Are natural kinds psychologically distinct from nominal kinds? Evidence from Learning and Development

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Abstract

Known theories of categorization operate under the assumption that all concepts are fundamentally similar. The current research argues that this assumption is unwarranted, and that there are different types of concepts that may differ in how they are represented and learned. We specifically focus on natural-kind and nominal-kind concepts. If these types of concepts are fundamentally different, they should exhibit important dissociations. Two learning regimes were contrasted: one in which participants were shown instances of the concept without being given a definition of the concept (implicit learning regime), and one in which participant were given a definition of the concept without being shown individual instances (explicit learning regime). Preschoolers and adults participated. The results show a strong dissociation between the two kinds of concepts in terms of acquisition, indicating that existing theories of categorization are incomplete.

Introduction

The ability to form categories by overlooking differences for the sake of generality is a critically important component of cognition. While the importance of concepts and categories is widely accepted, a number of puzzling questions remain unanswered. How do categories arise? Which processes underlie categorization? And how are categories represented in the cognitive system?

Several influential approaches have emerged in an attempt to answer these questions. According to the "classical view," categories are represented by sets of features that are individually necessary and jointly sufficient to determine category membership (Bruner, Goodnow, & Austin, 1956; Vygotsky, 1986/1934; for a review see Smith & Medin, 1981). For example, the concept *prime number* includes two features: an integer and no remainder when divided by one and by itself. Each feature is necessary and they are jointly sufficient to determine whether or not a number is a prime.

By the 1980s, the classical view came under severe attack for its inability to predict and account for several key phenomena in the study of concepts, such as, for example, the gradedness of category membership. (Mervis & Rosch, 1981; see also Murphy, 2002, Smith & Medin, 1981, for extensive reviews).

With the demise of the classical view, two theoretical approaches to conceptual development have emerged: the naïve-theory approach and the similarity-based approach. The naïve-theory approach argues that even if there are no truly defining features, features differ in their conceptual centrality, this centrality being often determined by a feature's causal status (Medin, 1989; Gelman & Coley, 1991; Keil, Smith, Simons, & Levin, 1998). For example, apples and basketballs are round, but the feature "roundness" is more central for basketballs than it is for apples.

On the contrary, the similarity-based approach suggests that categorization decisions are made on the basis of similarity between a to-be-categorized entity and existing categories (see Murphy, 2002; Sloutsky, 2003, for reviews). Categories could be represented as best examples or prototypes (Posner & Keele, 1968, Rosch & Mervis, 1975) or as sets of encountered exemplars (e.g., Nosofsky, 1986, 1992). In the former case, an entity is categorized as A if it is similar to A's prototype, whereas in the latter case an entity is categorized as A if it is similar to individual exemplars of A encountered previously.

Despite the differences among these theoretical approaches, there is an important commonality – they all implicitly assume that concepts (or at least most the concepts) are fundamentally the same, and therefore, all concepts have to be learned and represented in the same or a similar way.

However, it is possible that there are different classes of concepts that give rise to different types of representation. In particular, there is a normative distinction between *natural kinds* and *nominal kinds* (Kripke, 1972; see also Keil, 1989, for a review). While natural kinds refer to classes of entities that exist in nature (e.g., *bird*), nominal kinds refer to more arbitrary groupings based on a small set of necessary and sufficient properties (e.g., *triangle, acceleration*). While many everyday concepts are natural kinds, many scientific concepts are nominal kinds. It seems that the classical view of categorization considered nominal kinds as most representative concepts, whereas the naïve-theory and the similarity-based positions considered natural kinds as most representative ones.

The current study asks whether the normative distinction between natural and nominal kinds is accompanied by a psychological distinction between these two types of concepts. While natural kinds have a rich correlational structure (e.g., creatures that lay eggs, also have feathers and fly), nominal kinds are based on an isolated rule (e.g., motion is accelerated when the moving body changes velocity, vector, or both). If true, such psychological distinction should manifest itself in how natural kinds and nominal kinds are represented and learned. The goal of this research is to examine dissociations in learning of natural and nominal kinds.

