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Different kinds of concepts and different kinds of words: What words do for human cognition

Sandra R. Waxman

Northwestern University

Susan A. Gelman

University of Michigan

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Introduction

This book addresses the nature of concepts. A consideration of human concepts is incomplete without also considering language. Language is a fundamental human capacity, one that permits us to express our own concepts and to influence the concepts of others. Although humans and non-humans alike can form categories in the absence of language, there is nonetheless a crucial role for words in human conceptual development (see Gelman and Kalish 2006; Waxman and Lidz 2006; Woodward and Markman 1998 for recent reviews). We will argue that throughout human development, words are intimately linked with conceptual representations and permit us to transcend categories and concepts that are supported by immediate perceptual experiences. Even before infants produce their first words, their representations of objects and events are influenced by the words that they hear. With development, the influence of words becomes increasingly powerful and precise. Thus, we argue for strong developmental continuities in the powerful and uniquely human relation between words and concepts; we also underscore that throughout human development, decisions about categorization and naming are affected by a host of considerations that do not correlate in any simple way with perceptual properties.

Concepts, words, and development

The chapter is also motivated by our concern about the treatment of the constructs **concept**, **word,** and **development**. The depth and subtlety underlying each of these key constructs is often overlooked in current discussions. Consider first **concept**. The human mind is

remarkable for its flexibility. We can construe any particular scene, or any element within a scene, in a number of different ways, depending upon the perspective that we adopt at the moment and the task at hand. The human mind, including the minds of infants and young children, represents a rich range of concepts, ranging from distinct individuals (e.g., Fido) to categories and kinds. Our concepts include abstractions over individual objects (e.g., dog, animal), events (e.g., pushing, thinking), and properties (e.g., fluffy, mischievous). We represent concepts that can be derived from immediate perceptual experience (fluffy, cold), as well as concepts that relate to more complex internal emotional states (happy, mad) and abstract ideas (causation, animacy). Moreover, not all concepts are 'created equal': natural kind concepts that have been encoded in language (e.g., dogs, trees) are likely very different from arbitrary groupings created for a particular research task (e.g., tall red cubes, U-shaped blocks; see Gelman and Kalish 2006; Sloutsky *et al.* 2007; Smith and Heise 1992; Vygotsky 1962; Younger 2003, this volume). Although the latter are often organized around a small set of necessary and sufficient perceptual features, decades of research document that this organizational structure is not one that characterizes some of our most foundational concepts (e.g., concepts of number, kinship relations, emotions, natural kinds, and complex artifacts), for which it is difficult, if not impossible, to identify necessary and sufficient features (Armstrong *et al.* 1983; Murphy 2000; Murphy and Medin 1985).

Consider next the construct, **word**. Words are not isolated bits of sound; they are embedded within social, symbolic, and linguistic systems. It was for this reason, among others, that research agendas from the past that used acquisition patterns of isolated consonant-vowel-consonant syllables in the lab as a basis for generalizations about language acquisition fell out of favor (Smith and Medin 1981). These tasks fell out of favor not only because they failed to

represent the diversity of word forms in human language, but also because they failed to represent the diversity of word meanings. Languages include many different kinds of words (e.g., nouns, adjectives, verbs), each of which is recruited to convey a different kind of concept (e.g., categories of objects, properties, and events, respectively).

Yet even in the current literature, most of the developmental research on words and concepts has focused on only one kind of word: nouns. Although important insights have been gained, this focus is not without costs. Chief among them is that the principles underlying the acquisition of nouns and the conceptual consequences of their use differ importantly from the principles underlying the acquisition of other grammatical forms, including adjectives and verbs, and the conceptual consequences of using these forms. In short, because 'word' is not interchangeable with 'noun', any comprehensive theory of human conceptual development will have to consider the distinct developmental trajectories and the distinct conceptual entailments of different kinds of words. Furthermore, because words are elements within a complex linguistic system, any comprehensive theory will have to consider not only words on their own but also their combinatorial power.

Third, consider the construct, **development**. Words, concepts, and the links between them evolve over the course of human development. Therefore, the fundamental developmental question is not simply whether infants or young children can represent a given concept, whether they can grasp the meaning of a given word, or whether they represent words or concepts precisely as their elders do. Instead, the developmental question is what capacities are available at the time of acquisition and how these evolve over the course of development.

Plan of the chapter

With these observations in mind, we offer a description of the problem of word learning that acknowledges the diverse range of concepts and words in the human repertoire. We then turn our focus to infants and young children, reviewing evidence bearing on the early-emerging relation between words and concepts, the conceptual power afforded by this relation, and a developmental trajectory in which an early appreciation of different kinds of words and different kinds of concepts becomes increasingly precise and powerful. We consider how this evidence bears on claims, expressed explicitly or implicitly, in recent associationist accounts of word-learning and concept development (Sloutsky 2003; Smith *et al.* 1996). Central to these latter accounts is the assertion that the processes underlying the acquisition of words and concepts are identical to those underlying the acquisition of any other kind of knowledge (including associative learning, similarity assessment, and attentional weighting) (Rakison and Lupyan 2008; Sloutsky and Fisher 2005; Smith 2000; Smith *et al.* 2003). We challenge this assertion, articulating four overlapping assumptions, which separately and together, underlie this associationist view: (1) that the word-concept link is one of pure association, (2) that a word is merely an attentional spotlight, (3) that a word is merely another feature of an object, and (4) that a word indexes only a perceptual representation. To foreshadow, we demonstrate that because these accounts fail to acknowledge the diversity and flexibility of the constructs 'word' and 'concept', and because they fail to consider fully the forces underlying human 'development', they fall far short.

The problem of word learning

To acquire a human language, infants and young children must solve the problem of word learning. Although languages differ in the particular words that they use (e.g., 'dog' vs. 'chien'), and in the syntactic relationships between these words (e.g., whether or not adjectives

vary across contexts to reflect the gender or number of the noun that they modify), there are also aspects of human language that are universal. We presume that the phenomena we will consider within this chapter are of the latter sort. Consider an infant who observes a scene in which three cats are playing in a park. The infant has the representational capacity to construe this scene and the elements comprising it in multiple ways. For example, the infant may focus on one particular cat, cats in general, a salient property (fast, furry), the activities in which they are engaged (grooming, chasing), or any of a number of other relations. Some of these construals will correspond to words in the language the infant is in the process of acquiring. For example, for an infant acquiring English, a proper noun (e.g., 'Look, it's *Tabitha*') can be applied to a specific individual; a count noun (e.g., 'Look, it's a *cat*') can be applied to a specific individual, but also applies more broadly to other members of the same object category (to other cats, but not to dogs). And if we provide an adjective ('Look, it's *fluffy*'), the meaning is again quite different. Here, we refer to a property and not the individual or category itself, and we can extend that word to other instances of that property, independent of the particular entity embodying it (e.g., to any other fluffy thing, including (some, but not all) puppies and bedroom slippers). Finally, verbs ('Look, they're *running*') refer to a relation or an activity at that moment in time, and are extended to similar activities, perhaps involving very different actors (e.g., horses, children) at different times and places. This analysis can be extended far beyond nouns, verbs, and adjectives to words that express a broad range of abstract concepts including number ('three'), spatial relations ('in'), ownership ('mine'), causal relations ('because'), hypotheticals ('if'), and so on.

