Core knowledge, Naming and the Acquisition of the Fundamental (Folk)biologic Concept 'Alive'

Sandra R. Waxman (s-waxman@northwestern.edu)
Douglas L. Medin (medin@northwestern.edu)
Department of Psychology, 2029 Sheridan Road
Evanston, IL 60208 USA

Abstract

I begin by describing (in broad strokes) a collaborative research venture in which my colleagues and I have focused on the acquisition of folkbiologic knowledge. We adopt a cross-linguistic, cross-cultural view to ask a) what capacities young children bring to the task of acquisition and b) how the environment (including the objects and events that populate that child's world, the language used to describe them, and the cultural practices invoked to highlight them) shapes the process of acquisition. The work presented here focuses in children's construal of the concept 'alive' or 'living thing'. [1] After describing briefly the populations we have included thus far and our research strategy for identifying the contributions of language and culture in the acquisition of the concept 'alive', I offer evidence from 4- to 10-year-old children from the US, Indonesia, and Mexico. This work reveals important commonalities in early development and also illustrates an intimate connection between culture, language and conceptual organization in the evolution of knowledge. I close with a discussion of the advantages of combining psychological, linguistic and anthropologic methods. in developing theories.

Introduction

Acquisition of Folkbiological Knowledge

A considerable amount of research has been devoted to the acquisition of 'folkbiologic' knowledge, or people's everyday, intuitive knowledge about the biological world. Researchers have asked how to best characterize people's mental models of the natural world, how experience and goals influence people's mental models, and how these models influence reasoning and action (Medin & Atran, 1999). Another key focus has been to discover how folkbiologic concepts develop (Carey, 1985; Gelman & Kalish, 2006), and how they are shaped by language and belief systems (Angorro, et al., 2005; Astuti et al., 2004; Hatano & Siegler, 1993).

In this paper, we focus on the concept 'living thing' – a fundamental folkbiologic concept that includes members of both the plant and animal kingdoms. The developmental evidence reveals that this concept is difficult to acquire (Piaget, 1954; Hatano & Siegler, 1993; Angorro et al. 2005). For example, Piaget observed that young children tend to overattribute animacy, including inanimate objects (e.g., clouds, bicycles) that appear to move on their own. Researchers have also noted that young children tend to underattribute life, including animals but excluding plants from the set of entities that they judge to be alive. In

previous work, we have argued that this difficulty reflects, at least in part, children's difficulty establishing the scope of these fundamental concepts and their relation to one another. We tied this difficulty to the naming practices of the languages to which children are exposed (Angorro et al., 2005). We focused on the role of naming because for infants as young as 9 months of age, naming has powerful consequences on conceptual organization, and named categories support inductive inference (see Waxman & Lidz, 2006, for a review).

In the current paper, we expand this claim, considering in addition, the contribution of cultural belief systems in the acquisition of the concept 'alive'. To foreshadow, we suggest that by roughly 6 or 7 years of age, children appreciate many of these fundamental concepts, but that they have difficulty working out the scope of these concepts (e.g., 'alive', 'living thing', and 'animal') and the relations among them. We claim that both the expression and the resolution to this difficulty reflect both the naming and belief systems of their communities.

Background

Animals, Living Things, and the Interpretation of 'Alive'

Consider the concepts 'animal', 'living thing', and the interpretation of 'alive'. We have suggested that there are strong commonalities in the mental models underlying these concepts, but that there are also intriguing cross-cultural and cross-linguistic differences. See Figures 1 & 2.

In English (Figure 1), '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 (animal–inclusive) includes both humans and non-human animals; the other (animal-contrastive) includes only non-human animals. We have argued that this could have adverse consequences on acquisition (Angorro et al., 2005): If nouns support object categorization and induction, and if the same name points to two different nested categories, this should make it difficult for learners to identify the *scope* and relation of this word.

We suggest that English-speaking children may attempt to resolve this problem by avoiding it: mapping a unique term to each animal sense. In particular, children may

---

[1] We adopt the following convention. 'Concepts' are marked with single quotes; *words* referring to them are marked with italics.

