Children extend both words and non-verbal actions to novel exemplars

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Abstract

Markson and Bloom (1997) found that some learning processes involved in children's acquisition of a new word are also involved in their acquisition of a new fact. They argued that these findings provided evidence against a domain-specific system for word learning. However, Waxman and Booth (2000) found that whereas children quite readily extend newly learned words to novel exemplars within a category, they do not do this with newly learned facts. They therefore argued that because children did not extend some facts in a principled way, word learning and fact learning may result from different domain-specific processes. In the current study, we argue that facts are a poor comparison in this argument since facts vary in whether they are tied to particular individuals. A more appropriate comparison is a conventional non-verbal action on an object – ‘what we do with things like this’ – since they are routinely generalized categorically to new objects. Our study shows that 2½-year-old children extend novel non-verbal actions to new objects in the same way that they extend novel words to new objects. The findings provide support for the view that word learning represents a unique configuration of more general learning processes.

Introduction

Markson and Bloom (1997) found that some of the same learning processes involved in children's acquisition of a new word are also involved in their acquisition of a new fact. Specifically, they found that when children were shown a novel object and told either 'This is a koba' (name) or 'My uncle gave this to me' (fact) they learned quickly and retained the information very well over time in both cases. Markson and Bloom argued that these findings provided evidence 'that word learning is mediated by processes of human learning and memory that are not special to the domain of language' (1997, p. 815), since at least some word learning processes are the same as those used in the acquisition of facts in general.

In a related study, Waxman and Booth (2000) extended these findings by asking children to extend the new name or fact they had learned to novel exemplars. They found that the children quite readily extended the newly learned word koba to novel exemplars from the same category, but they did not do this with the newly learned fact (Behrend, Scofield & Kleinknecht, 2001 have recently replicated this finding with children as young as 2½). On the basis of these findings, Waxman and Booth argued that some aspects of word learning are unique, and thus the argument that language acquisition does not result from domain-specific mechanisms is premature. They argue instead, consistent with the arguments of scholars such as Macnamara (1982), Golinkoff, Mervis and Hirsh-Pasek (1994) and others, that linguistic reference and word learning represent a special domain of cognitive development including at least some domain-specific principles.

In a recent exchange of views on these studies, Bloom and Markson (2001) point out that no one would suppose that a particular fact (e.g. my uncle gave this to me) should extend to other objects categorically. The issue is 'whether word learning is done solely through more general cognitive systems, such as those involved in concept formation and intentional inference' (p. 90), or whether domain-specific learning processes are involved. Waxman and Booth (2001; and Waxman & Booth, 2000) counter that the demonstration that one component of word learning and fact learning is the same (as in the original Markson & Bloom study) does not constitute evidence that the systems as a whole are the same, and
indeed at least one component (categorical extension to novel exemplars) is different in the two cases. Both sides to this debate agree that a particular fact is not the kind of thing that anyone would extend to novel exemplars as a matter of course. However, there are other nonlinguistic behaviors that children might be expected to extend to novel exemplars in a manner similar to their word extensions. Specifically, children learn what to do with new objects – especially cultural artifacts – by watching adults interact with them nonlinguistically. In the current study, we demonstrated a nonverbal action on a novel object and then subsequently gave children the chance to extend this action to other object exemplars. We then did the same thing with a novel word (as in Waxman & Booth, 2000), attempting to create a learning context that was as similar as possible in the two conditions (action, word). We reasoned that if children extended both words and nonverbal actions to novel exemplars in the same way categorically, this would provide additional evidence that many aspects of word learning result from unique manifestations of more general learning processes.

Method

Participants
Participants were 20 2\(\frac{1}{2}\)-year-old children (mean = 2;8; range: 2;5–2;10), 7 girls and 13 boys. Two other children participated but were not included in the final analyses because they failed to pass the initial comprehension trial(s), and 2 were excluded due to experimenter error. Most children were recruited via an introductory letter to parents followed by a phone call; some were recruited through child care centers. In both cases, informed consent was obtained from parents before the study began.

Materials and design
Twenty-six small objects were used in the study. The objects were divided into 2 sets of 13 objects, each set including 7 objects used during training and 6 objects used in the extension trials (see Appendix). The 7 objects in each set used during training included 4 familiar objects and 3 novel objects. Before the study began, one of the 3 novel objects was randomly chosen as the target object for that set; the same target object was used across children (as in Waxman & Booth, 2000). The 6 objects in each set used for the extension trials included 2 novel exemplars for each of the 3 novel objects seen during training. The novel exemplars for the extension set differed from the training objects in size, color or texture. For example, Set 1 (which followed the set used in Waxman & Booth, 2000) included a green level (target), a sponge paintbrush (distractor) and a blue funnel (distractor). The extension set included a red level and a blue level (within category), a larger and smaller paintbrush (out of category) and a larger and smaller blue funnel (out of category). Each child heard one new noun for one object set and one nonverbal action for the other object set. Order of conditions (word or nonverbal action) was counterbalanced across children.2

