The role of object labels and familiarity in Japanese children's verb learning

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1. Introduction

In order to learn a new word, children first need to determine what form class the word belongs to, and find an appropriate referent in the situation in which the word is introduced. They then must determine what other instances the word should be (or should not be) generalized to. In doing so, children need to realize that generalization of words are governed by different principles across different word classes.

An object can appear in many different actions. For example, a ball can be rolled, thrown, or kicked. Thus, when a noun is introduced in the a scene in which the a referent object is used in a particular action, in extending it, children must know that the noun should be generalized to the an object of the same kind even when it is used in a different action. Likewise, an action can be done with many different objects. For example, we can throw a ball, a Frisbee, a stone, a disk, or almost anything we can lift up with our hands. Thus, in extending a verb that has been mapped onto an action involving an object, the object must be separated from the action and be treated as a variable that can be changed. Of course, verbs put some constraints on the types of arguments they can be used with, but within the range of the semantic constraints, different objects can be the argument of the verb.

Thus, in generalizing a noun and a verb, children need to focus on different kinds of similarity across different scenes. Suppose that a child hears the verb "throw" while watching her father throw a ball at one time and sees her father toss a ball at another time. At still a different time, the child sees a boy throw a Frisbee to a dog. The second scene is very similar to the first because the objects—the father and a ball—are the same. Nonetheless, the child cannot generalize the verb "throw" to this scene. Instead, she needs to apply the verb "throw" to the third scene, even though the objects in the scene are totally different. That is, to represent the meaning of a verb, children need to align relevant components of action events, compare across different scenes, focus only on the similarity of the higher order relation between the objects, and ignore the sameness or similarity in the objects.

This may sound simple to adults, but there are some grounds for believing that it may not be so trivial for young children. In fact, previous research investigating how English-speaking children generalize novel verbs indicates that young children tend to be very conservative in extending verb meanings (e.g., Forbes & Poulin-Dubois, 1997; see also Tomasello, 1992). In particular, they tend to be much less willing than adults to extend verbs when an object in the action event is changed, whether it is an actor (Kersten & Smith, 2002; Maguire et al., 2002) or an instrument (Behrend, 1995; Forbes & Farrar, 1993). Thus, it is important to test whether children can segregate the action from the whole event and generalize a verb based on the action alone, suspending attention to the first-order objects (i.e., the actor and the object).

In our previous research, Imai, Haryu, & Okada (2002) showed an ongoing action event to Japanese 3-and 5-year-olds children and introduced a novel noun or a verb while children were watching it, in order to examine how the children map the new word and generalize it. Specifically, we asked whether children understand two basic principles for noun generalization and verb generalization: (a) nouns get generalized on the basis of the sameness of objects, and the particular action in which the object is used is not relevant for noun generalization; (b) verbs get generalized on the basis of the sameness of actions, and the objects (both the agent and theme object) that appear in a particular action event are variables that can be replaced across different situations.

The question dealt by Imai et al. (2002) was deeply related to a long-lasting debate in the literature concerning the issue of whether noun learning is universally privileged over verb learning in early stages of lexical development (e.g., Gentner, 1982; Gentner & Boroditzky, 2001; Gopnik & Choi, 1990; Tardif, 1996). Japanese is one of the key languages for this debate, because in Japanese, like Chinese and Korean, arguments (both the Subject and the Object) are often dropped from a sentence when they are contextually clear, and as a result, verbs tend to appear more frequently than nouns in the maternal input (Gopnik & Choi, 1990; Ogura, 2001; Tardif, 1996).

