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Early word-learning entails reference, not merely associations

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Abstract

Recent years have witnessed a resurgence of classic tensions concerning the fundamental nature of human knowledge and the processes underlying its acquisition. This tension, especially evident in research on the acquisition of words and concepts, arises when researchers pit one type of content against another (perceptual vs. conceptual) and one type of process against another (associative vs. theory-based). But these dichotomies are false; they rest upon insufficient consideration of the structure and diversity of the words and concepts that we naturally acquire. As infants and young children establish categories and acquire words to describe them, they take advantage of *both* perceptual and conceptual information, and relate this to *both* the (rudimentary) theories they hold and the statistics that they witness.

Two different metaphors undergird recent work on early cognitive and language development. The *child-as-data-analyst* metaphor captures human infants' impressive capacity to attend to statistical regularities in their environments [1,2], and the rich sensory, perceptual, and computational resources that they bring to the task of acquisition. The *child-as-theorist* metaphor captures infants' impressive array of conceptual capacities, including core knowledge of physical objects, skeletal theories of animate objects, and a sensitivity to the distinct principles governing the behavior of each [3-7].

The basic thesis of this paper is simple: these two metaphors are not in competition. As infants and young children establish concepts and acquire words to describe them, they rely on *both* the (rudimentary) theories that they hold and the statistics that they witness [8-13]. This may seem like an uncontroversial point. However, it is not unanimously endorsed. In recent years, several researchers have argued to the contrary, asserting that word learning and conceptual development can be fully understood using the *child-as-data-analyst* model. It is thus important to identify the limitations of this view and reveal the complexity underlying the seemingly simple act of learning a word and mapping it to a concept.

Focusing exclusively on the child-as-data-analyst

As strong proponents of the *child-as-data-analyst* view, Sloutsky and his colleagues have adopted a strict associationist approach to word learning and conceptual development [14-17]. This work rests on three core assumptions: that the only building blocks for words and concepts are sensory and perceptual experiences, that these experiences are operated upon strictly by means of general-purpose processes (including associative learning, similarity assessment, and attentional weighting), and that higher-level conceptual processes are unnecessary to account for the evidence from children. This work is valuable for highlighting young children's sensitivity to perceptual information, for considering how domain-general

processes (e.g., association, feature-weighting) may operate in development, and for amplifying the aptness of the *child-as-data-analyst* metaphor. But despite claims to the contrary, it has *not* completely ruled out the *child-as-theorist* model.

Retaining a place for the child-as-theorist

In our view, capturing the processes underlying early word-learning and conceptual development requires that we also consider the *child-as-theorist*. We draw upon a rich intellectual history within psychology, linguistics, and philosophy [see 8,9,18 for reviews]. Our account reflects more than an empirical disagreement. More importantly, it reflects a fundamentally different set of assumptions concerning *words*, *concepts*, and *development*. We focus on four critical points.

1. Words do not merely associate; they refer. Words are quintessentially symbolic elements.
2. Words and concepts are more than a collection of sensory/perceptual features. As children build their lexical and conceptual repertoires, they are also guided by abstract conceptual knowledge (e.g., animacy, intention, cause).
3. Words and concepts are not unitary constructs. There are different kinds of words and different kinds of concepts, and sensitivity to this variety emerges within the first years of life.
4. Words are located within intricate linguistic and social systems. Thus, a word takes its meaning not merely from its history of co-occurrence with entities in the world, but also and importantly from the linguistic and social systems in which it is embedded.

Words refer; they do not merely associate

Consider the assertion that establishing a word's meaning requires only that it be associated directly and automatically to a portion of sensory/perceptual experience. On this view, a word is nothing more than a feature of the experience(s) with which it is associated, in much the same way as a black beret is a feature of Jean Piaget [14, see also 17]. This assertion runs aground because the words of human language are more than associations. Words refer [19, 20].

What does it mean to refer? At minimum, this means that a word links to a conceptual representation that is more abstract than the entities that happen to be present in the naming context [21]. For example, "a dog" refers to an instance of the abstract concept "dog", a concept that extends beyond the individual dogs that any of us will observe in our lifetimes. By two years of age, children refer to that abstract set directly, and can do so by means of generic expressions (e.g., "Dogs have four legs") [22-26].

