e.g., similarity ratings) are not. Indeed, what free-listing may index best is *global* category organization, the sum total of connections between items in a given category. Free-listing is therefore an appropriate tool for our purposes because there is reason to expect that global category structure will be sensitive to differences in conceptualizations of and experiences with animals that might vary across cultural groups.

Our present goal is to identify how the implicit psychological salience and organization of distinct animal kinds is influenced by the cultural and experiential factors. We adopt a cross-cultural, developmental approach to identify whether and how children's and adults' generation of animal names, a measure of their organization of animal kinds, is influenced by culturally-transmitted beliefs about and daily experience

with biological entities. We anticipated that rural children and adults would be more likely to generate names of animals that figure in their everyday outdoor experiences than urban children and adults. We suspected that the animal names generated by our urban sample would reflect animal kinds represented indirectly in experience (e.g. children's books, television, movies), and would therefore include mainly domestic and exotic animals. But if everyday outdoor experience is also important for our urban sample, then urban animals such as "squirrel", "pigeon" and "raccoon" may be commonly generated.

Method

Participant communities

We recruited participants from three communities and four age groups. Participants (N = 667) were rural majority culture children and adults from the town of Shawano, WI (n = 206); children and adults from the Menominee Indian Reservation directly north of Shawano County (n = 248); and children and adults from Boston, Chicago, and an urban suburb of Chicago (n = 213). We elaborate below on several relevant cultural and demographic factors associated with these communities. Age groups were 4-year-olds (n = 116, M = 4;8), 6-year-olds (n = 236. M = 6;5), 9-year-olds (n = 207, M = 9;5), and adults (n = 108, M = 36;11). See Table 1 sample sizes for the Age and Community variables.

Communities and participants

Rural Native American. The Menominee ("Wild Rice People") are the oldest continuous residents of Wisconsin. There are 4000 to 5000 Menominee living on tribal lands in Wisconsin. As in the past, the reservation is heavily forested. Hunting and fishing are important activities for most adult males and for many females and children.

The Menominee have a clan system organized around five major clans (bear, thunder/eagle, wolf, moose, and crane).

All of the participants were recruited from elementary schools on the Menominee reservation. Adult participants were parents of children attending these reservation schools. These Menominee children and adults are best considered monolingual English speakers: although they know at least a few Menominee words, especially those for clan animals, they are not fluent in the language and do not converse in it at home.

Rural European-American. Adjacent to and to the south of the Menominee reservation is Shawano County, encompassing farmland, small forest plots (typically 40-80 acres), and numerous lakes and rivers. Hunting, fishing, water recreation in the summer, and snow-mobiling in the woods in the winter are popular activities for adults and children. All of the majority culture children were recruited from public elementary schools in Shawano. Adult participants were parents of children attending these schools.

Urban sample. Urban participants were recruited from Boston, MA, and Chicago, IL. Children attended public schools located within the cities or a public school in a densely-populated suburb of Chicago. Adults were parents at the two Chicago-area schools. There is considerably less participation in nature-oriented activities in this urban sample as compared to the two rural samples. The ethnic demographics of the Chicago schools were approximately one third White, one third African-American, one sixth Hispanic and one sixth Asian; demographic data for Boston school children were not recorded and therefore are not available.

Procedure

All participants were interviewed individually by trained research assistants.

Children were interviewed in a quiet area of their school, Shawano adults at their children's schools, and Chicago adults in our lab space. For all participants, the animal free-listing task was part of a larger battery of biology-related tasks, and its place in the battery was counterbalanced across participants. There were no effects of task order.

In the animal free-listing task, participants were simply asked, "Name all of the animals that you can think of." When participants paused, they were prompted once to attempt to retrieve more animal names. The task ended when the participant either paused again or when they had produced 15 names.

Results

Clustering: Are animals named together in a structured way?

