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Naming Practices and the Acquisition of Key Biological Concepts:

Evidence from English and Indonesian

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Abstract

We examined Indonesian- and English-speaking children's acquisition of biological concepts (LIVING THING, HUMAN, NON-HUMAN ANIMAL, PLANT), their names, and the relations among them. In English, but not Indonesian, the name 'animal' is polysemous: one sense includes both human and non-human animals; the other excludes humans. Children are sensitive to the naming practices of their respective communities (Experiment 1). These cross-linguistic differences in naming are also reflected in children's categorization of biological entities in both spontaneous (Experiment 2) and structured (Experiment 3) tasks. Children in both populations appreciate an inclusive concept LIVING THING. However, they have some difficulty working out the relation between this concept and its constituents. This difficulty is especially evident in English and appears to be related to the polysemy of 'animal'. This work underscores the importance of language and cultural factors in the acquisition of fundamental concepts about the biological world.

Naming Practices and the Acquisition of Key Biological Concepts:

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A considerable amount of research has focused on “folkbiological” knowledge, or people’s everyday knowledge about living things. A central focus has been to discover how experiences and goals influence mental models of the natural world and reasoning (Medin & Atran, 1999; Wellman & Gelman, 1992). Another key focus has been to discover how fundamental biological concepts are acquired.

There is broad consensus that an appreciation of the fundamental concept LIVING THING[1] (members of the plant and animal kingdoms) is a late and laborious developmental achievement. Piaget (1954) noted young children’s tendency to mistakenly attribute life status to inanimate objects that appear to move on their own or to exhibit goal-directed behavior (e.g., clouds, bicycles). He interpreted this “childhood animism” as a reflection of children’s inchoate grasp of concepts such as ANIMAL and LIVING THING. More recent evidence indicates that even 10-year-old children have difficulty understanding the scope of LIVING THING (Hatano, Siegler, Richards, Inagaki, Stavy, & Wax, 1993).

In this paper, we take a fresh look at children’s apparent difficulty establishing the fundamental concepts ANIMAL, PLANT, and LIVING THING. We suggest that at least some of these concepts are supported by infants’ early causal expectations regarding animacy and agency (R. Gelman, 1990; Bertenthal, 1993; Woodward, Sommerville, & Guajardo, 2001; Leslie, 1994). In addition, we propose that the ways in which these concepts are named within a given language also shape their acquisition. We pursue this proposal by comparing children acquiring English with those acquiring Indonesian, languages with intriguing differences in the naming practices for key biological concepts.

Extensive evidence demonstrates that names, and nouns in particular, may be a catalyst in the formation of object categories from infancy (see Waxman and Lidz, 2006, for a review) through adulthood (Goss, 1961; Spiker, 1956). By 12 months of age, names serve as invitations to form categories (Waxman & Markow, 1995). Infants' ability to form an object category (e.g., ANIMAL) when presented with a set of disparate exemplars in the absence of a name (e.g. a dog, horse, duck) improves dramatically when these exemplars are introduced with the same name. By 9 months, this facilitative effect 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). If naming supports object categorization and induction in infants and young children (Gelman, 2003; Gelman & Markman, 1986; Graham, Kilbreath, & Welder, 2004; Waxman & Booth, 2001, Waxman, Lynch, Casey, & Baer, 1997), then names children learn for biological entities should also influence their categorization.

There is also evidence suggesting that early principles of organization may guide the acquisition of at least some fundamental folkbiological concepts. The concept ANIMAL appears to emerge early: infants are especially interested in animate objects and are captivated by animate properties, including faces, eyes, and autonomous, biological motion (Carey, Diamond, & Woods, 1980; Johnson, Slaughter, & Carey, 1998, Poulin-Dubois & Shultz, 1990; Berthenthal, 1993). Perhaps not surprisingly, then, by three to five months, infants begin to make a principled distinction between animate and inanimate objects (Bertenthal, 1993; Woodward, Sommerville, & Guajardo, 2001) and between agents and non-agents (Leslie, 1994), and this distinction is evident in preschoolers' reasoning (R. Gelman, 1990).

Figure 1 about here

If names serve as invitations to form categories, then the names that children hear for biological entities should support the acquisition of biological concepts. Decades of ethnobiological research provide insights into how the entities in the natural world are named across diverse languages (Berlin, 1992), and the evidence is surprising. The overarching biological concept LIVING THING rarely, if ever, is named with a single, dedicated noun. Reference to this concept is almost always accomplished by means of a phrase (e.g., 'living thing'). Thus, although in principle a dedicated name could support the acquisition of this abstract concept, this support rarely is present. In contrast, most languages name the concept ANIMAL. This, coupled with infants' early expectations regarding animacy, likely supports the early acquisition of the concept ANIMAL.

