J. Child Lang. **24** (1997), 695–717. Printed in the United Kingdom

The effect of perceptual similarity and linguistic input on children's acquisition of object labels*

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(*Received* 7 *May* 1996. *Revised* 11 *April* 1997)

ABSTRACT

This study investigated whether and when children establish various semantic relations between old and new words. Fifty two-year-olds were taught labels for objects previously referred to by an overextended term. We found that children were more likely to learn a new label when (*a*) it referred to a new object that was perceptually dissimilar, rather than similar, to a known one, and (*b*) when linguistic information indicated it had an inclusion, rather than a mutually exclusive, relation to a known label. Children were more likely to interpret a new label as mutually exclusive to a known one when their referents were perceptually dissimilar. These findings are discussed in light of theories of lexical development, particularly with regard to conceptualizations of constraints on the acquisition of word meaning.

INTRODUCTION

Young children acquire words at a remarkable rate. From about 1;6 till age 6, children acquire, on average, nine new words per day (Carey, 1982). Simultaneously, they have to work on the semantic relations among words (Shatz, 1993). Studies have demonstrated that children under certain circumstances can interpret labels as generally overlapping in meaning (Banigan & Mervis, 1988), or, more specifically, as synonyms (Mervis, Golinkoff & Bertrand, 1994), as subordinate or superordinate (Taylor & Gelman, 1989; Waxman & Hatch, 1992; Waxman & Senghas, 1992); and as

[*] This research was partly supported by a Fellowship from the Horace H. Rackham School of Graduate Studies of the University of Michigan to the first author. We wish to thank the children, teachers and staff of the University of Michigan Children's Center, and the parents and children who came to the Language Laboratory. We would also like to thank Alicia Baturoni, Thahn Bui, Sushmita Ghose, Kim Lebowitz and Netta Shaked for assistance with data collection; and Susan Gelman for comments on an earlier version of part of this work. Address for correspondence: Gil Diesendruck, Department of Psychology, University of Arizona, Tucson, AZ, 85721, USA.

mutually exclusive (Barrett, 1978; Merriman & Bowman, 1989). A central question deriving from these findings is how children decide on the semantic relation between a newly acquired word and known ones.

Various researchers argue that children are constrained in the way they generate hypotheses about the semantic relations among words (e.g. Clark, 1988; Golinkoff, Mervis & Hirsh-Pasek, 1994). Markman (1989) proposes that, from the onset of language acquisition, children have a mutual exclusivity bias: that is, they are prone to believe that any object can have only one category label. In other words, labels define mutually exclusive categories. Other researchers have opposed these 'constraints accounts' by arguing that if linguistic constraints are indeed restrictive and powerful mechanisms driving children's acquisition of words, they should operate in an all-or-none manner (Nelson, 1988; Kuczaj, 1990). As Behrend (1990) points out, however, although constraints may be flexible, there may be a limited and empirically testable set of factors that interact with constraints in the child's determination of word meaning. Thus, children might start off with an assumption that labels define mutually exclusive categories, but when presented with conclusive evidence that certain labels denote inclusive categories, children might override such a mutual exclusivity bias (Woodward & Markman, 1991). A critical enterprise then is to determine what counts as conclusive evidence, and how early in the acquisition process do children start relying on such evidence for modulating the operation of lexical biases.

The goal of the present study was to investigate the effect of two specific factors in children's acquisition of labels, and in their decisions about the semantic relation between a new and a known label. In particular, we examine whether such factors affect lexical acquisition early on in vocabulary building. For this purpose, we test whether they influence two-year-olds' acquisition and interpretation of object labels. We investigate the effects of (1) the linguistic input used to introduce labels and (2) the perceptual similarity between referents of different labels. These two factors are especially relevant because they are ubiquitous in the natural learning context of two-year-olds. These factors are also relevant because of the controversy over whether and when mutual exclusivity is honoured (Banigan & Mervis, 1988; Merriman & Bowman, 1989; Waxman & Senghas, 1992; Mervis, Johnson & Mervis, 1994); they are plausible candidates for providing conclusive evidence to two-year-olds about the relation between object labels, thus affecting the operation of the mutual exclusivity bias.

Linguistic input

Acquisition effects. A number of studies have shown that simply making reference to a familiar label when teaching three- to five-year-olds a new label fosters the acquisition of the new label (Waxman, Shipley & Shepperson,

1991; Waxman & Hatch, 1992). Moreover, various researchers have found that providing three-, four- and five-year-olds with information about the relation between a new and a known label improves their ability to learn the new label. In Callanan (1989), three-, four- and five-year-olds were either told that there was an inclusion relation between two objects ('This is a Y [the new name]. It is a kind of X [the old name]', or they were simply provided with a new label. Children acquired the new label more often in the inclusion condition than in the label-only condition. Au & Laframboise (1990) found that the most efficient verbal input for teaching a correct colour name for three-, four- and five-year-olds who had overextended a colour term for other colours (e.g. called a mauve swatch 'grey'), was one in which the correct name was introduced via an explicit linguistic contrast to the overextended one (e.g. 'see, it's not grey; it's mauve'). More recently, Gottfried & Tonks (1996) also found that three- and five-year-olds' acquisition of colour terms was enhanced when the relation, either inclusion or contrast, between a new and old label was made explicit.

Relation effects. Some studies indicate that providing children with explicit information about the relation between a new and a known label not only facilitates the acquisition of the new label, but also promotes the learning of that specific relation. Thus, Callanan (1989) found that three-, four- and five-year-olds in the inclusion condition were more likely to interpret the new name as a superordinate term than were children in the label-only condition. Merriman (1986) found that when two-year-olds were told that 'this is not an [X]; it is a [Y]', they interpreted Y and X as being mutually exclusive more often and synonymous less often than when they were not given any explicit information about the relation between the labels. In an unpublished study with two-year-olds, Shatz & Sidle (1991) found a similar trend. Children were randomly assigned to one of three training conditions: a similarity-contrast relation in which the difference between the new and old objects was stated (e.g. 'It's like a jacket, but it's a vest. See, it has no sleeves'); one in which an inclusion relation was stated (e.g. 'It's a kind of jacket; it's a vest. See, it has no sleeves'); and a control condition in which the old term was not mentioned (e.g. 'You wear it on your chest and it's a vest. See, it has no sleeves'). Although input condition had no effect on the NUMBER of new words acquired, there was a non-significant tendency for input condition to influence the TYPE of relation acquired: children in the contrast condition tended to interpret the two terms as mutually exclusive, whereas children in the other two conditions tended to interpret the new label as included in the old one's category. Gottfried & Tonks (1996) also found that their subjects tended to interpret a new colour label according to the relational input they were provided with.