(mis)appropriate the term *alive* to cover one sense (ANIMAL-INCLUSIVE), and the term *animal* to cover the other (ANIMAL-CONTRASTIVE). If this were the case, it could account, at least in part, for children's tendency to include animals (that is ANIMAL-INCLUSIVE), but not plants, when asked to identify living things. If this is the case, then the developmental trajectory should look different in a language that exhibited neither this overlapping category structure nor the polysemous use of *animal*.[2]
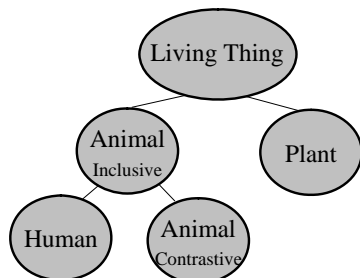

Figure 1: English. A Schematic Model

Indonesian provides a test case (Figure 2). In Indonesian, 'living thing' consists of three mutually exclusive categories, with no intervening node between these constituents and hence no polysemy. If naming practices influence the acquisition of these 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).
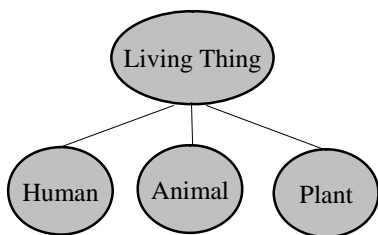

Figure 2: Indonesian and Tzotzil. A Schematic Model

Tzotzil Maya provides a different kind of test case. As in Indonesian, there is no overlapping term spanning both humans and non-human animals.[3] But unlike the Indonesian or US communities, the Mayan community belief system attributes life to certain natural kinds (e.g., sun, water). If children's emerging folkbiologic concepts are also influenced by culturally-shared belief systems, then the developmental trajectory should look different for children acquiring Tzotzil Maya.

Experiments

We tested these hypotheses in a series of experiments with children ranging from 4 to 10 years of age. Our US population included primarily majority-culture children attending urban and suburban public schools in the Chicago area. Our Indonesian population included children attending urban private and public schools in Jakarta. Our Tzotzil children were from a summer program in rural Chenalho.[4]

Task 1. "Could you call this an animal?"

We first checked our intuitions underlying Figures 1 and 2 by showing children from each community a picture of a person, and asking, "Could you call this an animal?". As predicted, Indonesian- and Tzotzil-speaking children responded categorically in the negative, suggesting that for them, people and animals are indeed mutually exclusive categories. English-speaking children responded differently: roughly 50% responded in the negative (animal-contrastive), and 50% in the positive (animal-inclusive). This is consistent with our prediction that English-speaking children appreciate both senses of the term *animal*.

Task 2. Predicate Sorting

To examine the content of children's folkbiologic concepts and the relations among them, we developed a sorting task with 17 cards, each depicting an entity, living or non-living. Children sorted these cards several different times, on the basis of different probes. In particular, they were asked to sort on the basis of whether the entities depicted a) were alive, b) could die, or c) could grow. Because each of these probes taps into a property of all living things, we reasoned that children's sorts would reflect the content of this concept. We characterized each child's pattern of response on each sort. We identified three primary patterns of response: (1) ANIMAL sorts were those in which the child included animals (but not plants). (2) LIVING THING sorts included animals and plants (but not natural kinds). (3) NATURAL KIND sorts included animals, plants, and natural kinds (but not artifacts). In assigning patterns of response, we permitted two errors. In the current analysis, we exclude children exhibiting no pattern.

Children in all three communities revealed an appreciation of an inclusive biological concept. More specifically, when they sorted on the basis of the predicates *grow* and *die*, children in all communities provided predominantly LIVING THING sorts. They distinguished living from the non-living things, placing humans, animals, and plants in the same category. However, when they sorted on the basis of the predicate *alive*, there were striking cross-community differences. See Figures 3-5.

First, as predicted, English-speaking children revealed a pointed and persistent difficulty interpreting the predicate *alive* and working out its relation to closely related categories. At age 4-5, children tend to interpret this term as referring to animals, but not plants. The tendency to include

---

[2] Strictly speaking, these senses of *animal* may be autohyponymous rather than polysemous.

[3] In Tzotzil, but not Indonesian, the 'animal' concept is unnamed.

[4] There are several other differences among these three populations, including SES and direct experience with the natural world. In the current paper, we focus primarily on differences in language and cultural belief systems.

all living things increases gradually, but not dramatically with age. By age 9-10, fewer than 50% of the English-speaking children sort on the basis of living things.
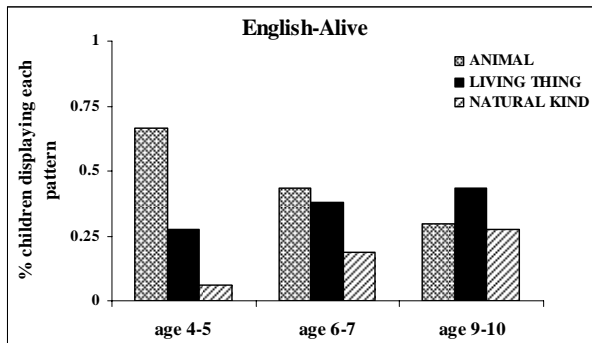