This crucial distinction between association and reference was illustrated concretely by Preissler and Carey [27]. An experimenter introduced 18- and 24-month-old infants to a photograph of a novel entity (a whisk) and named it ("a whisk"). Infants were then asked to extend the word -- either to another photograph of a whisk or to an actual, three-dimensional whisk. On a strictly associative account, infants should select the photograph, as it is perceptually more similar to the photograph that co-occurred with the introduction of the novel word. Instead, infants favored the three-dimensional object. This reveals that they understood something subtle and profound: Words refer to concepts, and are not tethered to their associated perceptual impressions.

Early words incorporate conceptual content: they go beyond perceptible referents

Central to a strict associationist account is the assumption that each word links to a sensory/perceptual counterpart. Yet even for words that do have perceptible referents in the context (e.g., dog, mama), word-learning cannot be characterized as simply mapping a word onto a perceptual unit. First, children expect that words map onto concepts that share a deeper set of properties than those that are available for inspection [10-12,28,29,30]. Second, words often refer to absent things (e.g., “Where’s your coat?”), and children readily interpret such expressions, even acquiring new words when their referents are absent during the naming episode [31,32]. Thus, early in development, the process of word-learning extends well beyond the paradigm case of ostensive definition.

Moreover, infants and young children acquire words for concepts that could not, in principle, be shared via ostension, words such as “mine”, “why”, “fair”, “almost”, “never” that map to abstract concepts with no concrete, real-world counterparts. Similarly, functional morphemes (e.g., articles like “a” and “the”) cannot be characterized in terms of real-world referents, but are nonetheless used felicitously by young children. Finally, there are many words that do have real-world referents, but whose meaning nonetheless cannot be gleaned from observation alone. Consider, for example, a scene in which a dog is running rapidly behind a cat. This scene equally represents the concepts *chase* and *flee*; mapping a word onto this scene depends not on a link between a word and the context, but rather crucially on the link between the word and its arguments (e.g., “The cat is X-ing the dog” vs. “The dog is X-ing the cat”) [12].

A strict associationist account thus considers only a subset of the words that children naturally acquire and a subset of the learning contexts that support word-learning. At best, this account would need to posit two distinct processes: one for words that have perceptible referents (and could therefore, in principle, be acquired via ostension), and another for words that do not.

This two-step process lacks the parsimony to which associationist accounts aspire, but without it, the theory lacks both descriptive and explanatory force.

Words and concepts are not unitary constructs

Some associationist accounts have suggested that words are attentional spotlights, highlighting referents in the context of word-learning. On this view, a word is an increment of sound that is added to a previously silent context. Notable here is the assumption that “word” is a precise unit of analysis, and that all words function alike, drawing children’s attention to the sensory/perceptual experience available at the moment. But this assumption runs into serious difficulty because even before infants can produce grammatical sentences, they distinguish among different *kinds* of words, and expect that each is linked to a different kind of *concept*.

What do we mean by ‘different kinds’ of words? At minimum, we refer to distinct grammatical forms (e.g., nouns, adjectives, verbs) and their various subtypes (e.g., proper vs. common nouns; transitive vs. intransitive verbs). A fundamental property of human language is that each grammatical form picks out a distinctly different aspect of experience. This diversity of words and their candidate concepts undermines the claim that words act uniformly as ‘attentional spotlights’. Moreover, infants appreciate this fundamental property: they expect that each kind of word highlights a different aspect of the same scene. Consequently, when asked to extend a novel word beyond the particular entities on which it was introduced, infants do so in principled ways, guided by the grammatical form of the word. If words were nothing more than simple associates, then *any* word should exert the same kind of influence on infants’ and young children’s construals, and this is not the case (Box 1).

Infants' appreciation of different kinds of words is relevant not only to the establishment of meaning but also to the role of words in reasoning. The inferences that children make about any given individual depend not only on the grammatical form with which it was introduced [9,33,34] but also on the kind of concept expressed [28,35]. For example, when 2-year-olds were introduced to the very same word ("a dax") applied to the very same novel object, their interpretation was guided by their assumption about the ontological status (animate vs. inanimate) of that object [36]. In short, different kinds of words refer to different kinds of concepts, and these concepts mediate infants' and children's reasoning and their acquisition of knowledge. See Box 2.

