

## Not by Perception Alone: Conceptual and Semantic Factors Underlying Children's Extension of Novel Adjectives

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The goal of this program of research is to bring into sharper focus the cognitive, perceptual, and linguistic potential of studying the acquisition of an oft-overlooked grammatical category *adjective*. We consider young learners' emerging ability to map novel adjectives to properties of the entities that they encounter in the world. This body of work reveals that perceptual information provides an insufficient base for mapping words to their meaning. It underscores a crucial conceptual/semantic component in the process of word learning, and in so doing, challenges accounts that appeal to perception alone.

### 1. Overview: Conceptual and perceptual influences on word learning

Questions concerning the role of conceptual knowledge in the acquisition of word meaning have been the topic of considerable debate for centuries. Some scholars have argued that word learning amounts to nothing more than a mapping process between a linguistic unit (e.g., a particular word or a particular grammatical form) and a perceptual unit of experience (e.g., a particular object, property or action, or a particular grammatical form) (Gasser & Smith, 1998; Smith, 1999). Others have favored a position that takes into consideration the importance of conceptual, as well as perceptual, information in the process of mapping words to their meaning (Gelman & Bloom, 2000; Gelman & Medin, 1993; Soja, Carey, & Spelke, 1992; Waxman, in press; Waxman & Booth, 2001; Waxman & Markow, 1995; Wierzbicka, 1986). In recent years, this debate has centered primarily on the acquisition of nouns. In the absence of a more broad-ranging empirical base, a great deal has been left to the imagination. Therefore, in this program of research, we consider the role of conceptual/semantic and perceptual information in young word learners' acquisition and extension of

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novel adjectives. Adjectives serve as an ideal testing ground, for if any word meanings are derived directly from perceptual experience, words that refer to perceptual qualia (like redness or softness) should be the prime candidates.

The current experiments are based on two assumptions, assumptions that we take to be not controversial. First, we assume that the children in our experiments (ranging from 2 to 3 years of age) can pick out novel adjectives in the input and distinguish them from words from other major grammatical categories. For evidence that this assumption is justified, see Waxman and Markow (1998), Waxman (1999), and Waxman and Booth (2001). Second, we assume that the children in our experiments have the sensory and perceptual capacities to detect (at least some) properties of the entities they encounter in the world (e.g., color, texture). Armed with these assumptions, the central question then becomes: How do young word learners map adjectives to properties?

### 2. How do learners map adjectives to object properties?

#### 2.1. The mapping is direct: Adjectives are extended broadly to all instances of the relevant property

According to the first position, this process is perfectly straightforward. *Thus the same colour being observed to-day in chalk or snow, which the mind yesterday received from milk, it considers that appearance alone...and having given it the name whiteness, it by that sound signifies the same quality wheresoever to be imagined or met with (Locke, 1975).*

This observation leads directly to a hypothesis about the process of acquisition: Once a learner has mapped an adjective (e.g., red) to a property of one individual, (e.g., a chair), then that learner should readily and broadly extend that adjective to any other individual sharing that perceptual property. They should therefore extend a newly mapped adjective a) to individuals from within the same category (e.g., to other red chairs) and b) to individuals from disparate categories (e.g., to red things including not only chairs, but shirts, cars, crayons, etc.).

This hypothesis seems to capture adult intuitions – at least the intuitions of adults who speak languages that, like English, have a fully developed adjectival class. There is, however, another possibility, and this too derives from our intuitions as mature speakers.

#### 2.2. The mapping is mediated by conceptual status: Adjectives are initially extended to individuals within a given basic level kind

Notice that the precise meaning associated with any given adjective is influenced by the noun that it modifies. For example, both ice cream and slippers can be described as *soft*, but *soft* does not apply to the same texture in each case; both a house and a cup of coffee can be described as *expensive*, these do not carry the same monetary value. Likewise, red cars and red hair do not share the same portion of the color spectrum. Why is this the case? It reflects

the fact that most adjectives do not indicate an absolute value in any fixed, objective sense, but instead, indicate a relative point along a continuum. The range of this continuum is delimited by the category itself (Dixon, 1982; Klibanoff & Waxman, 2000).

This phenomenon, which is known as the semantic dependency of adjectives on the nouns they modify, has been observed consistently across human languages. Syntactic and morphologic dependencies have been documented as well. For example, in languages that mark grammatical gender or number, adjectives must accord with the nouns they modify. These observations, coupled with other work on early acquisition, suggest that there may be a linguistic or conceptual priority for establishing an object's kind before marking its properties in language (See Waxman (in press) for fuller discussion).

