Children's use of argument structure, meta-knowledge of the lexicon, and extra-linguistic contextual cues in inferring meanings of novel verbs

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Abstract

Verbs are the centerpiece of the sentence, and understanding of verb meanings is essential for language acquisition. Yet verb learning is said to be more challenging than noun learning for young children for several reasons. First, while nouns tend to denote concrete objects, which are perceptually stable over time, verbs tend to refer to action events, which are temporally ephemeral, and the beginning and the end of the action referred to by the verb are not clearly specified. Second, a verb takes nouns as arguments, and the meaning of a verb is determined as the relation between the arguments. To infer the meaning of a verb, children need to attend to the relation between the objects in the event rather than the objects themselves. In so doing, children make use of a variety of cues such as argument structure, meta-knowledge of the lexicon, and extra-linguistic contextual cues. In this paper, I present two lines of my recent research concerning young children's novel verb learning. Specifically, I first report a cross-linguistic study (Imai et al., 2008) examining how Japanese-, English-, and Chinese-speaking children utilize structural and non-structural, extra-linguistic cues when inferring novel verb meanings. Second, I present another study examining how young children utilize sound-meaning correlates (sound symbolism) in their inference of novel verb meanings. In the end, I evaluate the relative importance of structural cues among different cues children use in verb learning.

1 Introduction

One of the core questions in the literature of lexical development is what factors influence young children's verb learning, and whether verb learning is universally more difficult than noun learning. Gentner (1982) argued that children acquire nouns more easily and earlier than verbs because the concepts denoted by nouns easier to access than those denoted by verbs. According to this view (the universal noun advantage view), children should experience more difficulty in learning verbs than in learning nouns. Some researchers, however, challenged this view, arguing that the structural properties of the input language are more important than universal cognitive factors. In this view, verbs can be learned more easily and earlier than nouns if the input language has properties to foster verb learning (the input-dependent view). For example, in argument-dropping languages such

as Korean, Japanese and Chinese, verbs may appear more frequently than nouns in the input, and tend to appear in the most salient position in the sentence (Choi & Gopnik,1995; Gentner, 1982). Another factor that has been noted to foster verb learning is morphological simplicity (Gentner, 1982; Tardif,1996). In fact, researchers advancing the input-dependent view have presented data showing that Korean- and Chinese-speaking children have more verbs than nouns in their early vocabularies (Choi & Gopnik,1995, Tardif,1996).

In this paper, I report two studies I conducted recently with colleagues to examine factors influencing verb learning. In the first study, we investigated how Japanese-, English-, and Chinese-speaking children utilize structural and non-structural, extra-linguistic cues when inferring novel verb meanings (Imai. Li, Haryu, Okada, Hirsh-Pasek, Golinkoff & Shigematsu, 2008). The second study I report in this paper examined the role of a non-structural *linguistic* cue in young children's verb learning (Imai, Kita, Okada, & Nagumo, in press). Specifically, we tested whether sound-meaning correlates (sound symbolism) fosters early verb learning, helping children to extract the invariant of verb meaning. In the end, I evaluate the relative importance of structural cues among different cues children use in verb learning.

2 Study 1: A Cross-Linguistic Comparison of Novel Noun and Verb Learning

In this study, we investigated how Japanese-, Mandarin-, and English-speaking children learn novel nouns and verbs in controlled, experimental settings.[1] Three- and 5-year-olds from the three language groups saw a dynamic video scene in which a woman was performing a novel action with a novel object, and introduced either a novel noun or verb. The children were then presented with two test scenes. One of the test scenes was the Action-Same-Object-Different (AS) scene in which the same woman was doing the same action but with a different object from the original scene. The other was the Object-Same-Action-Different (OS) scene in which the same woman was performing a different action with the same object. The children were asked to which of the two test scenes the newly introduced word was extended. Comparing children learning these three languages is extremely interesting because the three languages have different structural properties, which may affect the relative ease/difficulty of verb learning by children. On the first dimension, argument dropping is allowed in Japanese and Chinese but not in English. As a consequence of this linguistic property,

[1] For the details of the study, please see Imai et al., 2008. See also http://web.sfc.keio.ac.jp/~imai/pdf/HPSG_imai-talk_2008.pdf for the power point slides for the presentation.