There is, however, one potentially important complicating factor. See Figure 1. In many languages, including English, the noun 'animal' is polysemous: it can refer to all animate objects (a concept glossed as $\text{ANIMAL}_{\text{inclusive}}$ in Figure 1), but can also refer to the more restrictive concept that excludes humans ($\text{ANIMAL}_{\text{contrastive}}$). This type of polysemy, in which a single noun refers to two different nested categories, could have adverse consequences: if nouns support the formation of object categories, and if the same name 'animal' points to two different, but hierarchically-related concepts, then it should be difficult for children to settle on its meaning. This is a testable hypothesis, because this polysemy is not universal. In Indonesian, for example, 'animal' refers to $\text{ANIMAL}_{\text{contrastive}}$; it cannot be applied to humans, and the more inclusive $\text{ANIMAL}_{\text{inclusive}}$ concept remains unnamed. To examine how this cross-linguistic difference affects children's acquisition of concepts of the natural world, we recruited native monolingual Indonesian-speaking children (Jakarta) and monolingual English-speaking children (greater Chicago) from elementary schools in urban environments.

Experiment 1

We asked whether children's interpretations of 'animal' accord with those of adult speakers of their respective languages. Because adult interpretations of word meanings may not mirror precisely those held by children, we first asked how English- and Indonesian-speaking children interpret the word 'animal'.

Method

Participants

Participants were 6-year-olds (English N = 56, *M* = 6.25, *SD* = .43; Indonesian N = 52, *M* = 6.38, *SD* = .49) and 9-year-olds (English N = 39, *M* = 9.43, *SD* = .55; Indonesian N = 50, *M* = 9.31, *SD* = .51).

Materials and Procedure

The experimenter presented a photograph of a human, and asked, "Could you call this an 'animal'?" ("Mungkinkah ini 'hewan'?" in Indonesian).

Predictions

We predict that Indonesian-speaking children will interpret 'animal' as referring exclusively to non-human animals ($\text{ANIMAL}_{contrastive}$), but that English-speaking children appreciate both senses of 'animal' and will endorse both $\text{ANIMAL}_{inclusive}$ and $\text{ANIMAL}_{contrastive}$ interpretations. We further suspect that, because the $\text{ANIMAL}_{contrastive}$ interpretation is the preferred interpretation in English (Leddon, Waxman, & Medin, 2007), English-speaking children will favor an $\text{ANIMAL}_{contrastive}$ interpretation, but that their sensitivity to the $\text{ANIMAL}_{inclusive}$ interpretation will increase with age.

Results and Discussion

Children's responses reflected the naming patterns of their native language. An ANOVA with Language (2: English, Indonesian) and Age (2: six-year-olds, nine-year-olds) as between-subject factors confirmed these observations. Main effects of Language and Age (*F*s > 8.00, *p*s < .01) were qualified by a Language x Age interaction, $F(1, 198) = 6.30$, $p < .05$, $\eta_p^2 = .03$. Indonesian-speaking children at both ages uniformly endorsed the $\text{ANIMAL}_{contrastive}$ interpretation (2% and 4% $\text{ANIMAL}_{inclusive}$ interpretation at 6 and 9 years, respectively). In contrast, English-speaking children endorsed both the $\text{ANIMAL}_{contrastive}$ and $\text{ANIMAL}_{inclusive}$ interpretations. Six-year-olds strongly favored the $\text{ANIMAL}_{contrastive}$ meaning (86% $\text{ANIMAL}_{contrastive}$; 14% $\text{ANIMAL}_{inclusive}$), but by 9 years, children's endorsement of the otherwise covert $\text{ANIMAL}_{inclusive}$ interpretation was more pronounced (62% $\text{ANIMAL}_{contrastive}$; 38% $\text{ANIMAL}_{inclusive}$).

Experiment 2

Is this difference in naming practices is reflected in children's spontaneous categorization of biological entities? If naming a concept facilitates its access, then the concept ANIMAL$_{inclusive}$ should be more accessible in English than in Indonesian, and more accessible in older than younger English speakers.