The semantic dependency of adjectives may have a consequence in the process of acquisition. Learners may initially extend a novel adjective (e.g., red, applied to a chair) to other members of the same category (e.g., other red chairs), but may fail to extend it to members of different categories sharing that property (e.g., red apples, red cars, red hair, red crayons).

### 3. Background research

We have examined these possibilities in a series of experiments with children at 21 months (Waxman & Markow, 1998) and 3 years (Klibanoff & Waxman, 2000; Waxman & Klibanoff, 2000) of age. In these experiments, we asked, "Do learners initially depend upon the support of familiar basic level kinds in extending novel adjectives?" If this is the case, then learners should succeed in extending property terms (e.g., *red*, applied to a red chair) to other objects from the same basic level kind (e.g., other red chairs), but should fail to extend property terms to objects from different basic level categories (e.g., other red objects, including apples and crayons). Of course, if learners apply property terms broadly from the start, they should extend a property term (e.g., *red*, applied to a red chair) across basic level kinds (e.g., other red objects, including apples and crayons).

We devised a forced choice task in which children were introduced to a target object (e.g., a red object), and asked to choose between two test objects: a matching test object (another red object) and a contrasting test object (a blue object). Half of the children in each experiment were randomly assigned to the "Within-Basic" condition, in which the target (e.g., a red cup) and test objects (red cup; blue cup) were all drawn from the same basic level category. The remaining children were assigned to the "Across-Basic" condition, in which the target (e.g., a red hammer) and test objects (red cup; blue cup) were drawn from different basic level categories.

Children in each condition were randomly assigned to either an Adjective condition or to a No Word (control) condition.<sup>1</sup> In the Adjective condition, the experimenter labeled the target with a novel adjective, saying, for example, "See this? Tiki (a puppet) says this one is *zav-ish*." At test, she asked, "Can you find another one that is *zav-ish*?" For children in a No Word (control) condition, the procedure was identical, except that no novel words were introduced. In the No Word condition, the experimenter introduced the target saying, for example, "See this? Tiki (the puppet) likes this one". At test, she asked, "Can you find another one for Tiki?"

#### 3.1. Evidence: The mediating role of object kind in children's extension of novel adjectives

The results from these experiments revealed a clear and important mediating role of object kind in children's extension of novel adjectives. Figure 1 displays the results from an experiment with 3-year-olds (Klibanoff & Waxman, 2000); the same pattern was observed in 21-month-olds (Waxman & Markow, 1998). Children succeeded in mapping novel adjectives to object properties only when the target and test objects were all drawn from the same familiar basic level kind (e.g., all apples). In sharp contrast, when the target (e.g., a dog) and test objects (e.g., apples) were drawn from different basic level kinds, they failed to extend the novel adjectives systematically. In fact, like their counterparts in the No Word condition, they performed at chance.

Based on these results, and on converging evidence from several subsequent studies, we concluded that children's initial expectations for novel adjectives unfold within the support of a familiar basic level kind. Of course, we know that children can, under certain circumstances, venture beyond the limits of a basic level kind in extending a novel adjective. More recent work has been devoted to identifying the conditions that best support learners' ability to extend adjectives broadly across basic level kinds (Klibanoff & Waxman, 2000; Mintz & Gleitman, 1998, November). Yet we suspect that this early aspect of adjectival use (within basic level kinds) may serve as the entry point for working out the further semantic and syntactic properties of adjectives applied ostensively to objects.

This result is consistent with documentation of the dependency of adjectives on count nouns -- a dependency that has been observed across languages in morphological, semantic, syntactic, and lexical analyses. It is also consistent

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1. These experiments also included a third condition, in which children were introduced to novel nouns. These conditions were included because we were interested in ascertaining whether and when children distinguish between the extension patterns associated with these distinct grammatical forms. To summarize, we found that infants as young as 21 months expected nouns to refer to categories of objects, and not to properties of objects.

with arguments for the conceptual power of object kinds (aka sortals) in word learning (Macnamara, 1986).

