Title	Sound symbolism between a word and an action facilitates early verb learning
Sub Title	
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Publisher	Centre for Advanced Research on Logic and Sensibility The Global Centers of Excellence Program, Keio University
Publication year	2008
Jtitle	CARLS series of advanced study of logic and sensibility Vol.1, (2007.) ,p.267- 282
JaLC DOI	
Abstract	
Notes	Part 3 : Cognition and Language
Genre	Research Paper
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=KO12002001-20080331-0267

15 Sound Symbolism Between a Word and an Action Facilitates Early Verb Learning

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I. Introduction

Since the time of Saussure, it has been emphasized that an important principle of language is the arbitrary relationship between the sound and meaning of words (e.g., Saussure, 1916/1983, Newmeyer, 1993). Sound symbolism, in which the sound and meaning of words are systematically related, has only been occasionally discussed. For example, Köhler (1929) pointed out that when presented with a curvy round shape and a spikey angular shape, 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 and Westbury, 2005). Sapir (1929) also demonstrated that English speakers associate novel words containing the vowel [i] with smallness more frequently than words containing [a].

There is evidence that certain aspects of sound symbolism are universal. The magnitude sound symbolism mentioned above was also found in Chinese and Thai speakers (Huang, Pratoomraj, & Johnson, 1969). It has also been shown that people can correctly match antonym pairs such as *good-bad*, *strong-weak*, and *fast-slow* in foreign languages they do not know to the semantically equivalent pairs of words in their native language (e.g., Brown, Black, &

Table 1. Sound symbolism in Japanese mimetics

Mimetics	Meaning
(a) goro	'a heavy object rolling'
(b) koro	'a light object rolling'
(c) guru	'a heavy object rotating around an axis'
(d) kuru	'a light object rotating around an axis'
(e) bota	'think/much liquid hitting a solid surface'
(f) pota	'thin/little liquid hitting a solid surface'
(g) potapota	'thin/little liquid hitting a solid surface repeatedly'

Horowitz, 1955; Klank, Huang; & Johnson, 1971). Nevertheless, in mainstream linguistics, sound symbolism is considered to be a marginal phenomenon in language, and Newmeyer (1993) notes "the number of pictorial, imitative, or onomatopoetic non-derived words in any language in vanishingly small (p.758)".

Such a statement, however, turns out to be too strong when one looks beyond Indo-European languages. 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 other words referring to events and states in which sound is not essential. Sound symbolism in mimetics in Japanese can be illustrated in the words referring to motion events shown in Table 1. The combination of 'g'/'k' and 'r' often represent rotation as seen in (a) - (d). The voiced initial consonant is associated with larger mass and the voiceless initial consonant is associated with smaller mass as seen in (a) - (f). Any of the forms in (a)-(f) can be reduplicated to indicate that the event took place repeatedly, as illustrated in (g). (See Hamano 1998 and Kita, 1997, 2001 for more detailed accounts.)

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'. Mimetics constitute a large open class of words, and new

words can be easily created: one mid-sized dictionary of mimetics lists 1700 entries (Atoda & Hosino, 1995). These words are frequently used in everyday conversation, as well as in various forms of verbal arts from comic books to novels. Japanese is by no means an exception among the languages of the world. Many languages have a similar grammatical class of words with clear sound symbolism (see Childs 1994; Voetlz & Kilian-Hatz 2001; Ibarretxe-Antuñano, 2003): most of sub-Saharan African languages (called "ideophones"), many of the Southeast Asian languages (called "expressives"), Balto-Finnic languages, Basque, and some of the indigenous languages of South America and Australia (see Nuckolls, 1999 for a review). Furthermore, even in Indo-European languages such as English, systematic sound symbolism has also been described in words such as *squeeze*, *squirt*, *squint*, *bump*, *thump*, and *plump* (e.g., Firth, 1935/1957), though they do not form a clear grammatical class. Thus, arbitrariness, as emphasized by Saussure, does not fully capture the relationship between sound and meaning in words.

An interesting observation is that the use of sound symbolic words, especially in reference to action (*gitaigo*), are abundant in speech by and toward young children in Japanese. In Nagumo et al. (2006), Japanese mothers described pictures depicting a person acting in relation to an object to their two-year old child and an adult. They 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.)