Differential Structure of Concepts

To reiterate, natural-kind concepts often have multiple correlations among features of category members and between clusters of features and the category. Nominal kinds, on the other hand, are typically based on a small set of necessary and sufficient features that determine a rule for including new instances into a category. It could be said then that natural kinds are statistically dense, embedded in multiple redundancies, whereas nominal kinds are statistically sparse, that is based on a single rule embedded in irrelevant variance (cf. Gentner, 1978).

Because natural kinds are statistically dense, it is possible that natural kinds are acquired spontaneously and do not require explicit training. Even infants are sensitive to multiple correlations and can spontaneously acquire categories based on multiple correlations. (e.g., Younger, 1993). Therefore, is likely that the mere exposure to instances of a natural kind could suffice for the acquisition of the concept. For example, infants may learn to group dogs together after seeing a variety of dogs (Quinn, Eimas, & Rosenkrantz, 1993), and the basis for this learning is extraction of statistical information from a set of exemplars (Mareschal & Quinn, 2001). In fact, explicit training of a natural-kind category may hurt the acquisition of the natural kind.

Nominal kinds are statistically sparse, meaning that they lack redundancy, and that only a limited set of features or feature relations is relevant. Because only a small portion of total information is relevant for the membership in a concept, it might be difficulty for the learner to spontaneously determine what is relevant without having explicit instruction. This might be especially true for relational concepts, those that are based on a relation among features, not the features themselves (e.g., *ratio*). There are few reasons to believe that mere exposure to a limited set of instances would result in an acquisition of a relational concept. On the contrary, even feedback-based learning of relational concepts proved to be a challenge (Bruner, et al., 1956).

Furthermore, Billman & Knuston (1994) showed that in an unsupervised learning setting, adults could learn best the concept that is based on redundant relations. Adults failed to learn the concept when it was based on an isolated or orthogonal relation. Based on these considerations, we hypothesize that there might be an acquisitional dissociation between natural and nominal kinds, with the former requiring unsupervised exposure (i.e., implicit learning regime), and the latter requiring an explicit instruction about the inclusion rule (i.e., an explicit learning regime).

Overview of Experiments

In the three reported experiments, we systematically manipulated two factors: the type of the concept to be learned ("natural kind" vs. "nominal kind") and the learning regime (implicit learning regime vs. explicit learning regime). Preschool children (Experiment 1) and adults (Experiment 2 and 3) participated in the four resulting conditions: implicit or explicit learning of a concept that mimics natural kinds, and implicit or explicit learning of a concept that mimics a nominal kind.

For both kinds of concepts, the same animal-like artificial stimuli were created, such that none of the single features was predictive of the category membership. Only the relations between features mattered. Similar to natural kinds in the real world, the natural kind of the current experiment was based on multiple correlations among features (e.g., creatures that had a dark body, were likely to have a long tail and lots of wings)[1]. Conversely, in the nominal kind of the current experiment, only one, arbitrary selected, relation was predictive of category membership.

In the implicit learning regime, the learners were presented with instances of the target category without being told the defining rule of the category. Conversely, in the explicit learning regime, the learners were given the defining rule of the category without being shown specific instances.

We predicted an interaction between learning regime and kind of concept. The concept that is based on redundant relations (i.e., "natural kind") should be best learned in the implicit learning regime, and the concept that is based on an isolated relation (i.e., "nominal kind") should be best learned in the explicit learning regime.

Experiment 1

The goal of the first experiment was to examine the acquisition of natural-type and nominal-type concepts under different learning regimes by young children.