In the present study, we further investigate the effect of linguistic input on children's acquisition and interpretation of labels. Differently from the

studies cited above, however, we explicitly contrast inputs emphasizing an inclusive (e.g. [X] is a kind of [Y]') versus an overt exclusive relation (e.g. '[X] is not a [Y]') between a new and a familiar object label, and examine whether younger children, two-year-olds, can take advantage of these kinds of inputs. Both Callanan (1989) and Gottfried & Tonks (1996) for instance, tested the effect of relational input on children aged 3;0 to 5;0. The present study investigates whether two-year-olds can differentiate between these two kinds of input, as expressed in both their learning performance and their interpretation of the relation between the labels. Moreover, by directly comparing these two kinds of inputs, this study should reveal the relative efficacy of these inputs in teaching new labels for two-year-olds – a crucial age in the process of lexical acquisition.

Perceptual similarity

Children are more likely to categorize objects on the basis of perceptual than functional similarity (Tomikawa & Dodd, 1980) or taxonomic relation (Tversky, 1985). This preference is further enhanced by labelling (Gentner, 1982; Merriman, Scott & Marazita, 1993; Smith, Jones & Landau, 1996). Reviews of the literature on children's overextensions indeed point to the preponderance of perceptual similarity as a guide to word meanings (Macnamara, 1982; Mervis, 1987).

As for situating new words relative to old ones in the lexicon, Behrend (1990) argues that if a child views a novel object as very perceptually or functionally similar to a known object, he or she will not interpret the labels referring to these objects as mutually exclusive. Supporting the idea that in such circumstances children will allow overlapping categories (Woodward & Markman, 1991), Taylor & Gelman (1989) found that when children aged 1;6 to 2;6 were taught a new name for an object, the children referred to highly perceptually similar objects with the same name more often than they did to less perceptually similar ones (see also Tomasello, Mannle & Werdenschlag, 1988, for compatible findings). Correspondingly, two-year-olds interpreted labels for two 'least similar' target toys (whisk–tong) as mutually exclusive, more often than labels of other two target pairs (hook–clip and horn–flute) (Waxman & Senghas, 1992), and three- to five-year-olds were more likely to interpret animal labels as mutually exclusive when the animals were perceptually dissimilar than when the animals were similar (Diesendruck, Gelman & Lebowitz, 1997). Merriman & Bowman (1989) also found that children aged 2;0, 2;6 and 4;0 were affected by the perceptual similarity between objects when deciding on the extension of labels. Their sets of stimuli consisted of drawings of familiar objects varying in typicality (e.g. a typical spoon and a hybrid spoon–fork). Children were presented with six objects and asked 'Where is Y? Is there another Y?', Y being the name of the object known by the child (e.g. 'spoon'). Children were more likely to

pick a similar, in fact IDENTICAL, object (e.g. typical spoon) as a referent of a familiar word (e.g. 'spoon'), than a hybrid object (e.g. spoon–fork). It is unclear, however, what exactly accounted for children's response pattern; namely, whether it was the perceptual similarity between the 'similar' test object and the familiar object, or the fact that the objects were identical.

In this study we investigate the effect of perceptual similarity between familiar and new objects on both two-year-olds' acquisition of object labels and their decision about the relation between new and old labels. An important difference between the present study and the studies with two-year-olds reviewed above is that we designed a set of stimuli such that the SAME new object had a 'similar' version and a 'dissimilar' version. Thus, the two versions of each new object were equally similar/different to the corresponding familiar object in terms of their taxonomic relatedness, functional similarity, and thematic association. The only difference between the two versions of each new object was that one was perceptually more similar to the familiar object than the other. This manipulation allows us to examine the effect of perceptual similarity *per se* on two-year-olds' label extensions. Our prediction was that children would both acquire new labels more readily and be more likely to interpret two labels as mutually exclusive when their referents were perceptually dissimilar, than when their referents were similar.

Methodological improvements

Our method was designed so as to more directly and precisely assess both two-year-olds' acquisition of new labels and their interpretation of the relation between labels. First of all, we decided to test children for their overextensions of a known label to the new objects, before we taught them new labels. It was plausible that children would overextend a known label more often to similar than to dissimilar new objects. In two subsequent sessions then, we taught children new labels only for the new objects included in an overextension in the first test. This was done so as to test the effect of perceptual similarity on children's acquisition and relational interpretation of the new labels, above and beyond their tendency to overextend more for similar than for dissimilar objects. As Merriman & Bowman (1989) pointed out, this is a strong test of the mutual exclusivity bias. In this context, if children rely on a mutual exclusivity bias, they not only have to limit the extension of the new label so that it does not include the familiar object, but they also have to modify their extension of the known label so as to exclude the new object whose label they have just acquired. Had we taught children new labels for all new objects, instead of only for the ones included in an overextension, we would not have been able to determine whether perceptual similarity influenced children's decision about the semantic relation between two labels, or whether children exposed to the different

items simply started off from different vantage points (as might have been the case in Merriman & Bowman, 1989; and Waxman & Senghas, 1992).

Secondly, in both input conditions we told children about some unique and distinctive features of the new objects so as to foster the acquisition of the new labels and thus encourage children to stop overextending a familiar label to a new object. This improvement distinguishes the present study from some of the previous ones dealing with the issue of relating new words to old (e.g. Merriman & Bowman, 1989; Taylor & Gelman, 1989; Waxman & Senghas, 1992). Finally, we did not show children the familiar and new objects and ask them to pick '[X]' and then 'another [X]', as was done, with minor variations, in other studies (e.g. Banigan & Mervis, 1988; Merriman & Bowman, 1989; Waxman & Senghas, 1992). Asking young children 'is there another X?' might encourage them, for pragmatic reasons, to pick a second referent for a label, and thus increase the likelihood of getting overlapping choices for a spurious reason. Instead, we presented a set of new pictures every time the child was asked to identify either the familiar or new word; hence we were able to ask the child only once to pick a referent in each array (e.g. 'Is there *a* [X]?').

METHOD

Subjects

Fifty two-year-olds (mean age = 2;1; range = 1;9 to 2;6) participated in this study. There were 31 boys and 19 girls. Eleven of the children (six boys, five girls) were tested in a half-day preschool affiliated with a major midwestern university. Thirty-nine others (25 boys, 14 girls) were tested in a Language Development Laboratory, following a schedule coordinated by phone with their parents who had returned to the department of psychology a form expressing their interest. The mean age of children in each of the locations did not differ significantly. Thirty-nine undergraduate students served as subjects for the perceptual similarity ratings.

Design

The experiment was a 2 (perceptual similarity: dissimilar, similar) $\times 2$ (linguistic input: inclusive, mutually exclusive) $\times 3$ (test: Test 1, Test 2, Test 3) design. Test was a within-subjects factor; the other two factors were between subjects.

Stimuli

The stimuli consisted of coloured line drawings of objects. There were eight triads of target stimuli consisting of the following: an object whose label we expected the children to know (e.g. a chair); and two related objects whose correct label we expected the children not to know (e.g. stool) and to which

https://doi.org/10.1017/S0305000997003218 Published online by Cambridge University Press

they might overextend the known label (e.g. 'chair'). For convenience, the objects are referred to respectively as KNOWN and NEW. The two new objects differed in the degree of perceptual similarity between them and the known object. One of the new objects was considered perceptually SIMILAR to the known object (e.g. a bar stool with back support) and the other was considered perceptually DISSIMILAR to the known object (e.g. a typical stool). Figure 1 gives some examples of the items used.