One reason for the richness of mimetics in child directed speech may be that mimetics play a scaffolding role in acquisition of verbs. Verbs are known to be difficult for young children to learn compared to object names (e.g., Gentner, 1982; Childers & Tomasello, 2006). There are multiple reasons for the difficulty. For example, unlike objects, actions are ephemeral and difficult to individuate: it is not obvious when the action referred to by a given word starts and when it ends. Second, unlike nouns, verbs require arguments, where arguments must be treated as variables that can change across instances. Thus, to learn the meaning of a verb, children need to understand what aspect of the action event they are observing at the moment is invariant and what aspect of the event can vary, and generalize the verb only on the basis of the invariant component, while allowing changes in the variables. Previous research suggests that this cognitive process is difficult for children younger than 3-years of age (e.g., Imai et al., 2005; Kersten & Smith, 2004; Maguire

et al., 2002). Imai et al. (2006) has demonstrated that Japanese, Chinese, and English 3-year-olds fail to generalize a novel (non-sound symbolic) verb to the same action when the object changed. Perhaps care-takers' heavy use of sound symbolic action words reflect their naive belief that the iconicity provided by sound symbolism may help children focus on the manner component of the action, hence allowing them to extract the invariant component (i.e., the manner of the action) more easily than with conventional, non-sound symbolic verbs.

The current study investigated whether sound symbolism facilitates children's acquisition of action words. In particular, we tested whether the universal aspects of sound symbolism in mimetic verbs (a subtype of mimetics) could provide scaffolding for children to focus on the right features of events when learning the verbs. To test this effect, however, we first need to establish the crosslinguistic validity of the sound symbolism between the target action and the target words. We then need to establish that young children are indeed sensitive to this sound symbolism. Thus, in Experiment 1, we tested not only Japanese-speaking adults but also English-speaking adults to see whether they were able to detect the match between novel mimetics created for the study and the corresponding actions (see the material section in Experiment 1). In Experiment 2, we tested whether Japanese 2.5 and 3-year-olds were sensitive to the sound symbolism between the target words and the actions. Maurer et al. (2006) demonstrated that 2.5-year-old English-speaking children were sensitive to the sound-meaning link for shapes. Specifically, 2.5-olds matched rounder shapes to words containing the vowels [ah] or [u] (e.g. *bamu*) and pointed shapes to words containing the vowels [i], [ej] or [^] (e.g., k[^] t[ej]), just as adults did in Köhler's experiment. However, there is little previous research examining this phenomenon for actions either in children or adults. Thus, examining whether children as young as 2.5 or 3-years of age are able to detect the sound-action match between novel words and novel actions is in itself of great interest. The sound symbolism bootstrapping hypothesis was then tested in Experiment 3, also with 2.5- and 3-year-old Japanese children. Experiment 4 clarified (1) whether the advantage of mimetics came from the reduplicative structure (*bato-bato*) or the sound symbolism per se and (2) whether children were truly generalizing verbs or simply matching the sound to the action at the test trial.

II. Experiment 1: Stimuli construction and establishment of sound symbolism

The aim of Experiment 1 was to establish crosslinguistically-valid sound symbolism in the stimuli we then used for the following experiments. For this purpose, we first conducted a rating study by Japanese- and English-speaking adults (Experiment 1a). To further confirm the sound symbolism, we conducted a forced choice task, asking Japanese as well as English adult speakers to select the action to which the target (sound symbolic mimetic) word referred (Experiment 1b).

1. Experiment 1a: Rating of the degree of the match between sounds and actions

1.1. Method

Participants. Fifteen native Japanese speaking undergraduates living in Japan and 21 native British English speaking undergraduates in UK who had no knowledge of Japanese participated.

Materials. 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 heaviness/roughness and [a] expressing largeness, see Hamano, 1999), *chokachoka* (for fast walking with small steps), *hyaihyai* (for semi-swift walking with light, playful steps), *tokutoku* (for casual, normal-speed walking with small steps), and *nosunosu* (for slow walking with very heavy steps). For each novel mimetic, 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. Both Japanese and English participants were instructed to watch each video clip and listen to the associated novel mimetic, and judge how well the sound matched the action on a scale from 1 ("does not match at all) to 7 ("matched very well).