Method

Participants

Participants were 6-year-olds (English N = 33, *M* = 6.21, *SD* = .42; Indonesian N = 29, *M* = 6.17, *SD* = .47) and 9-year-olds (English N = 27, *M* = 9.30, *SD* = .47; Indonesian N = 36, *M* = 9.20, *SD* = .41)[2].

Materials

See Table 1.

Table 1 about here

Procedure

Each child was tested individually. To begin, the child and experimenter looked through the cards and identified them. Next, the experimenter spread out the cards in a random arrangement, and invited the child to place "…the kinds of things that belong together in the same pile."

<u>Coding</u>

We identified the four following response patterns[3]:

ANIMAL$_{contrastive:}$ three piles (humans <u>vs</u>. non-human animals <u>vs</u>. plants)

ANIMAL$_{inclusive:}$ two piles (humans and non-human animals <u>vs</u>. plants)

LIVING THING: one pile (all living things together)

OTHER: no discernable pattern

Predictions

If children's spontaneous sorting is influenced by naming practices, then Indonesian-speaking children should consistently set humans apart from non-human animals, favoring the ANIMAL$_{contrastive}$ pattern, but English-speaking children should reveal a more mixed response, with some distinguishing humans from non-human animals (ANIMAL$_{contrastive}$ pattern) and others classifying humans with non-human animals (ANIMAL$_{inclusive}$ pattern).

Results and Discussion

Children's spontaneous sorting varied as a function of naming patterns (see Table 2). Overall, English-speaking children were more likely than their Indonesian-speaking counterparts to spontaneously place humans and non-human animals together in the same category, and English-speaking 9-year-olds were more likely to reveal this sorting pattern than were 6-year-olds.

Table 2 about here

We compared the prevalence of the ANIMAL$_{contrastive}$ and ANIMAL$_{inclusive}$ patterns at each age and in each language. Six-year-olds from both language communities favored the ANIMAL$_{contrastive}$ pattern, but this pattern was stronger among Indonesian- than English-speaking children ($p < .05$, Fisher's exact test). Among 9-year-olds, the difference between language groups was more pronounced ($p < .001$, Fisher's exact test).

Indonesian-speaking children's strong tendency to produce the ANIMAL$_{contrastive}$ pattern persisted, but English-speaking children now favored the ANIMAL$_{inclusive}$ pattern. These results, coupled with those from Experiment 1, suggest that children's spontaneous categorizations reflect their appreciation of the naming practices in their communities.

Experiment 3

This experiment was designed to address two goals. The first was to ascertain whether the differences between Indonesian- and English-speaking children would persist when they were presented with a more structured sorting task designed to tap into the overarching concept LIVING THING. Children were explicitly instructed to sort a set of cards three different times, on the basis of three different predicates, each of which applies to all living things ('alive', 'die', and 'grow'). If children appreciate an overarching biological concept LIVING THING, then they should consistently separate the living from the non-living entities.

The second goal was to consider the consequences of the polysemy of the word 'animal' in English. There is extensive evidence documenting that even in the advance of language, infants and young children are sensitive to the concept ANIMAL$_{inclusive}$ (R. Gelman, 1990; Bertenthal, 1993; Woodward, Sommerville, & Guajardo, 2001). Turning to language, Experiments 1 and 2 show that Indonesian-speaking children reserve the word 'animal' to apply to ANIMAL$_{contrastive,}$ that English-speaking children apply it to both ANIMAL$_{inclusive}$ and ANIMAL$_{contrastive,}$ and that the mapping between 'animal' and the abstract ANIMAL$_{inclusive}$ concept is weaker. This finding, coupled with strong evidence that children favor a "one word–one concept" approach in word-learning (Markman &

Wachtel, 1988), suggests that children should be open to aligning a word other than 'animal' with the ANIMAL$_{inclusive}$ concept, should a suitable candidate arise.

An analysis of parental input to English-speaking children offers one such candidate. Leddon, Waxman, and Medin (2007) analyzed the conversations of 7 parent-child dyads using the CHILDES data base (MacWhinney, 2000). Parents of 1- to 5-year-old children spontaneously apply biological terms (including 'die' and 'grow') to all living things, but that they use the word 'alive' quite differently, applying it almost solely to humans and non-human animals, but excluding plants. Based on this input, English-speaking children may well align 'alive' with ANIMAL$_{inclusive}$.