The results of Imai et al. (2002) thus seem to support the universal noun advantage view. Both 3- and 5-year-olds successfully mapped a novel noun to an object, generalizing it to the same object used in a different action. In generalizing a novel verb, in contrast, the five-year-olds, but not the 3-year-olds, showed the understanding of the principle that verbs get generalized on the basis of the sameness of actions, and the objects that appear in a particular action event are variables that can be replaced across different situations (Imai et al., 2002, under review). The results were not different whether novel verbs were presented with the arguments or without them (Imai et al., in preparation). It appears that Japanese children easily filled in the arguments on their own (the young woman as the actor and the novel object as the theme), when they were dropped. A series of follow-up studies examined the close nature of the 3-year-olds' chance level performance in the verb condition. In a yes-no paradigm, 3-year-olds did not generalize a verb to the same object laying still on the table. The proportion of "yes" response was not different across the action-same-object-different test and the object-same-action-different test, and was again at the chance level. However, they were willing to generalize the verb to a scene in which a different actor was doing the same action with the same object.

Meyer, Leonard, Hirsh-Pasek, Imai, Haryu, Pulverman, and Addy (2003) replicated Imai et al.'s study with English-speaking children. The results were overall very similar to those obtained from Japanese children with one exception. Like Japanese children, English-speaking children, both 3- and 5-year-olds, correctly generalized a novel noun to the same object used in a different action from the original. In generalizing verbs, like Japanese 3-year-olds, English-speaking 3-year-olds performed at chance level whether novel verbs were presented with the arguments or without them. Interestingly, English-speaking 5-year-olds successfully mapped a novel verb to the action when the verb was embedded in the full argument structure ("Look, she is X-ing it") but not when the arguments were dropped ("Look, X-ing"), unlike Japanese 5-year-olds who succeeded in the task in both cases. This crosslinguistic difference suggests that some linguistic, mainly

structural, properties influence children's verb learning in that argument-dropping occurs rarely in English and that English-speaking 5-year-olds could generalize the verb to the same action only when the verb was presented in the structural form that is natural in their language. However, overall, the linguistic properties seem to be secondary, rather than primary, factors among factors that determine the ease of young children's verb learning, as Japanese and English-speaking children showed a very similar developmental pattern in spite of large differences in the language they were learning.

These results together with results from other laboratories with younger children suggest that children are overall very conservative in generalizing verbs, and go through progressive phases before they obtain an adult-like verb meaning representation in which the core meaning and the variables are fully segregated and aligned. At 18-months, children do not generalize a verb when an actor is changed (Maguaire et al., 2002). At three, they allow a change of the actor, but still do not allow a change of the object used in the action (Imai et al., 2002). At 5-years of age, children finally are able to generalize a newly learned verb to a new situation on the basis of the action alone, treating the object as a variable rather than the invariant component of the verb meaning.

1.1 Goal of the present research

The goal of the present research was to further specify the nature of young children's representation of verb meanings. In particular, we wished to identify the role of objects in action events in the representation, and examined whether manipulation of the objects could bootstrap children to adult-like representation of verb meanings.

It has been noted that object familiarity plays an important role in word learning. In particular, many studies have shown that object familiarity helps children relax default biases they possess in assigning the meaning of a novel word. For example, children in general have a strong bias toward mapping a novel word to a basic level object category (Golinkoff, Mervis & Hirsh-Pasek; 1994; Hall & Waxman, 1993; Imai & Haryu, 2001; Markman, 1989), and this bias sometimes overrides a cue from syntax that indicates other interpretation (e.g., Gelman & Taylor, 1984; Hall, 1991; Markman & Wactel, 1988). However, when the referred object is familiar and its name is already learned, they can map a new word to non-basic level concept, and interpret the word as a subordinate category name, a proper name, a material name, or a property name (e.g., Gelman & Taylor, 1984; Hall, 1991; Haryu & Imai, 2002; Imai & Haryu, 2001; Markman & Wachtel, 1988).