children learning Japanese or Chinese tend to hear verbs more frequently than children learning English do. As mentioned earlier, because of this distributional property, some researchers predict that children learning Japanese or Chinese will learn verbs earlier (and hence more easily) than nouns (Choi & Gopnik, 1995; Tardif, 1996). However, at the same time, this property may lead to the opposite prediction. It has been proposed that inferring the meaning of a verb is very difficult even for adults without cues from the argument structure (Gillette et al., 1999), and that children do utilize the structural cues in inferring verb meanings (e.g., Fisher, 1996; Hirsh-Pasek & Golinkoff, 1996). Thus, one could make the prediction that verb learning should be more difficult for children who are learning a language that occasionally allows argument dropping. (In fact, in Japanese, argument dropping occurs more than occasionally—it is *usually* dropped when the speaker believes that the arguments can be inferred from the context.) The second dimension is the presence of morphological inflection in verbs. On this dimension, Chinese contrasts not only to English but also to Japanese. While verbs are inflected in both English and Japanese, they are not in Chinese. In other words, nouns and verbs are not morphologically distinguished in Chinese. Remember that in Chinese and Japanese, verb arguments are often dropped, and a verb alone can constitute a sentence in the language. In the case of Japanese, even when this occurs, verbs can be identified by inflectional morphology. That is, when a verb is produced without the arguments, as in "Mite (Look), X-teiru (X-ing)," one can tell that the word X is a verb. However, in Chinese, when a word is produced on its own (and this can happen in a conversational discourse), it is difficult to tell whether it is a noun or a verb. In other words, one can identify a novel word as a verb *only when* it is embedded in an argument structure (see Li, Bates and MacWinney, 1993). It is of great theoretical interest to see whether the morphological simplicity of Chinese makes verb learning even easier when compared to Japanese, as argued by some researchers (Tardif, 1996). If children in all the three languages performed better in fast-mapping novel nouns than in fast-mapping novel verbs, it will be the strongest evidence for the universal noun advantage view. If the difficulty of noun and verb learning varies across the three languages, we can proceed to identify what properties of language affect the ease of word learning in young children.

2.1 The task and procedure

Three- and 5-year-old children from three language groups–Japanese, Mandarin Chinese, and English–were tested (Imai et al., in press; Mayer et al., 2003; Haryu et al., 2005). The children were all from monolingual families, living in Japan (a suburban Tokyo Metropolitan area), China (Beijing), and the United States (Philadelphia), respectively.

Six sets of video action events served as stimulus materials. Each set

consisted of a standard event and two test events. 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, 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, the person was doing a different action with the same object (Action-Change-Object-Same, henceforth OS). While watching the standard event, a child heard either a novel noun or a novel verb, depending on the condition. The child was then shown the two test videos, and was asked to which event the target word should be extended.

2.2 Conditions and instructions

Our major interest was to examine whether Japanese-, Chinese- and English-speaking children understand the basic principles governing noun generalization and verb generalization, so in all three language groups, children learned either six novel nouns or six novel verbs. In addition, we wished to see whether dropping of the verb arguments affects children's performance in learning novel verbs. Thus, in English and Japanese, we presented the verbs in two different forms: one with full arguments (Full Argument Verb condition), and the other with no arguments (Bare Verb condition). In providing the arguments, in English, the pronoun "she" served as the subject, and "it" as the object of the sentence (e.g., "*Look, she is X-ing it*"). In Japanese, the word "*oneesan* ('girl')" is used for the subject, and "*nanika* ('something')" was used in referring to the novel object.

As we noted earlier, in Chinese, when both arguments are dropped, one cannot tell whether the word is a verb or a noun. We thus conducted only the Noun and the Full Argument Verb conditions.

2.3 Children's performance in novel noun learning and novel verb learning

Children in all three languages in both age groups succeeded in the novel noun extension task. They extended a novel noun to the same object/different action event, and there was no crosslinguistic or developmental difference. Thus, 3-year-olds, regardless of the language they are learning, have a clear understanding that nouns refer to objects, and that the actions in which the referent object is used are irrelevant to the noun meaning.