Words participate in a complex linguistic and social system

Also missing from a strictly perceptually-based associationist account is the fact that each word participates in an exquisitely detailed linguistic, social, and symbolic system. Indeed, the meaning and conceptual power of a word derives not only from the word-form itself, or from an association between a word and a chunk of experience in the world. It also depends crucially on the relation of the word to other linguistic elements. In interpreting the meaning of a novel word, infants attend to its surrounding context, including the presence or absence of devices such as determiners (compare, "This is a blick" to "This is blick"), and the number and variety of arguments (noun phrases) (e.g., "chase" vs. "flee") [12].

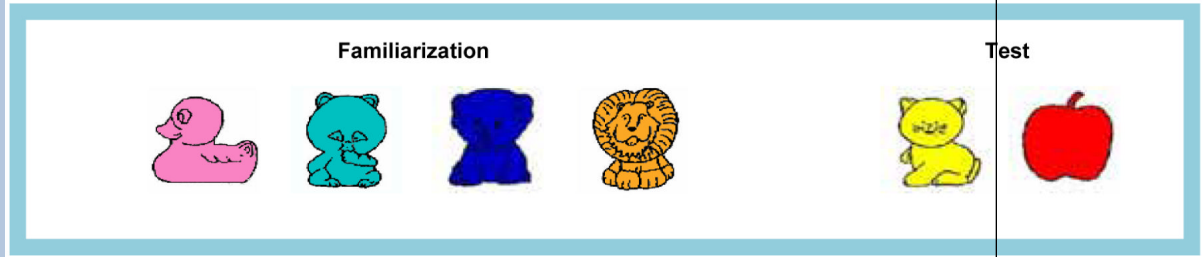
A hallmark of human language is that it is social and communicative. We are inherently a social and pedagogical species [37,]. We learn not only from direct observation but also from the thoughts and beliefs transmitted to us by others [38,39]. These reflections are directly relevant to word-learning. In seeking to establish a word's meaning, children consider a rich array of social cues, including the eye-gaze, trustworthiness, and intentionality of the speaker [32,40, 41]. Clearly, then, infants and young children do not automatically or promiscuously map a novel word that they hear to an object with which it co-occurs. Instead, even in infancy, words are interpreted as 'names for things' only when they are embedded within a linguistic or social context [20,42].

This point ties back to our concerns about the notion of words as attentional spotlights. If words were merely attentional spotlights, then many other attention-enhancing auditory stimuli ought to serve as spotlights as well, but this is not the case. Although infants are attentive to many auditory stimuli, including words presented alone ("hey!") and a host of non-linguistic elements (e.g., tones, gestures, squeaks), they link auditory stimuli such as these to concepts *only* if they are presented within a social or linguistic context that establishes their referential status [20,43,44]. See Box 1.

Conclusions

We have underscored that two metaphors -- *child-as-data-analyst* and *child-as-theorist* -- are at play in word-learning and conceptual development. As infants and young children build a repertoire of concepts and acquire words to describe them, they take advantage of both perceptual *and* conceptual information, and rely upon both the rudimentary theories that they hold *and* the statistics that they witness. Our goal in writing this paper is to emphasize that our theories of acquisition should do the same.

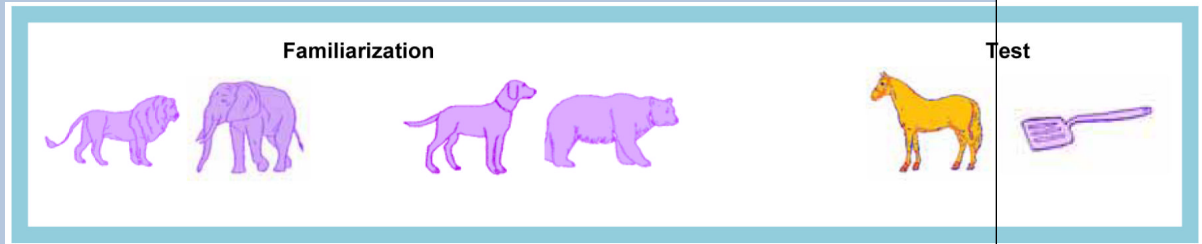
Box 1. What's in a word? Beyond signal-object association



Condition	Auditory signal	Successful Categorization
Word (consistent)	"This is a <i>toma</i> ...this is a <i>toma</i> ", etc.	Yes.
No Word	"Look at this...", etc.	No
Word (variable)	"This is a <i>toma</i> "...this is a <i>blicket</i> ", etc.	No
Melodies		No