Such an alignment permits children to circumvent the polysemy of 'animal', but also has a less advantageous consequence: if they align 'alive' in this way, then when they are asked about 'alive', as in most experiments probing their appreciation of the natural world, they should systematically exclude plants. Strikingly, this appears to capture the facts: when English-speaking children are asked to sort objects on the basis of the predicate 'alive', they systematically exclude plants (Piaget, 1973; Carey, 1985; Richards & Siegler, 1984; Waxman, 2005). Moreover, in Japanese and Hebrew – two other languages in which the word denoting the concept ANIMAL is polysemous – children also tend to deny that plants are alive (Hatano et al., 1993; Stavy & Wax, 1989).

If English-speaking children attempt to resolve the polysemy of 'animal', and if they (mis)appropriate the predicate 'alive' to cover the less-preferred ANIMAL$_{inclusive}$ sense, then their tendency to include plants when sorting on the basis of 'alive' should be attenuated relative to their performance with the other biological predicates. Moreover, this tendency to exclude plants under the predicate 'alive' should be more pronounced for

English- than Indonesian-speaking children because there is presumably no such polysemy to resolve.

Method

Participants

Participants were 4-year-olds (English N = 56, *M* = 4.52, *SD* = .50; Indonesian N = 46, *M* = 4.72, *SD* = .46), 6-year-olds (English N = 70, *M* = 6.49, *SD* = .50; Indonesian N = 46, *M* = 6.28, *SD* = .46) and 9-year-olds (English N = 53, *M* = 9.42, *SD* = .50; Indonesian N = 48, *M* = 9.08, *SD* = .45).

Materials

See Table 1.

Procedure

After the experimenter and child identified each card, the sorting task began. Instructions for each round of sorting were identical, except for the predicate involved. Cards were re-shuffled between each sort. The experimenter first presented the predicate 'alive', followed by the predicates 'die' and 'grow', in random order.

Coding

To capture individual children's interpretation of each predicate, we assigned children's sorts to one of the following response patterns, permitting one error of omission and one of commission.

ANIMAL$_{inclusive:}$ (includes humans and non-human animals; excludes plants and all others)

LIVING THING: (includes all living things; excludes all others)

NATURAL KIND: (includes all living things and natural kinds; excludes others)

OTHER: no discernable pattern

Results

This highly structured biological classification task revealed two main findings. First, English- and Indonesian-speaking children's performance with the predicates 'grow' and 'die' demonstrated an appreciation of an overarching biological concept LIVING THING. Second, their performance with 'alive' showed a different developmental trajectory suggesting that this predicate posed special interpretive difficulties for English-speaking children, and especially at the older ages.

An ANOVA using Language (2: English, Indonesian) and Age (3: 4-year-olds, 6-year-olds, 9-year-olds) as between-subjects factors, and Predicate (3: Alive, Die, Grow) and Category (5: Human, Animal, Plant, Natural Kind, Artifact) as within-subjects factors revealed main effects of Age (older children included more entities), Predicate (more entities were judged to be alive and to grow than to die) and Category (children were overall more likely to include humans and animals than plants, which in turn were included more than non-living natural kinds and artifact) (Fs > 20.00, ps < .001). Each main effect was qualified by a series of interactions. Taken together, these suggest that English-speaking children were less likely than their Indonesian counterparts to include plants and that this language effect was most prominent for the predicate 'alive' and in the responses of the oldest children (see Table 3).

Table 3 about here

Of greatest relevance, a Predicate x Language x Category interaction, $F(8, 313) = 4.42$, $p < .001$, $\eta_p^2 = .01$, revealed that under the term 'alive', English-speaking children were less likely than their Indonesian-speaking counterparts to include plants, $F(1, 317) = 9.67$, $p < .001$, $\eta_p^2 = .03$, and more likely to include non-living natural kinds, $F(1,3\ 17) = 20.39$, $p < .001$, $\eta_p^2 = .06$. Interestingly, it is not that English-speaking children are in the dark about properties of plants. In fact, they were more likely than Indonesian-speaking children to recognize that plants die and grow (Fs > 5.61, ps < .05).

A second important finding comes from post-hoc analyses of an Age x Language x Category interaction, $F(8, 313) = 4.48$, $p < .001$, $\eta_p^2 = .03$. At the two younger ages, both Indonesian- and English-speaking children were more likely to exclude plants than humans or non-human animals. For 9-year-olds, however, performance in the two languages diverged $F(4, 396) = 3.20$, $p < .05$, $\eta_p^2 = .03$. English-speaking children's tendency to exclude plants persisted, but older Indonesian children included plants as frequently as they did humans and non-human animals. Thus, English-speaking children's difficulty attributing life status to plants was especially prominent for 'alive', and especially evident in the older children.