In contrast to the success in the novel noun learning task, in none of the language groups, were 3-year-olds able to successfully extended novel verbs. It was not until they are 5 years old that children reliably can extend a novel verb to an event involving the same action but a different object. In this sense, the results suggest that learning a new verb is more difficult than learning a new noun. With this overall pattern in mind, however, we should also note

that the performance of Japanese-, Chinese-, and English-speaking children was not totally uniform. In fact, we found intriguing crosslinguistic differences in the pattern of novel *verb* learning. Specifically, the condition in which 5-year-olds successfully extended newly learned verbs varied across the three languages, which in turn suggests that children speaking different languages rely on different cues in learning verbs. Below, we describe how children of the three language groups generalized novel verbs in our task, starting with Japanese children.

Japanese children. Five-year-olds, but not 3-year-olds, showed understanding of the principle that verbs get extended on the basis of the sameness of actions, and that the objects that appear in a particular action event are variables that can be replaced across different instances. While the 5-year-olds extended a novel verb to the Action-Same-Object-Change test at reliably above chance level, the 3-year-olds showed only chance-level performance. To our surprise, Japanese children performed better when the verb was presented without the arguments than when it was presented with an explicit mention of the arguments. In summary, the pattern of the results from Japanese children suggest that 3-year-olds do tolerate a change in the actor but are unwilling to extend a newly learned verb to a new instance when the theme object is changed. This indicates that they do not fully understand the basic principle for verb extension-- that verbs are extended on the basis of the action independent of the object. Five-year-olds did seem to understand this principle well and were able to apply it immediately in a novel verb learning situation. Interestingly, however, they were able to do so when the arguments of the verb were omitted but not when they were explicitly mentioned.

English-speaking children. In spite of the linguistic differences between English and Japanese, English-speaking children's performance in the novel verb extension task was overall very similar to that of Japanese children: 3-year-olds showed chance-level performance, while 5-year-olds were able to extend a novel verb to the Action-Same-Object-Change test (Mayer et al., 2003).

There was one important difference between Japanese and English groups, however. Unlike Japanese children, who performed above chance in the Bare Verb condition but not in the Verb Full Argument condition, English-speaking 5-year-olds were able to extend the verb to the Action-Same-Object-Change test reliably above chance only when the verb arguments were specified ("Look, she is X-ing it"). They selected the AS tests only 55.6% when the verb arguments were omitted. This difference suggests that the structural characteristics of children's native language might influence the structural form in which children expect to hear a verb.

Chinese children and adults. The results from Chinese children were utterly surprising. Unlike Japanese and English-speaking children, both 3- and 5-year-olds selected the Object-Same-Action-Change test at *highly above*

chance level in the Verb Full Argument condition. This means that they mapped the novel verb to the object instead of the action: the Chinese 3- and 5-year-olds consistently selected the Object-Same-Action-Change test regardless of whether the word was presented as a noun or a verb.

Given these surprising results from Chinese children, we tested monolingual Mandarin-speaking adults living in Beijing, China, to see how they performed in the task. The Chinese adults who were assigned to the verb (with full arguments) condition selected the Action-Same-Object-Change (AS) test 100% of the time. These results suggest that (1) it was perfectly clear to Chinese-speaking adults that the target novel word presented in the Full Argument Verb condition was indeed a verb, and that (2) there was a large developmental shift from an object-naming bias to an action-naming bias in Chinese speakers.

To identify the age at which this shift takes place, we further tested 7- and 9-year-old Mandarin Chinese-speaking children in the Full Argument Verb condition and Bare Word condition. In the Full Argument Verb case, the 7-year-olds selected the AS test at chance (52.2%). At 9-years of age, Chinese children finally extended a novel verb to the AS test significantly above chance level (72%).

Given the surprising results from the Chinese speakers, we conducted a few different versions of the Verb Full Argument condition, trying to find a condition under which Chinese children (at least 5-year-olds) could reliably extend the verb to the action even when the object is changed.

First, the number of syllables in the word was changed. In the original study, we prepared novel words (both nouns and verbs) with two syllables. This was because two syllable words were most common for both nouns and verbs. However, verbs referring to simple actions such as “jump” “kick” “run” tend to be monosyllabic words. Thus, we constructed monosyllabic nonsense words and replicated the Verb Full Argument condition with them. Although this manipulation lifted the AS response a little, no statistically reliable difference was obtained.