Method

Participants Participants were 61 5-year-olds (32 girls and 29 boys), recruited from suburban middleclass preschools. The mean age in each condition (natural/implicit, natural/ explicit, nominal/implicit, nominal/ implicit) in months was 58.1 (*SD* = 4.6), 61.9 (*SD* = 2.7), 60.4 (*SD* = 5.2), and 60.3 (*SD* = 4.7), respectively. Additional 28 children were tested (8 in natural/implicit, 5 in natural/explicit, 7 in nominal/ implicit, and 8 in nominal/explicit) and omitted from the

[1] Note that these stimuli are not real-world natural kinds. They were designed to capture the correlational structure of natural kinds.

sample because their performance in the catch trials did not meet the criterion (see Procedure).

Stimuli The stimuli were colorful drawings of unfamiliar animals presented on a computer screen. Each instance had the following six elements: a body, antennas, horizontal and vertical wings, a tail, and buttons on the body (Figure 1). These six features could vary in at least one dimension. They could vary in size (e.g., long or small tail), in its shade (e.g., dark or light body), or in its number (e.g., few or lots of buttons). Each dimension could have one of five levels.

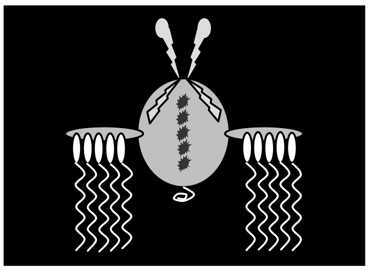

Figure 1: Example of the stimuli.

Categories were created, such that some included multiple correlations of features (i.e., they approximated a natural kind), whereas others were based on a single arbitrary selected relation (i.e., they approximated a nominal kind). Table 1 shows in abstract notation how stimuli differed between concepts. The numbers next to each of the elements correspond to the levels of the varying dimensions, low numbers representing low levels of the dimension (small, light, or few), and high numbers representing high levels of the dimension (large, dark, lots).

For the natural kind, size, shade, and number of elements correlated systematically[2]. Only levels 1, 2, 4 and 5 were used. In category A, a light body (level 1 or 2) had light antennas, short horizontal wings, a short tail, few long vertical wings, and few dark buttons. Conversely, a dark body (levels 4 and 5) went with dark antennas, long yellow wings, a long tail, lots of small aqua wings, and lots of light buttons. In the contrasting category B, the correlations were reversed. For example, a light body went with dark antennas, short yellow wings, a long tail, few short aqua wings, and lots of light buttons. No single feature was predictive of the category.

For the nominal kind, only the number of elements mattered, while the correlations among sizes and shades were varied randomly. In category A, there were fewer buttons than tails and aqua wings together, and in category B, there were more buttons than tails and aqua wings together[3]. The numbers of buttons, tails, and aqua wings were chosen in such a way that neither the number of a single element nor the correlation between two of the elements were predictive. This ensured that no other information (e.g., difference in quantity) was redundant with the rule. An additional set of stimuli was created that functioned as catch items. These items were from category B but had a diamond shaped body and no horizontal wings.

Table 1: Structure of Concepts in Experiment 1 and 2

	Elements	Category A		Category B	
Natural Kinds					
	Body	1	5	1	5
	Antennas	1	5	5	1
	Wings horiz.	1	5	1	5
	Tails	1	5	5	1
	Wings vert.	1	5	1	5
		5	1	5	1
	Buttons	1	5	5	1
		5	1	1	5
Nominal Kinds					
	Body	1	1	5	1
	Antennas	1	5	1	5
	Wings horiz.	5	5	5	1
	Tails	1	2	2	3
	Wings vert.	2	2	3	3
	Buttons	4	5	4	5

Note. The numbers refer to the levels of the varying dimensions.

Procedure The cover story presented to children involved the creature Fritz who lives on planet Elbee and who would like to get a pet. Pets on planet Elbee are called Ziblets and come from a magical store that carries both pets and dangerous wild animals. Children's task was to determine whether or not an animal from this magical store is Ziblet.