There is now considerable evidence that young children appreciate this nuanced relation between different kinds of words and different kinds of concepts. Although their words and concepts may be less precise or less elaborated than those of adult speakers, and their mappings

may be less fine-tuned, children nonetheless appreciate that there are distinct kinds of words, and recruit these distinctions as they map words to meaning (Brown 1957; see Waxman and Lidz 2006 for a recent review). They interpret a novel count noun applied to a scene as referring to an object kind (Markman 1989; Waxman 1990), a novel proper noun as referring to a specific individual (Gelman and Taylor 1984; Hall and Lavin 2004; Macnamara 1984), a novel adjective as referring to a property (Klibanoff and Waxman 2000; Mintz and Gleitman 2002; Waxman and Markow 1998), and a novel verb as referring to an action or event (Fisher 2002; Waxman *et al.* 2008). Notice that this means that in assigning meaning to a novel word, young children pay attention not only to the word itself, but also to surrounding linguistic elements. For example, the distinction between a count noun (e.g., 'This is a kitty') and a proper noun (e.g., 'This is Kitty') rests with the unstressed determiner, 'a'. The distinction between a transitive (e.g., 'Anne pushes Josh') and intransitive verb ('Anne and Josh are pushing') rests upon the positions of the words in an utterance (Fisher and Song 2006; Naigles 1990). Thus, when assigning meaning to a novel word, children are exquisitely sensitive not only to the word itself, but also to its relation among other elements within the linguistic stream.

In sum, learning the meaning of a word entails more than associating a particular sound with a particular object on the basis of co-occurrence. On the contrary, a comprehensive treatment of word learning will be one that acknowledges the rather precise dance between a range of conceptual options and a variety of linguistic forms. The problem of word learning is intimately related to the problem of concept acquisition.

But how do words and concepts come together in the developing mind? To address this question, we turn to consider whether and how words influence the conceptual systems of infants and young children. Because it is beyond the scope of the current chapter to provide a

comprehensive review, we focus here on two recurrent themes. The first theme illustrates the powerful, and increasingly precise, relation between words and concepts from infancy through early childhood. The second illustrates the conceptual consequences of naming on fundamental cognitive processes, including object categorization, object individuation, and inductive inference.

Theme 1: Even in infancy, there is a powerful, and increasingly precise, relation between words and concepts.

An early link between words and concepts

In our view, there is considerable developmental continuity in the role of words in human conceptual organization. First, even before infants begin to produce words on their own, they are sensitive to a link between words and concepts. Second, as development unfolds, this initial link between words and concepts becomes increasingly precise, tuned by the infants' experience with the objects and events they encounter and the structure of the language being learned (see Gelman and Kalish 2006; Waxman and Lidz 2006 for recent reviews). Third, even in infancy, words exert a unique influence on conceptual representations, as compared to other auditory signals (Balaban and Waxman 1997; Booth and Waxman 2008; Fulkerson and Waxman 2007; Gopnik and Nazzi 2003; Graham *et al.* 1998; Keates and Graham, in press; Poulin-Dubois *et al.* 1995; Waxman and Booth 2003; Waxman and Markow 1995; Xu 2002).

Thus by two years of age, children have made significant headway on the problem of word- and concept-learning. They have discovered that there are distinct kinds of words and have established a repertoire of distinct kinds of concepts. To be sure, many concepts can be established in the absence of words; the current volume is testimony to the conceptual capacities of non-verbal non-human animals, and the same is true of preverbal infants (Younger, this

volume). However, what is distinctive among humans is the capacity to forge links between concepts and words. And this distinctive capacity is evident remarkably early; young children recruit these links as they assign meaning to novel words. But how do infants break into this system? Which links between words and concepts, if any, are available as they begin the process of lexical acquisition?

In a series of experiments conducted over a decade ago, Waxman and Markow (1995) asked whether words influence infants' ability to conceptualize an object category (e.g., animal). This research focused on infants at 12 and 13 months of age who were just beginning to produce a few words on their own. During a **familiarization phase**, an experimenter offered the infant four different toys from a given object category (e.g., four animals), one at a time, in random order. This was immediately followed by a **test phase**, in which the experimenter simultaneously presented both (1) a new member of the now-familiar category (e.g., another animal) and (2) an object from a novel category (e.g., a fruit). To discover whether words influence infants' categorization, infants were randomly assigned to one of three conditions. In all three conditions, infants heard infant-directed speech; what differed were the comments the experimenter made during familiarization (see Figure 1). Notice that at test, infants in all conditions heard precisely the same phrase ('See what I have?').

Figure 1 here

The predictions were as follows: If infants noticed the commonality among the familiarization objects, then they should reveal a preference for the novel object at test. If words highlighted the relation among these objects, then infants hearing novel words should be more

likely than those hearing no novel words to prefer the novel test object. Finally, if this link between words and concepts is general at the start, then infants in both the noun and adjective conditions should be more likely than those in the no word condition to form categories.

All of the predictions were borne out. Infants in the no-word control condition showed no preference for the novel test object, suggesting that they had not detected the category-based commonalities among these familiarization objects. In contrast, infants in both the noun and adjective conditions revealed reliable novelty preferences. This constitutes clear evidence for an early, foundational link between words and object categories. It suggests, following in the spirit of Roger Brown (1958), that words serve as **invitations** to form categories. This apparently simple invitation has dramatic consequences: Providing 12-month-olds with a common name (at this developmental moment, either a noun or an adjective) for a set of distinct objects highlighted the commonalities among them that went undetected in the absence of a novel word (in the no-word condition). Moreover, this invitation has considerable force: The novel words were present only during familiarization, but their influence extended beyond the named objects, directing infants' attention to the new—and as yet unnamed—test objects.

What is it about words?