Because analyses based on group means cannot convey how *individual* children interpreted each predicate, we report individual patterns of response (see Figure 2). Consider first the patterns produced when children were probed with the predicates 'die' and 'grow'. The youngest children in both language communities produced a range of interpretations, including a large proportion of OTHER responses. Yet by age 6, one pattern – the LIVING THING pattern – predominated, and by age 9, this pattern characterized the large majority of the children. Thus, by six years of age, children appreciate an abstract concept of living things, and apply the biological predicates ‘die’ and ‘grow’ to this inclusive biological concept.

Figure 2 about here

A very different trajectory was observed for the predicate ‘alive’. In both language communities, the youngest children displayed an ANIMAL$_{inclusive}$ pattern, excluding plants. By age 6, there was also some evidence of the LIVING THING pattern. By age 9, however, the patterns produced by English- and Indonesian-speaking children diverged. English-speaking children endorsed both the ANIMAL$_{inclusive}$ and the LIVING THING patterns. In contrast, for Indonesian speakers, the ANIMAL$_{inclusive}$ pattern had nearly vanished, and the LIVING THING pattern was adopted by over 80% of the children.

We employed the frequencies of ANIMAL$_{inclusive}$, LIVING THING, and NATURAL KIND patterns in Chi-square goodness-of-fit analyses, against the null hypothesis that the response patterns were evenly distributed. At each age and in each language group, the distribution of sorting patterns for the predicates ‘die’ and ‘grow’ differed significantly from the expected chance value (χ^2s > 9.22, *p*s < .01). For these predicates, the LIVING THING pattern predominated throughout, and by age 9 to 10, this pattern overwhelmingly characterized the majority of the children. These results suggest that children at these ages appreciate a LIVING THING category, as witnessed by their interpretation of these two predicates.

A different trajectory was observed for the predicate 'alive'. At age 4, the distribution of sorting patterns differed significantly from the expected chance value in both languages (χ^2s > 12.78, *p*s < .01) and the ANIMAL$_{inclusive}$ pattern (rather than the LIVING THING pattern) predominated. At age 6, children's responses were evenly distributed among the three patterns ($\chi^2 < 5.30$, *ns*). By age 9, interpretations in the two language communities diverged. English-speaking children's responses remained evenly distributed among the three patterns, $\chi^2(1, N = 51) = 2.26$, *ns*. In contrast, responses among Indonesian speakers were not evenly distributed, $\chi^2(1, N = 48) = 50.89$, $p < .001$, but rather these children strongly favored the LIVING THING pattern.

Discussion

This structured sorting task revealed two main findings. First, performance with the predicates 'grow' and 'die' demonstrated in children as young as 6 years of age an appreciation of an overarching biological concept LIVING THING. Second, performance with the predicate 'alive' revealed interpretive challenges, especially for English-speaking children. Although their tendency to interpret the other biological predicates as referring to all living things increased steadily with age, they continued to exclude plants when sorting on the basis of 'alive'. This pattern stands in contrast to that exhibited by Indonesian-speaking children who, by 9 years of age, came to apply 'alive' to all living things.

General Discussion

Previous research has examined domain-specific reasoning in folkbiology (Medin & Atran, 1999; Hatano & Inagaki, 2003), and substantial developmental work has documented the powerful effects of naming on conceptual organization (Waxman &

Markow, 1995; Balaban & Waxman, 1997; Waxman, 1999; Waxman & Lidz, 2006; Echols & Marti, 2004) and inductive inference (Gelman, 2003; Gelman & Markman, 1986; Graham et al., 2004; Waxman & Booth, 2001, Waxman et al., 1997). The current work bridges these two enterprises by exploring interactions between language and conceptual structures in biological reasoning.

The current findings demonstrate that the way in which biological concepts are named influences their acquisition. When confronted directly (Experiment 1), English-speaking, but not Indonesian-speaking, children endorsed two different meanings of 'animal', supporting the observation that in English, 'animal' has two senses. This cross-linguistic difference was also evident in children's spontaneous sorting of biological entities (Experiment 2). Here, Indonesian-speaking children overwhelmingly formed distinct groups of human vs. non-human animals. In contrast, English-speaking children's spontaneous sorts reflected the two interpretations of 'animal'. Finally, in a constrained sorting task (Experiment 3), the consequences of this animal polysemy became evident: although children from both language communities demonstrated an appreciation of the overarching LIVING THING concept, as shown by their performance under the terms 'die' and 'grow', their interpretation of the predicate 'alive' varied as function of native language. By 9 years of age, Indonesian-speaking children applied this term to the overarching LIVING THING concept. However, English-speaking children at this age showed a persistent and pernicious difficulty applying this predicate to plants, as would be expected if they (mis)aligned this term to the $\text{ANIMAL}_{\text{inclusive}}$, and not the LIVING THING concept.