To link the present results with previous research on name generation, we first evaluated whether clusters of animals were likely to be recalled together, and whether the types of animals that cluster together vary across culture or development. Our goal was to index the positional distances, averaged over all participants' lists, between all animals mentioned by at least 15% of participants per community. This cut-off value was set to ensure that sufficient animals were included in analysis for inferences about category structure to be made. Following previous investigations (Crowe & Prescott, 2003; Schwartz & Baldo, 2001; Schwartz, et al., 2003; Storm, 1980), these analyses were conducted using multidimensional scaling (MDS), in order to map average positional distances between animals for a given community in a small number of dimensions. For each community, a proximity matrix was derived from a large vector containing each animal named by each member of the community. Our measure of proximity was the average one-dimensional Euclidean distance d between two animals, p and q, expressed

as

$$d_{pq} = \sum_{i} | p_n - q_n | / n$$

for all lists *i*, where *n* is the number of participants listing both animals *p* and *q* (this number varied across animal pairs). On this measure, the distance between an animal and itself is 0. Thus, small values reflect ordinal nearness between names on a list. The resulting symmetric animal-by-animal proximity matrices were submitted to MDS using the ALSCAL algorithm, a method for hierarchical clustering provided within the SPSS 13.0 Categories package (SPSS Inc., Chicago, IL). The 2-D MDS maps for each community are given in Figures 1-3, respectively. Stress values for each 2-D MDS solution were .35 for the Native American community, .32 for the Rural community, and .31 for the Urban community.

Though MDS maps are usually interpreted in terms of the dimensions that organize them (e.g., Caramazza, Hersh, & Torgerson, 1976; Henley, 1969), the dimensions underlying the structure of our MDS maps were not immediately apparent. This may owe in part to the moderately high stress values associated with each MDS solution, an indication that two dimensions do not fully capture the matrix of average distances between animals. However, because adding another solution did not dramatically improve stress values and because within each population we were able to identify clusters and sub-clusters, we retained for analysis the 2-D solutions, and proceeded by interpreting the results for each community on the basis of the clusterings within them.

The results suggest that, for all communities, animal free-listing is influenced by the habitat or characteristic environment of the animal. Each community's MDS map is

highly accordant and reveals clusters of native (roughly, northern forest-dwelling) animals and exotic (roughly, savanna- and jungle-dwelling) animals. There are several interesting exceptions to this schema, and some of them appear to reflect variation in semantic organization of animal kinds across communities. For example, *bear* appears to be located within an exotic cluster for the Urban community, midway between a native and exotic cluster for the rural, majority culture sample and within a native cluster distant from exotic animals for the Menominee sample. The farm animal cluster is close to small native mammals on the Menominee map but on the two majority-culture maps, the farm animal cluster is more distinct. Finally, each sample has at least one somewhat anomalous grouping. Within the rural, majority culture sample, *cheetah* is close to native animals; within the urban sample, *shark* is grouped with native animals; within the rural, Native-American sample, *mouse* is close to exotic animals.

It is important to note that although we have characterized the clusters in relation to habitat, they may have alternative interpretations. The term "exotic" does not define a habitat other than by exclusion, and what may be most relevant is the 'habitat' in which animals are portrayed in children's books, television programs (e.g., Sesame Street) and movies (e.g., Disney) . Certainly bears appear with giraffes more often in children's books, zoos and classroom alphabet posters than they do in the outdoors. In short, although the data suggest clustering by habitat, the clusters may also reflect media or in other forms of cultural representations.

Types of animals generated.

Table 2 summarizes the names most frequently generated by children and adults for the three samples. Echoing previous work, the kinds named are overwhelmingly

mammals, along with a few life forms, including *bird*, *fish*, and *snake*. The sole exception to this pattern, in which non-mammals are named at the level of life form, is found in the Menominee population, where children and adults named "eagle", an animal kind which, perhaps not coincidentally, represents one of the five main Menominee clans.

Our initial focus was on the generation of domestic, native and exotic animals. To evaluate these observations statistically, all names were coded for habitat status as native, exotic, or domestic animals. Names that were status-ambiguous (e.g., generic life form terms like *bird* or *fish)* and names for non-animal entries were excluded from the coding. This coding excluded from further analysis eight participants, who named only generic life form terms.