What is the mechanism underlying this powerful invitation? We proposed that providing a shared name for a set of disparate individuals promotes infants' attention to the commonalities among them. However, it is also possible that a more general learning mechanism is at play. After all, we know that infants devote more attention to objects that have been named than those that remain unnamed (Baldwin and Markman 1989). Perhaps, then, it is simply the presence of a word that heightens infants' interest in the objects, and object categorization then comes along 'for free'. If this is the case, then infants should successfully form object categories, whether the

familiarization objects are named with the **same** or with **different** words. To test this possibility, we compared the conceptual consequences of providing either the **same** or **different** words for a set of objects, focusing on infants at 6 and 12 months (Fulkerson *et al.* 2006; Waxman and Braun 2005). When the familiarization objects (e.g., four different animals) were introduced with the **same** name, infants at both ages successfully formed object categories. This replicates Waxman and Markow (1995) and reveals a facilitative effect of naming at six months, in infants who are just beginning to identify distinct words within the stream of language. Importantly, however, when the same objects were introduced with **distinct** names, infants at both 6 and 12 months failed to form categories. Thus, by 6 months and perhaps earlier, infants not only are sensitive to the **presence** of a word, but also track carefully the **details** of that word and the entities to which it is applied. In this way, naming can support the establishment of a stable repertoire of object categories, but can also provide infants with a means of tracing the identity of individuals within these categories (see section on Object Individuation, below).

We have also asked whether the facilitative effect of naming on infants' categorization can be attributed specifically to the presence of a consistently applied **word**, or whether it might be attributed more generally to an attention-engaging function associated with any kind of auditory stimulus. Put differently, when it comes to forming object categories, are words privileged over other, non-linguistic auditory stimuli? Evidence from Waxman and Markow (1995) suggests that words are indeed privileged vis-à-vis object categorization. Recall that all infants in their foundational study heard infant-directed speech, yet only those hearing novel words within this context successfully formed categories. Several more recent studies have approached this question by comparing the effects of words to nonlinguistic stimuli, including tones, melodies, and mechanical noises produced by simple toys. Taken together, the results

point to a privileged effect of names as early as six months of age. For example, Balaban and Waxman (1997) documented that words ('…a bird!') promote object categorization, but that tones (matched precisely to the word condition in amplitude, duration, and pause length) do not. Moreover, the evidence indicates that other, more complex nonlinguistic stimuli (e.g., repetitive, nonlinguistic mouth sounds; brief melodic phrases) also fail to promote categorization (Balaban and Waxman 1997; Fulkerson and Waxman 2007; but see Gogate *et al.* 2001; Sloutsky and Lo 1999).

This is not to say that nonlinguistic stimuli cannot be presented in such a way as to facilitate the formation of object categories. On the contrary, there are circumstances in which nonlinguistic stimuli can promote object categorization. Importantly, however, they do so **only** when it is made clear to the infant that these nonlinguistic stimuli are meant to have referential status and are meant to be interpreted as object names. For example, when nonlinguistic stimuli are presented within familiar naming routines or when they are produced intentionally by an experimenter who is interacting directly with the infant and a salient object, then nonlinguistic stimuli can promote object categorization (Fulkerson 1997; Fulkerson and Haaf 2003; Namy and Waxman 1998 2000 2002; Woodward and Hoyne 1999). In contrast, when the very same kinds of sounds are presented in the absence of social, pragmatic, or linguistic cues, infants fail to interpret them as names for things and they fail to support object categorization (Balaban and Waxman 1997; Campbell and Namy 2003; Fulkerson and Haaf 2003).

Interestingly, the same is true for words. As we have pointed out, human languages are comprised of different kinds of words, each with its own conceptual, linguistic, and/or referential function(s). As we have also pointed out, infants do not interpret novel words in a vacuum, but are instead influenced powerfully by the context in which it is presented. Recall for example that

when assigning meaning to a novel word, infants and young children are exquisitely sensitive to the surrounding words, or the grammatical context, in which it is presented. If it is presented as a count noun (this is a dax), they map the word to an object category; if it is presented as a proper noun (this is dax), they map it to a distinct individual; if it is presented as a verb (John is going to dax the puppy), they map it to an event category. The observation that infants use the surrounding context to arrive at the meaning of a novel word raises a very interesting question: How do they interpret words that are presented in isolation?

While words seldom occur in isolation in naturally-occurring speech (Aslin *et al.* 1996; Brent and Siskind 2001), when they do, they rarely represent names for objects. Instead, isolated words tend to be commands (’Stop!’) or exclamations (‘Wow!’). Infants appear to be sensitive to this state-of-affairs. When novel words are presented in naming phrases (e.g., ’Look at the dax!’), infants as young as 6-12 months interpret them as names for objects and readily map them to the objects with which they occur. But when the very same words are presented in isolation (e.g., ‘Look! Dax!’), their referential status is ambiguous, and infants fail to establish this mapping (Fennell and Waxman 2008; Fennell *et al.* 2007; Fulkerson and Waxman 2007; Namy and Waxman 2000).

This finding reveals that the conceptual status of words comes not from the sound of a word itself, but rather from its role within the linguistic and social system in which it is embedded. This finding, important in its own right, also fortifies the view that infants (like adults) take into consideration more than associations alone when establishing word-meaning (see section below). After all, even in experiments in which words are presented in isolation, the presence of the novel word (’blick’) is correlated perfectly with the presence of an object. Yet this correlation alone, however perfect, is not sufficient to support the establishment of a word-object mapping (Baldwin and Markman 1989; Baldwin *et al.* 1996; Sabbagh and Baldwin 2001).

Instead, infants take into account the surrounding context and the referential status of the novel word.

In sum, infants begin the process of word learning with a broad initial link between words and commonalities among objects. Although this link initially encompasses a broad range of words (including at least nouns and adjectives), it is not so broad as to include non-linguistic sounds. This initial link between words and concepts provides infants with a means to establish a rudimentary lexicon and sets the stage for the evolution of the more precise links between different kinds of words and different kinds of concepts. Notice that it is to the learner's advantage to begin with only the most general expectations: different languages make use of different grammatical categories, and they recruit these to convey meaning in slightly different ways. A broad initial link between words and concepts enables the learner to break into the system of word learning in the first place.

Increasingly precise links between kinds of words and kinds of concepts

When and how do infants begin to build more precise links between different kinds of words and different kinds of concepts? To the best of our knowledge, the earliest evidence comes from infants at roughly 14 months of age (Booth and Waxman 2008; Waxman and Booth 2003). Booth, Waxman, and their colleagues conducted a series of studies to examine how infants interpreted novel words when the objects with which they were presented offered the possibility of more than one candidate meaning. For example, infants were introduced to sets of objects (e.g., four purple animals) that shared both category-based commonalities (e.g., animal) and property-based commonalities (e.g., color: purple things). At issue was (a) whether infants could construe this set of objects flexibly, either as members of an **object category** (e.g., animals) or as embodying an **object property** (e.g., color: purple), and (b) whether their construals were

influenced differently by different kinds of words (nouns vs. adjectives). Retaining the logic of Waxman and Markow (1995), infants at 11 and 14 months were familiarized to four distinct objects, all from the same object category (e.g., animals) and all embodying the same object property (e.g., purple). In the **test phase**, infants were required to extend the novel word they had heard during familiarization to one of two test objects: a category match (e.g., a blue horse; same category as familiarization objects, but new property) versus a property match (e.g., a purple spatula; same property as familiarization objects, but a new category). The experimenter's comments varied as a function of the infant's condition assignment. See Figure 2.

