The Effects of Naming Practices on Children's Understanding of Living Things

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Abstract

We investigated the development of an understanding of the concept LIVING THING in 4- to 10-year-old monolingual children acquiring either English or Indonesian. In English, LIVING THING is comprised of two major constituent categories, ANIMAL and PLANT. However, the word *animal* has (at least) two senses, and these overlap in their scope. One sense of *animal* includes both humans and non-human animals; the other sense excludes humans and includes only non-human animals. In Indonesian, the constituents are organized differently: neither this overlapping category structure nor the polysemous use of *animal* exists. We consider the consequence of this cross-linguistic difference on acquisition, asking whether underlying category structure, coupled with the polysemy of the word *animal*, interferes with the acquisition of the concept ALIVE or LIVING THING. Using a Sorting Task, we compared English- and Indonesian-speaking children's ability to form a category that includes all and only LIVING THINGS. All children successfully formed this inclusive category when they were instructed to sort on the basis of terms like *die* or *grow*. Importantly, and as predicted, we found cross-linguistic differences when children were asked to sort the very same objects on the basis of the term *alive*. English-speaking children performed less well when sorting on the basis of *alive* than on the basis of the other terms, and indeed tended to include animals, but not plants. In contrast, Indonesian-speaking children showed no such decrement. We suggest that this cross-linguistic developmental difference likely stems from the naming practices and underlying conceptual structure in each respective language community.

Introduction

Acquisition of Folkbiologic Knowledge

A considerable amount of research has been focused on our concepts and reasoning about entities of the biological world. Of particular interest is 'folkbiologic' knowledge, or people's everyday, intuitive knowledge about the biological world. Within the domain of folkbiology, the focus is on identifying people's mental models of the natural world, examining how experience and goals influence their mental models, and exploring how these models influence reasoning and action (Medin & Atran, 1999; Wellman & Gelman, 1992). Another key focus has been to discover how folkbiologic concepts develop.

There is broad consensus across different measures, different lab groups, and different decades of research, that a more inclusive concept LIVING THING, one that includes members of both the plant and animal kingdoms, is a rather late and laborious developmental achievement. For example, Piaget (1954) argued that children have an inchoate notion, as witnessed by their tendency to mistakenly attribute animacy to inanimate objects (e.g., clouds, bicycles) that appear to move on their own or exhibit goal-directed behavior). This observation of 'childhood animism' led Piaget to assert that children have a very different understanding of fundamental folkbiologic concepts such as ANIMAL and LIVING THING, and have not yet worked out the scope and relations among them. Other examples of this difficulty come from Hatano et al. (1993) who documented that the majority of kindergarteners, second-graders, and fourth-graders from the U.S., Israel, and Japan had difficulty judging that plants as well animals are *alive* (Hatano et al., 1993).

In sum, developmental evidence suggests that several folkbiologic concepts, including LIVING THING, are difficult to acquire, and that this reflects, at least in part, children's difficulty establishing the scope of each of these concepts and the relations among them. For example, young children have a tendency to attribute animacy to too broad a set of entities (to inanimate objects) and at the same time, a tendency to attribute life to too restricted a set of entities (judging animals, but not plants, to be alive). In this paper we ask why this is the case. To foreshadow, we will suggest that by roughly 6 or 7 years of age, children do appreciate an inclusive concept LIVING THING that includes both plants and animals, and that they reveal this in certain tasks. However, we also argue that they have particular and pointed difficulty working out the scope of the terms for these concepts (e.g., *alive, living thing*, and *animal)* and the relations among them. We document in English-speaking children a rather clear difficulty interpreting the term *alive* and working out its relation to the term *animal.* We further document that Indonesian-speaking children reveal no such difficulty. More provocatively, we propose that the developmental trajectory for fundamental folkbiologic concepts is rooted in the naming practices and conceptual structure of the communities in which children are raised.

Living Thing

Consider the concept LIVING THING which encompasses all biological entities, both animals and plants.

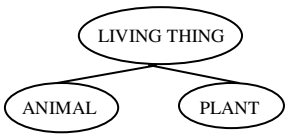


Figure 1: A schematic depiction of the concept LIVING THING.