We defined the native category broadly to include animals native to the United States. For urban children and adults, native animals like bear may be exotic but to impose consistency in cross-group comparisons, we coded them as native. Rabbit and duck and were also coded as native even though some children have rabbits and pets and some farms have domesticated ducks. These decisions are conservative judgment with respect to the claims we make about group differences.

Insert Table 2 about here

Table 2 reveals some striking group differences. The Urban samples name mainly exotic mammals, along with a fair number of domestic animals. The primary native animal generated is *bear* which arguably is exotic for this sample. We will return to this

relative absence of native animals among the urban sample shortly. Rural majority culture children also commonly generate exotic and domestic animals but also the native mammals including bear, wolf and deer. Rural majority culture adults show a similar pattern but generate more native mammals than do rural children. Menominee children and adults generate just a few exotic species and mainly give native species along with some domestic species. The tendency to focus on native species, present at all ages, is strongest in adults.

To assess these observations statistically, we focused specifically on the native and exotic animals across communities and ages, leaving domestic animals for a subsequent analysis. We submitted the average number of native and exotic animals to a mixed-design ANOVA with Kind (2: Native and Exotic) as a within participants factor and Community (3: Urban, Rural majority-culture, and Rural Native-American) and Age group (4: 4- and 5-year-olds, 6- and 7-year-olds, 9- and 10-year-olds, and Adults) as between participants factors. Significant main effects on all variables were qualified by a significant 3-way interaction effect between Kind, Community and Age group, $F(6, 655) = 48.27$, $p < .001$. Post hoc tests with the Bonferroni correction confirm our observations: the Urban community named reliably more exotic than native animals relative to the two other groups, and the Native-American (Menominee) community named reliably more native than exotic animals relative to the two other communities (all p's $< .001$).

Interactions between culture and development

The interaction between culture and development, shown in Figure 4, indicates that cultural differences increase with age. The rural majority culture and rural

Menominee communities showed a steeper downward trend across age groups than the Urban sample for exotic animals, while for native animals the Menominee sample had a steeper upward incline across ages than did the other two communities. Comparisons of Native versus Exotic animals named revealed significant between-community effects at each age group *except* the 4- and 5-year-olds, for whom no between-community comparisons reached significance. Post hoc tests with Bonferonni corrections on Age group, broken down by Community, showed that only the 4- and 5-year-olds differ reliably from the other age groups on the Exotic versus Native scores, but only for the two rural communities. There were no reliable age differences in the urban community.

Do city-dwelling participants name urban animals?

We suspected that although urban participants have considerable *exposure* to city-dwelling animals, they attach less significance to them than to exotic animals. The idea is that urban participants learn more about non-domestic animals from various media (which rarely feature native species) than from direct experience. To evaluate this idea, we noted, the frequency with which the three samples of participants mentioned the three most common city-dwelling animals—pigeon, squirrel, and raccoon. The rates of generating *pigeon* were uniformly low across all three samples, named by 2% of Urban participants and 0% of Rural majority culture and Menominee participants (n.s., χ^2 test). *Squirrel* was named by 5% of the urban participants, but by 21% of the Rural majority cultrue participants and 21% of rural Menominee participants. Likewise, *raccoon* was named by 3% of Urban participants, but by 15% and 16% of Rural majority culture and Menominee participants, respectively. For both squirrel and raccoon, these are significantly different rates of naming, $\chi^2(2)_{\text{squirrel}} = 26.94$, $p < .001$, and $\chi^2(2)_{raccoon} =$

22.42, $p < .001$. Direct exposure to animals, then, does not fully account for their prominence in spontaneous name generation.

Discussion

Our findings from the free-listing task converge well with previous reports (Crowe & Prescott, 2003; Storm, 1980), but also provide new insights into the role of culture and experience on the development of category structure in the animal domain. As in prior research, children and adults named mostly mammals (over 90%). In the results reported here, we document that this tendency to name mammals is evident across all three communities and at all ages. This finding extends the empirical base of research on the free-listing task. It also sets the stage for addressing more fine-tuned questions concerning the influence of contact with nature and cultural beliefs on the specific animals that participants brought to mind.

