



## PAPER

# Focusing on the relation: fewer exemplars facilitate children's initial verb learning and extension

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## Abstract

*One of the most prominent theories for why children struggle to learn verbs is that verb learning requires the abstraction of relations between an object and its action (Gentner, 2003). Two hypotheses suggest how children extract relations to extend a novel verb: (1) seeing many different exemplars allows children to detect the invariant relation between actions in different contexts (Gentner, 2003), and (2) repetition of fewer exemplars allows children to move beyond the entities involved to extract the relation (Kersten & Smith, 2002). We tested 2½- and 3-year-olds' ability to extend a novel verb after viewing the repetition of one novel actor compared to four different actors performing a novel action. Both ages were better at learning and extending a novel verb to a novel actor when shown only one actor rather than four different actors. These results indicate that during initial verb learning less information is more effective.*

## Introduction

Any theory of word learning must address not only how children learn object labels, such as *Jim* or *brick*, but also how they learn to express relations between objects, such as *Jim*, *break the brick* or *Throw the brick at Jim*. In English and many other languages, such relations are encoded primarily in verbs and prepositions. Unlike nouns, verbs are inherently relational as some agent must perform the action, as in intransitive verbs; or some action is performed on an object, as in transitive verbs. Although relational terms such as verbs are integral to language, they are harder to learn than object labels (Gentner, 1982; Hirsh-Pasek & Golinkoff, 2006; Imai, Haryu & Okada, 2005; but see Tardif, 2006). One of the major stumbling blocks for children learning and extending new verb labels is their focus on the objects and agents involved in the action to the neglect of the relation between them (Behrend, 1990; Forbes & Farrar, 1993; Gentner, 1988; Kersten & Smith, 2002). Here we investigate how children might overcome this natural object bias to appropriately learn and extend a novel verb label.

There is ample support for the claim that children are biased to attend to objects and agents, even in verb learning situations. Behrend (1990) found that 3- and 5-year-olds were less likely than adults to extend a novel

verb label to an action that included an instrument change. For example, if children were taught the label 'bocking' for cutting clay in half with a spaghetti portioner, they were less likely than adults to say that 'bocking' was an appropriate name for the same action performed with a stone as the clay cutting instrument. Similar findings were reported by Forbes and Farrar (1993) when teaching novel verbs to 3-year-olds, 10-year-olds, and adults.

Kersten and Smith (2002) further strengthened the claim that children focus on novel entities to the neglect of relations in a verb learning context. Using novel actions performed by novel or familiar animated characters, they taught 3- and 4-year-olds new verbs. When the agents were novel, children attended more to the agents than to the action. In contrast, when the agents were familiar children appropriately attended to the action upon hearing the novel verb. Thus, in the presence of novel agents, verb learning is impeded by children's attention to the entities rather than to the actions involved. To date, two distinct positions suggest ways in which children might overcome this bias to learn a new verb and extend it to novel contexts.

One theory suggests that children require *multiple different exemplars* to learn an action label. According to Gentner (2003) and Smiley and Huttenlocher (1995), children's initial word meanings are bound to specific objects and actors. Upon encountering a shared label

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across exemplars, children make comparisons and then uncover the relational commonality to which the label refers. Indeed, there is an abundance of related evidence with object categories that hearing a noun label applied to a diverse set of instances invites children to form an abstract object category (Balaban & Waxman, 1997; Gelman & Coley, 1990; Graham, Kilbreath & Welder, 2004; Liu, Golinkoff & Sak, 2001; Waxman & Klibanoff, 2000).

Evidence from natural speech samples indicates that this may be even more important in the acquisition of verbs than in the acquisition of nouns (Gallivan, 1987; Hoff & Naigles, 2002; Rinaldi, Barca & Burani, 2004; Sandhofer, Smith & Luo, 2000). For example, Gallivan (1987) found a strong positive correlation between a parent's production and their child's production of particular motion verbs. It seems that hearing these verbs in multiple situations over time speeds the child's ability to correctly use the verb in a natural situation. When comparing nouns and verbs in terms of parental input, Sandhofer *et al.* (2000) found that both English- and Mandarin-speaking parents use very few verbs, but repeat them often, while using many different nouns and repeating them much more rarely. Similar patterns of adult input speech have been reported in Italian (Rinaldi *et al.*, 2004). Thus, it seems necessary for children to see multiple instantiations of an action with a common label to correctly abstract and extend a novel verb.