Training procedure
Each child interacted with a female experimenter (E) during one 15-minute session. An observer (O) was also present and each session was videotaped. The training for each object set was identical with the only difference being what E said about the target novel object (E produced a novel noun or nonverbal action). Training always began with the target object. In the noun set, E pulled the target object from an opaque bag while saying, ‘Look at this one. This one is so special to me. And you know what? It’s called a koba. See? It’s a koba. Can you put it in the bucket?’ In the non-verbal action set, E demonstrated the non-verbal action (balancing the object on one elbow and moving the elbow up and down) while saying, ‘Look at this one. This one is so special to me. And you know what? Look what we can do with this. See? Look what we can do with it. Can you put it in the bucket?’ E then continued with the other objects in the training set, pulling each object out of the opaque bag in a random order and commenting on it in a general way (e.g. ‘Look at this. It has bumps on it. See?’) before handing the object to the child. After all the objects had been introduced and commented on, E pored the objects out of the bucket and asked a comprehension question to be sure the child remembered the target object (e.g. ‘Can you hand me the koba? Where’s the koba? Can you put it in the bucket?’ or ‘Can

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1 Waxman and Booth (2000) included 6 unfamiliar objects in their training set with 12 extension objects during the extension trials. We reduced the number of novel objects in our study mainly because our 2\(\frac{1}{2}\)-year-old children were somewhat younger than the 3-year-olds in Waxman and Booth’s study, and may have been overwhelmed by 12 objects at test. The logic of the design is identical to Waxman and Booth’s, however.

2 Our within-subjects design allows each child to serve as his/her own control. Because the order in which the items were presented (word first or non-verbal action first) was counterbalanced, any contamination between sets should have affected both the word and non-verbal action conditions equally.
you hand me the one that does this? Where’s the one that does this? Can you put it in the bucket?”). The comprehension question was repeated one time. If a child failed to choose the target in one of the comprehension trials, he or she was corrected in their choice (e.g. ‘Look. This is the koba. See?’ or ‘This is the one that does this. See?’). As noted above, the two children who failed both comprehension trials were not included in the final sample since they had apparently not learned the original word or action, so the question of their extending the word or action cannot be addressed.

Testing procedure: extension trials

After the training phase for an object set, E presented an extension task. The extension task was designed to show whether children extended the new nouns or non-verbal actions to objects in the same category as the target object or to objects outside of the category. Children were shown a new set of objects including two new exemplars of the target object from training, and two new exemplars of each of the distractor objects from training for a total of six new objects. For the noun set, E then asked the child to extend the noun to the new objects (e.g. ‘Are there any other ones that are kobas?’); in the non-verbal action set, E asked a similar question (e.g. ‘Are there any other ones that do this?’ while E pantomimed the action using her elbow). Once the child had chosen an object, he or she was asked to put the object in the bucket, removing that object from the object set. The extension question was repeated until the child said ‘no’ or had chosen all the objects.

Scoring

Children’s choices were identified as the object they first touched or pointed to in response to each of E’s questions. Following the initial coding, a second coder coded 20% of participant responses (n = 4 children) from the videotapes. Percent agreement between the two coders was 94%, with a Cohen’s Kappa of .85. Following the initial scoring, children were coded as ‘only within-category’ responders if they chose all and only objects within the category. Children were coded as ‘some out of category’ responders if they chose some objects that were not category members. (It is important to note, in this regard, that children did see objects at test that were in the same category as the distractor objects they had seen during training. So children in this study could have chosen along category lines, but those categories could have been the categories of the distractors, which would then have been scored from the point of view of the target as ‘out of category’.)

Results

Table 1 presents the number of children who extended the novel noun and the novel fact to different classes of novel exemplars. It can be readily seen that the nature of children’s extensions in the two conditions was basically the same (Cochran’s Q test non-significant; 2 × 2 ANOVA also showed no difference between conditions).

It is also important that in both conditions the children were significantly above chance in staying within category. On the first test trial, there are two correct choices of 6; the probability is thus .33 that they will choose the correct object. On the second test trial (assuming a correct choice on the first trial) there is 1 correct choice of 5 remaining objects; the probability is thus 1 of 5 or .20 that they will choose the correct object. The joint probability of choosing both within-category objects is thus .33 × .20 = .067. If children in our sample chose both within-category objects by chance, there should have been .067 × 20 children or 1.34 children choosing both within-category objects on the first two test trials. Instead, 11 of 20 children made within-category choices in the noun condition, and 12 of 20 made similar choices in the non-verbal action condition. Chi-square goodness-of-fit tests demonstrated that this patterning of choices was different from chance; for Noun, Chi-square = 46.93, p < .001, and for Action, Chi-square = 65.48, p < .001. Finally, in terms of individual patterns, Table 2 shows that 17 of the 20 children extended the newly learned noun and action in the same way (either staying within category or extending beyond category in the same way for both).