It is tempting to suggest that the animals that were most salient within a population were those with which participants have had meaningful experience. For example, we noted that urban participants of all ages leaned heavily toward naming exotic animals. The problem with this analysis is that it is potentially circular, unless one can specify the notion of "meaningful experience" in advance and independent of the name generation data themselves. In the case of urban participants, we suspected, but could not predict in advance, that they might not generate names for native animals commonly found in cities. We can come closer to avoiding circularity with our rural samples. Recall that the Rural and Native American groups inhabit adjacent counties and engage in similar practices with the natural world, especially fishing and hunting. At the same time, we did anticipate that the Menominee clan system might affect spontaneous

name generation and there is other evidence that Menominee children and adults are more "psychologically close" to their local environment than majority culture children and adults (Bang, et al, 2007). Menominee children and adults named more local and fewer exotic animals than their majority culture counterparts. Consider, for example, the respective sets of the five most often-mentioned animals among children: [*bear, dog, cat, deer, eagle]* versus [*dog, cat, lion, bear, tiger]*. There are commonalities (*dog, cat,* and *bear),* but the differences are instructive: Native animals fill out the Menominee set (*deer* and *eagle),* whereas exotic animals fill out the Rural set (*lion* and *tiger).* Moreover, our analyses of inter-item proximities placed *bear* as close to a cluster of exotic animals as to a cluster of native animals for the rural majority-culture community but solidly in a cluster of native animals and away from exotic animals for the Menominee community.

Our findings add cross-cultural significance to the literature on animal category organization, and are consistent with claims that free-listing retrieval is organized around something like habitats. In the case of exotic species, however, the habitat may be children's books, Disney movies, and alphabets posted on classroom walls. The naming patterns of the children diverge with age as a function of their cultural background. The 4- and 5-year-olds in each community were disposed to name mostly exotic animals, but by ages six and seven, Menominee children were already naming reliably more native animals than the rural European-American group, who were in turn naming more native animals than the Urban group.

These trends may be explained in terms of shared knowledge sources—the youngest children of the two rural-dwelling communities have spent less time with nature than their older counterparts, and are likely exposed to animals in story books and on TV

(as are the urban-dwelling children). When the local habitat comes to dominate, these symbolic media as sources of information on animals, rural children's animal-naming patterns reflect this shift. Apparently the local habitat is less relevant for our urban sample: city-dwellers named few local (city-dwelling) animals, our rural samples named many local animals.

These results open several further questions about what this broadly-shared structure means for human learning, reasoning and behavior. It appears that folk taxonomy predominates in reasoning about animals when the measures are similarity or semantic-distance judgments for animal pairs (Henley, 1969; Caramazza, Hersh, & Torgerson, 1976), and perhaps for inductive animal-property projections (Atran et al., 2001; Ross, et al., 2003). Depending on whether tasks are retrieval-based or analytic (as in free-listing versus similarity judgments), two different pictures of animal-category structure may emerge.

It is important to understand the contribution of an associative organization in real-world reasoning. For example, Medin et al (2006) asked expert European-American and Menominee fishermen to "name all the fish you can think of" and found that first few tended to be large prestigious gamefish for the European-Americans and food fish (e.g., trout) for the Menominee experts, reflecting differences in their orientation towards fish and fishing. This same associative organization presumably mediates the cultural difference in ecological organization that we described in the introduction to this paper.

In summary, representational structure surely influences, and is influenced by, the reasoning processes that call on information proprietary to semantic memory. This full story must await evidence that category structure meaningfully informs reasoning in the

animal domain. As the present study demonstrates, this is a story that must incorporate data on cultural variation—and cross-cultural universals—into its account of how the world shapes the mind.

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Tables

Table 1
Sample sizes for each age and community.

Age	Community		
	Rural Native American	Rural majority culture	Urban majority culture
4-year olds	46	28	42
6-year-olds	76	89	71
9-year-olds	98	56	53
Adults	28	33	47

Table 2.
Lists of animals mentioned by at least 20 percent of each sample for children and adults, with percent mention in bold.