The procedure had two phases: a training phase and a testing phase. In the training phase, children were given information about Ziblets (category A in Table 1). In the implicit learning regime, they were shown 24 pictures of Ziblets, presented one by one. They were told: "I will show you the Ziblets that other families on planet Elbee have as pets. Can you look at them and try to remember them?" In the explicit learning regime, children were presented with the defining rule. They were either told (for the natural kind) "A Ziblet with a dark body has dark antennas, long yellow wings, a long tail, one or two short aqua wings and two or three light buttons; and a Ziblet with a light body has light antennas, short yellow wings, a short tail, four or five long aqua wings and five or six dark buttons", or they were told (for the nominal kind) "For a Ziblet, the number of buttons is smaller than the number of tails and aqua wings together". Each separate element mentioned in the rule (e.g., a long tail) was depicted on the computer screen.

[2] Note that two of the elements (wings and buttons) varied in two dimensions (number and either size or shade). This was done to increase the overall redundancy among the correlations without adding more elements. The correlations within an element were not predictive of the category, as they may be easier to learn than correlations that span across two elements.

[3] Having three rather than two elements ensured that no perceptual features would correlate with the defining rule.

The testing phase was identical in both learning regimes. Sixteen testing trials were presented in random order, half of them being instances of Category A (Ziblets) and half of them being instances of Category B. Children's task was to determine whether an instance is a Ziblet or not. Six catch trials followed intermixed with instances of category A. To be included in the study, children had to reject four of the catcher trials.

Results and Discussion

Accuracy scores were calculated for each participant comparing proportion of hits with proportion of false alarms. Figure 2 shows the mean accuracy scores for each condition,. Note that an accuracy score of zero would be expected by change.

A 2 (concept: natural kind, nominal kind) by 2 (learning regime: implicit, explicit) between-subjects ANOVA revealed a significant interaction ($F(1,53) = 14.46$, $p < .001$), with the mean accuracy scores being above chance in the conditions natural/implicit ($t(15) = 4.07$, $p < .01$) and nominal/explicit ($t(15) = 3.2$, $p < .01$) but not in the conditions natural/ explicit and nominal/implicit.

An analysis of individual pattern of responses corroborated this trend. Eleven children in the natural/implicit condition (69%) and 12 children in the nominal/explicit condition (75%) had an accuracy score above 0.20. Conversely, only 5 children in the natural/explicit condition (31%) and only 3 children in the nominal/implicit condition (23%) had an accuracy score above 0.20.

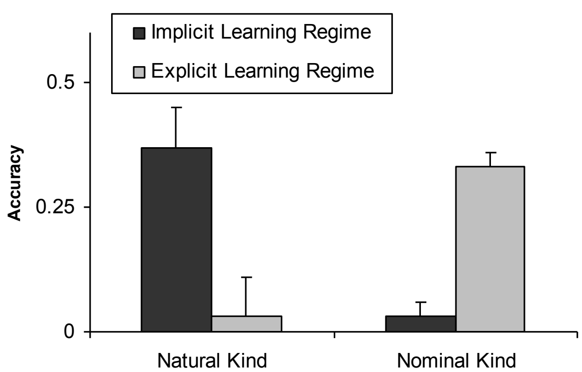

Figure 2: Accuracy Scores for Children.
Error bars represent standard errors.

In short, as predicted, children could learn the natural-type concept in the implicit learning regime, but not in the explicit learning regime; and they could learn the nominal-type concept in the explicit learning regime but not in the implicit learning regime. These findings cannot be due to differences in stimuli, as the same cartoon animals were used for both natural and nominal kinds. Furthermore, the findings cannot be due to differences in procedure, given that the learning regime for the natural kind (either implicit or explicit) was closely matched with the learning regime for the nominal kind.

These results reveal an important dissociation: while the implicit learning regime favored acquisition of concepts resembling natural kinds, the explicit learning regime favored acquisition of concepts resembling nominal kinds, thus supporting the contention that there is a psychological distinction between natural kinds and nominal kinds.