Given these results, it may be the case that familiarity of the objects in the action event affects young children's representation of a verb. In fact, the results from Kersten and Smith (2002) supported this possibility. These researchers showed late 3-year-olds a scene in which two novel objects and a motion were involved. The motion was a intransitive motion, in which Object A serves as an agent. As in Imai et al (2002), they introduced either a novel noun or a novel verb while children were watching the scene. They then presented children with four test events, an Object + Motion Match event, Motion Match (Object Change) event, Object Match (Motion Change) event, and No Match event, one at a time, and asked whether the newly learned noun or the verb can be applied to each event using the Yes-No paradigm. Parallel to Imai et al.'s results with Japanese children, Kersten and Smith found that, while 3-year-olds applied the noun to both Object +

Motion Match and Object Match (Motion Change) events equally willingly, they were only willing to apply the verb to only the Object + Motion Match event but not to the Motion Match (Object Change) event. However, when the researchers used familiar objects (two cars) instead of novel ones in the event, the 3-year-olds' generalized the verb more often to the Motion Match events than when the objects in the scene were unfamiliar.

Thus, we examined whether familiarity of objects bootstraps children to more adult-like, action-based verb generalization in our case as well in our case well, in which the event was a transitive action event where a novel object served as the theme object instead of the agent (as in Kersten and Smith, 2002). We also wished to specify the nature of the object familiarity effect in verb learning. If object familiarity affects children's verb learning, there are at least two possible reasons, though the two may not be necessary mutually exclusive (see the later discussion). First, object familiarity may help children learn a new verb by relaxing their bias toward interpreting a novel word to be a basic level object category label. Because they already know the label of the object, they may now be able to map the new word to other elements in the event more easily (Clark, 1990; Merriman, Marazita, & Jarvis, 1995). Second, object familiarity may foster verb learning because knowledge about the object helps the alignment of event components (Kersten & Smith, 2002; see also Waxman & Klibanoff, 2000).

To explore these possibilities, we examined the effect of object labels and object familiarity. Specifically, in Study 1, we examined whether the presence of a label for the object by itself fosters verb learning. If the difficulty of verb learning in our previous studies was due to the presence of an unlabeled novel object that strongly attracted children to name, children may be able to label the action without incorporating the object in its meaning when the object is labeled, even when the object is unfamiliar. In a previous study (Imai et al., in preparation), we compared a condition in which the arguments (the agent and the theme object) were explicitly specified with a pronoun "nanika" ('something') and one in which the arguments were dropped, and found no difference between the two conditions for Japanese children. Thus, in Study 1, we compared a condition in which the unfamiliar object in the action event was labeled to a case in which the object was unlabeled in the sentence introducing the target verb. If we find a difference between the *object labe*l condition and *no object label* condition, we can probably attribute the difference to the presence of the label rather than the presence of the arguments per se. In contrast, if knowledge of object is necessary for children to learn the meaning of a novel verb, then they should be able to perform better when the object is familiar whether or not it is labeled. This possibility was explored in Study 2.

In both studies, as in Imai et al. (2002), children were presented with a video of an action event which included an actor, a novel action, and an object (either familiar or unfamiliar, depending on the study). While children were watching the video, a novel verb was introduced. The children then saw two test events. In one test, the object was changed while other elements of the event (i.e., the actor and the action) were kept the same. In the other, the action was changed. The children were asked to determine which of the two test events the newly introduced verb would be generalized to.

2. Study 1

2.1 Method

Participants

Twenty eight three-year-old (mean age=3;6, range=3;2-3;10) and twenty six four-year-old (mean age=4;5, range=4;1-4;10) monolingual Japanese children took part in this study. Half of the children in each age group were randomly assigned to an *object label* condition, and others were assigned to a *no object label* condition.

Stimuli

Six sets of video action events were used as stimulus materials (see Figure 1 for a sample set). Each set consisted of a standard event and two test events, each lasting approximately for 10 seconds. In each standard event, a young woman was doing a novel repetitive action with a novel object. The two test events were variants of the standard event. In one test event, the same person was doing the same action with a different object (Action-Same-Object-Change, henceforth AS) from the standard event. In the other test event, the person was doing a different action with the same object (Action-Change-Object-Same, henceforth OS). Special care was taken in constructing the stimuli so that the similarity between the object in the standard event and that in the AS event would be low in all sets to eliminate the potential confounding of the effect of object similarity (Haryu, Imai & Okada, 2003).