Words exert a powerful, precise and nuanced influence on infants' behavior. Infants ranging from six to twelve months viewed a series of familiarization objects from a single category (e.g., animals), followed by two test objects (one from the same category (e.g., a cat) and another from a new category (e.g., an apple). When the familiarization objects were presented in conjunction with the same novel noun (Word condition), infants successfully categorized, exhibiting a reliable novelty-preference at test. But when precisely the same objects were presented under different auditory conditions, infants were equally attentive during familiarization, but failed to categorize during familiarization. This was the case when the familiarization objects were accompanied by infant-directed speech but no novel word (No Word condition), when each familiarization object was paired with a *different* novel word (Variable Word condition), and when the familiarization objects were paired with melodies or tones, infants failed to categorize [9,45-47].

Thus, infants are sensitive to the introduction of novel words, and expect different *kinds* of naming episodes to have distinct conceptual consequences. Providing a common noun for a set of distinct objects promotes object categorization. But providing a unique noun for each promotes object individuation.



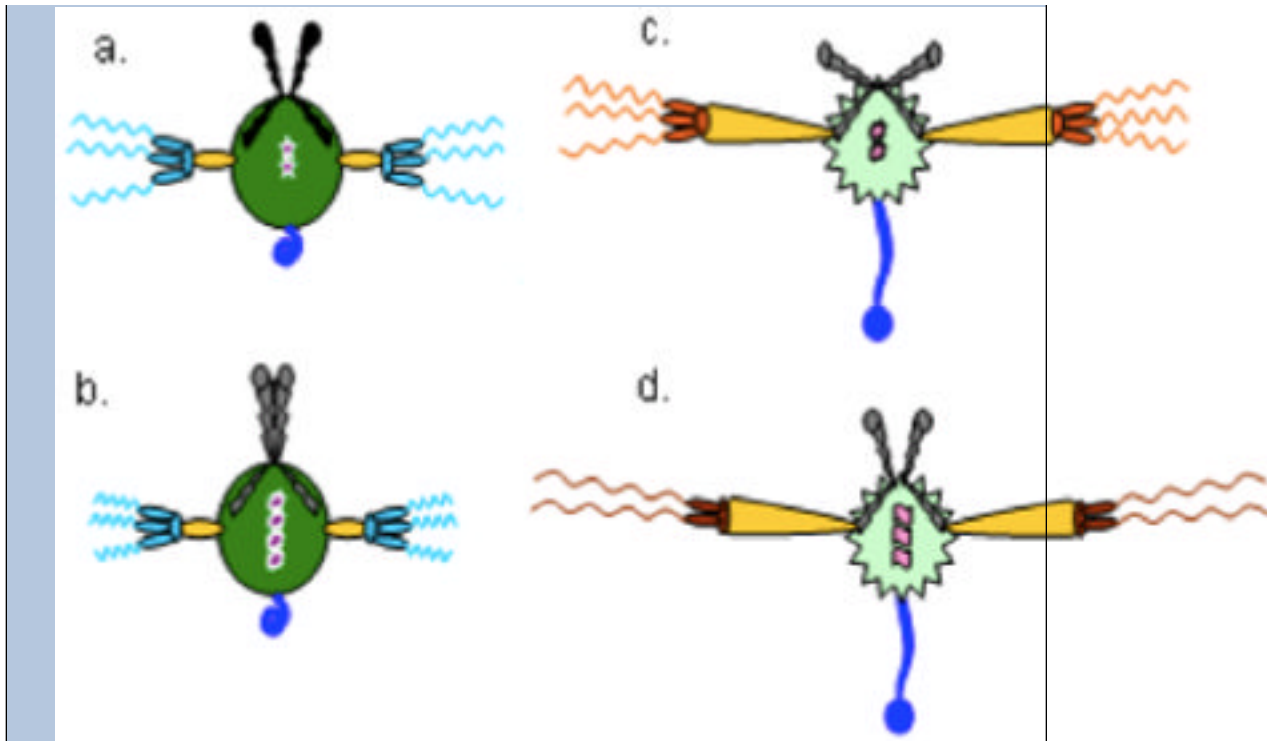
Condition	Auditory signal	Focus on shared Category or Property?
Noun	“This one is a <i>dax</i> ”, etc.	Category
Adjective	“This one is <i>dax...</i> ”, etc.	Property

Another closely-related experimental series reveals even more nuanced effects: different *kinds* of words highlight different *kinds* of commonalities. When infants were familiarized to objects sharing *both* category- and property-based commonalities, their construal of the relation depended upon the grammatical form of the word used to describe them [9,48]. Infants first mapped count nouns specifically to category-based (not property-based) commonalities (14 months); they later discovered that adjectives map specifically to property-based (not category-based) commonalities (18- to 21-months).