Among these constituents, ANIMAL appears to emerge first in development, and there appear to be perceptual, conceptual and linguistic factors supporting its early acquisition. For example, infants are especially interested animate objects and readily acquire a distinction between animate and inanimate objects (Gelman, 1990; Bertenthal, 1993; Woodward, 1999; Woodward et al., 2001). Moreover, there are linguistic factors that favor the acquisition of the concept ANIMAL. In particular, across languages, this concept tends to be named with a dedicated noun, whereas the concepts PLANT and LIVING THING are often unnamed (Berlin, 1992; Waxman, in press). In such cases, these concepts are described with phrases (e.g., *living thing*) rather than with a dedicated noun.

This is important because there is a powerful relation between naming and object categorization from infancy (see Waxman (1999) or Waxman & Lidz (in press) for a review). For infants as young as 9 months of age, naming serves as an invitation to form categories. Although they may have difficulty forming an object category (e.g., animal) when a set of exemplars is presented alone (e.g. a dog, a horse, a duck, a fish), their categorization improves dramatically if these exemplars are introduced with the same (novel) noun. By 9 months, this facilitative effect of names on object categorization is specific to words (and not tones), and by 14 months, it is specific to nouns (and not adjectives or verbs) (Balaban & Waxman, 1997; Waxman & Markow, 1995; Waxman & Booth, 2001; Echols & Marti, 2004). In short, naming has powerful consequences on categorization, and named categories support inductive inference (Gelman, 2003; Gelman & Markman, 1987; Graham et al, 2004; Waxman & Booth, 2001, Waxman et al., 1997).

Let us return to consider the consequences of these observations for the acquisition of the fundamental concepts of folkbiology. A careful consideration reveals that the mental model depicted in Figure 1 requires further elaboration. In English, the concept ANIMAL actually consists of two constituents: PEOPLE and NON-HUMAN ANIMAL. See Figure 2.

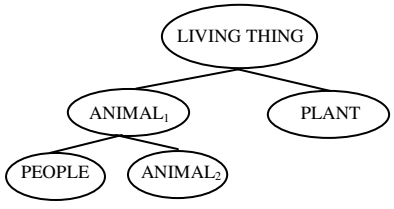


Figure 2: A depiction of LIVING THING as schematized in English.

On the face of it, this nested hierarchical structure should pose no difficulty in acquisition. After all, children readily acquire such nested structures (e.g., SPINACH and BROCCOLI are members of the category VEGETABLE, which in turn is a member of the category FOOD). But in the case of the folkbiologic hierarchy, there is an added obstacle: the very same name, *animal*, designates two different categories with different scopes.

This type of polysemy, in which a single word refers to two different nested categories, is unusual, and it could have adverse consequences on acquisition. We know that nouns support the formation of object categories and lend these categories inductive force. But if the same name *animal* points to two different nested categories, this should make it difficult for learners to identify the *scope* of this word.

Children may attempt to resolve this difficulty by avoiding the polysemy, attempting to map a unique term to each animal sense. We suspect that children readily map *animal* to ANIMAL_2, that they will accept a different term to cover ANIMAL_1, and that as a result, they tend to (mis)appropriate the term *alive* as a name for the broader animal sense (ANIMAL_1). In this way, English-speaking children can circumvent the problematic polysemy of the term *animal.* But there is another, less advantageous consequence: if children do (mis)appropriate the term *alive* for the otherwise covert ANIMAL_1, this would account, at least in part, for their tendency to include animals (that is ANIMAL_1), but to exclude plants, when asked to identify living things (see Stavy & Wax, 1989, for a similar analysis of Hebrew).

If this is the case, then the developmental trajectory for these folkbiologic categories should look different in a language community that exhibited no such polysemy or nested categories. Indonesian provides this test case. In Indonesian, LIVING THING consists of three mutually exclusive categories: PEOPLE (*manusia*), ANIMAL (*hewan*), and PLANT (*tumbuhan*) (see Figure 3).

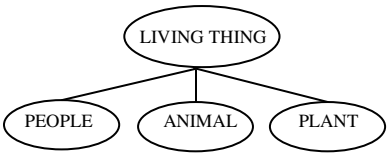


Figure 3: A depiction of LIVING THING as schematized in Indonesian.