Experimental studies have also shown that viewing many rather than fewer instances facilitates the formation of nonlinguistic relational categories (Bomba & Siqueland, 1983; Gomez, 2002). For example, Bomba and Siqueland (1983) found that 3- and 4-month-old infants acquired an abstract spatial relation more easily when familiarized with 12 than with six exemplars of that relation. From this perspective, viewing many exemplars may help to direct attention to the relational commonality and away from the elements forming the relation. The same logic could hold in the process of learning a novel relational action label: viewing multiple different exemplars may highlight the common relation beyond the individual agents or objects.

A second position, however, suggests that children extract relational categories more effectively with repetition of a *limited number of exemplars*. Based on literature on nonlinguistic relational category formation, Casasola (2005) and others (Casasola & Cohen, 2002; Kersten & Smith, 2002; Quinn, Polly, Furer, Dobson & Narter, 2002) have argued that before infants learn to attend to a relation between objects, they attend to the objects composing that relation. With repeated exposure, however, infants' attention can move to the relation between the objects and eventually infants can learn to abstract the relation independent of the specific objects. On this view, because infants are biased toward objects in processing relations, limiting the number of objects used to instantiate a relation should benefit infants more than presenting multiple exemplars.

Work by Quinn and his associates (Quinn, Adams, Kennedy, Shettler & Wasnik, 2003; Quinn, Cummins, Kase, Martin & Weissman, 1996; Quinn, Norris, Pasko, Schmader & Mash, 1999; Quinn *et al.*, 2002) supports this proposal that children's initial understanding of relations is specific to particular objects and is only later extended to new objects. For example, research suggests that at 3 months of age, children comprehend the relational concepts of *above* versus *below* when shown the same object multiple times during familiarization and test, but not when shown multiple different objects depicting the relationship. It is not until 6 months that they can extract these relations when they are instantiated with novel object combinations (Quinn *et al.*, 1996). Similarly, the concept of *between* appears at 6–7 months with familiar objects, but only at 9–10 months with novel objects (Quinn *et al.*, 2003).

Casasola (2005) found that repetition of fewer exemplars also allowed for the extension of relational understanding to novel object pairs. She habituated 10- and 14-month-old infants to examples of a support relation (*on*) with either two pairs of objects or six pairs (e.g. a stacking cup and a toy dog). Fourteen-month-olds displayed knowledge of the spatial category with novel objects *only* in the two-exemplar condition. Younger children and those in the six-exemplar condition did not show this effect. Showing fewer objects multiple times appears to allow infants to familiarize themselves sufficiently with the items so as to move beyond the particular objects to attend to the relation between those objects.

Thus, research on relational category formation suggests that children do best in abstracting and extending relational categories when fewer novel objects are shown multiple times in the target relation (Casasola, 2005; Casasola & Cohen, 2002; Kersten & Smith, 2002; Quinn *et al.*, 2002). Furthermore, one theory of language acquisition, the 'less is more' theory (Newport, 1990), is consistent with the notion that restriction of information is useful for getting language off the ground. It stands to reason that verb learning might follow a similar pattern. However, there is equally convincing data indicating that multiple exemplars are necessary for relational understanding and verb acquisition (Bomba & Siqueland, 1983; Gentner, 2003; Gomez, 2002; Smiley & Huttenlocher, 1995). To date, it remains an open question as to whether children are aided or hindered by seeing many novel exemplars in a verb learning task. Here we address this question with children who are 2 and 3 years of age.

## Method

### Participants

There were two age groups, 30–32 months of age ( $M = 31.42$ ,  $SD = .90$ ) and 36–38 months ( $M = 37.49$ ,  $SD = .92$ ), primarily Caucasian, drawn from a suburban area ( $n = 78$ ). Participants were removed due to experimenter