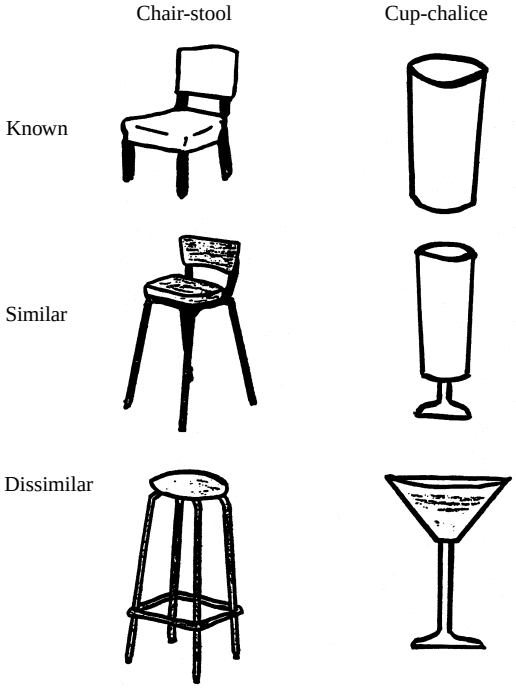

Fig. 1. Examples of items used in the study.

The perceptual similarity between the new objects and the known ones was assessed by adults' ratings of the stimuli. Each subject was presented with 18 pairs of drawings, each consisting of a known object and a new one, either a similar or a dissimilar one. The pairs were presented in a random order for half of the subjects and in the opposite order for the other half. The subjects were instructed to judge the degree to which the two depicted objects looked alike and to consider shape, size, complexity, and individual features and parts in doing so. They were further instructed not to spend too much time making their judgement and instead to make an intuitive evaluation of the overall similarity between the pictures. Their responses were coded on a 1–7

scale, in which 1 stood for 'not at all similar' and 7 for 'extremely similar'. The complete list of the stimuli and the mean ratings of pairs by the similarity status of the new object (i.e. similar or dissimilar) are presented in Table 1. The differences between the ratings for the similar and dissimilar

TABLE 1. *Stimuli and adults' ratings of perceptual similarity*

Triad	Picture type	*M*	S.D.	Paired-*t*(38)
1-Chair/stool	S[a]	5·26	1·07	−10·26[b]
	D	2·82	1·27	
2-Cup/chalice	S	5·64	0·93	−9·81[b]
	D	3·23	1·44	
3-Glasses/goggles	S	4·15	1·29	−3·09[b]
	D	3·44	1·14	
4-Scissors/clippers	S	5·13	1·28	−7·80[b]
	D	3·28	1·25	
5-Hammer/mallet	S	5·67	0·95	−5·66[b]
	D	4·38	1·46	
6-Airplane/glider	S	5·26	1·29	−10·58[b]
	D	3·00	1·17	
7-Shoe/sandal	S	4·44	1·35	−4·40[b]
	D	3·54	1·23	
8-Boat/sailboard	S	3·82	1·39	−2·58[b]
	D	3·15	1·46	
9-Van/trailer	S	3·61	1·14	1·58
	D	3·92	1·28	

[a] S = similar; D = dissimilar.
[b] Significant, $p < 0·05$.

pictures of each new object were statistically analysed. All but the triad VAN-TRAILER reached significance ($p < 0·05$). This triad was not used with the children, but the remaining triads were.

In addition to the target pictures, we also used a set of distracter pictures. These were pictures of objects very familiar to the children (e.g. ball, tree, knife), less familiar objects (e.g. satellite, blender, gas-pump), and pairs of less familiar objects very similar to one another (e.g. two different picks, two different harps). These last are called LESS FAMILIAR-PAIRED DISTRACTERS.

Procedure

Subjects were randomly assigned to four different conditions: (*a*) dissimilar object, inclusive input ($N = 11$, 7 boys and 4 girls); (*b*) similar object, inclusive input ($N = 13$, 7 boys and 6 girls); (*c*) dissimilar object, mutually exclusive input ($N = 12$, 8 boys and 4 girls); (*d*) similar object, mutually exclusive input ($N = 14$, 9 boys and 5 girls). Subjects were seen for three sessions occurring 1–3 days apart. All subjects were tested individually,

either at their preschool in a separate room or at the Language Development Laboratory, by a single female experimenter. The same experimenter tested children in the two settings.

Session 1 – Test 1. The goal of Test 1 was to identify pairs of objects for which the child overextended the known label to the new object (similar or dissimilar, depending on the child's condition). Prior to the actual test, however, the experimenter conducted four practice trials to encourage children to respond negatively if they believed no referent of the target word was present among the pictures. As will be clear from the description of the procedure, children often times were presented with a set of pictures in which there was no referent of the label being used by the experimenter. We wanted to stress to the children that it would be appropriate for them, in those occasions, not to pick any of the pictures. This was accomplished in the practice trials by showing children pictures of highly familiar objects (e.g. a pair of pants and a banana) and asking them whether among those pictures there was a different highly familiar object (e.g. a house); and by presenting children with some less familiar pictures (e.g. camera, golf club) and asking them whether among them there was a different familiar object (e.g. a dog). Over 90 % of the children responded negatively on at least one of the practice trials. The experimenter corrected the children whenever they gave an inappropriate response. After the practice trials, the experimenter conducted the test.

The testing procedure used in Test 1 was exactly the same as the one used in both Tests 2 and 3. For each pair of target stimuli (e.g. chair/stool) a trial consisted of four presentations, two in which the target object was the known one (e.g. chair) and two in which the target object was the new one (e.g. either two similar or two dissimilar stools, depending on the child's condition). In each presentation children were asked, 'Is there an [X] here?', and if needed, 'Where? Put your finger on it'. On two presentations, one in which the target object was a known one and another in which it was a new one, 'X' was the known label; on the other two presentations, 'X' was the new label. The following example illustrates this method with the CHAIR-STOOL set:

(1) (Pictures of CHAIR, tree, unicorn, harp) 'Is there a chair here? Where? Put your finger on it'.
(2) (Pictures of STOOL, ball, tape, teakettle) 'Is there a chair here?…'
(3) (Pictures of CHAIR, knife, wrench, lyre) 'Is there a stool here?…'
(4) (Pictures of STOOL, stairs, gas-pump, iron) 'Is there a stool here?…'

An overextension was defined as a case in which a child knew the known label but did not know the new label, and he or she picked the new object as the referent of the known label (i.e. in the above example, the child answered 'yes' and pointed to the target object on the first and second presentations, but responded negatively or incorrectly in the third and fourth presentations).