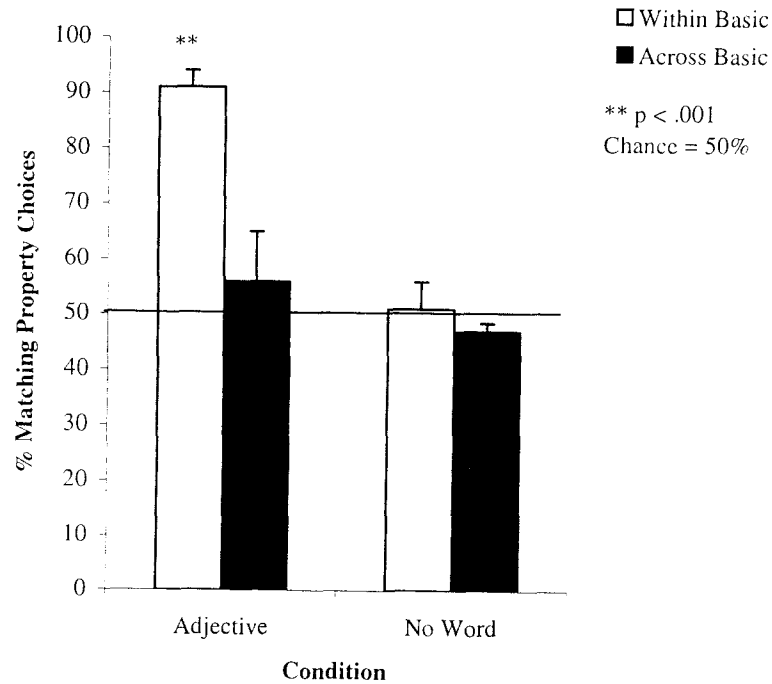


Figure 1. Taken from Klibanoff & Waxman (2000). Children successfully extend novel adjectives within, but not across, members of a basic level kind.

#### 4. Current studies

In the current studies, we pursue this notion of dependency vigorously. Our goal was to uncover the conceptual/semantic factors underlying the foundational role of basic level kinds in the extension of novel adjectives. We therefore developed a design that permitted us to hold perceptual similarity among stimuli constant while systematically varying their conceptual status.

The underlying logic for the current studies derives from evidence that preschoolers' construal of ambiguous stimulus materials can be manipulated as a function of simple introductions (Bloom & Markson, 1998; Gelman & Ebeling, 1998; Soja, Carey, & Spelke, 1991). Following this logic, we began by creating a set of ambiguous stimuli that could plausibly be interpreted as either objects (pictures of things) or non-objects (portions of substance). See Table 1. We

conducted extensive preliminary work, with an independent group of children, to be sure that children could indeed interpret each of our stimuli flexibly as either a picture of an object or as a non-object (a portions of substance), depending upon our introductory comments. See Waxman, Bouck, and Rushkewicz (in preparation) for details regarding stimulus selection.

Table 1. Table of stimuli for Experiments 1 and 2.

Condition	Target	Test Objects	
		Property Match	Property Contrast
"Within-Basic"			
"Across-Basic"			

#### 4.1. Design

To parallel the designs that we have used in previous experiments, we organized these stimuli into triads. Each triad included one target (e.g., a yellow stimulus), a matching test stimulus (e.g., a different yellow stimulus), and a contrasting test stimulus (e.g., a green stimulus; test objects varied slightly in form and deferred from target). We created two books, each including 12 different triads. In the "Within-Basic" book, the perceptual similarity among target and test stimuli approximated that of the within-basic level sets in previous work, and in the "Across-Basic" book, the perceptual similarity approximated that of the across-basic level sets (See Table 1).<sup>2</sup> In each book, half of the target properties were color (e.g., yellow, green); the remaining half were texture (e.g., shiny, rough).

Children in each experiment were randomly assigned to either a "Within-Basic" or an "Across-Basic" condition. Half of the children in each condition were assigned to a Novel Adjective condition, and half to a No Word control condition.

We conducted two experiments. In Experiment 1, we described the stimuli as objects ("pictures of things"); in Experiment 2, we described the very same

2. Perceptual similarity ratings were conducted with an independent group of adults. See Waxman et al. (in preparation) for details.

stimuli as non-objects ("blobs of stuff"). This design permitted us to isolate effect of the conceptual status of basic level kind membership in the extension of novel adjectives.

If children's strong initial tendency to restrict the application of novel adjectives only to objects from the same basic level kind is driven primarily by perceptual factors, then the results of both experiments should parallel those documented in previous work. Whether the stimuli are construed as "pictures of things" or as "blobs of stuff", children should succeed in mapping adjectives to properties on the "Within-Basic" trials, but fail to do so on the "Across-Basic" trials. However, if children's extension of novel adjectives is mediated by conceptual factors, then our description of the stimuli should influence children's patterns of extension. When the stimuli are construed as object ("pictures of things"), children's reliance on the basic level kind to delimit extensions should be evident, as in previous work. However, construing the stimuli as non-objects ("blobs of stuff") should have a dramatically different effect: Faced with the very same stimuli, two-year-olds should now succeed in mapping adjectives systematically on both the "Within-Basic" and "Across-Basic" trials.