Experiment 2

The goal of this experiment was to extend the findings of Experiment 1 to adult participants. Adults participated in the same four conditions that were used for children in Experiment 1: natural/implicit, natural/explicit, nominal/ implicit, and nominal/explicit.

Method

Participants Participants were 54 introductory psychology students at a large mid-western university who participated for class credit. Additional nine adults (two or three in each condition) were tested and omitted from the sample because their performance in the catch trials did not meet the criterion (see Procedure).

Stimuli The stimuli were identical to the ones used in Experiment 1.

Procedure Adults were asked to learn about creatures called Ziblets in order to distinguish them from creatures that are not Ziblets. In the implicit learning regime, they were presented with 24 instances and asked to remember them. In the explicit learning regime, they were given the same defining rule that was presented to children. Again, no instances were presented; only pictures of the elements accompanied the rule.

Thirty-two testing trials followed in which instances were presented on the screen, and adults had to determine whether the see a Ziblet or not. Half of the instances were from category A (Ziblets) and half of them were from category B.

Eight catch trials followed intermixed with three trials from category A. To be included in the study, adults had to respond correctly in at least 6 catch trials. At the end of the procedure, adults were asked to give a verbal description of the difference between Ziblets and other animals presented on the screen.

Results and Discussion

Mean accuracy scores are presented in Figure 3 (with standard error as error bars). A 2 (concept: natural, nominal) by 2 (learning regime: implicit, explicit) between-subjects ANOVA revealed a significant effect of learning regime ($F(1,50) = 13.15$, $p < .01$) with accuracy scores being higher in the explicit learning regime ($M = 0.62$, $SD = xx$) than in the implicit learning regime ($M = 0.23$, $SD = xx$), and a significant interaction ($F(1,50) = 11.9$, $p < .01$). When presented with the natural kind, participants performed above chance in both learning regimes ($t_{implicit}(13) = 5.3$, $p < .001$; $t_{explicit}(13) = 3.68$, $p < .01$), but when presented with the nominal kind, they performed above chance only in the explicit learning regime ($t(10) = 6.12$, $p < .001$).

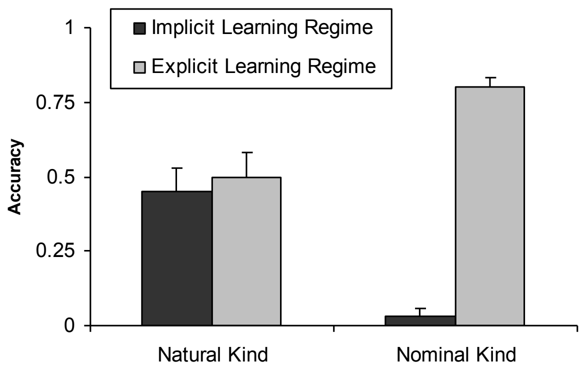

Figure 3: Accuracy Scores for Adults.

Adults' verbal responses were analyzed in terms of whether or not they contained the defining rule. For the natural kind, a response was coded as correct when the statement included at least one of the correlations. For the nominal kind, a response was coded as correct when the statement included the numerical relation. Table 2 shows the pattern of results. As expected, adults could verbalize the defining rule of the nominal kind in the explicit but not in the implicit learning regime. For the natural kind, even though adults' categorization accuracy did not differ as a function of learning regime, their verbal responses did. Only three the adults could verbalize the rule of natural kinds in the implicit learning regime whereas 7 adults could verbalize the rule in the explicit learning regime[4].

Table 2: Number of Correct Verbal Statements (Percentage correct in parentheses).

	Concept	
Learning Regime	Natural	Nominal
Implicit	3 (21%)	0
Explicit	7 (50%)	8 (73%)

Overall, learning of nominal kinds in adults exhibited tendencies similar to those in young children: participants ably learned the concept when presented with the defining rule of the concept, and they performed poorly when they were presented with instances of the category.