These nuanced effects cannot be reduced to simple word-object associations. Infants are exquisitely sensitive to distinct kinds of words, and recruit these distinctions precisely in establishing meaning. To establish meaning, infants attend not only to the novel word itself: they depend crucially upon its surrounding linguistic elements (e.g., determiners; arguments). Even in infancy, words support conceptual flexibility and engage our most fundamental logical commitments (e.g., distinct individuals; categories and kinds).

Box 2: Conceptual variety

An important feature of the human mind is the variety and flexibility of the concepts we can consider. John Stuart Mill [49] proposed a continuum, with inductively rich groupings which he dubbed *natural kinds* (e.g., “dogs”) at one end, and *arbitrary* groupings that capture a single property at the other (e.g., “white things”). Like adults, preschool children intuitively attribute greater inductive strength to natural kinds than to arbitrary categories [28]. Thus, any investigation seeking to assess the role of concepts in early cognition must consider this variety.



A recent study illustrates how the concept one chooses to study influences the conclusions one draws. Sloutsky, Kloos, and Fisher (SKF) [16] sought to examine the relative importance of conceptual and perceptual information in children's inductive inferences. An experimenter introduced children to two novel categories of bug-like animals ("ziblets" [a & c, above] and "flurps" [b & d, above]), where category membership was defined as the ratio of fingers to buttons. The experimenter provided a novel noun label for each category, taught a new fact about one of the animals, and then measured whether children extended this fact to another animal from the same category (as defined by finger:button ratio), or to another animal that was more similar in appearance. Previous work with induction tasks using familiar natural kinds (e.g., birds versus bats; girls versus boys) reveals that by 3-4 years of age, children judge conceptual similarity (membership in a shared natural kind category) as relatively more important than perceptual similarity (shared features but not shared category membership) [28]. Yet SKF reported that children were guided by perceptual similarity and not category membership. They concluded that for children, "looks are everything".

We offer a different interpretation, one that takes into account the *kind* of category under investigation. By three years, children share with adults clear intuitions about the kinds of categories that are inductively rich and the kinds of words that describe them (e.g., count nouns and generics). But SKF's ziblets and flurps are arbitrary categories: they differ in appearance by only a single arbitrary property (fingers:buttons ratio). There is considerable evidence that neither children nor adults generalize arbitrary, accidental, or temporary properties (or words referring to such properties) to other instances of a kind [50]. If the goal is to test children's reasoning about natural kinds—or any category with strong inductive potential—SKF's categories fall short.

Box: Questions for future research

1. Are the processes and consequences of word-learning continuous from infancy through adulthood?
2. How does word-learning in humans compare to the acquisition of 'words' or word-like units in non-human species? Which aspects are shared, and which appear to be unique?
3. How are human infants' earliest words and foundational concepts shaped by the particular linguistic, social, and cultural communities in which they are immersed?
4. How does associative learning contribute the acquisition of commonsense theories? To what extent is associative learning constrained by causal theories? Does the process of associative learning differ across content domains?
5. One striking symptom of autism is an impairment in language, including word-learning. These language difficulties have been linked to impairments in the interpersonal and social domain, including theory of mind. Do these language difficulties also reflect impairments in underlying associative capacities? Do they reflect impairments in appreciating the essentially symbolic and linguistic nature of words?