Community	*Age group*							
	4-year-olds	%	6-year-olds	%	9-year-olds	%	Adults	%
Rural Native American								
	dog	.50	bear	.70	bear	.86	bear	.96
	bear	.46	dog	.64	cat	.67	deer	.82
	cat	.43	deer	.63	dog	.62	dog	.68
	elephant	.34	cat	.58	deer	.50	cat	.68
	lion	.34	eagle	.43	eagle	.45	wolf	.64
	cow	.34	bird	.39	bird	.39	squirrel	.43
	deer	.27	lion	.36	fish	.38	eagle	.43
	tiger	.27	tiger	.28	wolf	.37	raccoon	.39
	dinosaur	.22	wolf	.28	snake	.34	snake	.36
	monkey	.22	snake	.28	rabbit	.32	fox	.36
	zebra	.20	horse	.26	squirrel	.36	elephant	.32
	pig	.20	fish	.26	lion	.30	chipmunk	.32
	fish	.20	mouse	.24	monkey	.30	beaver	.32
			elephant	.22	tiger	.30	badger	.32
			cow	.22	elephant	.26	skunk	.29
					horse	.26	bird	.29
					chipmunk	.22	horse	.25
					mouse	.21	fish	.25
					cow	.21	rabbit	.21
					pig	.21	porcupine	.21
							otter	.21
							moose	.21
							giraffe	.21
							buffalo	.21
Rural majority-culture								
	lion	.46	cat	.70	dog	.89	dog	.88
	tiger	.46	dog	.70	cat	.88	cat	.82
	dog	.32	lion	.53	lion	.46	horse	.52
	bear	.32	bear	.47	bear	.45	bird	.52
	cow	.32	tiger	.44	fish	.42	cow	.52
	pig	.29	bird	.42	snake	.38	bear	.45
	cat	.25	horse	.35	horse	.38	deer	.42
	fish	.25	cow	.34	cow	.38	squirrel	.42
	giraffe	.25	fish	.31	monkey	.36	elephant	.39

Table 2., *cont.*

	bird	.21	deer	.33	bird	.34	giraffe	.33
	horse	.21	monkey	.29	tiger	.32	monkey	.33
	monkey	.21	snake	.29	wolf	.27	tiger	.33
			elephant	.29	zebra	.27	rabbit	.33
			cheetah	.27	mouse	.25	snake	.33
			rabbit	.25	giraffe	.23	hamster	.33
			giraffe	.24	pig	.23	pig	.33
			zebra	.22	elephant	.21	chipmunk	.27
			frog	.22	deer	.21	lion	.24
			turtle	.22	duck	.21	raccoon	.24
							duck	.21
							fox	.21
							mouse	.21
							chicken	.21
Urban majority-culture								
	dog	.55	dog	.66	dog	.64	cat	.75
	cat	.45	cat	.66	cat	.64	dog	.73
	bird	.45	lion	.56	tiger	.55	elephant	.46
	giraffe	.45	tiger	.48	fish	.53	fish	.44
	lion	.39	elephant	.48	bird	.59	tiger	.42
	elephant	.39	bird	.46	lion	.47	giraffe	.40
	tiger	.33	bear	.38	cow	.33	horse	.40
	bear	.26	fish	.34	turtle	.32	cow	.35
	zebra	.24	giraffe	.34	cheetah	.28	lion	.31
	dinosaur	.21	monkey	.40	elephant	.26	bird	.31
			cow	.27	horse	.26	bear	.29
			cheetah	.27	snake	.26	zebra	.28
			horse	.25	frog	.26	whale	.23
			pig	.23	bear	.25	snake	.23
			zebra	.23	monkey	.25	monkey	.28
			gorilla	.23	pig	.25	rhino	.28
			snake	.21	dolphin	.25		
			frog	.21	shark	.23		
			dinosaur	.20	mouse	.28		
					rabbit	.28		

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Figure 1.

MDS, Rural Native American.