We then provided additional linguistic cue to indicate that the novel word was a verb. In the original instruction in the Verb Full Argument condition, the experimenter said, “Ayi (girl) zai (progressive) X (novel word) yi (one) ge (classifier) dongxi (thing) ne (mode marking particle)[ff01](She is X-ing something).” In this instruction, the novel word X could be unambiguously identified as a verb by the structure of the sentence, in particular, by the word order and the presence of the aspect marker “zai”. However, “zai” is also used as a verb, meaning roughly “to exist” or “to be present (at a place).” In this case, the word that comes after “zai” is usually a noun. Young children thus could have been confused because of this homonymous use of “zai” and mistakenly assumed that the word was a noun. We thus presented the verb in three different sentences using three different auxiliaries, namely, “zai,”

"zhengzai," and "yizhizai," all of which mark the progressive aspect, to provide even clearer and stronger clues that the novel word was a verb. However, again, this manipulation did not bring a statistically reliable increase in the Chinese children's performance.

Thus far, the results suggested that Chinese children as old as five years of age could not extend newly learned verbs to the same action in the face of a change in the object even when a novel word was presented in such a way as to make it clear that it was a verb. It is possible that the lack of morphological distinction between nouns and verbs makes it difficult for Chinese children to extract the extension principle for verbs, in contrast to the general assumption in the literature that Chinese is a verb-friendly language. At the same time, there must be conditions under which Chinese preschoolers, especially 5-year-olds, can extend to novel verbs to the action in the face of a change in the object. What cue do they need in addition to linguistic cues? We suspected that that the difficulty in identifying a word's grammatical form class solely from structural cues such as morphological marking or word order leads Chinese children to rely heavily on extra-linguistic cues.

Upon reflection, in this light, there is one property of our stimuli that may have given Chinese children a subtle cue that the object is the one that should be attended to in the event. We created the standard video clips in such a way that the actor holds the object for a moment (for about half a second) before starting the action. We did so to make sure that children see the object clearly, as the details of the object may not be clearly observable when it is in motion. Of course, the novel word was presented after the action started whether it was presented as a noun or a verb. It should be stressed that the object was not unnaturally highlighted in the original stimuli, and it did not affect Japanese or English- speaking children. However, if Chinese children were very sensitive to extra-linguistic, situational cues, this first segment of the video might have lead Chinese children to think that the object was in a way "topicalized".

To test this possibility, we removed the segment of the video clip in which the actor was holding the object. In the new video, thus, the object is already in motion at the very start of the event presentation. We replicated the Verb Full Argument condition with Chinese 3- and 5-year-olds with this version of the stimuli. We again presented the monosyllabic nonsense words in three sentences with three different aspect marking auxiliaries, in order to highlight that the word was a verb to give the children as much linguistic support as possible.

Consistent with our expectation, this manipulation—removing the half a second segment of the video clip in which the object was held still indeed brought a drastic change in Chinese children's performance in the verb learning task and their performance was now equivalent to the level of performance by Japanese- or English-speaking children. The Chinese

3-year-olds were now at the chance level, just like Japanese- and English-speaking 3-year-olds, and the Chinese 5-year-olds now selected the Action-Same test above chance level, just like their Japanese and English counterparts. We then conducted the noun condition with Chinese 3- and 5-year-olds using this revised stimuli to see whether they could still select the Object-Same test, and confirmed that they had no problem in doing so. Thus, it was not the case that Chinese children mapped the novel word simply to the most salient component of the event, whether it was a noun or a verb. They were able to extend a novel verb to the same action only when the action was maximally salient, but even under this condition, they had no problem in mapping a novel noun to the object. Taken together, this shows that Chinese 5-year-olds *can* extend novel verbs to the same action with a different object, but they need support from contextual and/or perceptual cues in order to do so. When contextual cues are in conflict with linguistic cues, it appears that Chinese preschoolers rely more heavily on extra-linguistic cues than linguistic cues, unlike Japanese or English-speaking children. It may be that the lack of obvious morphological distinction between nouns and verbs leads Chinese children to be more attentive to extra-linguistic cues than Japanese or English-speaking children are.