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REFERENCES

1. Saffran JR, et al. Statistical learning by 8-month-old infants. *Science* 1996;274:1926–1928. [PubMed: 8943209]
2. Rakison DH, Lupyan G. Developing object concepts in infancy: An associative learning perspective. *SRCD Monographs*. 2008
3. Baillargeon R. Innate ideas revisited: For a principle of persistence in infants' physical reasoning. *Perspectives on Psychological Science* 2008;3:2–13.
4. Spelke ES. Core knowledge. *American Psychologist* 2000;55:1233–1243. [PubMed: 11280937]
5. Carey, S. *The origin of concepts*. Oxford University Press; New York: in press
6. Gelman, R.; Williams, EM. Enabling constraints for cognitive development and learning: Domain specificity and epigenesis. In: Kuhn, D.; Siegler, R., editors. *Handbook of child psychology*. 4th edition. Vol. 2. Wiley; Hoboken, NJ: 1998. p. 575-630. Cognition, perception, and language
7. Wellman, HM.; Gelman, SA. Knowledge acquisition. In: Kuhn, D.; Siegler, R., editors. *Handbook of child psychology*. 4th edition. Vol. 2. Wiley; Hoboken, NJ: 1998. p. 523-573. Cognition, perception, and language
8. Gelman, SA.; Kalish, CW. Conceptual development. In: Kuhn, D.; Siegler, RS., editors. *Handbook of child psychology*. 6th ed.. Vol. 2. Wiley; Hoboken, NJ: 2006. p. 687-733. Cognition, perception, and language
9. Waxman, SR.; Lidz, JL. Early word learning. In: Kuhn, D.; Siegler, RS., editors. *Handbook of child psychology*. 6th ed.. Vol. 2. Wiley; Hoboken, NJ: 2006. p. 299-335. Cognition, perception, and language
10. Gopnik A, Sobel DM. Detectingblickets: How young children use information about novel causal powers in categorization and induction. *Child Development* 2000;71:1205–1222. [PubMed: 11108092]

11. Booth AE, Waxman SR. Deja vu all over again: re-re-visiting the conceptual status of early word learning: Comment on Smith and Samuelson (2006). *Developmental Psychology* 2006;42:1344–1346. [PubMed: 17087566]
12. Gleitman LR, Cassidy K, Papafragou A, Nappa R, Trueswell JT. Hard words. *Journal of Language Learning and Development* 2005;1:23–64.
13. Xu F, Tenenbaum JB. Sensitivity to sampling in Bayesian word learning. *Developmental Science* 2007;10:288–297. [PubMed: 17444970]
14. Sloutsky VM. The role of similarity in the development of categorization. *Trends in Cognitive Sciences* 2003;7:246–251. [PubMed: 12804690]
15. Sloutsky VM, et al. How much does a shared name make things similar? Linguistic Labels, Similarity and the Development of Inductive Inference. *Child Development* 2001;72(6):1695–1709. [PubMed: 11768140]
16. Sloutsky VM, et al. When looks are everything: Appearance similarity versus kind information in early induction. *Psychological Science* 2007;18:179–185. [PubMed: 17425540]
17. Smith LB, Samuelson L. An attentional learning account of the shape bias: Reply to Cimpian and Markman (2005) and Booth, Waxman, and Huang (2005). *Developmental Psychology* 2006;42:1339–1343. [PubMed: 17087565]
18. Gopnik, A.; Meltzoff, AN. *Words, thoughts, and theories*. Bradford Books/MIT Press; Cambridge, MA: 1997.
19. Gliga T, Csibra G. One-year-old infants appreciate the referential nature of deictic gestures and words. *Psychological Science*. in press.
20. Fennell, CT., et al. With referential cues, infants successfully use phonetic detail in word learning; Proceedings of the 31st Boston University Conference on Language Development; Somerville, MA: Cascadilla Press. 2007;
21. Putnam H. Meaning and reference. *The Journal of Philosophy* 1973;70:699–711.
22. Cimpian A, Markman EM. Preschool children’s use of cues to generic meaning. *Cognition* 2008;107:19–53. [PubMed: 17765216]
23. Gelman, SA. Learning words for kinds: Generic noun phrases in acquisition. In: Hall, DG.; Waxman, SR., editors. *Weaving a lexicon*. MIT Press; Cambridge, MA: 2004. p. 445-484.
24. Leslie SJ. Generics: Cognition and acquisition. *The Philosophical Review* 2008;117(1):1–49.
25. Chambers CG, et al. When hearsay trumps evidence: How generic language guides preschoolers’ inferences about unfamiliar things. *Language and Cognitive Processes* 2008;23:749–766.
26. Prasada S. Acquiring generic knowledge. *Trends in Cognitive Sciences* 2000;4:66–72. [PubMed: 10652524]
27. Preissler MA, Carey S. Do both pictures and words function as symbols for 18- and 24-month-old children? *Journal of Cognition and Development* 2004;5:185–212.
28. Gelman, SA. *The essential child: Origins of essentialism in everyday thought*. Oxford University Press; New York: 2003.
29. Graham SA, et al. Thirteen-month-olds rely on shared labels and shape similarity for inductive inferences. *Child Development* 2004;75:409–427. [PubMed: 15056196]
30. Legare, CH., et al. The function of causal explanatory reasoning; Proceedings of the 30th Annual Meeting of the Cognitive Science Society; 2008;
31. Ganea PA, et al. Thinking of things unseen: Infants’ use of language to update mental representations. *Psychological Science* 2007;18:734–739. [PubMed: 17680946]
32. Akhtar, N.; Tomasello, M. The social nature of words and word learning. In: Golinkoff, RM.; Hirsh-Pasek, K.; Bloom, L.; Smith, LB.; Woodward, AL.; Akhtar, N.; Tomasello, M.; Hollich, G., editors. *Becoming a word learner: A debate on lexical acquisition*. Oxford University Press; New York: 2000. p. 115-135.
33. Bloom, P. *How children learn the meanings of words*. MIT Press; Cambridge, MA: 2000.
34. Hall, DG.; Lavin, T. The use and misuse of part-of-speech information in word learning. In: Hall, DG.; Waxman, SR., editors. *Weaving a Lexicon*. MIT Press; Cambridge, MA: 2004.
35. Opfer JE, Bulloch MJ. Causal relations drive young children’s induction, naming, and categorization. *Cognition* 2007;105:206–217. [PubMed: 17045580]