(a) standard

(b) object-same-action-different

(c) action-same-object-different

Fig. 1. Sample stimulus set used in Study 1

Procedure

In the *object label* condition, two novel words, a target verb and a label for the object, were introduced. The experimenter said to the child, "Hora! (Look!), oneesan (a young woman) ga (Subject-marking particle) Y wo (Object-marking particle) X-teiru (X-ing) ('Look, the girl is Xing a Y'), " where X was the verb and Y was the object label. In the *no object label* condition, the arguments were dropped ("Mite, X-teiru"), and hence the object was not labeled. A forced-choice procedure was used. In the test trial, in both conditions, the child was asked "X-teiru no (Genitive marking particle) wa (Topic marking particle) docchi (which/where)? ('In which (movie is she) X-ing?')" The presentation order of the six sets was randomized, and the location of the AS and OS test events with respect to the participant was counter-balanced across the six sets within each participant.

2.2 Results and discussion

Labeling the object did not improve children's performance in novel verb generalization (see Table 1). A 2 (age; three-year-olds vs. four-year-olds) X 2 (condition; object name specified vs. object name unspecified) ANOVA conducted on the proportion of AS responses revealed that four-year-olds performed better than 3-year-olds, $F(1,50)=8.27$, $p<.01$, but did not detect any significant effect for object labels, $F(1,50)=.03$, $p>.1$, or the interaction involving this factor, $F(1,50)=.10$, $p>.1$. Replicating the previous results (Imai et al., 2002; Haryu et al., 2003), both 3- or 4-year-olds failed to generalize a novel verb to the same action when the object was replaced with a different object that was perceptually dissimilar to the object in the original event. The proportion of the AS responses made by the four-year-olds was at the chance level both in the *object label* condition and *no object label* condition (56.3 %, $t(12)=.58$, $p>.1$, and 55.2 %, $t(12)=.41$, $p>.1$, respectively). The 3-year-olds generalized the verb to the AS test event 26.2 % of the time in the *object label* condition ($t(13)=3.33$, $p<.01$) and 31 % of the time in the *no object label* condition ($t(13)=3.04$, $p<.01$), both significantly below the chance.

The results of Study 1 suggest that the presence of a label of the object of itself does not foster young children's verb generalization. In Study 2, we then examined the possibility that familiarity of the object fosters the process of alignment and hence helps children focus on the action component as the basis for verb generalization. Specifically, we replaced the unfamiliar object used in Study 1 with a familiar object, retaining the other two elements of the event (the actor and the action). Although the effect of object label was not found in Study 1, it is possible that the effect of the object label interacts with object familiarity. That is, a label of the object might foster the alignment process when the object is familiar. We thus set up the *object label* condition and the *no object label* condition in Study 2, as in Study 1.

Table 1. The proportion of AS responses in each condition in each age group in Study 1 and Study 2.

		Object Label condition	*No Object Label* condition
Study 1 (Unfamiliar Object)	three-year-olds	26.2 %[a]**	31.0 %**
	four-year-olds	56.3 %	55.2 %
Study 2 (Familiar Object)	three-year-olds	44.0 %	47.6 %
	four-year-olds	73.0 %*	61.5 %

a : significantly below chance, $p>0.01$.

3. Study 2

3.1 Method

Participants

Twenty eight three-year-old (mean age=3;8, range=3;4-3;11) and twenty six four-year-old (mean=4;6, range=4;1-4;10) monolingual Japanese children participated in this study. None of the children had participated in Study 1. The children in each age group were randomly assigned to either the *object label* condition or the *no object label* condition.

Stimuli

Six sets of video action events were used as stimulus materials. In each set, the actor and the action in the standard event were exactly the same as those used in Study 1, but the object was replaced with an object that was familiar to young children (e.g., a ball). Subsequently, the object of the OS test event in Study 2 was replaced with the one used in the standard event, but the other elements of the event were the same as those used in the parallel set in Study 1. The AS test event was the same as that used in Study 1. Again, we were careful that shape similarity between the object in the standard event and that in the AS test event was low. The familiar objects used in this study were a ball, a pillow, an umbrella, a baseball bat, a shovel, and a tambourine.