2.4 Discussion of Study 1

The research reviewed above provides us with important insights about factors affecting young children's verb learning. The fact that 3-year-olds succeeded in learning novel nouns but failed in learning novel verbs clearly suggests that verbs are universally more difficult to learn than nouns, and supports that cognitive factors play a prominent role over the language-specific structural factors in determining the ease of novel verb learning. At the same time, however, language-specific structural factors do affect the strategy young children take in their inference of verb meanings. Following the common assumption in the literature that learning an argument-dropping language gives an advantage to verb learning (Choi & Gopnik, 1995; Tardif, 1996), we had expected that Chinese and Japanese children might perform better than English-speaking children in the novel verb learning task. Furthermore, we had suspected that Chinese-speaking children might show even higher performance than Japanese-speaking children because of the morphological simplicity of Chinese verbs (Tardif, 1996). Contrary to these predictions, Chinese children did not perform any better than Japanese- or English-speaking children. In fact, Chinese speaking children showed greater difficulty in learning novel verbs than English- or Japanese-speaking children without extra scaffolding was provided. Chinese children were extremely sensitive to contextual cues when learning novel verbs for action events, and unless the action was made very salient, Chinese 5-year-olds were not able to map a novel verb to the action. It should be

noted that Chinese-speaking children did not determine the novel word form class solely based on contextual (or perceptual) saliency of the event, as they were able to map novel nouns to the objects under the action-salient situation.

Why were Chinese children so sensitive to contextual cues, even to the extent that linguistic cues that are apparent to Chinese-speaking adults were bluntly overridden. As discussed earlier, one important structural property that sets Chinese against Japanese and English is the lack of morphological distinction between nouns and verbs. Thus, unlike the case with Japanese or English, Chinese speakers cannot determine the grammatical form class of a word by morphological markings. Furthermore, even though word order provides a cue for determining the form class of each word in the sentence, it is only probabilistic: Although the basic word order is SVO, there are other word orders: OSV, SOV, and VOS are also found in the spoken language (Li, Bates, & MacWhinney, 1993). Thus, to identify the grammatical class of each word in the sentence and assign its thematic roles to it, Chinese speakers have to coordinate semantic, syntactic, semi-morphological grammatical cues such as aspect markers, object markers and passive markers in "a complex system of mutual constraints" (Li et al., 1993, p. 193). This linguistic property may lead Chinese children to rely more on extra-linguistic, contextual cues than on linguistic cues in novel word learning.

It is also noteworthy that the condition in which children performed best in our novel verb extension task was different for English- and Japanese-speaking children. The action events used in our research involve only three elements, an actor, an action, and an object. Thus, even when children heard a verb without the explicit mention of the subject and the object of the sentence, it should have been easy to infer what the dropped arguments would have been. In Japanese, it is natural to drop the arguments when the speaker thinks that the hearer can infer them from the observational and/or pragmatic cues. From the Japanese point of view, it was obvious that the subject was the actor and the theme object was the novel object, and hence it was more natural that the arguments be dropped in this case. Japanese children in fact could have been distracted by hearing this unnecessary information. In sharp contrast, English-speaking 5-year-olds extended the verb to the AS test only when the verb was accompanied by the pronouns "she" and "it." It appears that the English-speaking children would not extend a novel verb when the verb was presented in an unusual structural form, even though the arguments of the verb could have been easily inferred from observation of the event.

In the next section, I will present a study examining the influence of a non-structural, yet linguistic factor—the correlates between the sounds of words and their meanings– on young children's verb learning.

3 Study 2: Use of sound-meaning correlates in early verb learning

Since the time of Saussure, the arbitrary relationship between the sound of a word and its meaning has been held as an important principle of language (e.g., Saussure, 1916/1983). In mainstream linguistics, sound symbolism, in which the sound and meaning of words are systematically related, is considered to be a marginal phenomenon in language. However, many languages of the world have a large grammatically-defined word class in which sound symbolism is clear. For example, in Japanese, mimetics (*giongo/gitaigo*) include not only onomatopoeias for animal sounds (such as *nyaa* for cats) but also words referring to events and states in which sound is not essential. For example, the voiced initial consonant is associated with larger mass and the voiceless initial consonant is associated with smaller mass. In Japanese, mimetics can also refer to tactile, visual and emotional experiences: e.g., *nurunuru* 'being slimy', *pika* 'a flash of light', and *sowasowa* 'being restless'.