1.2. Results

The Japanese speakers on average judged the sound-symbolic fit to be better for the matching actions ($M = 5.6$, $SD = 0.59$) than the non-matching actions ($M = 2.0$, $SD = 0.52$), $t\,(14) = 23.4$, $p < .001$, $d = 6.05$. So did the English speakers: the matching actions ($M = 4.2$, $SD = 0.92$); the non-matching actions ($M = 3.6$, $SD = 0.79$), $t\,(20) = 2.77$, $p < .5$, $d = 0.603$.

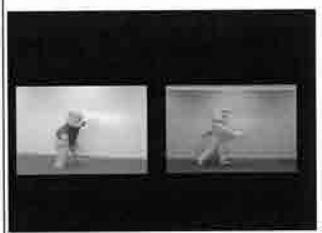
2. Experiment 1b: Forced choice matching task

2.1. Method

Participants. Fifteen native Japanese speaking undergraduates and 18 native British English speaking undergraduates in UK who had no knowledge of Japanese participated. No one had participated in Experiment 1a.
Material and procedure. The same novel mimetics and the corresponding video clips with matching and non-matching actions as in Experiment 1 were used. The participants were tested individually. The stimuli, both visual (action videos) and auditory (target mimetics), were again presented in PowerPoint slides. 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.

2.2. Results and Discussion

The Japanese adults selected the sound-symbolically matching action for each of the 6 novel mimetics 100% of the time. English adults selected the matching action above chance level, 64% (SD =21), $t\,(17)$ =2.83, $p < .05$, $d = 0.67$ (see Figure 1). 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 people who had no knowledge of Japanese. Given these results, we next tested whether children as young as 2 and 3-year-olds are sensitive to the sound symbolism between the novel mimetics and the corresponding actions.

	Training		Test
Sample set for Exp. 3	 Mimetic Match Action		 Same Action (Mimetic Match) Same-Object distractor
Sample set for Exp. 4	 Mimetic non-Match Action		 Same-Object distractor (Mimetic Match) Same Action
Mimetic verb (Exp.3&4)	Mite! Nosunosu-shiteru! "Look, (he) is nosunosu-ing"		Nosunosu-shiteru no wa docchi? "In which movie is (he) nosunosu-ing?"
Novel verb (Exp. 3)	Mite! X-tteiru! (X: non-sound symbolic regular verb form) "Look, (he is) X-ing!"		X-shiteru no wa docchi? "In which movie (is he) X-ing?"

Note. The distractor in the test phase contained a different action but by the same actor. The same action is the correct choice for the verb generalization task (Experiments 3 and 4). The test videos used for Experiment 3 were also used for the novel mimetic-action matching task (Experiments 1b and 2).

Figure 1. Sample stimulus sets used for Experiments 1-4.

3. Experiment 2

3.1. Method

Participants. Fifteen 2.5 year-old (range = 29-35 months, $M = 32.7$ months) and 17 3-year-old (range = 37-47 months, $M = 42.7$ months) monolingual Japanese children were tested. The children, mostly from middle class families, were enrolled in preschools in a suburban city. Two other children were tested but excluded from the final sample because of a position bias in their response.
Materials and procedure. The same novel mimetics and corresponding video clips as in Experiments 1a and 1b were used and presented in PowerPoint slides. The children were tested individually. Prior to testing, the children received four practice trials to familiarize them with the pointing procedure. As in Experiment 1b, during the test, children were shown two video clips side by side, one matching the target mimetic and the other non-matching, and were asked to point to the video that was showing the action that the target novel mimetic referred to. (The experimenter asked: Mite! (look!) batobato-shiteru (batobato-doing) nowa (is) docchi (which) 'Look! Which (video) shows doing batobato'?)

3.2. Results and Discussion

Japanese 2.5-year-olds and 3-year-olds selected the "matching" action (i.e., the video that adult Japanese speakers judged as a match to the target mimetic) significantly above chance (2.5 year-olds: 76%, $t\,(14) = 6.49$, $p < .001$, $d = 1.68$; 3-year-olds: 75%, , $t\,(16) = 12.3$ $p < .01$, $d = 2.98$, see Figure 2). The results of Experiment 2 together with those of Experiments 1a and 1b showed that not only Japanese adults but also English-speaking adults who had no exposure to Japanese mimetics as well as Japanese children as young as 2.5-year-olds were able to detect the sound symbolism between the novel mimetic verbs and novel actions.