There appears to be no "intervening conceptual node" between these constituents and the overarching concept LIVING THING, and hence no covert category for this node and no polysemy within the folkbiologic hierarchy. If conceptual structure and naming practices influence the acquisition of these key constituent categories, then Indonesian-speaking children should not exhibit the same obstacles to working out the scope of *animal* and *alive* as has been documented in English, Hebrew, and Japanese (Hatano et al., 1993).

Experiment 1

As a first step, we checked this intuition directly. We showed English- and Indonesian-speaking children a picture of a person, and asked if a person could be described with the term *animal*. If humans and animals are mutually exclusive categories, as we suggest is the case in Indonesian, then children should respond in the negative. If humans and animals can both be considered animals, as we have suggested is the case for $ANIMAL_1$ in English, then they should respond in the affirmative.

Participants In Jakarta, Indonesia, we interviewed 36 6- to 7-year-olds and 34 9- to 10-year-olds; in Illinois we interviewed 4 5-year-olds, 15 6- to 7-year-olds, and 8 9- to 10-year-olds. Children in both communities were of middle class families and were living in urban environments.

Materials and Procedure Children were interviewed individually. The experimenter showed each child a picture of a person and asked a single probe, "Could you call this an animal?"

Results

English- and Indonesian-speaking children's judgments differed markedly, although they were all being raised in urban environments. Across all ages, only 4% of the Indonesian-speaking children agreed that a person could be called an animal. In sharp contrast, 55% of the English-speaking children answered this question affirmatively. See Figure 4.

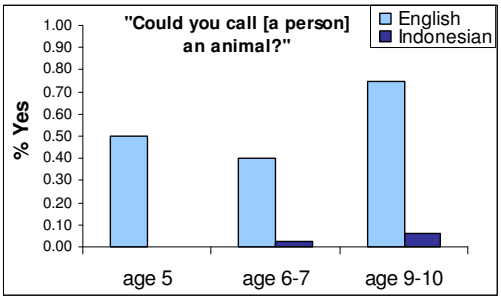


Figure 4: Children's Yes responses to the question of whether a person could be called an animal.

This finding provides support for the proposal that children acquiring Indonesian and English do indeed have different naming practices for objects in the biological world. Specifically, when they are questioned directly, Indonesian-speaking children clearly denied that the term *animal* can be applied to a person. Yet roughly half of the English-speaking children accepted this broader scope of the term, judging that it can indeed be applied to people. Importantly, English-speaking children's acceptance of this more inclusive $ANIMAL_1$ sense was not uniform; presumably, the other half of the children interpreted the term *animal* more narrowly ($ANIMAL_2$). This is consistent with the idea that in English, where the term *animal* is polysemous, there is slippage in the meaning that children assign. In the next experiment, we went on to examine the consequences of this difference in naming practices on children's categorization of entities in the folkbiologic world.

Experiment 2

The goal of the second experiment was to examine children's appreciation of the content of core folkbiologic concepts and the relations among them. We developed a sorting task with a set of 17 cards, each depicting an entity, living or non-living. Children sorted these cards four different times, on the basis of four different probes. Specifically, they were asked to sort these cards on the basis of whether they a) were alive, b) could die, c) need food, and d) could grow. Because each of these probes taps into a property of all living things (i.e., biological entities), we reasoned that children's sorts would provide an index of their intuitions of content of the concept LIVING THING. An examination of their sorts should therefore shed light on which entities they include and which they exclude from this concept. If children appreciate an inclusive biological concept, they should distinguish the living things from the non-living things. Crucially, if *alive* is especially difficult for English-speaking children, children's performance with this probe should be attenuated relative to performance with the remaining probes. Moreover, if their difficulty is related to underlying conceptual structure and polysemy (as in Figure 2), then this relative decrement for *alive* should be evident in children acquiring English, but not in those acquiring Indonesian.