As can be seen in the example above, in each of the four presentations a child saw four pictures: a target object, a familiar distracter, a less familiar distracter, and one of the less familiar-paired distracters (e.g. a chair, a tree, a unicorn, and a harp). The less familiar distracters were included so that children would not overextend a known, or new, label to a new object simply because it was a less familiar object. In other words, in each presentation in which a new object was present (e.g. stool) there was at least one other object children did not have a label for (e.g. unicorn). The less familiar-paired distracters were included so that the choice of a new object could not be based solely on the fact that the children had been exposed to it more than one time in the course of a trial; they also saw very similar distracters more than once (e.g. a harp and a lyre). The specific familiar, less familiar, and less familiar paired distracters the child saw accompanying each pair of target stimuli were assigned randomly. The position of the different types of pictures was randomly changed after each presentation to avoid any preferred position bias. Finally, the order in which the child saw the four presentations was also random.

The procedure was repeated until the child overextended four words or until the experimenter ran through the eight-item stimulus set. We limited the procedure in this way (i.e. concluding it once the child overextended four words) because otherwise the task would have been too demanding for two-year-olds. To maximize the likelihood of getting children tested on the same words in the subsequent sessions, we fixed the first four words to be presented to all children in Test 1 but allowed their order of presentation to be random. The first four target stimuli shown to the child were the ones numbered 1–4 in Table 1. If a child did not overextend all of the first four words, then additional targets were introduced, as needed, in the order displayed in Table 1. The target pairs in which an overextension occurred comprised that child's set of stimuli for subsequent sessions.

Session 2 – Training 1 and Test 2. In this session children were taught the labels of the new objects they had referred to with overextensions in Test 1. The instructions varied according to the child's condition. In the INCLUSIVE conditions, the linguistic input suggested the existence of an inclusion relation between the known and new labels. For example, children who overextended 'chair' to stools in Test 1 were told, 'This is a stool. It is a *kind of* chair; it's a stool. See, it has long legs and it's difficult to climb on it. It's a stool'. In the MUTUALLY EXCLUSIVE conditions, the linguistic input implied that the known and new labels referred to categories with no overlap. For example, children were told, 'This is a stool. It is *not a* chair; it's a stool. See, it has long legs and it's difficult to climb on it. It's a stool.' With both kinds of linguistic input, the experimenter pointed out to the child the same specific functional and perceptual features of the new object. The instructions for all stimuli are presented in Table 2.

TABLE 2. *Linguistic input for the inclusive and mutually exclusive conditions*

New label	Input
Stool	'This is a stool. It is [*a kind of/not a*] chair; it's a stool. See, it has long legs and it's difficult to climb on it. It's a stool.'
Chalice	'This is a chalice. It is [*a kind of/not a*] cup; it's a chalice. See, it is very thin here, for people to hold it. It's a chalice.'
Goggles	'These are goggles. They are [*a kind of/not*] glasses; they are goggles. See, they have black elastic bands on their sides, and people use them to protect their eyes. They are goggles.'
Clippers	'These are clippers. They are [*a kind of/not*] scissors; they are clippers. See, they have no place to put the fingers, and people use them to cut harder things. They are clippers.'
Mallet	'This is a mallet. It is [*a kind of/not a*] hammer; it's a mallet. See, its head is flat, and it is used by judges. It's a mallet.'
Glider	'This is a glider. It is [*a kind of/not an*] airplane; it's a glider. See, it has coloured wings and can carry only one person. It's a glider.'
Sandal	'This is a sandal. It is [*a kind of/not a*] shoe; it's a sandal. See, it is open, and people use it when it is hot. It's a sandal.'
Sailboard	'This is a sailboard. It is [*a kind of/not a*] boat; it's a sailboard. See, it has a surf-board, and it is all open. It's a sailboard.'

The child was taught two new labels for two stimulus items and then played with the experimenter in some unrelated activity (e.g. stickers) for a brief period of time (2–3 min). Children were then tested for their learning of these two new labels by the same four-presentation procedure used in Test 1. The distracters used in the test were the same as the ones used in Test 1, though they appeared in a different order. After another brief period of play, the child was taught the remaining new labels in his or her sub-set, played briefly again, and then was tested for the learning of the remaining labels. The same pattern of training–play–test for no more than two words at a time was maintained, regardless of the number of words a child overextended in Test 1.

Session 3 – Training 2 and Test 3. This session was identical to Session 2. It was incorporated in the design for two reasons. First, Vygotsky (1962) argued that for an adequate assessment of the process of children's acquisition of word meanings, one has to observe them more than one time. Second, children seem to learn new words better when they are taught those words more than once (Au & Laframboise, 1990; Shatz & Sidle, 1991).

Coding

Learning a new word was defined as cases in which a child picked the new object as the referent of the new label in Tests 2 or 3. In the example described above, if in answer to 'Is there a stool here?' the child pointed to

the stool, then that child would be considered as having learned the new label *stool*.

Children's responses to target pairs in Tests 2 and 3 were sorted according to the type of semantic relation established between the new and known labels into the following categories: (*a*) MUTUALLY EXCLUSIVE: the child picked only the known object as the referent of the known label and only the new object as the referent of the new label. (*b*) SUBORDINATE: the child picked both the known and new objects as the referents of the known label but only the new object as the referent of the new label. (*c*) SYNONYMOUS: the child picked both the known and new objects as the referents of the known label and also picked both as the referents of the new label. (*d*) SUPERORDINATE: the child picked both the known and new objects as the referents of the new label but only the known object as the referent of the known label. (*e*) OVEREXTENSION: the child did not learn the new label and kept overextending the known label to the new object. (*f*) NARROWING: the child did not learn the new label and yet stopped overextending the known label to the new object. (*g*) Other patterns of responses. Table 3 gives examples of these categories.

TABLE 3. *Coding: examples of response patterns*

Semantic relation	Labels requested	Child's choice
Mutually exclusive	Chair?	Chair
	Stool?	Stool
Subordinate	Chair?	Chair and stool
	Stool?	Stool
Synonymous	Chair?	Chair and stool
	Stool?	Chair and stool
Superordinate	Chair?	Chair
	Stool?	Chair and stool
Overextension	Chair?	Chair and stool
	Stool?	'no' or distracter
Narrowing	Chair?	Chair
	Stool?	'no' or distracter
Other	Chair?	Distracter
	Stool?	Chair

Codes (*e*) and (*f*) were included because they provide some information that is often disregarded in this kind of research. Specifically, if the child stops overextending the known label to the new object even though he or she does not learn the new label, then nonetheless some learning may have taken place – the child no longer assigns one label for two objects. This possibility is especially relevant in the context of this task, in which known labels were overextended to the new objects just 2 or 3 days prior to Tests 2 and 3. We expected that in cases where the new words were not learned, children in the dissimilar conditions as well as those receiving mutually exclusive input

would narrow overextensions more often than children in the similar conditions and those receiving inclusive input.