In Experiment 3, we next tested the sound symbolism bootstrapping hypothesis. As discussed earlier, previous research has demonstrated that young children—as old as 3-years of age—would not easily generalize a newly learned verb to the same action when the object involved in the action event is changed (Kersten & Smith, 2004; Imai et al., 2005; 2006). If the sound symbolism hypothesis bears out, children who are taught novel mimetics that

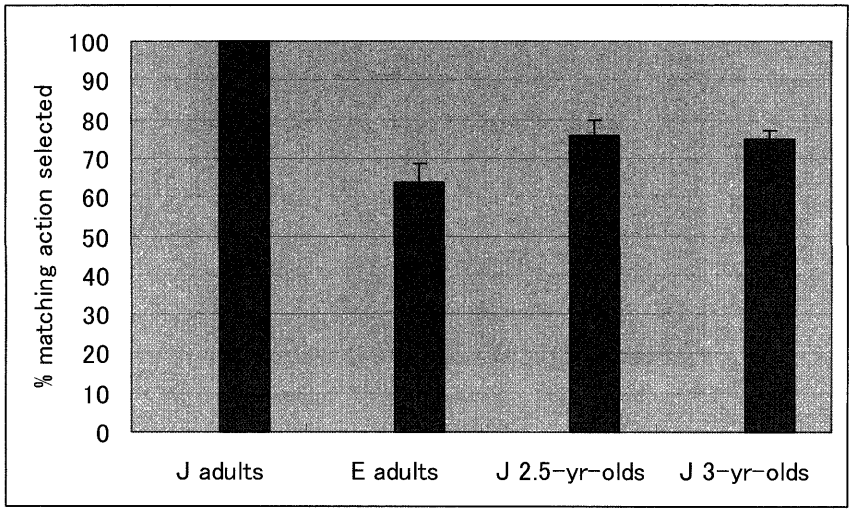


Figure 2. Percentage of the "sound-symbolically matching action" choice in Experiments 1b and 2 (The chance level is 50 %.)

match the referent action should be able to generalize it in the face of a change of the object, whereas the same age children should fail without the help of the sound symbolism. To test this hypothesis, we taught 2.5- and 3-year-olds novel verbs that were shown to have sound symbolic properties in the above experiments and novel verbs which did not carry such properties.

4. Experiment 3

4.1. Method

Participants. Thirty 2.5-year-olds (12 boys and 18 girls, range = 29-35 months, M = 32 months) and 34 3-year-olds (15 boys and 19 girls, range = 37-48 months, M = 48months) were randomly assigned to either the *sound symbolic mimetic verb* condition or the *non-sound symbolic verb* condition. Four other 2-year-olds and four other 3-year-olds were tested but excluded from the final sample because of a position bias.

Materials and procedure. As in Experiments 1b and 2, 6 sets of visual stimuli were presented in PowerPoint slides. However, this time, each set

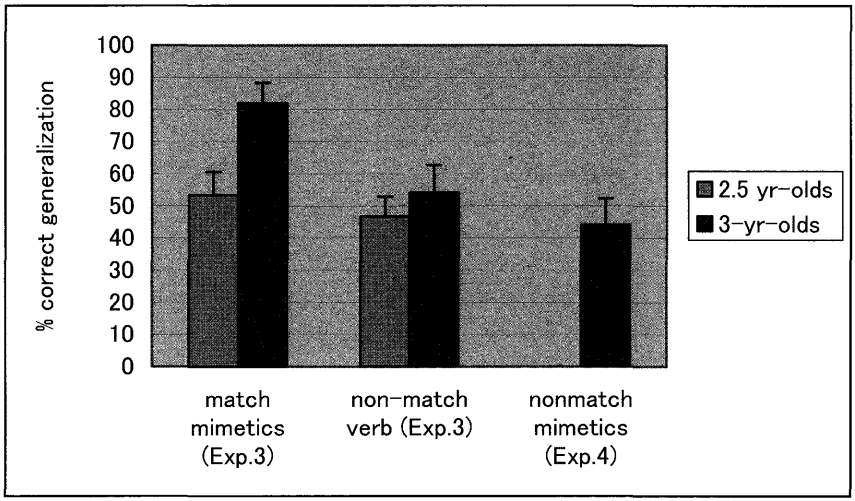


Figure 3. Percentage of the Same-Action choice in 2.5- and 3-year-olds in Experiments 3 and 4 (3-year-olds only). (The chance level is 50 %.)

consisted of two slides, with the first page showing a training event and the second page showing two test events. In the training event, the action matched the target mimetic sound- symbolically. In the same-action test event, the action was the same as the training event but the object (the actor) changed. In the same-object event, the object was the same but the action changed. The two test events were the same as those used in Experiments 1b and 2.