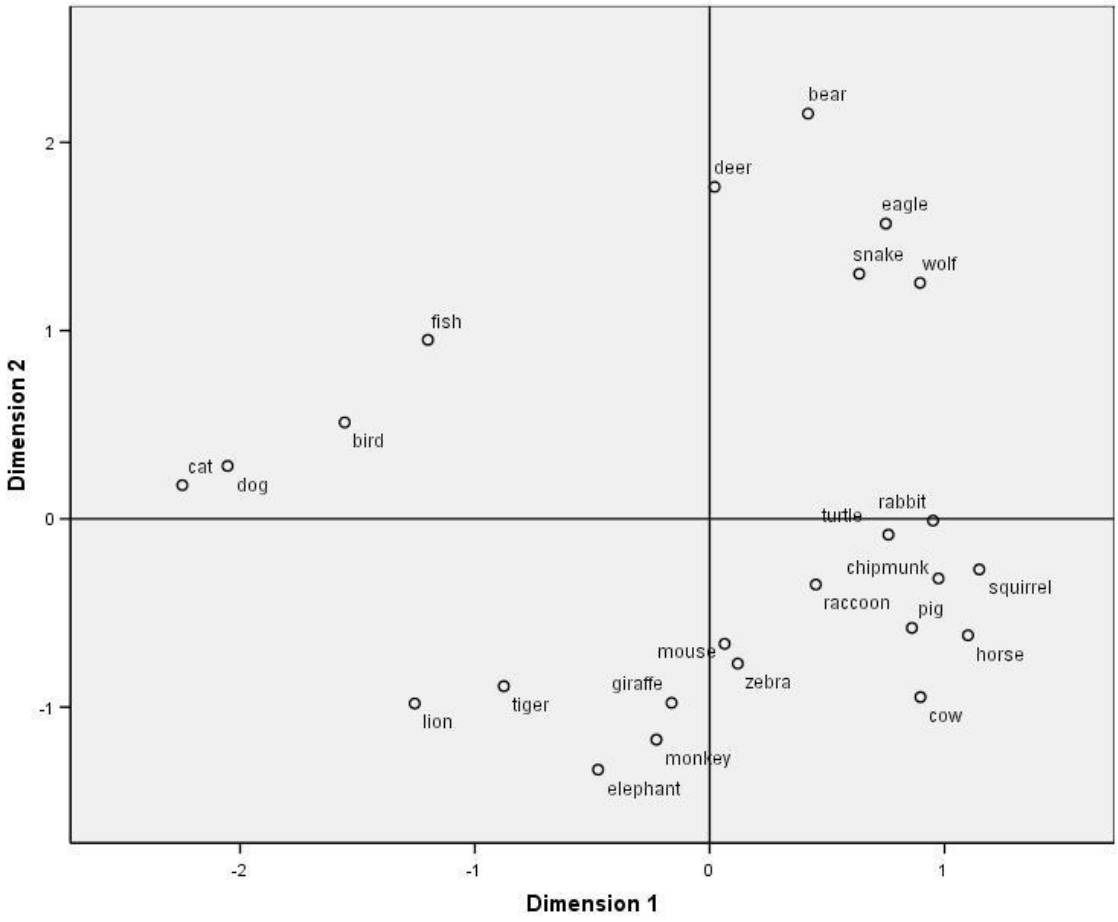


Figure 2.

MDS, Rural majority-culture.