36. Booth A, et al. Conceptual information permeates word learning in infancy. *Developmental Psychology* 2005;41:491–505. [PubMed: 15910157]
37. Gergely G, et al. On pedagogy. *Developmental Science* 2007;10:139–46. [PubMed: 17181712]
38. Gelman SA. Learning from others: Children’s construction of concepts. *Annual Review of Psychology* 2009;60:115–40.
39. Koenig MA, et al. Trust in testimony: Children’s use of true and false statements. *Psychological Science* 2004;15:694–698. [PubMed: 15447641]
40. Baldwin, DA. Understanding the link between joint attention and language. In: Moore, C.; Dunham, PJ., editors. *Joint attention: Its origins and role in development*. Lawrence Erlbaum Associates, Inc.; Hillsdale, NJ, England: 1995. p. 131-158.
41. Jaswal VK. Don’t believe everything you hear: Preschoolers’ sensitivity to speaker intent in category induction. *Child Development* 2004;75:1871–1885. [PubMed: 15566385]
42. Keats J, Graham SA. Category markers or attributes: Why do labels guide infants’ inductive inferences? *Psychological Science*. in press.
43. Namy LL, Waxman SR. Naming and exclaiming: Infants’ sensitivity to naming contexts. *Journal of Cognition and Development* 2000;1:405–428.
44. Woodward AL, Hoyne KL. Infants’ learning about words and sounds in relation to objects. *Child Development* 1999;70:65–77. [PubMed: 10191515]
45. Waxman SR, Markow DB. Words as invitations to form categories: Evidence from 12- to 13-month-old infants. *Cognitive Psychology* 1995;29:257–302. [PubMed: 8556847]
46. Fulkerson AL, Waxman SR. Words (but not tones) facilitate object categorization: Evidence from 6- and 12-month-olds. *Cognition* 2007;105:218–228. [PubMed: 17064677]
47. Waxman SR, Braun IE. Consistent (but not variable) names as invitations to form object categories: New evidence from 12-month-old infants. *Cognition* 2005;95:B59–B68. [PubMed: 15788158]
48. Booth AE, Waxman SR. A horse of a different color: Specifying with precision infants’ mappings of novel nouns and adjectives. *Child Development*. in press.
49. Mill, JS. *A system of logic, ratiocinative and inductive*. Longmans; London: 1843.
50. Gelman SA, Waxman SR. Looking beyond looks: Comments on Sloutsky, Kloos & Fisher, “When looks are everything: Appearance similarity versus kind information in early induction”. *Psychological Science* 2007;18:554–555. [PubMed: 17576270]