**Table 1** *Training and test phases (multiple exemplars condition)*

Trial	Script	Video display		
		Left	Center	Right
Center	Now watch blinking!		Baby	
+Training: A1	Blinking! Do you see her blinking? Watch her blinking.		Actress 1: Action A	
Center	We're going to see more blinking!		Baby	
Training: A2	Hey, Blinking! Do you see her blinking? Watch her blinking.		Actress 2: Action A	
Center	More blinking!		Baby	
Training: A3	Look! She's blinking! Watch her blinking! She's blinking!		Actress 3: Action A	
Center	We're going to see more blinking!		Baby	
Training: A4	Wow! More blinking! She's blinking. Watch her blinking!		Actress 4: Action A	
Center	Find blinking!		Baby	
Test: A1	Point to the girl who's blinking. Can you point to the one who's blinking?	Actress 5: Action A		Actress 6: Action B
Center	Find blinking again!		Baby	
*Test: A2	Point to the girl who's blinking. Can you point to the one who is blinking?	Actress 5: Action A		Actress 6: Action B

+ For the One Exemplar condition, the visual images of Training Trials 2–4 are identical to Training Trial 1. The script is identical to the one above.

\* After completion of this section the training is continued with new actions and a new label ('hirshing') used in the identical script followed by Test B1 and Test B2.

error (10) and fussiness or failure to complete the task (four), leaving 32 (16 males; 16 females) children in each age group.

### Apparatus

Participants saw a 34 × 26 inch television and two digital cameras balanced on either side of the TV. One camera served as a videotape player feeding the video stimuli to the television, while the other was used to record the participant's responses. The participant sat alone in a chair 72 inches in front of the center of the television with the experimenter directly behind the chair. From this spot, the experimenter recorded the child's pointing responses during the 1 min 13 sec experiment. All participants' responses were videotaped allowing for 10% of randomly selected videos to be coded offline by a blind coder. Reliability for online and offline coding was 100%.

### Materials and procedure

The stimuli were digital movies created using Adobe Premiere 6.5. There were four whole body actions performed by female actresses. Actions were intransitive with the belief that these, although relational in nature (Gentner & Boroditsky, 2001), might be easier for children to acquire than transitive action labels. Children were randomly assigned to either the single or multiple exemplar condition. Both conditions were identical except for the visual display during the training session.

All auditory stimuli were presented in infant-directed speech by a female experimenter who stood behind the child. The experiment contained six phases: centering and pointing practice, followed by training A, test phase A, training B, and test phase B (see Table 1). The logic of the design was to teach participants a novel label for a novel action and then test for label extension.

Between each 6-second training clip and each 6-second test clip was a 3-second 'centering' clip showing a smiling baby's face in the center of the television screen. This clip was designed to reorient children's attention to the center of the screen between test trials. The novel verb was introduced prior to (and following) each training trial.

During the *pointing practice phase*, children were trained to point in response to the experimenter's questions. This included two items with familiar objects (e.g. truck, cow) and one with familiar actions (dancing, drinking). Children were permitted to fail only one of these three practice trials before being removed from the study; no child was discarded from the sample for this reason. The location of the correct response (left or right) was counterbalanced within and between children.

In *training phase A*, participants were given a novel label for a novel action that took up the whole screen and was performed by a female actress. Four 6-second training trials were each separated by a 3-second centering trial. The appearance of the action was accompanied by the experimenter labeling, 'Look, she's blinking! Do you see her blinking? Watch her blinking!' Each 6-second clip was labeled three times following a fixed script. The key manipulation was the number of different exemplars the child saw during training. In the *multiple exemplar condition*, children saw four different female actresses performing the same action for 6 seconds each; in the *single exemplar condition*, a video clip of one actress (randomly selected from the multiple exemplar condition) was repeated four times. The target action was counterbalanced across conditions.

*Test phase A* was the same regardless of training condition. Its purpose was to determine whether the child had learned the name for the novel action and could extend it to a novel actor. The video display was a split screen showing two novel actresses each performing different actions. One side of the screen displayed the target action from training; the other showed a novel action.

As the video appeared, the experimenter asked the child, 'Who is blinking? Point to her blinking. Can you find her blinking?' and then recorded the child's response (Test A1). This trial was then repeated a second time (Test A2). The side on which the match appeared was counterbalanced across and within children.

*Training and test phases B* were identical to training phase A but with a third novel action, new actresses, and another novel label ('hirshing') given in the same syntactic frames as above. As in testing phase A, in testing phase B the children saw two new actresses, one performing the target action and the other performing a different novel action. They were asked, 'Who is hirshing? Point to her hirshing', etc. The test trial was then repeated. Thus, phase B was simply a replication of phase A with a second set of actions.