## 4.2. Experiment 1: Pictures of things

### 4.2.1. Participants

Participants were 48 two-year-old children (mean age 30 months, ranging from 28 to 32 months). All were enrolled in local preschool programs and all were acquiring English as their first language. The conditions were balanced with regard to age and gender. Children were tested in a quiet area of their preschool.

### 4.2.2. Procedure

The experimenter introduced the stimuli as objects, by describing them as *pictures of things*. She set the stage by introducing children to the book saying, "Look! This book has lots of different *pictures of things*". On each page, she reinforced this construal. For children in the *Adjective* condition, she said, for example, "Look at this picture. This is a *blick-ish* one. Can you find another one that is *blick-ish*?" For children in the No Word condition, she simply said, "Look at this picture. Look here at this one. Can you find another one?"

### 4.2.3. Prediction

If children construed the stimuli as pictures of objects, then we should replicate the previous pattern of results based on actual objects (Klibanoff & Waxman, 2000; Waxman & Markow, 1998): Children assigned to the "Within-Basic" condition should extend the novel adjectives systematically to the

Matching test object, while those assigned to the "Across-Basic" condition should fail to extend the novel adjectives systematically at test. Performance in the No Word control condition should be at chance.

### 4.2.4. Results

The results of Experiment 1, displayed in Figure 2, support this prediction. A Condition (Adjective vs. No Word) x Level ("Within" vs. "Across-Basic") ANOVA revealed a main effect for Condition,  $F(1,44) = 8.41, p = .006$ . Children in the Novel Adjective condition ( $M=60.42$ ) selected the matching test object more frequently than those in the No Word control condition ( $M=44.31$ ). However, this main effect was qualified by a Condition x Level interaction,  $F(1,44) = 5.21, p = .027$ , which singled out performance in the Novel Adjective condition. Children in this condition who were assigned to the "Within-Basic" condition succeeded in mapping the novel adjectives to the matching test object ( $M=69.63$ ). Children assigned to the "Across-Basic" condition failed to map the adjective successfully ( $M=51.20$ ). Children in the No Word control condition performed at chance in both the "Within-Basic" ( $M=40.83$ ) and "Across-Basic" conditions ( $M=47.78$ ). Moreover, post hoc analyses revealed no reliable differences among the latter three conditions.

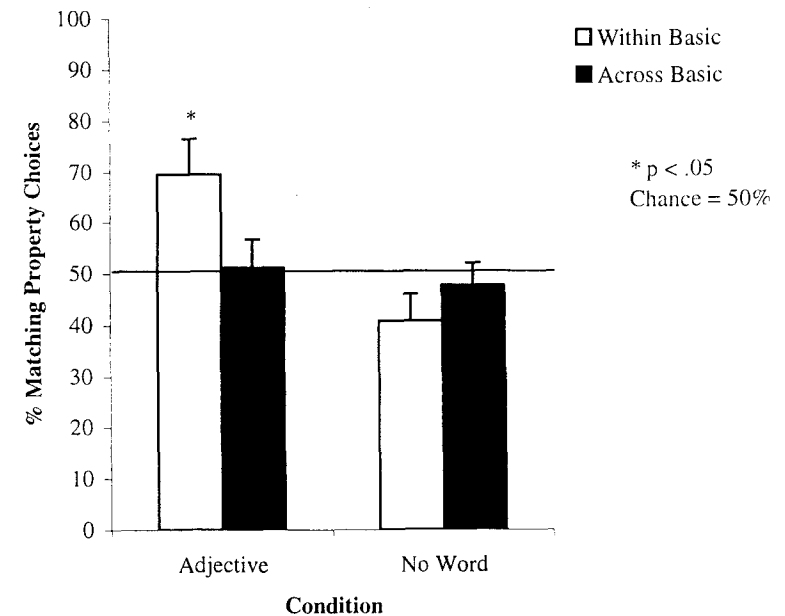


Figure 2. Experiment 1: "Pictures of things"

### 4.3. Experiment 2: *Blobs of stuff*

#### 4.3.1. Participants

Participants were 48 two-year-old children (mean age 30 months, ranging from 28 to 32 months). All were enrolled in local preschool programs and all were acquiring English as their first language. The conditions were balanced with regard to age and gender. Children were tested in a quiet area of their preschool.

#### 4.3.2. Procedure

We used the **very same stimuli** as in Experiment 1, but the experimenter described them this time as non-objects, saying "Look! This book has lots of different *blobs of stuff*." Notice that the perceptual information provided to children in this experiment is identical to that in the last; what varies across the experiments is the conceptual status of the objects (objects vs. non-objects).