In future work, a primary goal will be to better understand how children represent the (often covert) ANIMAL$_{inclusive}$ or ANIMATE concept, and how their representation is affected by naming practices. There is strong evidence that infants are sensitive to this concept even in advance of language. But the naming practices matter. We have suggested that the polysemy in English interferes with children's interpretation of a closely-related predicate 'alive' and with their ability to attribute life status to plants. In support of this suggestion, we documented that in Indonesian, where there is no such polysemy, this (mis)alignment is less persistent and that by 9 years of age, children readily attribute life status to plants as well as animate beings. What remains unanswered is whether this difference is attributable to its polysemy or its unnamed status. Answers to this question will rest upon evidence from languages that name the ANIMATE node, but in which the name is not polysemous. Czech appears to be one such language: ANIMAL$_{inclusive}$ is named ('živočich'), and this name is distinct from that for ANIMAL$_{contrastive}$ ('zvíře')[4].

It is also important to examine carefully the input that children receive regarding fundamental concepts associated with the natural world, identifying the contexts in which these concepts are discussed (e.g., home, school, religious institutions), the words with which these concepts are described, degrees of expertise characterizing the adults with whom children interact (Tarlowski, 2006), and the religious and spiritual beliefs endorsed by family and community (Evans, 2001).

In closing, the current results underscore the importance of language and cultural factors in the acquisition of fundamental concepts about the biological world.

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Footnotes

1) Small capitals denote CATEGORIES; single-quotes denote their ‘names’.

2) All of the English-speaking children and 17 of the older Indonesian-speaking children were later included in our intuition check (Experiment 1), with an approximately 5-minute break between tasks. An analysis on these English-speaking children revealed a tendency to *consistently* show an $\text{ANIMAL}_{inclusive}$ or $\text{ANIMAL}_{contrastive}$ response across both experiments, although it did not reach significance ($p<.10$, Fisher’s exact test). Thus, consistent with the polysemy of ‘animal’, some children may apply the same interpretation uniformly across contexts, while others may vary.

3). To be credited with any of the discernible patterns, the child could not make any errors.

4). Bennis, personal communication, October 2005.

Author Note

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Tables

Table 1

Experiments 2 and 3: Complete list of materials. Each picture was presented on a 8.5” x 5.5” laminated card. Differences in Experiment 3 items indicate adjustments to accommodate familiarity in Indonesia.

	CATEGORY				
	Human	**Animal**	**Plant**	**Natural Kind**	**Artifact**
EXPERIMENT 2					
	person	monkey rabbit toucan beetle	pine tree dandelions	sun rocks	bicycle scissors
EXPERIMENT 3					
English	person	bear squirrel blue jay trout bee worm	maple tree cranberry bush dandelions	sun clouds water rocks	bicycle scissors pencil
Indonesian	person	bear rabbit perkukut gourami bee worm	palm tree cranberry bush dandelions	sun clouds water rocks	bicycle scissors pencil

Table 2

Experiment 2: Number of children adopting each sorting pattern

AGE		LANGUAGE	INDIVIDUAL PATTERNS			
			$\text{ANIMAL}_{\text{contrastive}}$	**$\text{ANIMAL}_{\text{inclusive}}$**	**LIVING THING**	**OTHER**
6-yr-olds		English	6	4	2	21
		Indo	16	1	0	12
9-yr-olds		English	3	6	4	14
		Indo	25	1	0	9