At the same time, unlike young children, for the natural-kind type concept, adults performed equally well under different learning regimes. Although this was surprising, given that the rule of the natural concept was rather lengthy, involving statements about the dimensions of six elements, we content that real natural kinds involve more than six simple correlations, thus making explicit learning of real natural kinds difficult. This contention, however, remains speculative, and it will be examined in future research.

Experiment 3

The goal of this experiment was to document that the dissociation found in Experiments 1 and 2 is not limited to the particular nominal kind used in those experiments. Recall that the nominal kind used in Experiments 1 and 2 was based on a mathematical relation – a relation that may differ considerably from the correlations relevant for the natural kind. This difference was minimized in Experiment 3 by using the same training stimuli for all participants. These stimuli were identical to the training set of the "natural kind" used in the implicit and explicit learning regime of the previous experiments. The test items of Experiment 3 differed from the test items of the previous experiments in that only one correlation – rather than multiple correlations – was relevant for category membership. Therefore, the category to be learned was statistically sparse rather than statistically dense.

Method

Participants A new group of 28 students participated in this experiment (14 in the implicit learning regime, and 14 in the explicit learning regime). Additional 3 adults were tested and omitted from the sample because their performance in the catch trials did not meet the criterion.

Stimuli Table 3 shows in abstract notation the dimensions of the stimuli used in this experiment. Category A shows examples of Ziblets – identical to the ones used in Experiment 2a. The contrasting category B shows examples of Non-Ziblets. The items in this category are new. They differ from the Ziblets in only one of the correlations (between shades, between sizes or between numbers), rather than in all three correlations.

Table 3: Structure of Concepts in Experiment 2b

			Category B					
Elements	Category A		Shade		Size		Number	
Body	1	5	1	5	1	1	1	1
Antennas	1	5	5	1	1	1	1	1
Wings horiz.	1	5	1	1	1	5	1	1
Tails	1	5	1	1	5	1	1	1
Wings vert[5].	1	5	1	1	1	1	1	5
Buttons	1	5	1	1	1	1	5	1

Note. The numbers refer to levels of dimensions. The subsets of Category B (Shade, Size, Number) differ in whether the correlation between shades, sizes, or numbers was violated.

[4] The finding that some adults failed verbalize the correct rule even in the explicit learning regime may be an artifact of the procedure. Instead of describing the difference between Ziblets and Non-Ziblets, a large majority of the adults described the difference between test items and catch items.

[5] As in the previous experiment, vertical wings and buttons differed also in a second dimension (see Table 1). This information is omitted from Table 3 for ease of description.

Procedure The procedure was identical to the procedure used in Experiment 2. Within the set of test items from category B, six pertained to ones in which the shade correlation was violated, five pertained to ones in which the size correlation was violated, and five pertained to the ones in which the number correlation was violated.

Results and Discussion

Despite the more difficult testing trials, adults perform above chance in both conditions (implicit: $t(16) = 3.64$, $p < .01$; $M = 0.17$, $SE = .05$; explicit: $t(15) = 7.74$, $p < .001$; $M = 0.44$, $SE = .06$). They could learn the natural kind even when the difference between target and contrasting category was only in one correlation.

More importantly, however, it was found that the increased difficulty of test trial affected learning in the implicit, but not in the explicit condition. T-tests comparing performance in this experiment with the respective performance in Experiment 2 revealed a significant difference in the implicit learning regime ($t(31) = 3.76$, $p < .01$), adults performing better when several correlations are violated (Experiment 2) rather than just one (Experiment 3). This attenuation in performance was not observed in the explicit learning regime. These results further indicate that the dissociation between natural kids and nominal kinds reflects the structure of to-be-learned categories rather than the property of a particular relation used in Experiments 1 and 2.