Figure 3: English Sorting Patterns

Second, Indonesian-speaking children reveal a very different developmental trajectory. As was the case in English, at 4-5 years they too prefer to extend this term to animals (and not plants). However, in this population there is a marked increase in LIVING THING sorts: by 9-10 years, they interpret *alive* as referring to all living things. We tie this difference between English- and Indonesian-speakers interpretation of *alive* primarily to differences in naming practices.
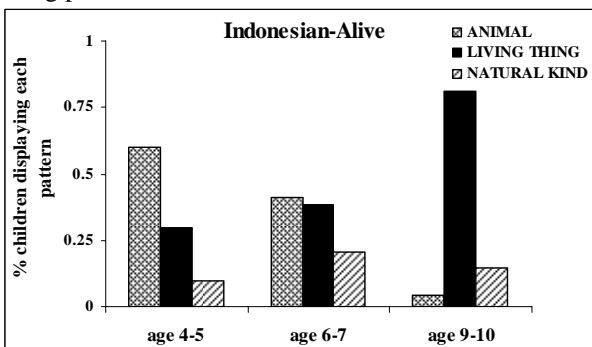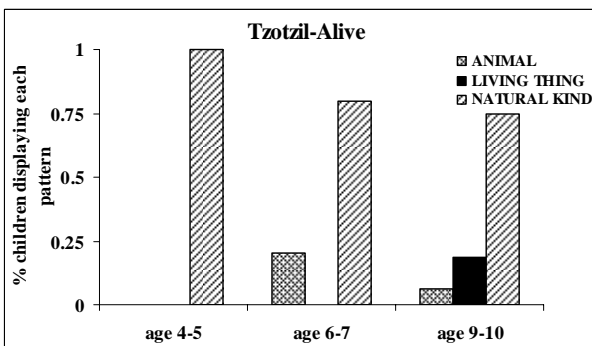

Figure 4: Indonesian Sorting Patterns

Figure 5: Tzotzil Sorting Patterns

Third, Maya children speaking Tzotzil reveal yet a third developmental trajectory. Although the structure of the

Tzotzil naming system resembles that of Indonesian, Tzotzil speakers endorse a broader interpretation of *alive*, one that includes certain natural kinds -- the sun, clouds, and water -- that are considered to be inanimate in the English and Indonesian communities. This interpretation is evident at 4-5 years and persists throughout our developmental window, although by 9-10 years, children begin to entertain a different interpretation which includes plants and animals but excludes these other natural kinds. In future work, we will pursue this phenomenon in older children and adults.

Conclusions and Future Directions

We suggest that these cross-community developmental differences reflect the naming practices and belief systems in each respective community. In closing, we will discuss the implications of this work for theories of development, identify avenues for future research, and highlight the advantages of combining psychological, linguistic and anthropologic methods in developing theories of acquisition.

Acknowledgments

References

Anggoro, F.K., Waxman, S.R., & Medin, D.L. (2005). The effects of naming practices on children's understanding of living things. In B. Bara, L. Barsalou, & M. Bucciarelli (Eds) *Proceedings of the Twenty-seventh Annual Meeting of the Cognitive Science Society*, 139-144. Mahwah, NJ: Lawrence Erlbaum Associates.

Astuti, R., Solomon, G.E., Carey, S. (2004) *Constraints on conceptual development: a case study of the acquisition of folkbiological and folksociological knowledge in Madagascar*. Monograph of the Society for Research in Child Development.

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

Hatano, G., & Siegler, R.S. (1993). The development of biological knowledge: A multi-national study. *Cognitive Development*. 8(1), 47-62.

Gelman, S.A. & Kalish, C.W. (2006). Conceptual Development. In D. Kuhn & R. Siegler (Eds.), *Handbook of Child Psychology*, 6th ed., Vol. 2.

Medin, D. L. & Atran, S. (Eds.) (1999). *Folkbiology*. Cambridge , MA: Bradford.

Piaget, J. (1954). *The Construction of Reality in the Child* (M. Cook, Trans.). New York: Basic Books.

Waxman, S.R. & Lidz, J. (2006). Early word learning. In D. Kuhn & R. Siegler (Eds.), *Handbook of Child Psychology*, 6th ed., Vol. 2.