Japanese is by no means an exception among languages of the world. Many languages of the world have a similar grammatical class of words with clear sound symbolism (for an overview, see Hinton, Nichols, & Ohara, 1994; Nuckrolls, 1999; Voetlz & Kilian-Hatz 2001). Even in Indo-European languages such as English, there is clear sound symbolism in words such as *squeeze*, *squirt*, *squint*, *bump*, *thump*, and *plump* (e.g., Firth, 1935/1957, Reid, 1967), though such words do not form a distinct grammatically defined class. Systematic relations between certain phonemes and meanings have also been pointed out. For example, roughly half of the common English words starting with *gl-* imply something visual, as in *glance*, *glare*, *gleam*, *glimmer* (Bloomfield, 1933/1984; Bolinger 1950). Thus, the literature suggests that the principle of arbitrary relationship between the sound of a word and its meaning is not as absolute as Saussure had proposed.

There has been a body of empirical work which demonstrates the psychological reality of sound symbolism. Kohler found that when presented with a curvy round shape and a spiky angular shape(Kohler, 1929) one has the intuition that *baluma* is a better name for the former and *takete* is a better name for the latter (see also Ramachandran & Hubbard, 2001). Sapir (1929) also demonstrated that English speakers associate novel words containing the vowel /i/ with smallness more frequently than words containing /a/. This phenomenon has been described as magnitude sound symbolism.

An interesting observation is that sound-symbolic words, especially those which refer to action (*gitaigo*), are used abundantly in speech by and toward young children in Japanese (though use of these words is by no means limited to children's language, as mentioned earlier). In our previous unpublished study, twenty-two Japanese mothers described pictures depicting

a person acting in relation to an object (e.g., a boy throwing a ball, rolling a carpet, jumping over a flower, wiping a mirror with a cloth, etc.) to their children (18-20 months) as well as to an adult experimenter. Altogether, 577 references to the actions were made when the mothers were talking to their children, and 57% of the action references were made using mimetic words, and 39% were made using conventional verbs. In contrast, when the mothers described the pictures to the experimenter, 81% of the action references were made using conventional verbs, while only 12% were using mimetic words. Thus, the mothers used mimetics five times more often with the child than with the adult when referring to actions (see also Yoshida & Smith, 2006 for similar findings).

An intriguing possibility is that richness of mimetics in child-directed speech may play a scaffolding role in the acquisition of verbs. As discussed earlier, verbs are known to be difficult for young children to learn compared to object names (e.g., Gentner, 1982). To learn the meaning of a verb, children need to understand what aspect of the action events they are observing at the moment they hear the verb are invariant, and what aspect of the event can vary across the different events the verb refers to. This understanding is critical for children to be able to generalize the verb correctly, i.e., generalizing it only on the basis of the essential component of the verb meaning, while allowing changes in the variables.

Given the difficulty in learning verbs, perhaps care-takers' heavy use of sound-symbolic action words reflects their naive belief that the iconicity provided by sound symbolism may help children focus on the manner component of the action. In the study we report below, we empirically test this possibility. If the sound symbolism hypothesis is borne out, children who are taught novel mimetics that match the referent action should be able to generalize it in the face of a change of the theme object or the actor, whereas children of the same age should fail without the help of the sound symbolism. To test this hypothesis, we taught a group of 3-year-old Japanese children novel verbs that carried sound-symbolic properties. We also taught novel verbs which did not carry such properties to a different group of 3-year-olds. Here, we tested whether 3-year-old children were better able to generalize novel verbs to the same-manner action performed by a different actor when novel words carried sound symbolism than when the words did not have any sound-meaning relation.