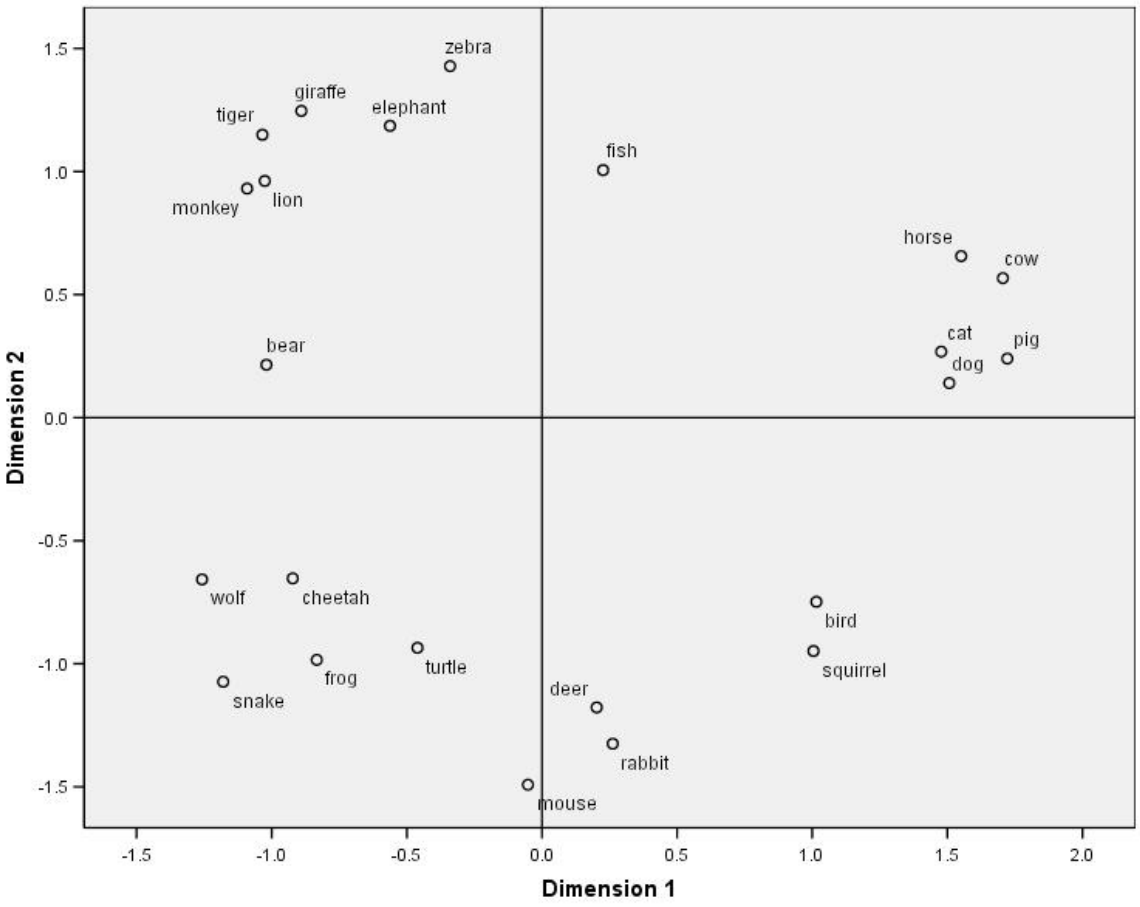


Figure 3.

MDS, Urban majority-culture.