#### 4.3.3. Predictions

If children's failure to extend novel adjectives broadly to objects from different basic level kinds is related primarily to perceptual factors, then the results of this experiment should parallel those of the first. Children should succeed in mapping adjectives to properties on the "Within-Basic" trials, but fail to do so, as before, on the "Across-Basic" trials. However, if children's extension of novel adjectives is mediated by conceptual factors, then construing the stimuli as non-objects should have a dramatically different effect: Faced with the very same stimuli (now described as non-objects), two-year-olds should now succeed in mapping adjectives to object properties on both the "Within-Basic" and "Across-Basic" trials.

#### 4.3.4. Results

The results, displayed in Figure 3, indicate that the extension of novel adjectives is indeed dependent upon the conceptual status of the entities being described. An ANOVA revealed a main effect for condition,  $F(1,44) = 8.89$ ,  $p = .006$ . Importantly, however, there was no Level  $\times$  Condition interaction. Instead, two-year-olds now succeeded in mapping adjectives on both within ( $M=72.50$ ) and across ( $M=62.98$ ) basic level trials. There was no difference between performance in these two conditions. Children in the No Word control condition performed at chance ( $M=51.89$  and  $51.46$  in within and across basic level trials, respectively).

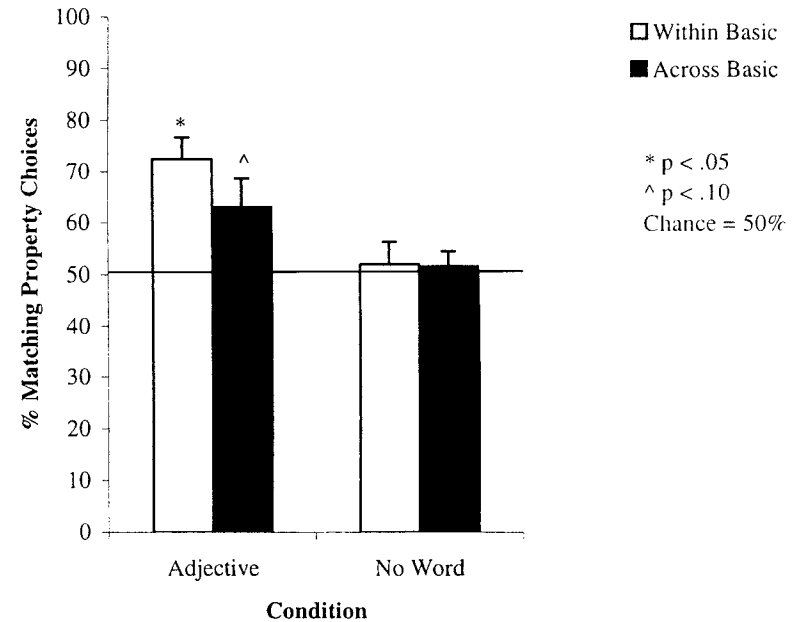


Figure 3. Experiment 2: "Blobs of stuff"

### 5. Summary and conclusions

The extension of a novel adjective, applied to an individual object, is mediated by conceptual/semantic factors related to object kind. When a set of ambiguous stimuli were construed as objects (Experiment 1), children restricted their extension of novel adjectives to other members of the same basic-level categories, failing to extend them systematically to objects from different basic level kinds. Yet when the very same stimuli were construed as non-objects (Experiment 2), children evidenced no such restriction: they successfully mapped adjectives to a broader range of individuals. Strikingly, this range included stimuli that children had failed to include in Experiment 1, when these very same individuals were construed as objects. This effect cannot be explained by an appeal to perceptual factors, since the very same materials were included in both experiments.

Taken together, these results make three contributions. They replicate the foundational role of the basic level in the extension of novel adjectives (Klibanoff & Waxman, 2000; Mintz & Gleitman, 1998, November; Waxman & Klibanoff, 2000; Waxman & Markow, 1998). The results also go one step

further, to reveal that this foundational role is at play in the context of 2-dimensional, as well as 3-dimensional, representations of objects.

More provocatively, these results provide clear evidence that the extension of a novel adjective, applied to an individual, is mediated by conceptual/semantic factors related to the *kind* of individual being described, and not merely by perception. This finding underscores the force of conceptual information in word learning, and broadens the scope of the debate. In past work, issues regarding the contribution of conceptual information in word learning have been debated primarily within the arena of the grammatical form *noun*. The results described here demonstrate that even in the context of mapping a novel adjective to what is undeniably a fundamentally perceptual experience (color; texture), word learners are influenced by the *conceptual* status of the entity being described. Now is the time for researchers in the field of child language to follow the lead of the children themselves, and to take heed of conceptual factors in developing theories of word learning.

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