Method

Participants English-speaking participants were recruited from public schools and private preschools in Evanston and Chicago, Illinois. They included 51 4- to 5-year-olds, 68 6- to 7-year-olds, and 53 9- to 10-year-olds. Our Indonesian-speaking participants were recruited from private pre- and elementary schools in Jakarta, and included 28 4- to 5-year-olds, 30 6- to 7-year-olds, and 32 9- to 10-year-olds.

Materials We constructed a set of seventeen cards, each of which depicted an image of a single entity, either living or non-living. See Figure 5.

1	person	10	dandelions
2	bear	11	sun
3	squirrel/rabbit*	12	clouds
4	blue jay/perkutut*	13	water
5	trout/gourami*	14	rock
6	bee	15	bicycle
7	worm	16	scissors
8	maple tree/palm tree*	17	pencil
9	cranberry bush		

Figure 5: Complete list of materials for the sorting task. Asterisks indicate adjustments to accommodate differences in familiarity across communities.

Procedure We asked children to sort the cards four different times, each time on the basis of a different term. First, the experimenter randomized the cards, and asked children to sort them based on the term *alive*. After completing the first sort, the experimenter re-shuffled the cards and asked children to sort these same cards based on the terms *die*, *need food*, and *grow*. These terms were presented in random order, and cards were re-shuffled before each sort. Instructions for each sort were identical, except for the term involved. Instructions (using the term *alive*) were as follows:

> "I have a game we can play. Let's make piles, OK? Let's put one pile here (indicate left) and another one here (indicate right). OK, now, let's get started. Hmmm…I wonder which ones are *alive*. Let's put the ones that are *alive* here, and the ones that are NOT *alive* here. [Show first picture.] OK, what's this? That's right, it's a (X). Where does it go? Are (X)'s *alive* (over here) or NOT *alive* (over here)?"

After completing the first sort, children sorted on the basis of the remaining terms.

Scoring For each of the child's four sorts, we tabulated the % of cards that were sorted correctly. A perfectly correct sort was one that included all of the living things (cards 1-10) and none of the non-living things (cards 11-17).

Results

The results are consistent with the proposal that children do appreciate the overarching concept LIVING THING, as witnessed by their successful sorting on the basis of the three probes: *die*, *need food*, and *grow*. The results also suggest that the term *alive* poses a unique challenge for children acquiring English, but no such challenge for those acquiring Indonesian. See Figure 6.

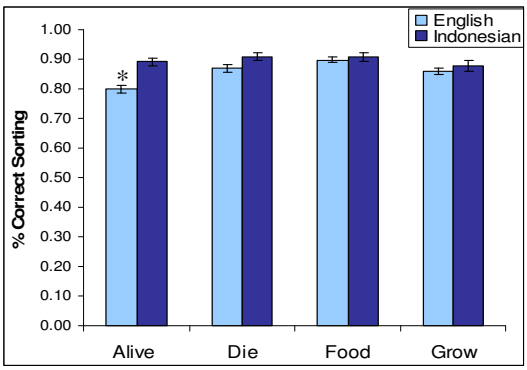


Figure 6: English- and Indonesian-speaking children's success rates on sorting based on *alive*, *die*, *need food*, and *grow*. Asterisk indicates significance in pair-wise comparisons among probes within a language community.

These observations were supported by an ANOVA, with Community (2: Illinois, Jakarta) and Age (3: 4-5, 6-7, 9-10 years old) as between-subjects factors, and Term (4: *alive*, *die*, *need food*, and *grow*) as a within-subjects factor. A main effect of Age, F (2, 256) = 66.06, $p < .001$, revealed that sorting improved with age ($M_{4\text{-}5}$= .78, $M_{6\text{-}7}$= .87, $M_{9\text{-}10}$= .95). Main effects of Community and Term were mediated by a Community x Term interaction, F (3, 768) = 7.00, $p < .001$. As predicted, English-speaking children were less successful on the *alive* probe than on the remaining three probes (all p's < .001), whereas Indonesian-speaking children revealed no differences among the four probes (all p's > .1).