RESULTS

Amount of overextensions

Our first analysis regarded the number of labels children randomly assigned to the different conditions overextended in Test 1. We conducted an ANOVA with perceptual similarity and linguistic input as between-subjects factors and number of overextensions as the dependent measure. Obviously, in Test 1 children had not been exposed to the two conditions of linguistic input; this factor was included to test for any preexisting differences in the groups. As expected (see Table 4), children in the similar conditions

TABLE 4. *Number of children overextending labels in Test 1 by condition*

	Number of labels overextended			
Condition	1	2	3	4
Inclusive/dissimilar	—	4	4	3
Inclusive/similar	—	—	4	9
Mutually exclusive/dissimilar	1	2	4	5
Mutually exclusive/similar	—	—	5	9

overextended more labels in Test 1 ($M = 3{\cdot}67$) than children in the dissimilar conditions ($M = 3{\cdot}00$), $F(1, 46) = 10{\cdot}67$, $p < 0{\cdot}005$, but the difference between the two groups of children assigned to the two linguistic input conditions was not significant (Ms = 3·33 and 3·38, for the inclusive and mutually exclusive conditions respectively; $F(1, 46) = 0{\cdot}07$, $p > 0{\cdot}7$).

Amount of learning

ANOVAs assessing amount of learning were carried out using arc-sine transformed data. Because the number of labels taught to each child varied (according to the number of overextensions in Test 1), subjects' learning performance was coded in terms of proportion of words learned, out of those taught, in Tests 2 and 3. ANOVAs were conducted only on data from children who were TAUGHT more than one word in either test. Just one child was taught only one word and another child did not participate in Session 3. These two children were dropped from all further analyses unless noted. A preliminary $2 \times 2 \times 2$ repeated-measures ANOVA with test location (preschool or laboratory) and gender as between-subjects factors and test (Test 2 and Test 3) as within-subjects factor was conducted on the proportion of labels learned. There were no significant differences either between the preschool and the laboratory, $F(1, 44) = 0{\cdot}19$, $p > 0{\cdot}5$, or between girls and

https://doi.org/10.1017/S0305000997003218 Published online by Cambridge University Press

boys, $F(1, 44) = 0{\cdot}36$, $p > 0{\cdot}5$. These two factors were not included in subsequent analyses on amount of learning.

A $2 \times 2 \times 2$ repeated-measures ANOVA with perceptual similarity and linguistic input as between-subjects factors and test as a within-subjects factor, was conducted on the proportion of labels learned. As expected, children learned more new labels in Test 3 ($M = 0{\cdot}74$, S.D. $= 0{\cdot}34$) than in Test 2 ($M = 0{\cdot}61$, S.D. $= 0{\cdot}33$), $F(1, 44) = 9{\cdot}02$, $p < 0{\cdot}005$. Perceptual similarity had a significant effect, $F(1,44) = 4{\cdot}80$, $p < 0{\cdot}05$; as predicted children in the dissimilar conditions learned more than children in the similar conditions (see Table 5). Children receiving the inclusive instruction tended to

TABLE 5. *Mean proportion of new labels learned* (*out of those taught*)*

	Perceptual similarity	
Linguistic input	Dissimilar	Similar
Test 2		
Inclusive	0·72 (0·32)	0·58 (0·37)
Mutually exclusive	0·64 (0·31)	0·52 (0·32)
Test 3		
Inclusive	0·92 (0·17)	0·75 (0·35)
Mutually exclusive	0·79 (0·26)	0·51 (0·38)

* Data are derived from the children who were taught more than one word. S.D.s are in parentheses.

learn more than children receiving the mutually exclusive instruction, $F(1, 44) = 3{\cdot}29$, $p < 0{\cdot}08$ (see Table 5). No significant interactions were found. Given children's better learning performance in Test 3, we conducted a separate 2×2 ANOVA on the proportion of new labels learned in Test 3 only, with perceptual similarity and linguistic input as between-subjects variables. The effects of both perceptual similarity, $F(1, 44) = 5{\cdot}59$, $p < 0{\cdot}05$, and linguistic input, $F(1, 44) = 5{\cdot}26$, $p < 0{\cdot}05$, were significant. The interaction was not significant.

Children's performance was also analysed with regard to whether condition affected the number of good versus poor word learners. Good learners were defined as children learning more than 50% of the new labels taught to them by Test 3; poor learners were those learning 50% or less. Of 22 children in the dissimilar conditions, 18 were good word learners and only four were poor word learners. Of 26 children in the similar conditions, 14 were good word learners and 12 were poor word learners, $\chi^2(1, N = 48) = 4{\cdot}20$, $p < 0{\cdot}05$. Linguistic input did not have a significant effect on this measure. Of the 24 children in the inclusive conditions, 18 were good and six were poor word learners. In the mutually exclusive conditions, 14 children were good word learners and 10 were poor word learners.

Given the difference in the amount of labels overextended in Test 1, and thus on the number of labels taught in Sessions 2 and 3, between children in the similar and dissimilar conditions, we ran an analysis to check whether this disparity could account for the difference in learning performance between children in these two conditions. It could be argued that the fewer labels a child was taught, the easier they would be to learn. For this purpose, we created a discrete variable, amount of overextensions, by combining in one group the children who overextended four labels in Test 1 ($N = 25$), and in another, those who overextended less than four labels in Test 1 ($N = 23$). A $2 \times 2 \times 2$ repeated-measures ANOVA with overextension and perceptual similarity as between-subjects factors and proportion of labels learned in Test 2 and Test 3 as the dependent measures revealed no significant effect of amount of overextensions, $F(1, 44) = 1{\cdot}08$, $p > 0{\cdot}3$, and no interaction between overextension and perceptual similarity, $F(1, 44) = 0{\cdot}01$, $p > 0{\cdot}9$. Thus, the influence of perceptual dissimilarity on word learning cannot be accounted for by the differences in amount of overextensions in the groups.

Type of learning

Analyses on type of learning addressed the kinds of semantic relations between the new and known labels the children's responses revealed. For each child, the proportion of labels learned according to a given type was recorded. Across conditions and Tests 2 and 3, 191 of the 219 words learned were interpreted as mutually exclusive, subordinate, or synonymous. Table 6 shows the means for these three main types of learning, by condition and test.

TABLE 6. *Mean proportion of new labels that were learned, by type of semantic relation and test**

Condition	Type of semantic relation		
	Mutually exclusive	Subordinate	Synonymous
Test 2			
Inclusive/dissimilar	0·46	0·31	0·17
Inclusive/similar	0·17	0·49	0·34
Mutually exclusive/dissimilar	0·43	0·25	0·25
Mutually exclusive/similar	0·30	0·27	0·17
Test 3			
Inclusive/dissimilar	0·47	0·26	0·22
Inclusive/similar	0·20	0·34	0·33
Mutually exclusive/dissimilar	0·47	0·20	0·15
Mutually exclusive/similar	0·33	0·10	0·37

* Data derived from the children who learned more than one word.

https://doi.org/10.1017/S0305000997003218 Published online by Cambridge University Press

Four-way ANOVAs with arc-sine transformations were conducted for each main type of learning separately, with perceptual similarity, linguistic input, location, and gender entered as between-subjects factors. Because most of the learning occurred in Test 3, only the data from that test were used, and test was not included as a factor. Only the data from children who LEARNED more than one word were included ($N = 38$).

An ANOVA using the proportion of labels learned with a mutual exclusivity interpretation as the dependent measure revealed a significant effect of perceptual similarity, $F(1, 27) = 6{\cdot}54$, $p < 0{\cdot}02$; as expected children in the dissimilar conditions made more mutual exclusivity interpretations than children in the similar conditions. Linguistic input, however, did not have a significant effect, $F(1, 27) = 1{\cdot}70$, $p > 0{\cdot}2$. The interaction between perceptual similarity and linguistic input was not significant.

