

1 Early word-learning entails reference, not merely associations

2 Sandra R. Waxman

3 Department of Psychology

4 Northwestern University

5 2029 Sheridan Rd

6 Evanston, IL 60208-2710

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10 Susan A. Gelman

11 Department of Psychology

12 University of Michigan

13 2040 East Hall

14 Ann Arbor, MI 48109-1043

15

16 Corresponding author: Waxman, S.R. (s-waxman@northwestern.edu)

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Abstract

3

Recent years have witnessed a resurgence of classic tensions concerning the fundamental

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nature of human knowledge and the processes underlying its acquisition. This tension,

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especially evident in research on the acquisition of words and concepts, arises when

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researchers pit one type of content against another (perceptual vs. conceptual) and one

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type of process against another (associative vs. theory-based). But these dichotomies are

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false; they rest upon insufficient consideration of the structure and diversity of the words

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and concepts that we naturally acquire. As infants and young children establish categories

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and acquire words to describe them, they take advantage of *both* perceptual and conceptual

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information, and relate this to *both* the (rudimentary) theories they hold and the statistics

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that they witness.

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

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

17 ***Focusing exclusively on the child-as-data-analyst***

18 As strong proponents of the *child-as-data-analyst* view, Sloutsky and his
19 colleagues have adopted a strict associationist approach to word learning and conceptual
20 development [14-17]. This work rests on three core assumptions: that the only building
21 blocks for words and concepts are sensory and perceptual experiences, that these
22 experiences are operated upon strictly by means of general-purpose processes (including
23 associative learning, similarity assessment, and attentional weighting), and that higher-

1 level conceptual processes are unnecessary to account for the evidence from children.
2 This work is valuable for highlighting young children's sensitivity to perceptual
3 information, for considering how domain-general processes (e.g., association, feature-
4 weighting) may operate in development, and for amplifying the aptness of the *child-as-*
5 *data-analyst* metaphor. But despite claims to the contrary, it has *not* completely ruled out
6 the *child-as-theorist* model.

7 ***Retaining a place for the child-as-theorist***

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

14 (1) Words do not merely associate; they refer. Words are quintessentially
15 symbolic elements.

16 (2) Words and concepts are more than a collection of sensory/perceptual features.
17 As children build their lexical and conceptual repertoires, they are also guided by abstract
18 conceptual knowledge (e.g., animacy, intention, cause).

19 (3) Words and concepts are not unitary constructs. There are different kinds of
20 words and different kinds of concepts, and sensitivity to this variety emerges within the
21 first years of life.

1 (4) Words are located within intricate linguistic and social systems. Thus, a word
2 takes its meaning not merely from its history of co-occurrence with entities in the world,
3 but also and importantly from the linguistic and social systems in which it is embedded.

4 ***Words refer; they do not merely associate***

5 Consider the assertion that establishing a word's meaning requires only that it be
6 associated directly and automatically to a portion of sensory/perceptual experience. On
7 this view, a word is nothing more than a feature of the experience(s) with which it is
8 associated, in much the same way as a black beret is a feature of Jean Piaget [14, see also
9 17]. This assertion runs aground because the words of human language are more than
10 associations. Words refer [19,20].

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

17 This crucial distinction between association and reference was illustrated
18 concretely by Preissler and Carey [27]. An experimenter introduced 18- and 24-month-
19 old infants to a photograph of a novel entity (a whisk) and named it ("a whisk"). Infants
20 were then asked to extend the word -- either to another photograph of a whisk or to an
21 actual, three-dimensional whisk. On a strictly associative account, infants should select
22 the photograph, as it is perceptually more similar to the photograph that co-occurred with
23 the introduction of the novel word. Instead, infants favored the three-dimensional object.

1 This reveals that they understood something subtle and profound: Words refer to
2 concepts, and are not tethered to their associated perceptual impressions.

3 ***Early words incorporate conceptual content: they go beyond perceptible referents***

4 Central to a strict associationist account is the assumption that each word links to
5 a sensory/perceptual counterpart. Yet even for words that do have perceptible referents
6 in the context (e.g., dog, mama), word-learning cannot be characterized as simply
7 mapping a word onto a perceptual unit. First, children expect that words map onto
8 concepts that share a deeper set of properties than those that are available for inspection
9 [10-12,28,29,30]. Second, words often refer to absent things (e.g., “Where’s your coat?”),
10 and children readily interpret such expressions, even acquiring new words when their
11 referents are absent during the naming episode [31,32]. Thus, early in development, the
12 process of word-learning extends well beyond the paradigm case of ostensive definition.