Procedure

The procedure for the *no object label* condition was identical to that for the *no object label* condition in Study 1. In the *object label* condition, the object was labeled with the familiar, basic level category name. For example, the experimenter said to the child, “Hora! (Look!), Oneesan(a young woman) ga (Subject-marking particle) bouru (ball) wo (Object-marking particle) X-tteiru (X-ing)” (‘Look, the girl is X-ing a ball’).

3.2 Results

The effect of object labels

We first tested whether the presence of the object label affected children's performance. A 2 (Object Label) X 2 (Age) ANOVA detected no difference across the *object label* and *no object label* conditions, $F(1,50)=0.148$, $p>0.1$. The Age effect was again significant, $F(1,50)=4.29$, $p<0.05$.

Children's performance in each condition in each age group was tested against the chance level probability (50%). The four-year-olds made AS responses 73 % of the time when the name of the familiar object was given as the argument in introducing a novel verb, which turned out to be significantly above the chance level, $t(12)=2.58$, $p<.05$. The performance of the 4-year-olds in the *no object label* condition made AS responses 61.5 % of the time, which was not different from chance, $t(12)=.94$, $p>.1$. However, the 4-year-olds' performance across the *object label* and *no object label* conditions was not significantly different, $t(24)=0.759$, $p>0.1$. The performance of the three-year-old children was at the chance level both in the *object label* condition and the no object label condition (44%), $t(13)=.73$, $p>.1$, or in the object name unspecified condition (47.6%), $t(13)=.21$, $p>.1$.

The effect of object familiarity

In order to examine whether object familiarity affected the children's performance, the results of Study 1 and Study 2 were combined and were submitted to a 2 (age; three-year-old vs. four-year-old) X 2 (object familiarity: Study 1 vs. Study 2) X 2(condition; with object label vs. no object label) ANOVA on the proportion of AS responses. The effect of object familiarity was significant, $F(1,100)=4.21$, $p<.05$, as well as the effect of Age, $F(1.100)=12.03$, $p<.001$. No effect for Object Label or interactions involving this factor was found.

4. General Discussion

We confirmed that objects play an important role in early verb learning. This in turn suggests that the key cognitive process involved in learning a novel verb is decomposing the event into appropriate elements, aligning them, and extracting the higher-order relation between the first-order elements (i.e., objects) as the invariant for the verb meaning, as proposed by Gentner (1978). Extraction of higher-order similarity is not easy for young children (Gentner & Ratterman, 1991), but familiarity of the objects helps the process of alignment. We did not find that the object label by itself helps the alignment process, at least in Japanese children. This suggests that the difficulty young children experience in learning a novel verb may not be due to the bias toward naming a novel object. Rather the difficulty seems to lie in the cognitive operation which verb generalization requires.

However, we need to see if this is also the case with English-speaking children. As stated earlier, unlike Japanese children, English-speaking 5-year-olds generalized a novel verb to the same action only when the subject and the object in the sentence were provided.

The arguments of the verb provided in the instruction (*she* and *it*) added little semantic information to what they could observe in the video, but English-speaking children needed them nonetheless. Given this result, it is important to see if there is any effect of object labels for English-speaking children.

The research reported in this paper strengthened the conclusion proposed by Imai et al. (2002) that learning a novel verb is difficult because it requires alignment of elements in the event and extraction of a higher-order relation as the invariant of the verb's meaning. At early stages of lexical development, children are overall very conservative in generalizing verbs, and go through progressive phases before they obtain an adult-like verb meaning representation.