Figure 2 here

Infants' expectations regarding word meaning became increasingly precise from 11 to 14 months. At 11 months, infants displayed a broad link between word and concept. They were sensitive to both the category- and property-based commonalities, and were willing to map novel nouns and novel adjectives to either type of commonality. By 14 months, the link between words and concepts was more precise. Infants mapped novel **nouns** specifically to category-based commonalities, but not to property-based commonalities. But they continued to map novel *adjectives* broadly to either category- or property-based commonalities. Thus, by 14 months, infants acquiring English are sensitive to at least some of the relevant cues in the speech stream that distinguish nouns from adjectives (e.g., the presence of unstressed determiners and pronouns), and they recruit these distinctions actively when mapping words to meaning.

More recently, this paradigm has been adapted to examine infants' expectations for yet another kind of word -- verbs (Waxman *et al.* 2008). Once again, we maintained the same logic, but this time presented infants with a series of dynamic scenes (e.g., a man waving a balloon)

during familiarization. We constructed the test trials to ask a) whether infants could construe these scenes flexibly, noticing the consistent action (e.g., waving) as well as the consistent object (e.g., the balloon) and b) whether their construals would vary with the grammatical form of the novel word used to describe the scene. To examine the influence of language on their construals, infants were randomly assigned to a Verb, Noun, or No Word (control) condition. We reasoned that if infants have specific expectations for both verbs and nouns, then they should map words from these grammatical categories differently, mapping nouns specifically to object categories and verbs specifically to event categories. The results were straightforward. By 24 months, infants mapped nouns specifically to the participant objects, and not to the actions in which they were engaged at the time of naming. Perhaps more provocatively, the results revealed for the first time that infants map verbs specifically to the categories of events, and not to the participant objects that were present at the time of naming (Waxman *et al.* 2008).

Taken together, these results support the claim that (1) infants begin the task of word-learning equipped with a broad expectation that links novel words (independent of their grammatical form) to a broad range of commonalities, (2) this initially general expectation gives way to a more specific set of expectations, linking **particular** kinds of words (e.g., nouns, adjectives, verbs) to **particular** kinds of concepts (concepts of objects, properties, and actions), and (3) these more specific links do not all emerge concurrently. Instead, infants appear to tease apart first the grammatical form **noun** and map this form specifically to object categories. This noun-category link sets the stage for the evolution of more specific expectations linking adjectives and verbs to their respective meanings.

Thus, words influence infants' construals of the objects and events that they observe, and in the second year of life, the links between kinds of words and kinds of concepts become

increasingly precise. These distinct links between kinds of words and kinds of concepts support our capacity to move flexibly and nimbly among various construals. In addition, naming permits us to consider the perceptible commonalities that we can observe firsthand, but at the same time to move beyond these to consider the deeper, perhaps hidden commonalities that characterize some of our most fundamental concepts (see Diesendruck 2003; Diesendruck *et al.* 1998; Gelman and Kalish 2006; Waxman *et al.* 1997). We turn to these issues next.

Theme 2: Words have conceptual consequences beyond categorization; they support individuation, inductive inference, and causal reasoning.

When young children acquire novel words, they acquire more than names for things. Word learning engages and supports some of the most fundamental logical and conceptual capacities of the human mind, including the processes of object individuation, inductive inference, and reasoning about causal and non-obvious properties.

Object individuation

Object individuation, or the ability to track the identity of distinct individuals over time and place, is a fundamental conceptual and logical capacity (Macnamara 1986). It permits us to know whether, for example, the kitten we see now is the same kitten we saw previously, or whether they are two different individuals. Under certain experimental conditions, infants have difficulty tracking the identity of two distinct objects (Xu and Carey 1996). But when each of the objects is labeled with a distinct count noun label, babies successfully track these as distinct individuals (Van de Walle *et al.* 2000; Wilcox and Baillargeon 1998; Xu 1999; Xu and Carey 1996). Apparently, providing distinct names for distinct objects not only fails to promote categorization (Keates and Graham in press; Waxman and Braun 2005); it highlights their

uniqueness (rather than their commonalities) and supports very young infants' ability to trace their identity over time.

Inductive inference

A chief function of categories is to support inductive reasoning (Murphy 2002; Smith and Medin 1981). Induction is the capacity to extend knowledge to novel instances, for example, inferring that a newly encountered mushroom is poisonous on the basis of past encounters with other poisonous mushrooms. All organisms use categories as a structure for forming inductive inferences. Detecting food, enemies, or prey all require responding to new and perceptibly distinct items as if they were comparable to previously viewed items, and drawing appropriate inferences accordingly. One of the most central, accessible, and predictive cues to membership in an object category is perceptual similarity. However, when they are provided with names for things, children do not rely on similarity alone to make category judgments. Below we discuss how words play an important role in the sorts of inductive inferences that children make.

The world is filled with objects for which appearances can be deceiving. These may be the result of evolutionary processes (e.g., a legless lizard resembles a snake more than it resembles a typical lizard) or the product of human ingenuity (e.g., a sponge can be painted to resemble a chunk of granite). In either case, a recurring issue facing infants, children, and adults alike is how to reason when there is a conflict between category membership (what a thing is) and perceptual similarity (what a thing is like) (Flavell *et al.* 1983; Malt 1994). A clear pattern of developmental evidence has emerged from research on this topic conducted over the past 20 years. Young children, like adults, use category membership as a basis for inductive inference even when it conflicts with perceptual similarity. When faced with such conflicts, words provide critical cues to category membership.

Figure 1 (from Gelman and Markman 1986 1987) illustrates this point. The leaf-insect and the leaf are overall more similar: both are large, green, with striped markings on the back, and share overall shape. Children are highly attentive to these similarities, and when asked to sort pictures in the absence of labeling rely heavily on perceptual features. However, if each item is given a label ('leaf,' 'bug,' 'bug') and asked to draw novel inferences about the leaf-insect, children more often rely on category membership as conveyed by the label. Once children learn a new fact about one member of a category, they generalize the fact to other members of that category, even if the two category members look substantially different. Children are more willing to make category-based inferences when the perceptual and category information are in accord than when they conflict—thus, children do not rely on category labels *exclusively* to guide their inferences. Nonetheless, conventional labels powerfully direct children's responses. These effects are not just due to children discounting the information in drawings, as children draw inferences to dissimilar category members even when the perceptual cues are detailed and realistic, as with three-dimensional objects and photographs (Deák and Bauer 1996; Gelman and O'Reilly 1988). These effects are also not due to a desire to comply with experimental task demands, as children use the novel labels in conversations with others who had not been present during initial labeling (Jaswal *et al.* in press).