Surprisingly, there was a significant effect of location, $F(1, 27) = 6{\cdot}52$, $p < 0{\cdot}02$; children who were tested in the preschool showed a greater proportion of mutual exclusivity interpretations ($M = 0{\cdot}49$) than those tested in the laboratory ($M = 0{\cdot}32$). Gender did not have a significant effect, $F(1, 27) = 0{\cdot}64$, $p > 0{\cdot}4$. There was a significant interaction between linguistic input and gender, $F(1, 27) = 5{\cdot}28$, $p < 0{\cdot}05$: boys made more mutual exclusivity interpretations in the mutually exclusive conditions ($M = 0{\cdot}53$, $N = 12$) than in the inclusive conditions ($M = 0{\cdot}29$, $N = 12$); girls, however, made more mutual exclusivity interpretations in the inclusive conditions ($M = 0{\cdot}39$, $N = 9$) than in the mutually exclusive conditions ($M = 0{\cdot}10$, $N = 5$). ANOVA tests for simple effects revealed that input had a significant effect for boys, $F(1, 25) = 6{\cdot}81$, $p < 0{\cdot}05$; but not for girls, $F(1, 25) = 0{\cdot}76$, $p > 0{\cdot}3$. There was also a significant interaction between perceptual similarity and location, $F(1, 27) = 7{\cdot}97$, $p < 0{\cdot}01$: children tested in the preschool made more mutual exclusivity interpretations in the dissimilar conditions ($M = 0{\cdot}88$, $N = 4$) than in the similar conditions ($M = 0{\cdot}24$, $N = 6$); whereas children tested in the laboratory made only slightly more mutual exclusivity interpretations in the dissimilar conditions ($M = 0{\cdot}37$, $N = 15$) than in the similar conditions ($M = 0{\cdot}27$, $N = 13$). ANOVA tests for simple effects revealed a significant effect of perceptual similarity for the preschool children, $F(1, 25) = 16{\cdot}17$, $p < 0{\cdot}001$; but not for the children tested in the Lab, $F(1, 25) = 0{\cdot}54$, $p > 0{\cdot}4$. Given the small number of subjects in each cell, it is hard to interpret these interactions. As for the overall effect of location, a plausible explanation is that children tested in the preschool felt more comfortable – and may have been more attentive – than the children tested in the lab, given that the preschool children were in a more familiar environment. There was no experimenter bias, as the same experimenters tested in both locations.

We again checked for the effect of the amount of overextensions in Test 1 on the proportion of mutual exclusivity interpretations. The same discrete variable of amount of overextensions was used. A 2×2 ANOVA with

perceptual similarity and overextension as between-subjects factors revealed neither a significant effect of overextension, $F(1, 34) = 0{\cdot}71$, $p > 0{\cdot}4$, nor a significant interaction, $F(1, 34) = 0{\cdot}63$, $p > 0{\cdot}4$.

Although as can be seen in Table 6 there was a trend for children in the similar conditions to make more synonymy interpretations than children in the dissimilar conditions, and a trend for children in the inclusive conditions to make more subordinate interpretations than children in the mutually exclusive conditions, these differences did not reach significance.

Overextensions in Tests 2 and 3 continued to occur more often in the similar conditions than in the dissimilar conditions, as they had in Test 1, although the difference diminished with retesting. For this analysis, all 50 subjects were categorized as to whether they made at least one overextension in Test 2; all 49 subjects participating in Test 3 were so categorized. In Test 2, 15 of the 27 children in the similar conditions made at least one overextension, whereas only six of the 23 children in the dissimilar conditions did so, $\chi^2(1, N = 50) = 4{\cdot}43$, $p < 0{\cdot}04$. In Test 3, eight of the 26 children in the similar conditions and two of the 23 in the dissimilar conditions did so, $\chi^2(1, N = 49) = 3{\cdot}67$, $p < 0{\cdot}06$. There was no significant effect for linguistic input. In terms of narrowing of overextensions, neither perceptual similarity nor linguistic input had a significant effect. Children in the mutually exclusive conditions only tended to be more likely to narrow overextensions than children in the inclusive conditions. Seven of the 25 children in the mutually exclusive conditions but only two of the 24 in the inclusive conditions narrowed at least one overextension.

Consistency

For the children who learned more than one word in Test 3, their performance was examined for consistency of interpretations in that test. A child was defined as making a consistent interpretation if he or she made the same type of interpretation for at least two new labels. There was a tendency for children in the dissimilar conditions to be more consistent with mutual exclusivity interpretations: nine of the 19 children in the dissimilar conditions who learned at least two labels were consistent, whereas only four of the 19 children in the similar conditions were. This trend however, did not reach significance. Conversely, only one child in the dissimilar conditions made consistent synonymy interpretations, whereas six children in the similar conditions did so, $\chi^2(1, N = 38) = 4{\cdot}38$, $p < 0{\cdot}04$. There were no effects for subordinate interpretations, and linguistic input had no effect.

Consistency was also analysed in terms of the number of words interpreted in the same way in Tests 2 and 3. Children were categorized as to whether they had at least one word interpreted in the same way in both tests. Linguistic input did not affect this measure. Perceptual similarity, however, had a significant effect for mutual exclusivity interpretations. Nine of 23

children in the dissimilar conditions versus three of 27 in the similar conditions interpreted at least one new label as mutually exclusive to the known label in both tests, $\chi^2(1, N = 49) = 5{\cdot}02$, $p < 0{\cdot}03$. There were no significant effects for other types of interpretations.

DISCUSSION

One of our main goals in designing the procedure for this study was to try to facilitate children's acquisition of new labels. We believed that to assess children's choice of a semantic relation between new and old labels, new labels had to be easily acquired. As compared to other studies which also assessed children's amount of learning, it seems that our procedure succeeded in doing that. Across conditions, children in Test 2 learned 61 % of the new labels taught and 74 % in Test 3. Banigan & Mervis (1988) found that two-year-olds in their most effective input condition comprehended approximately 42 % of the new names. Merriman & Bowman (1989) found that two-year-olds correctly identified the referent of the new label only 40 % of the time in the hybrid condition and 27 % in the typical condition.

Acquisition effects

We expected two-year-olds in the dissimilar conditions to learn more labels than children in the similar conditions. Our results support this prediction. Children had an easier time acquiring labels for objects that were evidently distinct from familiar objects than they did for objects quite similar to familiar objects. This finding is consistent with claims in the literature about the importance of providing children with clear and discerning information about objects in order to facilitate learning (Mervis, 1987; Banigan & Mervis, 1988). This seems to be particularly relevant in our study, given that children had overextended a known label to the new object two to three days prior to being taught the new label. It is plausible then, that children in the similar conditions were quite reluctant to learn a new label for an object that looked so similar to a familiar object. It is important to emphasize that in the present study the objects were dissimilar only in terms of their appearance, not in terms of their taxonomic relatedness. The finding that perceptual dissimilarity facilitated word learning, then, is compatible with Tomasello *et al.*'s (1988) results that two-year-olds were more likely to learn a new label for an object taxonomically similar to a previously labelled object (e.g. the label 'sax' for saxophone, after having learned 'horn') than for a taxonomically dissimilar object (e.g. the label 'clip', after having learned 'horn').