Before testing this, however, it was necessary to establish that children are able to detect the sound symbolism in the stimulus materials. For this purpose, we first conducted an experiment examining whether Japanese children aged 25-month-olds and 3-year-olds, as well as English-speaking adults who have no knowledge of Japanese are able to match the target novel mimetic word which were supposed to carry sound symbolism to the target action video. I present this matching study as Study 2A, and the verb learning

(generalization) study as Study 2B below.[2]

3.1 Study 2A: Testing the ability of Japanese 25-months-olds, 3-year-olds, and English-speaking adults to detect sound-meaning correlates in the stimulus materials

3.1.1 Materials

Based on Hamano's analysis (Hamano, 1998), we created six *novel* Japanese mimetics expressing different manners of walking along the fast-slow and heavy-light dimensions: *batobato* (for running with heavy steps, with "b" expressing heavy forceful movement and "t" expressing hitting, see Hamano, 1998 for the description of this sound symbolism and that used for the following novel words), *chokachoka* (for fast walking with small steps, "ch" expressing light, subdued movement and unreliability, "k"expressing outward movement), *hyaihyai* (for semi-swift walking with light, playful steps, with "h" expressing weakness and unreliability and "y" expressing leisurely, unreliable motion), *tokutoku* (for casual, normal-speed walking with small steps, with "t" expressing a light tapping movement and lightness and "k" expressing outward movement), *yotoyoto* (for staggering, as if very tired, with "y" expressing leisurely, unreliable motion, and "t" expressing hitting of a surface) and *nosunosu*(for slow walking with very heavy steps, with "n" expressing sluggishness and "s" expressing friction). For each of the six novel mimetic words, we created two video clips with a character walking in a manner that, to our judgment, sound-symbolically either matched or did not match the mimetic. Specifically, the non-matching video in each novel mimetic word was created so that it clearly differed from the matching video along dimensions such as heaviness of movement, size of steps (large steps vs. small steps), and speed of movement. Altogether 12 videos were created.

3.1.2 Participants and Procedure of Study 2A

Eighteen 2-year-old (range=23-26 months, *M*=25 months, 10 boys and 8 girls) and 17 3-year-old (range=37-47months, *M*=42.7 months, 9 boys and 8 girls) monolingual Japanese children were tested. In addition, fifteen native Japanese speaking undergraduates and 18 native British English speaking undergraduates in the UK who had no knowledge of Japanese participated.

The 6 novel mimetics and the corresponding video clips with matching and non-matching actions described above were used. The participants were

[2] For full description of the study, see Imai, Kita, Nagumo & Okada (in press, *Cognition*).

tested individually. For each target mimetic, the sound-matching action and sound-non-matching action were presented simultaneously side by side, with the right-left position of the matching and non-matching videos counter-balanced across the 6 sets. Participants were instructed to select the action that they thought the word referred to.

3.1.3 Results of Study 2A

The Japanese adults selected the sound-symbolically matching action for each of the 6 novel mimetics 100% of the time. English adults also selected the matching action above chance level (64%). Japanese children, both 2-year-olds and 3-year-olds, selected the "matching" action significantly above chance (2-year-olds: 65.7%; 3-year-olds: 75%). These results showed that, even though the mimetics were newly created, Japanese adults were able to detect the match between the sound and the action perfectly, and this sound-action match was also detectable by English-speaking adults and Japanese children as young as 25 months old.

As it was established that Japanese children were able to detect the sound symbolism between the novel mimetic words and the target action, we now tested whether the sound symbolism played a scaffolding role in young children's novel verb learning.

3.2 Study 2B: Examination of the role of sound symbolism in young children's novel verb learning

3.2.1 Participants and procedure

Thirty four 3-year-olds were randomly assigned to either the *sound-symbolic mimetic verb* condition or the *non-sound-symbolic verb* condition. As in Experiment2A, six sets of visual stimuli were presented in PowerPoint slides. However, this time, each set consisted of two slides, with the first page showing a training event and the second page showing two test events. The action that sound-symbolically matched the target mimetic word served as the training event. In the same-action test event, the action was the same as the training event but the actor changed. In the same-actor event, the actor was the same but the action changed.

As in Experiment 1, children were tested individually by a female native speaker of Japanese at their preschool. In both conditions, children were first shown the training video with the verb. Each target video lasted approximately 5 second, and was shown twice. In both condition, the target novel word was repeated twice. The experimenter said the instruction sentence in natural, child-directed speech. Care was taken, however, that novel mimetic verbs as well as novel non-sound symbolic verbs were said at

the onset of the movement of the actor and at the same speed. They were then shown the two test events, and were asked to indicate to which video the verb should be generalized. In the *sound-symbolic mimetic verb* condition, the six verbs were those used in Experiments 2A (*chokachoka, hyaihyai, tokutoku, batobato, nosunosu and yotoyoto)*. In the *non-sound-symbolic verb* condition, the novel nonsense verbs were ones that had been used in previous novel verb learning studies with Japanese children (Imai et al., 2005). These verbs were presented in the morpho-syntactic form of regular, non-sound-symbolic verbs with no reduplication and they had no detectable sound-symbolic link between the word and action. The novel words used were: *chimoru, nuheru, rikoru, yachiru, nekeru, hekuru*. They are introduced in the same sentence frame used in the *sound symbolic mimetic verb* condition.