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

1 A strict associationist account thus considers only a subset of the words that
2 children naturally acquire and a subset of the learning contexts that support word-
3 learning. At best, this account would need to posit two distinct processes: one for words
4 that have perceptible referents (and could therefore, in principle, be acquired via
5 ostension), and another for words that do not. This two-step process lacks the parsimony
6 to which associationist accounts aspire, but without it, the theory lacks both descriptive
7 and explanatory force.

8 ***Words and concepts are not unitary constructs***

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

17 What do we mean by ‘different kinds’ of words? At minimum, we refer to
18 distinct grammatical forms (e.g., nouns, adjectives, verbs) and their various subtypes (e.g.,
19 proper vs. common nouns; transitive vs. intransitive verbs). A fundamental property of
20 human language is that each grammatical form picks out a distinctly different aspect of
21 experience. This diversity of words and their candidate concepts undermines the claim
22 that words act uniformly as ‘attentional spotlights’. Moreover, infants appreciate this

1 fundamental property: they expect that each kind of word highlights a different aspect of
2 the same scene. Consequently, when asked to extend a novel word beyond the particular
3 entities on which it was introduced, infants do so in principled ways, guided by the
4 grammatical form of the word. If words were nothing more than simple associates, then
5 *any* word should exert the same kind of influence on infants' and young children's
6 construals, and this is not the case (Box 1).

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

16 ***Words participate in a complex linguistic and social system***

17 Also missing from a strictly perceptually-based associationist account is the fact
18 that each word participates in an exquisitely detailed linguistic, social, and symbolic
19 system. Indeed, the meaning and conceptual power of a word derives not only from the
20 word-form itself, or from an association between a word and a chunk of experience in the
21 world. It also depends crucially on the relation of the word to other linguistic elements. In
22 interpreting the meaning of a novel word, infants attend to its surrounding context,

1 including the presence or absence of devices such as determiners (compare, “This is a
2 blick” to “This is blick”), and the number and variety of arguments (noun phrases) (e.g.,
3 “chase” vs. “flee”) [12].

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

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

20 ***Conclusions***

21 We have underscored that two metaphors -- *child-as-data-analyst* and *child-as-theorist* –
22 are at play in word-learning and conceptual development. As infants and young children

1 build a repertoire of concepts and acquire words to describe them, they take advantage of
2 both perceptual *and* conceptual information, and rely upon both the rudimentary theories
3 that they hold *and* the statistics that they witness. Our goal in writing this paper is to
4 emphasize that our theories of acquisition should do the same.

5

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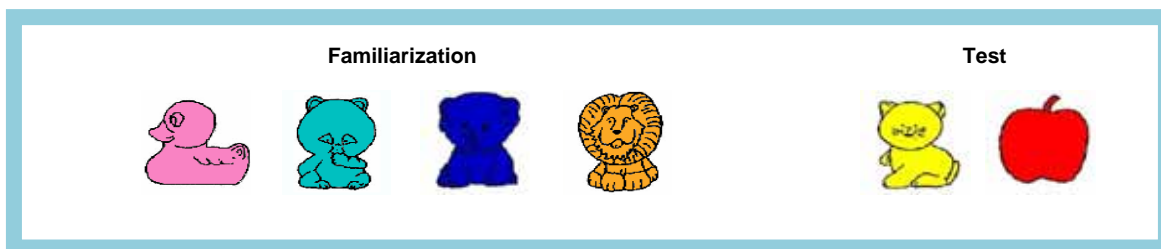
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1

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



3

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

4

5 Words exert a powerful, precise and nuanced influence on infants' behavior.

6 Infants ranging from six to twelve months viewed a series of familiarization objects from

7 a single category (e.g., animals), followed by two test objects (one from the same

8 category (e.g., a cat) and another from a new category (e.g., an apple). When the

9 familiarization objects were presented in conjunction with the same novel noun (Word

10 condition), infants successfully categorized, exhibiting a reliable novelty-preference at

11 test. But when precisely the same objects were presented under different auditory

12 conditions, infants were equally attentive during familiarization, but failed to categorize

13 during familiarization. This was the case when the familiarization objects were