To succeed perfectly in this task, children must choose the two appropriate extension objects and then refuse to choose any others. However, it is possible that 2½-year-old children have more difficulty in refusing to continue the game than older children (in the previous studies, the children were 3- and 4-year-olds). Thus, in addition to the analyses considering all of the children’s responses, we also considered only the first two responses.
two conditions: first two responses only

<table>
<thead>
<tr>
<th>Number of children</th>
<th>Only within-category</th>
<th>Some out of category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noun</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Action</td>
<td>16</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: Table 3 shows the number of children who chose only objects within the same category as the target object and the number of children who chose some objects that were not in the same category as the target object \( (N = 20) \).

children made at test.\(^3\) Table 3 presents the number of children who extended the novel noun and the novel fact to different classes of novel exemplars considering the first two responses only. Once again the nature of children's extensions in the two conditions was the same (Cochran's Q test non-significant; \( 2 \times 2 \) ANOVA also showed no difference between conditions). Also once again in both conditions the children were significantly above chance in staying within category. Chi-square goodness-of-fit tests demonstrated that the patterning of children's responses differed significantly from chance, \( \chi^2 = 171.90, \ p < .001 \), for both conditions. In terms of individual patterns, Table 4 shows that 14 of the 20 children extended the newly learned noun and action in the same way (either staying within category or extending beyond category in the same way for both nouns and actions).

\(^3\) The only other study of this kind that has included children as young as 2\(1/2\) (Behrend et al., 2001) limited the number of extension trials to either one trial (Study 2) or two extension trials (Study 1). Although we could have reduced the number of our extension trials, by giving children multiple opportunities to choose objects in the extension trials, we are able to report on both children's total number of choices and their first two choices.

Discussion

Bloom and Markson (2001) point out that language has many aspects, and there is nothing inconsistent about claiming that some aspects (e.g. syntax) are domain specific and unique whereas others (e.g. word learning) are based on domain-general processes. They claim further that by all current evidence word learning seems to rely mostly, if not totally, on more general learning processes.

Waxman and Booth (2001) argue that the way children extend novel nouns to novel exemplars categorically – while refusing to do so for novel facts – provides evidence against this proposal. But, as everyone recognizes, particular facts are not the kinds of things that readily extend categorically to new objects. In the current study, we made a much more appropriate comparison to word learning, namely, the learning of novel actions on objects. Actions are more appropriate because they are the kinds of things that are routinely generalized categorically to new objects. It is important to note that in this context our novel action was somewhat arbitrary (bouncing an object up and down on the elbow) and not an obvious object affordance that each of the novel exemplars might have elicited independently. Indeed, our action might even be considered wholly conventional – the adult's action implies that 'this is what we do with this object' as with many artifacts (e.g. pencils, scissors) – which makes it especially like a conventional linguistic symbol, although linguistic symbols are used for communicative rather than instrumental purposes. In any case, using an arbitrary (perhaps conventional) action, we found that children extended non-verbal actions to new objects in very much the same way that they extend words to new objects. It is also worth noting that in another study of word learning children learned similar non-verbal actions for novel objects as readily as they learned novel names for novel objects and were able to produce both the non-verbal actions and novel nouns.
following both a 24-hour and one-week delay (Childers & Tomasello, 2002).

Obviously, there are still other aspects of word learning that may turn out to be domain specific and may not rely on general learning processes. But the current study has established that one obvious candidate – categorical extension – is not unique to word learning, but rather represents a more general dimension of the social learning of adult activities, including as a special case conventional or even symbolic activities. Whether all aspects of word learning derive from modifications/adaptations of more general learning processes will require specific investigation of each candidate aspect in turn (see Keil, 1990, for a useful discussion of methodological issues in deciding between domain-general and domain-specific mechanisms in individual cases). Yet, even if each component of word learning is shared with some other cognitive domain(s), it is still possible, indeed likely, that word learning involves a unique configuration of these components.

Appendix

Set 1: Training Set (target on left)  Set 1: Test Set

Set 2: Training Set (target on left)  Set 2: Test Set

Acknowledgements

We thank Hillery Gross, Sara Bell, Lorie Salinas and Wendy Ezell for their assistance in data collection and coding. We also thank the parents and children who participated in the study, and the teachers and directors at Laurel Heights United Methodist Church Child Development Center, the First Presbyterian Church Children’s Center and the University Presbyterian Church Children’s Center.

References


Received: 2 October 2001
Accepted: 25 January 2002