## Results

### *Which responses were analyzed?*

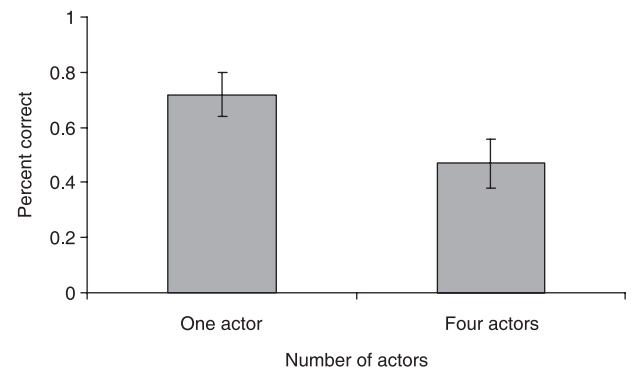
Responses were considered correct if the child pointed at the target action performed by a new agent when it was requested by name. Many children (33%) did not consistently give the same responses in test A1 and test A2 or test B1 and test B2, despite the fact that the video and questions were identical. Our interpretation is that even at 31 months, children are sensitive to the conversational implication of asking the same question twice and that participants assumed they were asked for a *second* response because their first response did not satisfy. For these reasons, only the data from test trials A1 and B1 are reported. Note that with a pointing task, a child may achieve a correct response by chance 50% of the time. For this reason, children were reported as passing the task if they pointed to the correct action in both tests A1 and B1, reducing chance to 25%.

### *Were children able to map and extend the new action name?*

A 2 (sex: male, female)  $\times$  2 (condition: single versus multiple exemplars)  $\times$  2 (age group: 31-month-olds, 36-month-olds) ANOVA on the percentage of correct responses revealed no significant sex or age group differences (all  $ps > .30$ ). There was, however, a significant effect of condition,  $F(1, 62) = 4.29$ ,  $p < .05$ . As depicted in Figure 1 children were significantly more likely to correctly extend a label when there was one actor (72%,  $SD = .46$ ) than when there were multiple actors (47% correct,  $SD = .51$ ).

### *Were children's extensions above chance levels?*

Because there were no significant age differences the results from both age groups were collapsed. A two-tailed one-sample  $t$ -test was performed because there were no



**Figure 1** Percentage of participants extending the target action label correctly.

**Table 2** Results by condition and age group and by condition and test trials

	Percent correct one actor	Percent correct multiple actors
30–32 mo.	62.5 ( $SD = .50$ )	43.8 ( $SD = .51$ )
36–38 mo.	81.3 ( $SD = .40$ )	50.0 ( $SD = .52$ )
Test A1	93.6 ( $SD = .25$ )	75.0 ( $SD = .44$ )
Test B1	86.7 ( $SD = .35$ )	67.7 ( $SD = .48$ )

*a priori* assumptions about which condition would be easier for children. The results show the percentage of children passing the task was significantly above chance (25%) when given one exemplar,  $t(31) = 5.81$ ,  $p < .001$ , and when given multiple exemplars,  $t(31) = 2.44$ ,  $p = .02$ . Confirming that this finding was not carried by one age group or test trial, Table 2 indicates that the ability to extend a label more effectively after seeing one exemplar four times compared to four different exemplars was robust across age group and test trial.

## Discussion

The purpose of the current experiment was to adjudicate between two views on the mechanisms that allow children to abstract and label relations. On the one hand, Gentner (2003) and Smiley and Huttenlocher (1995) suggested that children need to see multiple exemplars of a target action to extract the relational features encoded in a particular verb. On the other hand, research in relational category formation has shown that young children are aided in extracting relational categories with fewer exemplars (Casasola, 2005) or when familiar items are used to instantiate the relation (Quinn *et al.*, 1999, 2002, 2003; Kersten & Smith, 2002). The results here support the findings from the latter perspective: children were significantly better at mapping and extending a novel verb label when they were shown fewer rather than many exemplars. As in Casasola (2005) and Quinn's work (Quinn *et al.*, 1999, 2002, 2003; Kersten & Smith, 2002) on relational category formation, too much variability in

early exposures hindered children's ability to abstract and attach a label to relations in an action.