Table 3

Experiment 3: Proportion of items included each category on each predicate

				CATEGORY				
				Human	Animal	Plant	Nat. Kind	Artifact
						Alive		
AGE	4-yr-olds	LANGUAGE	English	0.91	0.87	0.50	0.33	0.30
			Indo	0.98	0.95	0.51	0.27	0.28
	6-yr-olds		English	0.99	0.96	0.57	0.38	0.20
			Indo	1.00	0.99	0.55	0.24	0.18
	9-yr-olds		English	1.00	0.99	0.72	0.25	0.02
			Indo	1.00	1.00	0.94	0.12	0.00
		Mean English		**0.97**	**0.94**	**0.60**	**0.32**	**0.17**
		Mean Indo		**0.99**	**0.98**	**0.67**	**0.21**	**0.15**
						Die		
AGE	4-yr-olds	LANGUAGE	English	0.71	0.69	0.63	0.12	0.08
			Indo	0.78	0.76	0.46	0.14	0.10
	6-yr-olds		English	0.83	0.89	0.77	0.03	0.08
			Indo	0.93	0.87	0.68	0.08	0.07
	9-yr-olds		English	1.00	0.99	0.95	0.13	0.09
			Indo	1.00	1.00	0.96	0.02	0.00
		Mean English		**0.85**	**0.86**	**0.78**	**0.09**	**0.08**
		Mean Indo		**0.91**	**0.88**	**0.70**	**0.08**	**0.06**
						Grow		
AGE	4-yr-olds	LANGUAGE	English	0.88	0.61	0.83	0.19	0.07
			Indo	0.87	0.59	0.70	0.27	0.17
	6-yr-olds		English	0.97	0.81	0.92	0.14	0.03
			Indo	0.98	0.78	0.83	0.16	0.07
	9-yr-olds		English	1.00	0.94	0.96	0.23	0.01
			Indo	1.00	0.98	0.99	0.02	0.00
		Mean English		**0.95**	**0.79**	**0.90**	**0.19**	**0.04**
		Mean Indo		**0.95**	**0.79**	**0.84**	**0.15**	**0.08**

Figure Caption

Figure 1. A schematic depiction of English and Indonesian names for fundamental biological concepts. Notice that the node corresponding to ANIMATE or $\text{ANIMAL}_{\text{inclusive}}$ is unnamed in Indonesian.