Interestingly also, there was some indication that in Test 3 two-year-olds in the inclusive input conditions learned more new labels than the children in the exclusive conditions. This finding suggests that it is easier for toddlers to acquire a new label when it is introduced as being related in kind to a familiar label than when it is introduced as being different from a familiar

label. Callanan (1985) found that parents introduce new labels using instructions similar to the one used in our inclusive conditions. It is possible then that children in these conditions were somewhat used to being taught labels in that way, and thus had an easier time acquiring them. Our findings, however, contrast with previous studies in which no significant differences between input conditions similar to the ones used in our study were found (Shatz & Sidle, 1991; Gottfried & Tonks, 1996). Gottfried & Tonks (1996) used almost identical input conditions to the ones used in this study. However, whereas we tested two-year-olds, they focused on three-, four- and five-year-olds. By then, these different instructions may not affect children's amount of learning, though they may affect children's interpretation. As for Shatz & Sidle's (1991), their 'contrast' condition was somewhat different from the one used in this study's exclusive condition. Children in their contrast condition were told: 'this is a [new label], it's *like* a [old label] but it's a [new label].' (our emphasis). It is possible that children interpreted instructions with this wording the same way they did the inclusion instructions, that is, as also emphasizing similarities between the two objects.

In sum then, differences in the degree of perceptual similarity between referents of a familiar and a new label, significantly affected two-year-olds' acquisition of new labels. Moreover, it seems that input emphasizing an inclusive relation between a new and familiar label facilitated two-year-olds' acquisition of new labels.

Relation effects

Quite surprisingly, although linguistic input seemed to affect whether children acquired a new label, it did not affect the sorts of relations between two labels children acquired. Children who were taught the new label by being told 'it was not' a known label, were not more likely to interpret the labels as indeed mutually exclusive, than did children who were told the new label was 'a kind of' known label. Also, regardless of instructions, children were equally likely to interpret the new label as a subordinate to the known label. As suggested by the finding of an input effect regarding acquisition *per se*, it is unlikely that the two-year-olds ignored the instructions altogether. Furthermore, Merriman (1986) found that mutually exclusive instructions increased the likelihood of mutual exclusivity interpretations among two-year-olds, when compared to instructions without explicit relational information. It seems improbable also that our subjects' low use of linguistic input for deciding on relations had to do with a more basic difficulty in understanding inclusion relations or categorizing objects at either subordinate or superordinate levels (but see Mervis & Crisafi, 1982; Gelman & Baillargeon, 1983). Overall in our study, approximately 25% of the new labels were interpreted as subordinates to known labels. This figure is congruent with findings that two- and three-year-olds are quite likely to

interpret a new label as a subordinate term to a familiar label (Taylor & Gelman, 1989; Waxman, Shipley & Shepperson, 1991; Mervis, Golinkoff & Bertrand, 1994). Our results then confirm that two-year-olds can create various semantic relations between labels.

What is plausible though, is that two-year-olds have some difficulty discerning the specific semantic relation between labels implied by a particular input. Thus, although they are capable of creating all sorts of semantic relations between two labels, they do so not necessarily based on the linguistic input they receive. Previous studies found that by age 3;0 children are capable of distinguishing between inputs emphasizing inclusive versus exclusive relations (Callanan, 1989; Gottfried & Tonks, 1996). In fact, work in progress suggests that even two-and-a-half-year-olds are capable of differentiating between our linguistic inputs for creating different sorts of semantic relations between two labels (Diesendruck & Shatz, 1997). As Shatz & Wilcox (1991) have argued, with development not only do the constraints on word learning change, but the input and how the child interprets the input change as well, thus leading to different patterns of acquisition depending on age.

One of our main hypotheses was that two-year-olds would use information about the perceptual similarity between objects to situate new labels relative to old ones. As predicted, when the two objects were perceptually dissimilar, toddlers were more likely to interpret their labels as mutually exclusive than when the two objects were perceptually similar. This was manifest in a variety of measures. Compared to the similar conditions, in the dissimilar conditions, children interpreted more new labels as mutually exclusive from known ones and tended to interpret fewer labels as synonyms, more children interpreted multiple words as mutually exclusive, more children were consistent in their mutual exclusivity interpretation across sessions, and fewer children continued overextending after the two training sessions. Moreover, even though perceptual similarity affected the amount of over-extensions in Test 1, it independently influenced the interpretation of new labels learned; children in the dissimilar conditions went on more frequently to interpret the labels as mutually exclusive than did children in the similar conditions.

Our findings in the dissimilar conditions stand in contrast to Banigan & Mervis's (1988) results. In their study, out of 67 new category labels acquired by two-year-olds, only three received mutual exclusivity interpretations. Methodological differences between the two studies may account for this disparity. When testing for children's acquisition of the new labels in this study, the experimenter did not continuously ask children to pick 'another' referent of a target label, as was done in Banigan & Mervis (1988). We believe that our procedure reduced the likelihood of children picking multiple referents for a single label (i.e. creating inclusive categories) for

pragmatic reasons. Moreover, it is possible that given differences between the two studies in the manner (e.g. instructions) in which the experimenter taught new labels, children went on to interpret the relation between new and old labels differently as well.

Based on our findings, perceptual similarity may qualify as a sort of conclusive evidence for two-year-olds that labels do not denote mutually exclusive categories. In other words, it is one of the factors that help toddlers decide on the semantic relation between two labels. It is important to emphasize that perceptual similarity alone cannot account for the specific types of interpretation children make. Perceptual similarity might help children set the boundaries of their labels at one specific level, as if delimiting the extension of a category. In fact, our findings on the effect of perceptual similarity on the amount of overextensions may be interpreted as a manifestation of this process. Perceptual similarity, however, does not determine whether a label is subordinate, mutually exclusive or superordinate to another one. In our study, the fact that two different objects had different labels led children to interpret the labels as referring to mutually exclusive categories. If there were no labels associated with the objects, children might have thought that the objects belonged to the same category (e.g. a collie and a chihuahua are both dogs despite being perceptually dissimilar). Thus, to account for the process of acquisition of word meaning, one has to postulate the existence of constraints that bias children's interpretations of the meaning of words and their construal of categories. Such constraints – particularly the mutual exclusivity bias – may be fundamental in a model explaining children's acquisition of word meaning. Perceptual similarity then, can be conceived as a factor moderating the operation of a mutual exclusivity bias. As Woodward & Markman (1991) would argue, various findings taken as violations of mutual exclusivity can then be reinterpreted as evidence of the moderating role of perceptual similarity in children's decisions about the relation between new and known labels (e.g. Merriman & Bowman, 1989; Taylor & Gelman, 1989; Waxman & Senghas, 1992).