We pursued this phenomenon by conducting a subsequent analysis to consider more carefully the scope of the term *alive*. Our goal was to ascertain the range of entities that English- and Indonesian-speaking children included when sorting on the basis of this term. As predicted, children of all ages and from both language communities identified humans and non-human animals as *alive*. However, there were developmental and community differences in their judgments regarding the inclusion of plants and non-living natural kinds. (See Figure 7.) Children from the youngest two age groups included plants at a rate of roughly 50-70%, with Indonesian-speaking children surpassing English-speaking children modestly. However, by 9 to 10 years of age, this modest Indonesian advantage became quite striking, with Indonesian-speaking children including plants at a rate of 100%, as compared to the roughly 70% inclusion rate of their English-speaking age-mates. Children's performance with non-living natural kind items is also suggestive. English-speaking children included these items at a rate of roughly 30% across all age groups. In contrast, Indonesian-speaking children's tendency to include these items dropped significantly, and was barely evident at 9 and 10 years of age. This pattern is consistent with the prediction that children acquiring English experience some difficulty in grasping the scope, and boundaries, of LIVING THING.

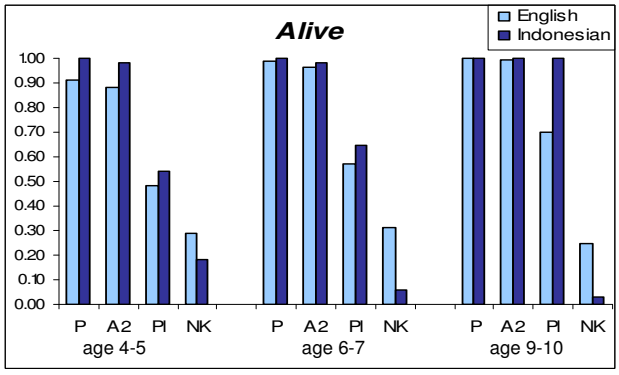


Figure 7: English- and Indonesian-speaking children's rates of success on sorting People (P), Non-human Animals (A2), Plants (Pl), and Natural Kinds (NK) based on *alive*.

This analysis suggests that the 'slippage' between the terms *alive* and *animal* is more pronounced and longer-lived in English than in Indonesian.

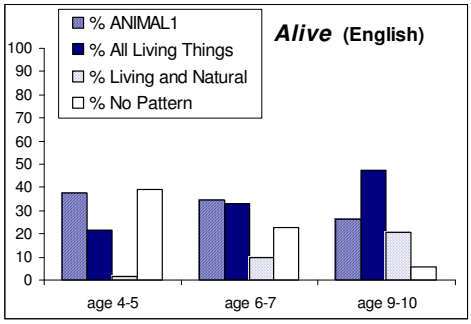
This interpretation is intriguing. But because analyses based on group means cannot tell us how individual children interpreted the term *alive* in the sorting task, we went on, in the next analysis, to characterize each individual

child's pattern of response. We identified four possible patterns of response: $ANIMAL_1$, All Living Things, All Living and Natural Things, and No Pattern. For example, a child would be credited with an $ANIMAL_1$ pattern if she included cards 1-7 (see Figure 5) but excluded the remaining cards. In assigning children's patterns of response, we permitted one error of omission and one error of commission.

Perhaps not surprisingly, younger children were most likely to respond with No Pattern. However, an examination of the distribution of the remaining three patterns reveals some very intriguing trends. See Figure 8.

Consider first the English-speaking children. For 4- to 5-year-olds, the predominant response is the $ANIMAL_1$ pattern. Moreover, the proportion of children exhibiting this pattern remains comparable across all three ages, with roughly 30–40% of all English-speaking children at all ages interpret *alive* as referring to $ANIMAL_1$, including humans and non-human animals, but not plants. In addition, the tendency in this population to exhibit an All Living Things pattern increases gradually, but not dramatically, over this same developmental period. Yet by 9 to 10 years of age, roughly 50% of all children interpret *alive* as referring to the inclusive category of LIVING THING.

A very different developmental trajectory is evident for the Indonesian-speaking children. Like their English-speaking counterparts, roughly 40% of the youngest children interpret *alive* as referring to $ANIMAL_1$. However, in this population, this interpretation recedes quite dramatically, and is absent entirely in 9- and 10-year-olds. At the same time, there is a marked increase in the proportion of children interpreting *alive* as referring to the more inclusive category LIVING THING. By 6 to 7 years of age, this interpretation outshadows the $ANIMAL_1$ pattern, and by 9 to 10 years of age, it has been adopted by fully 97% of all children. [1]



[1] Consistent with our previous analysis, the proportion of English-speaking children showing the All Living and Natural Things pattern increased with age, a tendency that was not found in Indonesian-speaking children.