Figure 2. Experiment 3: Individual children's sorting patterns on each predicate

Figure 1

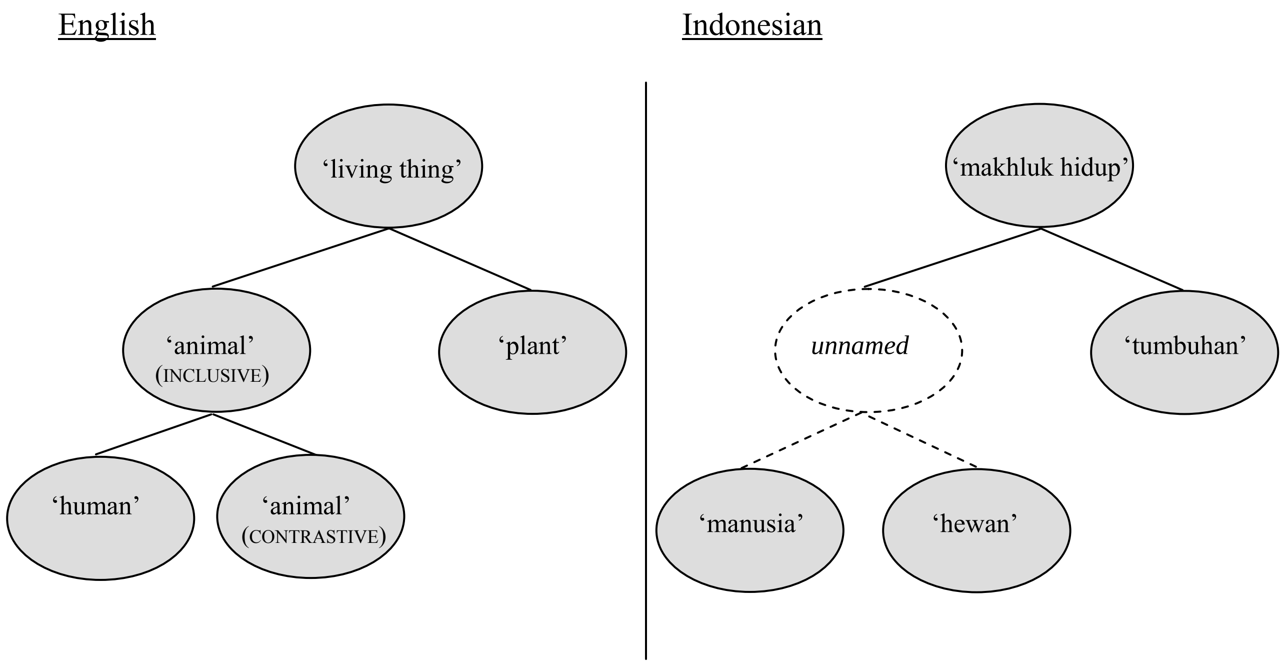
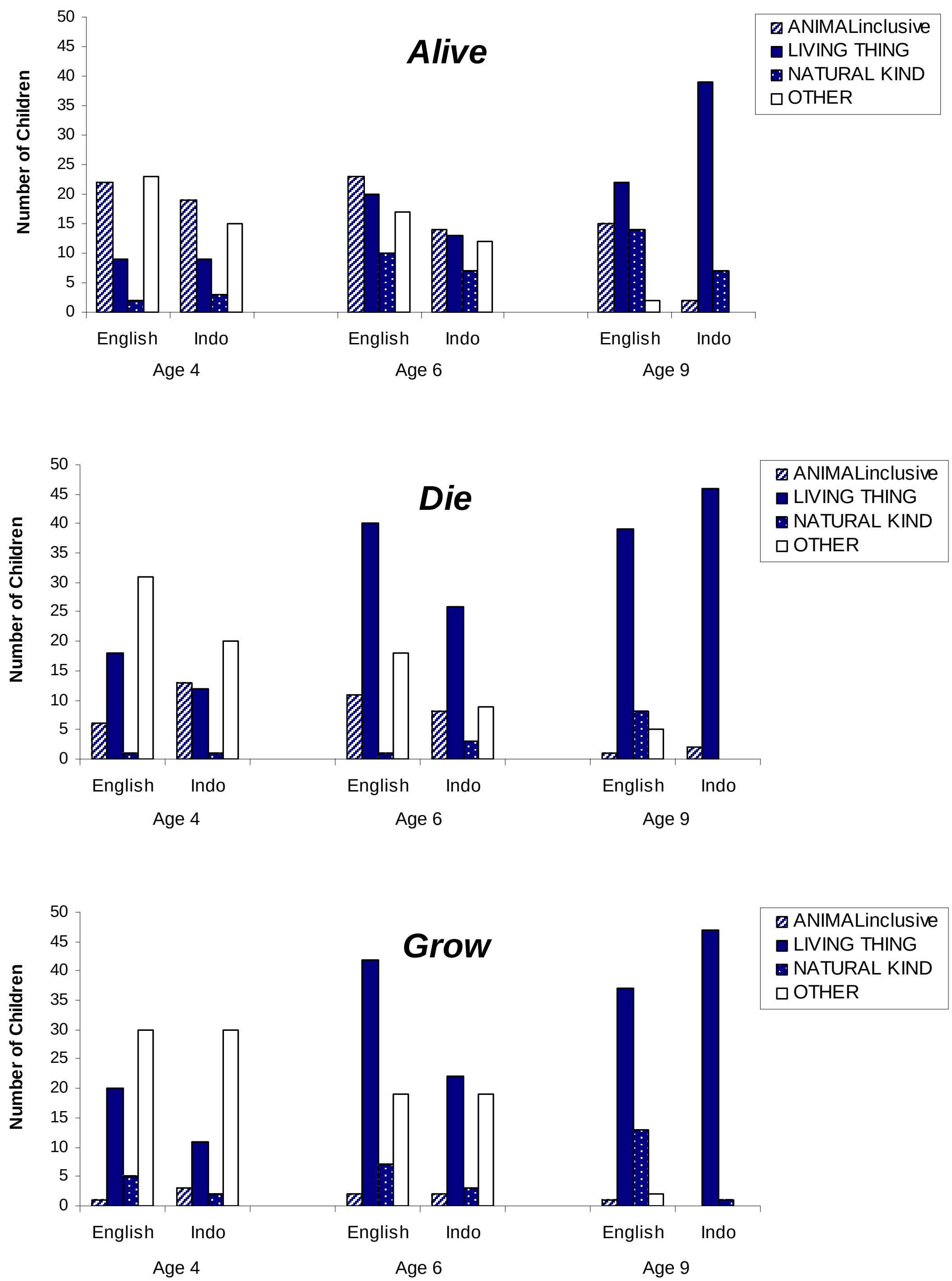

English
Indonesian
'living thing'
'animal'
(INCLUSIVE)
'plant'
'human'
'animal'
(CONTRASTIVE)
'makhluk hidup'
unnamed
'tumbuhan'
'manusia'
'hewan'

Figure 2


Alive
Die
Grow
Number of Children
0
5
10
15
20
25
30
35
40
45
50
ANIMALinclusive
LIVING THING
NATURAL KIND
OTHER
English
Indo
Age 4
Age 6
Age 9