In conclusion, we found that both linguistic input and perceptual similarity affect two-year-olds' acquisition of new labels. Moreover, having acquired a new label, two-year-olds are influenced by the perceptual similarity between the referents of labels in deciding on the relation between them. Overall then, two-year-olds are capable of maintaining various semantic relations between new and old labels. Their choice of relation is based on the particulars of the learning context and their word-learning biases. These biases, however, do not work in an all-or-none manner. Instead, they are general tendencies that can be overcome by children when presented with relevant and understandable information to do so. Our task as researchers is to identify the potential sources of information that, at various points of development, might affect children's decisions about the meaning of words. As suggested

above, the most obvious and important place to look for these sources is in children's intrinsic propensities and their natural learning contexts.

REFERENCES

Au, T. K.-F. & Laframboise, D. E. (1990). Acquiring color names via linguistic contrast: the influence of contrasting terms. *Child Development* **61**, 1808–23.

Banigan, R. L. & Mervis, C. B. (1988). Role of adult input in young children's category evolution: II an experimental study. *Journal of Child Language* **15**, 493–504.

Barrett, M. D. (1978). Lexical development and overextension in child language. *Journal of Child Language* **5**, 205–19.

Behrend, D. A. (1990). Constraints and development: a reply to Nelson (1988). *Cognitive Development* **5**, 313–30.

Callanan, M. (1985). How parents label objects for young children: the role of input in the acquisition of category hierarchies. *Child Development* **56**, 508–23.

Callanan, M. (1989). Development of object categories and inclusion relations: preschoolers' hypotheses about word meanings. *Developmental Psychology* **25**, 207–16.

Carey, S. (1982). Semantic development: The state of the art. In E. Wanner and L. R. Gleitman (eds), *Language acquisition: the state of the art* (pp. 347–89). Cambridge: C.U.P.

Clark, E. V. (1988). On the logic of contrast. *Journal of Child Language* **15**, 317–35.

Diesendruck, G., Gelman, S. A. & Lebowitz, K. (1997). *Conceptual and linguistic biases in children's word learning*. Manuscript submitted for publication.

Diesendruck, G. & Shatz, M. (1997). *Taxonomic relatedness and linguistic input as clues to two-year-olds' interpretation of the relation between labels*. Poster presented at the Biennial Meetings of the Society for Research in Child Development, Washington, DC.

Gelman, R. & Baillargeon, R. (1983). A review of some Piagetian concepts. In J. H. Flavell and E. M. Markman (eds), P. H. Mussen (Series ed.), *Handbook of child psychology: Vol. 3, Cognitive development* (pp. 167–230). New York: Wiley.

Gentner, D. (1982). A study of early word meaning using artificial objects: what looks like a Jiggy but acts like a Zimbo? In J. Gardner (ed.), *Readings in developmental psychology* (pp. 137–43). Boston: Little Brown.

Golinkoff, R. M., Mervis, C. B. & Hirsch-Pasek, K. (1994). Early object labels: the case for lexical principles. *Journal of Child Language* **21**, 125–55.

Gottfried, G. M. & Tonks, S. J. M. (1996). Specifying the relation between novel and known: input affects the acquisition of novel color terms. *Child Development* **67**, 850–66.

Kuczaj II, S. A. (1990). Constraining constraint theories. *Cognitive Development* **5**, 341–4.

Macnamara, J. (1982). *Names for things*. Cambridge, MA: MIT Press.

Markman, E. M. (1989). *Categorization and naming in children: problems of induction*. Cambridge, MA: MIT Press.

Merriman, W. E. (1986). Some reasons for the occurrence and eventual correction of children's naming errors. *Child Development* **57**, 942–52.

Merriman, W. E. & Bowman, L. L. (1989). The mutual exclusivity bias in children's word learning. *Monographs of the Society for Research in Child Development* **54**, (3–4, Serial No. 220).

Merriman, W. E., Scott, P. D. & Marazita, J. (1993). An appearance-function shift in children's object naming. *Journal of Child Language* **20**, 101–18.

Mervis, C. B. (1987). Child-basic object categories and early lexical development. In U. Neisser (ed.), *Concepts and conceptual development: ecological and intellectual factors in categorization* (pp. 201–33). Cambridge: C.U.P.

Mervis, C. B. & Crisafi, M. A. (1982). Order of acquisition of subordinate- basic- and superordinate-level categories. *Child Development* **53**, 258–66.

Mervis, C. B., Johnson, K. E. & Mervis, C. A. (1994). Acquisition of subordinate categories by three-year-olds: the roles of attribute salience, linguistic input, and child characteristics. *Cognitive Development* **9**, 211–34.

Mervis, C. B., Golinkoff, R. M. & Bertrand, J. (1994). Two-year-olds readily learn multiple labels for the same basic-level category. *Child Development* **65**, 1163–77.
Nelson, K. (1988). Constraints on word learning? *Cognitive Development* **3**, 221–46.
Shatz, M. (1993, July). *Ways to words : early strategies for building a lexicon*. Paper presented at the 6th International Congress for the Study of Child Language, Trieste, Italy.
Shatz, M. & Sidle, A. L. (1991). *Correction of object-name overextensions in two-year-olds*. Unpublished manuscript, The University of Michigan, Ann Arbor.
Shatz, M. & Wilcox, S. A. (1991). Constraints on the acquisition of English modals. In S. A. Gelman and J. P. Byrnes (eds), *Perspectives on language and thought : interrelations in development* (pp. 319–53). Cambridge: C.U.P.
Smith, L. B., Jones, S. S. & Landau, B. (1996). Naming in young children: a dumb attentional mechanism. *Cognition* **60**, 143–71.
Taylor, M. & Gelman, S. A. (1989). Incorporating new words into the lexicon: preliminary evidence for language hierarchies in two-year-old children. *Child Development* **60**, 625–36.
Tomasello, M., Mannle, S. & Werdenschlag, L. (1988). The effect of previously learned words on the child's acquisition of words for similar referents. *Journal of Child Language* **15**, 505–15.
Tomikawa, S. A. & Dodd, D. H. (1980). Early word meanings: perceptually or functionally based? *Child Development* **51**, 1103–9.
Tversky, B. (1985). Development of taxonomic organization of named and pictured categories. *Developmental Psychology* **21**, 1111–19.
Vygotsky, L. (1962). *Thought and language*. Cambridge, MA: MIT Press.
Waxman, S. R. & Hatch, T. (1992). Beyond the basics: preschool children label objects flexibly at multiple hierarchical level. *Journal of Child Language* **19**, 153–66.
Waxman, S. R. & Senghas, A. (1992). Relations among word meanings in early lexical development. *Developmental Psychology* **28**, 862–73.
Waxman, S. R., Shipley, E. F. & Shepperson, B. (1991). Establishing new subcategories: the role of category labels and existing knowledge. *Child Development* **62**, 127–38.
Woodward, A. L. & Markman, E. M. (1991). Constraints on learning as default assumptions: comments on Merriman and Bowman's 'The Mutual Exclusivity Bias in children's word learning'. *Developmental Review* **11**, 137–63.