The effect of labeling on induction holds for a range of concepts, including types of animals (bird, fish, rabbit), types of natural substances (gold, cotton), and types of social categories (male, female, smart, shy) (Cimpian *et al.* 2007; Gelman *et al.* 1986; Giles 2005; Heyman and Gelman 2000a 2000b; Hirschfeld 1996; Waxman and Shumer 2008). Hearing a novel social category given its own kind label ('She is a carrot-eater') leads to 5- and 7-year-olds to infer that the behavior is more stable and enduring than when the same category is described

otherwise, with a non-label descriptive phrase ('She eats carrots whenever she can') (Gelman and Heyman 1999; Liu *et al.* 2007). Furthermore, hearing a label for a familiar social category can lead children (8-12 years) to treat an individual's ability as more innate and less susceptible to change (Heyman in press). Labeling effects extend beyond childhood into adults (Carnaghi *et al.* 2008; Reynaert and Gelman 2007; Yamauchi 2005), including judgments about one's own characteristics (Walton and Banaji 2004) as well as those of others (Baron 2007; Diesendruck and haLevi 2006).

This appreciation that words can signal non-obvious properties seems to be in place at the very start of word learning (Gelman and Coley 1991; Jaswal and Markman 2007; Jaswal 2007; Keates and Graham in press). For example, in a series of studies, an experimenter introduces a 13-month-old infant to a target object. For half the infants, the experimenter named the target object with a novel noun; for the remaining infants, no names were provided. All infants then witnessed the experimenter perform an action with the object. Crucially, this action revealed a property of the object that was not available by visual inspection alone (e.g., that it made a particular noise when shaken). Infants were then provided with an opportunity to explore a series of other objects. The results were striking. Infants who had heard no name generalized the hidden property narrowly, trying to elicit it only with test objects that strongly resembled the target object. But infants who heard the target labeled with a novel noun revealed a very different pattern. They now generalized the 'hidden' property more broadly to include other members of the object category, even those that did not bear a strong a perceptual resemblance to the target object (Booth and Waxman 2002a; Gopnik and Sobel 2000; Graham *et al.* 2004; Jaswal and Markman 2007; Nazzi and Gopnik 2001; Welder and Graham 2001).

By four years of age, children display subtlety and flexibility regarding when they do and do not make category-based inductive inferences (Gelman 2003). They do not use a simple matching strategy, in which they extend properties only when two items share identical labels. For example, items that receive a common adjective label do not show the naming effect; the shared label must be kind-referring (Gelman and Coley 1991). The effect emerges not only with familiar labels, although not uniformly with all labels. For example, children do not use novel labels as the basis for induction when the labels fail to capture a perceptually coherent set (Davidson and Gelman 1990; Gelman and Waxman 2007; Sloutsky *et al.* 2007). These results reveal that children assess the extent to which entities are members of the same category (often conveyed via a label or phrase, though not necessarily), and independently assess the extent to which the property in question is a relatively enduring (versus temporary or accidental) feature (but see Sloutsky 2003, for debate). Category-based induction results only when the entities belong to a category and the property is relatively enduring.

Importantly, labels do not exert their effects from simple association with an object, as speaker cues regarding communicative intent powerfully influence whether or not a child makes use of the label. Jaswal (2004) showed preschool children (3 and 4 years of age) anomalous category instances (a cat that looked like a dog) and asked them to make various inductive inferences (e.g., would it drink milk or eat bones?). As others have found, labeling the items greatly reduced children's reliance on perceptual similarity (e.g., without labels, children typically reported that the cat-like animal would drink milk, but when it was labeled as 'a dog' then they typically reported that it would eat bones). What is most significant for present purposes, however, is that children's use of the label was powerfully affected by whether the label appeared to be applied intentionally or not. When the experimenter prefaced the label with

an additional phrase that clarified that the label was certainly intentional and not merely a slip of the tongue ('You're not going to believe this, but this is actually a dog'), they were much more likely to make use of the label in drawing inductive inferences.

Causal and non-obvious properties

Young preschoolers extend novel words on the basis of causal powers more than outward properties (Gopnik and Sobel 2000). For example, if a red cylinder ('a blicket') causes a machine to light up, then children report that another 'blicket' is more likely to be a blue cube that causes the machine to light up, than a red cylinder that does not cause the machine to light up (see also Legare *et al.* 2008). Similarly, by 7-9 years of age, children treat causal features as more central for novel word extensions. In one set of studies, children learned descriptions of novel animals, in which one feature caused two other features. When asked to determine which test item was more likely to be an example of the animal they had learned, children preferred an animal with a cause feature and an effect feature rather than an animal with two effect features (Ahn *et al.* 2000). These findings provide support for a 'causal status hypothesis' (Ahn 1998; Rehder 2003; Gelman and Kalish 1993), according to which causal features are more central than effect features, in both labeling and conceptual reasoning.

Children also privilege internal, non-obvious properties in their word extensions. By four or five years of age, children often recognize that an animal cannot be transformed into another kind of thing (for example, the word 'skunk' cannot be applied to an object that was originally 'a raccoon', even if the animal is transformed to look just like a skunk). Instead, labels are applied stably, despite striking transformations and perceptual change (Keil 1989; Gelman and Wellman 1991). When children learn a new category label, they are especially likely to learn the word when told that instances with the same label share non-obvious, internal features as contrasted to

superficial features (Diesendruck *et al.* 1998). This finding is culturally general, appearing not only among middle-class children in the U.S., but also in middle-class and Favela-dwelling children in Brazil (Diesendruck 2001). Functional features are also central in children's early word extensions (Booth and Waxman 2002b; Kemler Nelson 1999; Ware and Booth 2007).

This finding highlights another important way in which words permit humans to transcend what is available in their perceptual world. Words permit us to retain and sustain our flexible representations, highlighting different construals or perspectives depending upon the task at hand. Other animals have concepts. None has our flexibility and ease of alternative representations. Language is essential not only in permitting these various construals, but in sustaining them. Using a word can shift the hearer's attention or perspective, or make less salient relations more accessible.

Taken together, the research we have described converges on the view that although human and non-human animals share the capacity to form categories in the absence of language, there is nonetheless a crucial role for words in human conceptual development (see Gelman and Kalish 2006; Waxman and Lidz 2006; Woodward and Markman 1998 for recent reviews). We have interpreted this work as evidence that throughout human development, words are more than isolated entities that are somehow attached to particular objects or events. Instead, we have suggested that words, embedded within human linguistic and social systems, are intimately linked with our conceptual representations and permit us to transcend categories and concepts that are supported by immediate perceptual experiences. This interpretation, however, is not uncontroversial.