General Discussion

The results reported here seem to support a psychological distinction between natural and nominal kinds. The natural kind was best learned through an implicit learning regime (especially for children); and the nominal kind was best learned through an explicit learning regime. The findings with nominal kinds applied whether the concept was based on a mathematical relation (Experiment 2) or a correlation between two features (Experiment 3). This suggests that the dissociation in acquisition reflects the structure of the category rather than the particular relation.

We argue that the key psychological distinction between concepts is the statistical density of the defining relation. A statistically dense concept (one in with multiply redundant correlations matter) seems to require a different learning environment than a statistically sparse concept (one in which only a single relation matters). It is possible that this learning dissociation reflects itself also in the way the concepts are represented. For example, it is possible that Rosch-type effects are more likely to be found with statistically dense concepts than with statistically sparse concepts.

Finding dissociation in learning between different types of concepts indicates that a theory of categorization is incomplete if it pertains only to one kind of concept. A more complete account would address the processes of categorization for both natural and nominal kinds.

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References

Billman, A. J., & Knutson, D. (1996). Unsupervised concept learning. *Journal of Experimental Psychology, 22*(2), 458-487.

Bruner, J. S., Goodnow, J. J., & Austin, G. A. (1956). *A study of thinking.* Wiley.

Gelman, S. A., & Coley, J. (1991). Language and categorization: The acquisition of natural kind terms. In S. A. Gelman, & J. P. Byrnes (Eds.), *Perspectives on language and thought: Interrelations in development*. New York: Cambridge University Press.

Gentner, D. (1978). On relational meaning: The acquisition of verb meaning. *Child Development, 49*, 988- 998.

Keil, F. C. (1989). *Concepts, kinds, and cognitive development.* Cambridge, MA: MIT Press.

Keil, F. C., Smith, W. C., Simons, D. J., & Levin, D. T. (1998). Two dogmas of conceptual empiricism: Implications for hybrid models of the structure of knowledge. *Cognition, 65*, 103-135.

Kripke, S. (1972). Naming and necessity. In D. Davidson & G. Harman (Eds.), *Semantics of natural language*. Dordrecht, Holland: Reider.

Mareschal, D., & Quinn, P. C. (2001). Categorization in infancy. Trends in Cognitive Sciences, 5, 443-450.

Medin, D. L.; Lynch, E. B., & Solomon, K. O. (2000). Are there kinds of concepts? *Annual Review of Psychology, 51*, 121-147.

Mervis, C. G., & Rosch, E. (1981). Categorization of natural objects. *Annual Review of Psychology, 32*, 89-116.

Murphy, G. L. (2002). *The big book of concepts.* MIT Press.

Nosofsky, R. M. (1986). Attention, similarity, and the identification-categorization relationship. *Journal of Experimental Psychology: General, 115,* 39-57.

Nosofsky, R. M. (1992) Similarity scaling and cognitive process models. *Annual Review of Psychology, 43*, 25-53 1992

Posner, M. I., & Keele, S. W. (1968). On the genesis of abstract ideas. *Journal of Experimental Psychology, 77*, 353-363.,

Quinn, P. C., Eimas, P. D., & Rosenkrantz, S. L. (1993). Evidence for representations of perceptually similar natural categories by 3-month-old and 4-month-old infants. *Perception, 22*, 463-475.

Rosch, E., & Mervis, C. B. (1975). Family resemblance: Studies in the internal structure of categories. *Cognitive Psychology, 7,* 573-605.

Sloutsky, V. M. (2003). The role of similarity in the development of categorization. *Trends in Cognitive Sciences, 7*, 246-251.

Smith, E. E., & Medin, D, L. (1981). *Categories and concepts*. Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1986/1934). *Thought and language*. MIT Press.

Younger, B. (1993). Understanding category members as "the same sort of thing": Explicit categorization in ten-month infants. *Child Development, 64*, 309-320.