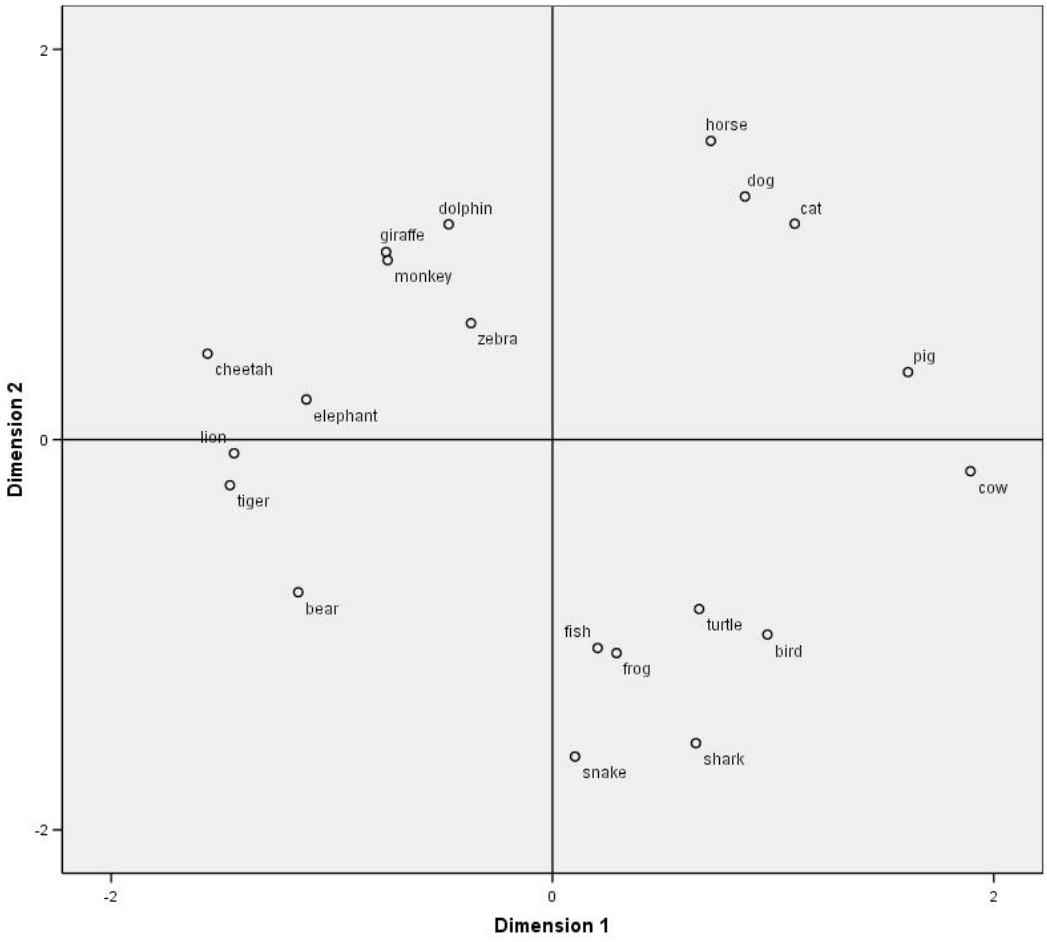
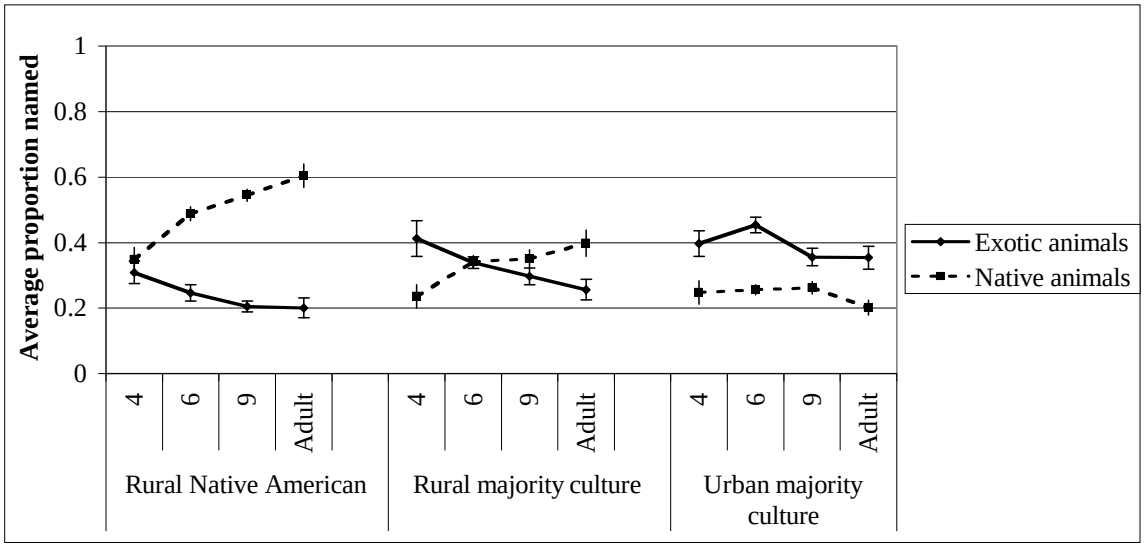


Figure 4.
Mean proportion of exotic and native animals named by the Urban, Rural and Rural Native-American communities as a function of age.



Footnotes

1. For convenience we shall also refer to our European-American sample as “majority culture.”