14 accompanied by infant-directed speech but no novel word (No Word condition), when

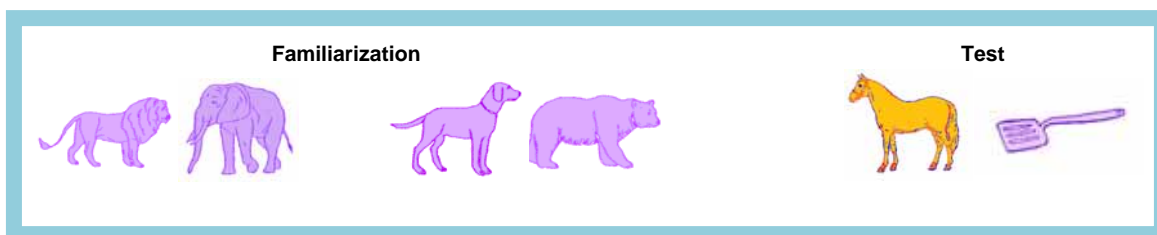
15 each familiarization object was paired with a *different* novel word (Variable Word

1 condition), and when the familiarization objects were paired with melodies or tones,
 2 infants failed to categorize [9,45-47].

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

7

8



9

10

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

11

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

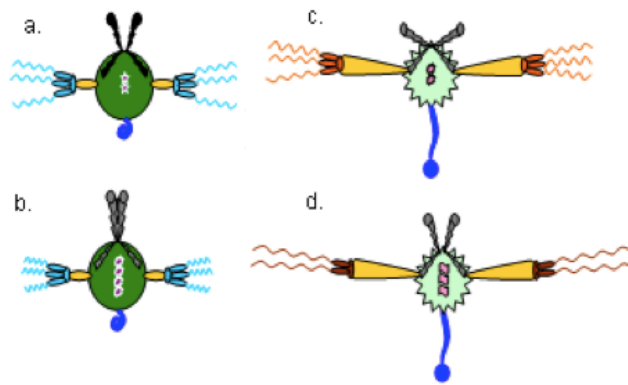
1 These nuanced effects cannot be reduced to simple word-object associations.
2 Infants are exquisitely sensitive to distinct kinds of words, and recruit these distinctions
3 precisely in establishing meaning. To establish meaning, infants attend not only to the
4 novel word itself: they depend crucially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

1

2

3 **Box 2: Conceptual variety**

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



11

12 A recent study illustrates how the concept one chooses to study influences the
 13 conclusions one draws. Sloutsky, Kloos, and Fisher (SKF) [16] sought to examine the
 14 relative importance of conceptual and perceptual information in children’s inductive
 15 inferences. An experimenter introduced children to two novel categories of bug-like
 16 animals (“ziblets” [a & c, above] and “flurps” [b & d, above]), where category
 17 membership was defined as the ratio of fingers to buttons. The experimenter provided a
 18 novel noun label for each category, taught a new fact about one of the animals, and then

1 measured whether children extended this fact to another animal from the same category
2 (as defined by finger:button ratio), or to another animal that was more similar in
3 appearance. Previous work with induction tasks using familiar natural kinds (e.g., birds
4 versus bats; girls versus boys) reveals that by 3-4 years of age, children judge conceptual
5 similarity (membership in a shared natural kind category) as relatively more important
6 than perceptual similarity (shared features but not shared category membership) [28]. Yet
7 SKF reported that children were guided by perceptual similarity and not category
8 membership. They concluded that for children, “looks are everything”.

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

1

2 **Box: Questions for future research**3 1. Are the processes and consequences of word-learning continuous from infancy through
4 adulthood?5 2. How does word-learning in humans compare to the acquisition of ‘words’ or word-like
6 units in non-human species? Which aspects are shared, and which appear to be unique?7 3. How are human infants’ earliest words and foundational concepts shaped by the
8 particular linguistic, social, and cultural communities in which they are immersed?9 4. How does associative learning contribute the acquisition of commonsense theories? To
10 what extent is associative learning constrained by causal theories? Does the process of
11 associative learning differ across content domains?12 5. One striking symptom of autism is an impairment in language, including word-
13 learning. These language difficulties have been linked to impairments in the interpersonal
14 and social domain, including theory of mind. Do these language difficulties also reflect
15 impairments in underlying associative capacities? Do they reflect impairments in
16 appreciating the essentially symbolic and linguistic nature of words?

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