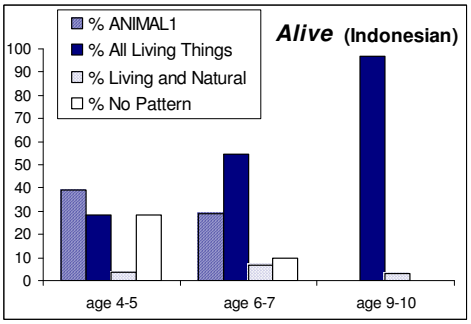


Figure 8: Patterns of individual children's sorting on *alive*.

We interpret this pattern of results as evidence for the hypothesis that underlying conceptual structures and naming practices influence the acquisition of the core folkbiologic concepts such as ALIVE, ANIMAL, their names, and the relation among them. Children in both communities begin with some uncertainty about the meaning of *alive*. A sizeable proportion appear to interpret is as referring to $ANIMAL_1$, and thus extend it to animals, but exclude plants. For English-speakers, this pattern persists, probably as a default assumption, because it permits children to circumvent the problematic polysemy of the term *animal.* It does so by appropriating the term (*alive)* to cover one sense of the term animal ($ANIMAL_1$), and interpreting the tern *animal* primarily to cover the other sense of the term ($ANIMAL_2$). We suggest that it is for this reason that children as old as 10 years of age continue to mistakenly map *alive* to $ANIMAL_1$ (rather than mapping it to LIVING THING) in the sorting task. In contrast, in Indonesian, where there is no such problematic polysemy, and no intervening node or covert category corresponding to $ANIMAL_1$, the tendency to map *alive* to $ANIMAL_1$ recedes, making way for the correct mapping for *alive* to all and only living things (including plants).

General Discussion

The results of these experiments converge on two important points. First, the concept LIVING THING may indeed be available quite early in development. By 6 to 7 years of age, children in both English- and Indonesian-speaking communities made a clear distinction between living and non-living things, as witnessed by their near-ceiling performance when sorting on the basis of terms *die*, *need food*, and *grow*.

Second, we have documented an intriguing difference in the developmental trajectory of the term *alive*. Our results reveal that Indonesian-speaking children's tendency to interpret *alive* as referring to inclusive LIVING THING increases markedly over the school-aged years, and reaches near ceiling success by 9 to 10 years of age. In sharp contrast, the proportion of English-speaking children exhibiting this pattern shows only a modest increase, and by 9 to 10 years of age, only about 50% of the children demonstrated this pattern.

Our explanation for this difference is located at the intersection of naming and conceptual organization. In English, the word *animal* has (at least) two meanings with

overlapping scope: one that includes people and one that excludes them. Stavy and Wax (1989) have brought up a similar pattern of polysemy in Hebrew. We suggest that English- and Hebrew-speaking children's persistent difficulty with *alive* reflects the naming patterns and conceptual structure in which they are immersed.

In future work, it will be important to examine alternative explanations for these effects. Because our English and Indonesian participants all live in urban areas and have roughly the same amount of experience with the natural world, we have argued that differences reported here are related to the naming practices of the two communities. There are, however, other potential differences between the communities (e.g., socio-economic status; formal education system; religious beliefs) and these warrant further investigation. In particular, it would be fascinating to examine English-speaking children who are taught that people are not animals (e.g., children being raised in Christian fundamentalist communities). These children might perform more like the Indonesian than the US samples described here. It will also be important to examine the language input to children in each community, and to document the frequency with which the terms *animal* and *alive* are used, the scope of these terms, and the contexts in which they occur (e.g., school vs. home).

In conclusion, we propose that the concept LIVING THING is available to young children, and that the development of folkbiologic knowledge is influenced by the conceptual structure and naming practices of the language under acquisition.

Acknowledgments

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