Simple attentional mechanisms?

We now consider the implications of this evidence for a family of approaches that share a commitment to the view that word and concept acquisition can be accounted for fully on the basis of simple attentional mechanisms (Sloutsky 2003; Smith 2000). Following in the empiricist tradition, this family of approaches makes several assumptions: that the raw materials for word-meanings and concepts are built up from sensory experiences, that these experiences are operated upon by means of general-purpose processes (including associative learning, similarity assessment, and attentional weighting), and that these processes can account fully for the acquisition of words and concepts. We have argued for a different view. Although we acknowledge the benefits of trying to account for complex mental representations with a minimum of conceptual architecture, and although we acknowledge that general learning principles, sensory experiences, and correlational structure within the environment are certainly at play in the acquisition of words and concepts, we assert that these cannot provide a complete account for the acquisition of words and concepts. In short, they are insufficient because they fail to acknowledge the contribution of abstract conceptual information in words and concepts throughout development, and because they fail to acknowledge the diversity in the kinds of words and kinds of concepts that are the hallmarks of human cognition.

Below we briefly review four interrelated assumptions found in associative and similarity approaches, and evaluate them in light of the evidence presented in the previous sections. To foreshadow, we will demonstrate that each assumption, though appealing in its own way, falls short because it uses too blunt a tool when considering the notions of ’word’, ‘concept’, and ‘development’.

Assumption # 1: The word-concept link is one of pure association.

One of the key debates in the field of non-human primate communication is whether the symbols that apes acquire are truly symbolic. The question can be rephrased as: is a sign merely **associated with** a given environmental cue, or does the sign **refer**? The debate rests on the assumption that human signs do refer (Saussure 1966), and is concerned with whether or not this referential capacity extends to apes—with arguments on either side (e.g., Gardner, Gardner, and Nichols 1989; Matsuzawa 2003; Pinker and Bloom 1990; Savage-Rumbaugh 1993; Seidenberg and Petitto 1979; Terrace 1979). Ironically, the debate now is no longer only about apes, but also about human children. Within developmental research, there are strong assertions that word learning requires nothing more and nothing less than establishing an association between a word and a perceptual/sensory experience (Samuelson and Smith 1999; Sloutsky 2003: Smith 2000). However, there are also strong reasons to doubt that this is the case.

Importance of social and interpersonal cues. The process of word-learning is steeped in subtle social and interpersonal information exchange. Hearing a word in the context of an object does not automatically or promiscuously connect that word with the object, as should be the case if word-learning were based on associative processes alone. In seeking to establish the meaning of a novel word, children consider the gaze of the speaker (Baldwin 1995), the extent to which the speaker's behavior seems intentional versus accidental (Akhtar and Tomasello 2000; Carpenter *et al.* 1998; Jaswal 2004), the speaker's degree of certainty (Sabbagh and Baldwin 2001), the trustworthiness of the speaker (Koenig *et al.* 2004; Koenig and Echols 2003), etc. That these links require more than associative mappings can be seen in children with autism, who have difficulty gauging social implications. They correspondingly have difficulty with these mappings (Baron-Cohen *et al.* 1997; Tager-Flusberg 2000), but not with establishing other kinds of associations. Similar conclusions can be drawn from the research with human infants.

Words are interpreted as 'names for things' only if they are embedded within a social, linguistic, or symbolic system (Fennell *et al.* 2007; Namy and Waxman 2000; Woodward and Hoyne 1999). Strikingly, when words are presented in isolation, infants do not form associations between them and the objects with which they are introduced. It is only when they are embedded within a linguistic or social context that clarifies their referential status that infants interpret words as names for things. The same is true for non-linguistic elements (e.g., tones, melodies, squeaks). Presented on their own, infants do not tend to establish associations to objects or to events. Yet when they are presented within a context that clarifies that they are intended as names for things, infants can, under certain circumstances, establish this connection. These effects illustrate the limitations of a simple associative account for word and concept learning.

Words link to mental representations--not to environmental features. An experiment conducted by Preissler and Carey (2004; Preissler and Bloom 2007) illustrates quite concretely the pitfalls of associationist models of word-learning. Eighteen- and 24-month-old infants saw an experimenter point to a photograph of a whisk, and learned a word for this novel entity ('whisk'). Importantly, when given a choice of extending the novel word to a new photograph of another whisk, or to an actual 3-dimensional whisk, children preferred the object as referent. They understood something subtle about naming and reference: a word is mapped to a representation (i.e., a concept), and not merely to a perceptual impression (see also Ganea *et al.* 2008).

A very different illustration of this point comes from the example we offered in the Introduction: a host of different kinds of words may be correctly applied to the very same scene (e.g., cats playing in the park). Infants construe the scene differently, depending not only upon the presence of a word, but importantly upon the kind of word presented and its position among

other linguistic elements. More generally, the point is this: words cannot link solely to environmental features, because human concepts include both sensory-based and abstract entities that extend beyond perceptible features. This point will be developed further under Assumption #4, below.

Certain kinds of words, including generic nouns, cannot be learned by association alone. Word *use* (in both children's speech and adults' child-directed speech) extends beyond simply supplying a label when a referent appears. Adults use labels to refer to absent things, and children readily interpret such expressions (Baldwin 1991; Ganea *et al.* 2007; Saylor and Baldwin 2004). Likewise, children and adults frequently use nouns to refer to abstract **kinds** of things—for example, 'dogs' in the sentence 'Dogs are 4-legged'. These expressions, known as generic noun phrases (Carlson and Pelletier 1995; Gelman 2004), emerge in children's speech by about 2-1/2 years of age in English– which is the earliest that English-speakers have productive control over the morphological devices required for their expression (plurals, articles, tense) (Gelman *et al.* 2008). By preschool age, children understand the semantic implications of generics as kind-referring (Gelman and Raman 2003; Cimpian and Markman 2008), as extending beyond current context (Gelman and Bloom 2007), and as expressing stable and important properties (Hollander *et al.* in press; Graham and Chambers 2005). When preschoolers learn a novel label and are asked to extend that label to new instances, generics draw children's attention toward the critical feature mentioned even when it competes with similarity (Hollander *et al.* in press). Likewise, when children learn a novel word introduced generically rather than specifically, they are more likely to extend the word to a taxonomic match (e.g., apple to banana) than to a shape match (e.g., apple to baseball (Tare and Gelman 2008)). When asked to make comparison judgments (noting either similarities or differences), presenting the items in generic

form (’Can you tell me some things that are (the same) (different) about dogs and cats?’) leads preschool children and adults to deeper, less obvious comparisons than when the items are presented in specific form (’Can you tell me some things that are (the same) (different) about this dog and this cat?’; Gelman *et al.* 2008).