3.2.2 Results of Study 2B

Supporting the sound symbolism bootstrapping hypothesis, 3-year-olds were able to generalize the novel sound-symbolic verbs to the same action test at significantly above chance level (82%), but failed to do so when the verb did not carry sound-symbolic properties (54%). There was a statistically significant difference across the two conditions.

3.3 Discussion of Study 2

The fact that 3-year-olds did not succeed in generalizing non-sound-symbolic verbs may not be so surprising, considering that 3 consistently failed to generalize verbs that were not sound-symbolic in the face of change in the actor or the theme object in previous studies (e.g., Imai et al., 2005, 2008; Kersten & Smith, 2002). In this light, the fact that 3-year-olds were able to generalize the sound-symbolic verb at a rate over 80 % is very impressive. However, another possibility is that children selected the “correct” (i.e., the same-action) video simply because they were able to match the sound of the novel mimetic verb and the action at the test stage, without any consideration of which test event the verb learned in the training phase could be generalized to.

To rule out this possibility, we further conducted a control experiment. In this experiment, the target mimetic word taught did not sound-symbolically match the action in the training event. Hence, in the training phase, the target mimetic word did not sound-symbolically match the “correct” (in light of verb generalization) choice (i.e., the same-action test event with a different actor from the training event) either. However, the target mimetic verb sound-symbolically *did* match the “incorrect” choice (i.e., the same-actor test event with a different action). If the 3-year-olds in the sound-symbolic mimetic verb condition in Study 2B were simply sound-symbolically matching the word to the action during the test phase, the children in the control experiment should select the incorrect same-actor test event. A

separate group of 3-year-olds were tested. It turned out that, the 3-year-olds in the control study neither chose the "correct" sound symbolically non-matching test nor the "incorrect" test that sound symbolically matched the target verb. This result ruled out the concern that the 3-year-olds in the sound symbolically matching mimetic verb condition simply matched the sound to the action without being engaged in verb learning, and the hypothesis that sound symbolism fosters early verb learning.

4 General Discussion: The Role of Structural and Non-Structural Factors in Early Verb Learning

In this paper, I reported two recent studies I conducted that examined factors influencing early verb learning. Verb learning requires extracting the invariant of the relation between the objects serving as the verb arguments, and generalization solely on the bases on the invariant. The results of the two studies together indicate that this process is a challenge for young children independent of the structural properties of the input language, and support the view that the influence of cognitive factors is stronger than that of linguistic structural factors. In Study 1, Chinese children showed particularly severe difficulty in novel verb learning compared to Japanese and English-speaking age peers, suggesting that the lack of morphological distinction between nouns and verbs, together with the habit of dropping arguments may hinder rather than foster verb learning. Chinese children, however, seem to rely on extra-linguistic contextual cue in verb learning more strongly than Japanese- and English-speaking children, presumably to compensate the weakness of the structural information in the input language. The degree of success soared by 40 % with the scaffolding by contextual cue for Chinese children. In contrast, the additional structural cue—providing the verb in multiple sentence structures—raised the proportion of the correct generalization only by about 10%. The second study showed sound symbolism carried in the verb drastically improved Japanese 3-year-olds' performance of novel verb learning, again by about 40%. Sound symbolism is in the realm of language, but definitely not a structural factor. Sound symbolsim in fact lies between language and the world outside language, as it connects direct sensory experience to language. Clearly, children utilize multiple cues in verb learning, including perceptual cues, social cues, statistical cues, and structural cues (Hollich, Hirsh-Pasek & Golinkoff, 2002). The two studies I presented in this paper converge to suggest that, although children do use structural cues in their inference of verb meaning, if they are easily accessible, social and perceptual cues are more prominent factors than structural cues in early stages of verb learning.

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