It is important to note that in both conditions children were above chance levels in their ability to extend the novel label. However, there were significant differences between the two conditions. In fact, 25% more children were able to reliably extend the label to the novel exemplar in the single exemplar condition. Thus, this is a significantly more effective way for children to learn a novel verb label at ages 2 and 3 years. Why might this be the case? We suggest that, as proposed by Casasola (2005) and others (Casasola & Cohen, 2002; Kersten & Smith, 2002; Quinn *et al.*, 2002) concerning nonlinguistic relational category formation, by seeing multiple instances of the same exemplar, children in the single actor condition were given the opportunity to gain greater familiarity with the actor instantiating the relation, thereby enabling them to focus more attention on the action relation itself. This greater attention to the action relation during training resulted in more effective verb learning and superior performance in the single exemplar condition.

If 2½- and 3-year-old children benefit from viewing fewer exemplars, might this trend be stronger for younger children? In previous work (Maguire, Meyers & Salkind, 2003), 24- to 26-month-olds completed the identical study as a preferential looking task. Here, visual fixation towards the target action (the correct extension) was measured as the dependent variable instead of pointing. This paradigm has proven successful for testing young children's verb comprehension in multiple studies (Forbes & Poulin-Dubois, 1997; Golinkoff, Hirsh-Pasek, Cauley & Gordon, 1987; Maguire, Hennon, Hirsh-Pasek, Golinkoff, Slutzky & Sootsman, 2002; Naigles, 1997). In this case we found that, unlike their peers of only 6 months older, younger participants were unable to correctly extend the label in either the one actor or multiple actors conditions. Thus, previous research does not support the hypothesis that the benefit of viewing fewer exemplars is even stronger for younger children. Rather, results suggest that the extraction of the relation between an agent and an action is a difficult task. As much prior work suggests (e.g. Hirsh-Pasek & Golinkoff, 2006), the development of verb concepts takes years to master, not becoming adult-like until quite late compared to object concepts.

What kind of action concept did children acquire in the single actor condition of the current experiments? The representation created with such limited exposure is likely much narrower than the range of instances a verb covers. For example, children may have interpreted 'blicking' narrowly as a young Caucasian woman performing the target action. In adult vocabularies, however, verbs apply to a wide range of the same actions performed by different entities and in variable ways. For example, 'running' is running whether the agent is your brother, an Olympian, Grandma, or the family dog. 'Running' can even apply to inanimate objects like the refrigerator or one's car. For this reason, limited variability in the exemplars labeled by a verb may be quite important for

forming an initial representation – a conjecture supported by the results here. Initial, narrow meanings may be crucial in forming a solid mental representation of a relation before children can extend the boundaries of the relational category to nonhuman entities, and even metaphorically to inanimate objects.

The notion that relational words, or specifically verb meanings, start narrow and gradually broaden is a common argument. This argument is made both in terms of narrowly extending verb syntactic structures (Akhtar & Tomasello, 1997; Tomasello, 1992; Tomasello, Brooks & Stern, 1998; Sandhofer *et al.*, 2000) and in learning verb labels (Behrend, 1990; Forbes & Farrar, 1993; Maguire, Hirsh-Pasek & Golinkoff, 2006). For example, Behrend (1990) and Forbes and Farrar (1993) demonstrated that initial verb meanings are quite specific for children compared to adults. In fact, Smiley and Huttenlocher (1995) argued that children construe some verb meanings so narrowly that they initially limit labels to actions only they themselves perform, taking up to a month to extend to other agents.

Children will need to see many more exemplars of an action to acquire an adult-like concept of a verb's meaning. Perhaps even in this paradigm, children would have learned a verb label with multiple exemplars as consistently as in the single exemplar condition had they been given an opportunity to directly compare the exemplars to find the commonality. While past research indicates that comparisons help in abstracting relations (Behrend, 1995; Gentner & Boroditsky, 2001), this kind of opportunity is not common in real-world verb learning situations. Rarely do children see two agents side by side performing the same action as it is labeled. Instead, it is more likely that children have to hold a representation in memory for an extended time period and compare each new instance to their mental representation of a similar event. Although our time delay of 3 seconds between exemplars is arguably much less than children usually experience, it forces children to compare instances to a stored mental representation to abstract commonalities.

In conclusion, the present results suggest that fewer exemplars aid in initial verb learning as compared to multiple exemplars. Once a solid representation of a labeled action is available and the child has a stored mental representation against which to compare subsequent exemplars, the child can begin to stretch the boundaries of their relational category. To gain an adult-like representation of a verb, the child will require multiple exemplars; but, initially, too much information is more of a hindrance than a help in verb learning.

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