The associationist model might suggest that generics are acquired by learning a limited set of forms that are associated or correlated with generic meaning in the input. Such a model was proposed by Smith, Jones, and Landau (1996) to account for how count vs. mass nouns are learned. If this model accounts for the acquisition of generics, we should expect a gradual process, by which children slowly learn to map generic meaning onto each of a variety of particular forms. For example, children might first acquire the most common form, and only later acquire less common forms. However, this description does not match the developmental facts: (a) generic referents are not observable, (b) the linguistic contexts associated with generic noun phrases vary widely, and (c) generic noun phrases have no morphological marker in some languages (e.g., Mandarin, Quechua). An associative model runs into difficulty accounting for the ease with which children acquire generic noun phrases.

Associationist models are unconstrained. How is it that children acquire a basic set of concepts in a fairly regular way, across wide variations in experience, without gross deviations? The general answer, on an empiricist view, is that the structure of the input is responsible, and that basic conceptual distinctions can be recovered from low-level features of input. But it is also clear that among the myriad associations that are present in the environment, only certain associations among them, or links between words and concepts, will be detected readily; others may not be extracted at all (Booth and Waxman 2008; Keil 1981; Quine 1960). Of all the possible correlations available in the input, why is it that some concepts emerge early in

development and reliably across input conditions, while others do not? Why is it that some concepts are difficult to acquire or resistant to evidence from the environment? The most parsimonious answer to this question is that in addition to the structure in the input, there is also structure in the mind of the learner (Chomsky 1959; R. Gelman and Williams 1998; S. Gelman and Kalish 2006; Waxman and Lidz 2006). The acquisition of some concepts is guided not only by what is available in the input but also what is available in the mind.

Assumption # 2: A word is an attentional spotlight, nothing more.

Some researchers have proposed that words focus infants' and children's attention on objects, and that the facilitative effect of words on categorization and induction comes along for free, merely as a by-product of this heightened attention (see Waxman and Braun (2005) for a fuller articulation of this assumption and its shortcomings). Here we focus on three distinct, but interrelated, pitfalls of this assumption.

Words presented in isolation do not lead to concept formation. If words acted strictly as attentional spotlights, then words presented alone would promote concept formation. There is considerable evidence documenting that this is not the case (as reviewed earlier: Fennell and Waxman 2008; Fennell *et al.* 2007; Namy and Waxman 2000).

Not all input serves equally to spotlight attention. If a word is an attentional spotlight, then any attention-enhancing stimulus (e.g., tone, gesture, etc.) should serve as a spotlight as well. This is not the case. . For example, as reviewed earlier, both words and tones augment infants' attention to objects, but only words serve as invitations to form categories of objects (Balaban and Waxman 1997; Fulkerson and Waxman 2007). In addition, many other non-linguistic elements (tone, gesture, squeak) are attention-enhancing, yet they do not serve as invitations to form object categories. Instead, if such stimuli are to evoke a categorization

response, they must be presented within a social or linguistic context that somehow conveys their referential status (Namy and Waxman 2000; Woodward and Hoyne 1999).

Not all words are equal; not all concepts are equal. If words were no more than attentional spotlights, then whether the same or different words were applied to a distinct set of objects, these should promote categorization. But this is not the case. Applying the same noun to a set of objects highlights commonalities among them and promotes object categorization; applying a different noun to each object has a very different effect, highlighting distinctions among them and promoting object individuation (Waxman and Braun 2005; Xu *et al.* 2005).

Moreover, the metaphor of word-as-attentional-spotlight is too diffuse because from the beginning of word-learning, different words highlight different kinds of categories. As we have seen earlier, nouns spotlight categories of objects (e.g., animal) but not properties of objects (e.g., fuzzy) (Booth and Waxman in press; Waxman and Markow 1998), or the actions in which they are engaged (Waxman *et al.* 2008). Verbs spotlight event categories and not object categories, etc. Words do not function as a general spotlight.

Assumption # 3: A word is merely another feature.

Another closely related assumption is that words are simply one more perceptual feature that items can share. So, for example, if two entities are both called 'birds', they become more perceptually similar, because they share a verbal feature in addition to their visual features (Sloutsky and Fisher 2004). This increase in perceptual (verbal plus visual) similarity leads children to treat the instances as more alike. We do not doubt that sharing a common label highlights commonalities among objects. This observation was made over 40 years ago (Rossman and Goss 1951). What we doubt is that the common label is nothing more than another feature in an undifferentiated similarity space (Sloutsky 2003; Smith *et al.* 1996). Here, we

focus on three classes of evidence that reveal that words are more than 'just another feature' attached to an object: (1) Words are distinctive, and influence categorization and judgments more than (and differently from) other features. (2) Different kinds of words (and different uses of words) yield different kinds of effects, none of which could be predicted on the 'just another feature' account. (3) The effects of wording are graded, not absolute. We discuss each of these points below.

Words are distinctive. One serious problem with the word-as-feature account is that it cannot distinguish words from any other kind of associated auditory cues (e.g., tones). On the 'words-are-just-another-feature' account, the introduction of any additional shared feature should have the same effect on categorization and inductive inference. But it does not. As noted earlier, tones do not consistently yield the same effects as words (Balaban and Waxman 1997; Fulkerson and Waxman 2007).

Perhaps in an attempt to circumvent this concern, Sloutsky has argued that words are, in some sense, a 'super feature': on his view, auditory features override visual features in children's processing. This is an exceedingly tricky claim, as it is not clear how one could adequately calibrate the strength of the two dimensions (auditory, visual), and without such a calibration, it is impossible to deliver on any claim that is predicated on pitting one against the other for salience. Moreover, even if such a calibration were possible, we cannot assume that the calibration derived at one time persists across contexts. To take just one example, it is reasonable to assume that when infants first hear a new word, sound, or linguistic construction, isolating and identifying this unit in fluent speech may be difficult, and may deplete attentional resources for other tasks, including inspection of the visual input. But eventually, as this auditory unit becomes more familiar, identifying it should require less attention. Put differently, attentional demands do

not operate as steady states, but are instead responsive to momentary environmental contingencies.

Different kinds of words (and different uses of words) have different kinds of effects. Most crucially, where the 'words-as-features' view falls short is in failing to differentiate among different kinds of words. If words were nothing more or less than simple attentional cues, then different kinds of words should nonetheless exert the same sorts of effects on infants' and young children's construals. Yet as reviewed earlier, children notice different kinds of commonalities and render different sorts of inductive inferences, depending on whether a word is introduced as a count noun, proper noun, mass noun, adjective, preposition, or verb (Bloom 2000; Gelman and Coley 1991; Gelman and Markman 1986; Waxman and Lidz 2006). Moreover, as also noted earlier, words fail to exert effects unless they are presented in a linguistic context and have referential status. In short, children's sensitivity to different word types makes clear that children are not simply treating an auditory cue as a featural similarity.