The conservatism children show in verb generalization sharply contrasts to liberal, yet principled generalization patterns young children show in generalizing novel nouns. The results of the present research showed that 3-year-olds can generalize a newly introduced noun to the *identical* object used in a different action. However, in other studies, we tested how young Japanese children generalize novel nouns to other, non-identical instances in various situations. Testing noun generalization in Japanese children was particularly interesting because ontologically distinct subclasses of nouns, i.e., nouns denoting object kinds, nouns denoting substance kinds, and nouns denoting unique individuals, are not grammatically distinguished in Japanese (Imai & Haryu, 2001). In spite of this linguistic property, Japanese children generalized newly introduced nouns flexibly and reasonably under various experimental situations in which no direct social support was provided. For example, when a novel object (either animate or inanimate) was labeled with a novel noun, Japanese 2-year-old children spontaneously generalized the noun to other objects that were similar to the original in shape (but not in other perceptual dimensions) assuming it to be a basic-level object category name. At the same time, they could relax this default assumption quite readily. When a novel noun was associated with a substance, they generalized it on the basis of material identity, ignoring the sameness in shape (Imai and Gentner, 1997). When a familiar animal was named, they interpreted it to be a proper name of the named animal (Imai & Haryu, 2001). When a named object was inanimate and was a typical member of the familiar category, they mapped the new noun to a category subordinate to a old, familiar one; but when the inanimate object was an atypical member of the familiar category, they mapped the new label to a new basic-level category, restructuring the boundary (Haryu & Imai, 2002).

Given the conservative verb generalization on one hand, and the liberal yet principled noun generalization on the other, we are probably eligible to conclude that noun learning is easier than verb learning. We acknowledge that our conclusion is in conflict with conclusions drawn by other researchers using the distribution of nouns and verbs in young children's vocabulary as the index of the relative ease/difficulty of noun and verb learning (e.g., Gopnik & Choi, 1990; Tardif, 1996). How can we resolve the discrepancy between our results and the results from previous research showing that Chinese and Korean 2-year-olds know more than or equal number of verbs to nouns in their vocabulary on one hand, (Gopnik & Choi, 1990;Tardiff, 1996) and our own data?

We consider that two approaches are asking qualitatively different questions and phenomena, with definitions of "ease/difficulty" of word learning. The researchers who

endorse the input dominant view seem to have implicitly assumed that the words in children's earliest vocabulary reflect the inherent ease to learn those words. This assumption requires some caution, however. The fact that a child uses a particular word in a particular situation appropriately does not guarantee that she can use the word in other situations correctly. In other words, a child may not have acquired the full meaning of a given word but may produce the word appropriately in limited contexts (Dromi, 1984; Bowerman, 1982). Thus, in our view, the question of what word class is predominant in the earliest vocabulary is an important question of its own, but may not provide a direct answer for the question of what word class is *easier* to learn than others. It is possible that certain verbs are included in children's vocabulary from earliest stages of lexical development. It is also possible that Chinese and Korean children may "possess" verbs more than, or as many as, nouns in their vocabulary at some point of development, depending on the sampling and coding methods (Gopnik & Choi, 1990 ; Tardif, 1996; Tadif et al., 1998). Furthermore, we have absolutely no intention to claim that children cannot learn verbs until 5-year of age. Our point is that young children's representation of verb meanings is not quite adult-like. In adults' representation, the elements of an event such as the agent, the patient, and the relation between the objects (the action in our case) are separated from one another and properly aligned, so that the only the invariant component for verb meaning, i.e., the higher-order relation among objects, is readily available for generalization even at a single exposure to the verb. In contrast, in young children's representation of verb meaning, the objects and the action are not fully segregated.

Note that children can still understand verbs they hear with "holistic" representation, especially when verbs are used with rich social support. Children possess high ability to recruit social cues and utilize them in inferring word meanings and this ability no doubt is one of the major forces that propel early word learning (Baldwin, 1991;L.Bloom, 1993; Tomasello, 1997). At the same time, with the holistic representation, children can generalize a word only to a limited situations that share commonality with the original situation not only in the invariant component but also in other components that can be varied across contexts (e.g., social contexts, objects, location, and so on.), as we demonstrated in our studies. Properties of objects such as familiarity do foster the process of alignment and help children extract the higher-order relation (the action component) as the invariant for verb meaning. However, the shift from the "holistic" to the "analytic and well-aligned" representation occurs only gradually, and it takes a long time until children become able to use the higher-order relation as the sole basis for generalization even when no direct social support was provided.

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