In contrast, we propose that children interpret auditory cues as the referential signals they are intended to be. In this framework, children treat different words as referring to different kinds of concepts (e.g., count nouns label taxonomic kinds; proper nouns label individuals), and these concepts mediate children's judgments.

Assumption # 4: A word indexes a perceptual representation, nothing more.

A fourth assertion offered within associationist accounts is that young children's concepts, and the words they use to describe them, are grounded exclusively in perception: '[Y]oung children's naming of objects is principally a matter of mapping words to selected perceptual properties.' (Smith *et al.* 1996, p. 144). Although we certainly agree that perceptual features are important in the concepts held by humans and non-humans alike, we take issue with

the claim that in human concepts, perceptual features are primary. Instead, many human concepts seem to possess two distinct though interrelated levels: the level of observable reality and the level of explanation and cause. It is an open question whether non-humans represent this second level as well (e.g., Povinelli 2000). But certainly for humans, this two-tier structure has the capacity to motivate further development, by leading children to consider and develop deeper understandings (Wellman and Gelman 1998). The ability to consider contrasting representations is a powerful capacity that may lead children to new insights (see also Inhelder and Piaget 1958).

Hidden features have conceptual consequences. On the words-as-perceptual-cues account, if two response items are equated for perceptual similarity with the target, but in addition, one has a conceptual, hidden commonality, then naming should not lead the child to prefer one over the other, because words map to perceptual features alone. This prediction does not fare well in the face of the evidence. For example, for infants and toddlers, providing a shared label for two distinct objects leads infants and young children to expect that despite the perceptual distance between them, those objects are members of the same the category and as such, will share non-obvious features (Booth *et al.* 2005; Gelman and Markman 1987; Keates and Graham in press; Jaswal 2004; Waxman and Shumer 2008).

Moreover, many human concepts are abstract and extend beyond perceptible features of the environment: both sophisticated concepts (e.g., 'justice', 'communism') and basic, early-acquired concepts ('mine', 'good', 'cause'). As reviewed earlier, a wealth of findings indicates that children treat words as indicating a deeper set of properties (Gelman and Markman 1986; Gopnik and Sobel 2000; Graham *et al.* 2004; Gelman and Heyman 1999; Mandler 2004; Walton and Banaji 2004; Yamauchi 2005).

The problem of context-sensitivity. A further problem with the words-map-onto-percepts-only view is that any position that relies solely on similarity-based processing will have difficulty accounting for context-sensitivity. Children's concepts and word learning are notable for the context-sensitive, selective use of similarity. Preschool-aged children realize that although a person and a toy monkey look alike, they are unlikely to share internal properties; they also understand that although a worm and a person look different, they are likely to share insides (Carey 1985; Gelman 2003; Keil 1989). Simple attention to correlated attributes is not sufficient to account for these expectations. For example, 3- and 4-year-olds predict that a wooden pillow will be hard rather than soft, even though all the pillows children have previously encountered have been soft (Kalish and Gelman 1992). Likewise, 2- to 4-year-old children are more likely to use perceptual similarity cues when similarity corresponds to function (McCarrell and Callanan 1995; Ware and Booth 2007). For example, after looking at pictures of two creatures that differed only in eye size and leg length, children were invited to make an inference concerning sight ('Which one sees really well in the dark?') or movement ('Which one can jump really high?'). Children attended selectively to different perceptual features depending on the particular function (eyes, when the question concerned sight; legs, when the question concerned movement). Giles and Heyman (2004) found that preschool children judged the same behavior differently depending on the category of the individual involved. For example, if a girl (vs. boy vs. dog) spills a child's milk, the implications differ accordingly, in how this is explained. These examples of selectivity would seem more readily explained as an instance of causal reasoning than as a reflection of attentional weights.

Conclusions

In this chapter we have argued that words and concepts are intriquitely intertwined throughout human development, and that the link between them has important conceptual consequences, motivating us to move beyond the information immediately available to us by virtue of our perceptual experiences. We have summarized current theoretical views and empirical evidence attesting to power and complexity of these links between words and concepts, and have argued against the view that simple attentional mechanisms can account fully for the acquisition of words and concepts. We have also pointed out that sweeping claims about words and concepts need to be tempered by careful consideration of the kind of concept and the kind of linguistic expression that is recruited to capture it. Yet, we have noted that at their core, most approaches espousing a simple attentional view tend to treat 'word', 'concept', and 'development' as unanalyzed units. This is a shortcoming: Concepts that the human mind deals with are more complicated, subtle, flexible and diverse; the words that comprise the languages of the world support this conceptual complexity, subtlety, flexibility and diversity.

One major open question concerns what if anything is unique about human concepts. Here it is interesting to consider that non-human primates have full access to the broad attentional mechanisms considered earlier--including the capacity to note similarity and to track statistical features of the environment --yet only humans have a full and expressive language system. On the attentional learning view, these differences might be understood in terms of evolutionarily-based differences in which sorts of features human infants attend to (as distinct from the young of other species). For example, perhaps the human species has evolved a propensity for processing auditory information, and this propensity thereby encourages attention to language. Yet this view cannot account for the acquisition of full and expressive visuo-gestural languages. However, the model that we have proposed here -- a model in which human

learning and development are linked to mechanisms **beyond** attentional learning to include social understandings, causal reasoning, and theory-based concepts – is consistent with the acquisition underlying the full range of human language.

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Figure Captions

Figure 1. A representative set of stimuli (Waxman and Markow 1995).

Figure 2. A representative set of stimuli (Booth and Waxman 2008; Waxman and Booth 2003).

Figure 1.

Familiarization Phase		**Test Phase**
Pink duck Purple raccoon	Blue dog Orange lion	Yellow cat Red apple
Noun: See the *blicket*?	See the *blicket*?	See what I have?
Adjective: See the *blickish* one?	See the *blickish* one?	See what I have?
No Word: See here?	See here?	See what I have?

Figure 2.

Familiarization Phase		**Test Phase**	
Purple lion Purple elephant	Purple dog Purple bear	<u>Property-match</u> Purple spatula	<u>Categ –match</u> Blue horse
Noun: These are blickets. This one is a blicket and this one is a blicket.	These are blickets. This one is a blicket and this one is a blicket.	Look at these.	Can you give me the blicket?
Adjective: These are blickish. This one is blickish and this one is blickish.	These are blickish. This one is blickish and this one is blickish.	Look at these.	Can you give me the blickish one?
No Word: Look at these. Look at this one and look at this one.	Look at these. Look at this one and look at this one.	Look at these.	Can you give me one?