As in Experiment 1, children were tested individually at their preschool. In both the sound-symbolic mimetic verb and non-sound-symbolic (non-mimetic) verb conditions, children were first shown the training video with the verb. They were then shown the two test events, and were asked to indicate to which video the verb should be applied. In the sound-symbolic verb condition, the six verbs were those used in Experiments 1 and 2. In the non-symbolic verb conditions, the novel nonsense verbs were borrowed from 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 had no detectable sound symbolic link between the word and action. The novel words used were: *chimoru, nuheru, rikoru, yachiru, nekeru, hekuru.* Fourteen Japanese adults

rated how well the sound of the novel nonsense verbs matched the actions in the test video clips, using the same procedure as in Experiment 1a. The sound-meaning match score was equally low for the same action (correct) test and the same object (incorrect) test videos (same-action:, $M = 3.4$, $SD = 1.1$; same-object: M=3.1 $SD = 1.1$; t (13)=1.08 , $p > .1$).

4.2. Results and Discussion

Supporting the sound symbolism boostrapping hypothesis, 3-year-olds were able to generalize the novel sound symbolic verbs to the same action test (82%, t (16) = 4.67, $p < .01$, $d = 1.13$), while failing to do so when the verb did not carry sound symbolic properties (54%, t (16) = .454, $p > .1$, see Figure 3). There was a significant difference across the two conditions, t (32)=2.38, $p < .05$, $d = 0.81$. However, this effect was not found in 2.5-year-olds. In neither condition, did the 2.5-year-olds succeed in the generalization significantly above chance (Sound symbolic verb condition: 53.3%, t (14) =.456, $p > .1$; Non-sound symbolic verb condition: 46.7%; t (14) =-.544, $p > .1$), and their performance in the two conditions did not differ from one another, t (28) = .699, $p > .1$).

The fact that 2.5-year-olds did not succeed in generalizing the sound symbolic mimetic verbs may not be so surprising, considering that 3-year-olds consistently failed to generalize verbs that were not sound symbolic in the face of an object change in earlier studies (e.g., Imai et al., 2005, 2006; Kersten & Smith, 2002; Maguire et al., 2006), including the non-sound symbolic verb condition in this experiment. One may concern that children were simply matching the sound symbolic verb and the action at test instead of considering which test event the verb could be generalized to. However, this possibility seems unlikely given the fact that the 2.5-year-olds were able to make the word-action match as well as the 3-year-olds (Experiment 2), but failed in the generalization of the same words here. If children had been simply matching the sound of the word and the action, the 2.5-year-olds should have succeeded in this generalization task as well. The difference in the performance of the 2.5-year-olds across the two situations suggests that novel mimetic verb generalization involves more than simply matching the sound to the action and cannot be reduced to mere sound-action matching process at the test phase.

Nonetheless, to directly rule out the possibility that 3-year-olds in

Experiment 3 simply were matching the sound and the action without undertaking the process of verb generalization, we conducted Experiment 4. In this study, we designed the stimuli such that the same-object test event (with a different action from the training event) sound-symbolically matched the mimetic verb taught for the training event. If the 3-year-olds in Experiment 3 were simply matching the word to the action during the test phase, the children in Experiment 4 should select the incorrect same-object test event that sound-symbolically matched the mimetic verb. If, on the other hand, they were actually attempting to generalize the novel mimetic verb, they would not simply map the word to the incorrect same-object test, but at the same time, without the support of sound iconicity, they would be likely to fail to generalize the word to the correct same-action test event. Experiment 4 also allowed us to test whether the bootstrapping effect for verb learning found in Experiment 3 was be due to the sound-symbolic property or simply due to the prosodic property of the novel mimetics. The novel mimetics consisted of reduplication of a CVCV cluster (e.g., *bato-bato-suru* (do)), which was typical of mimetics. Perhaps the effect could come from the prosodic property of reduplication matching the temporal aspect of the action. If the latter possibility were in fact the case, we should expect that children in Experiment 4 should succeed in verb generalization, just as the children who were taught novel sound-symbolically matching mimetics in Experiment 3.

5. Experiment 4

5.1. Method

Participants. Seventeen monolingual Japanese-speaking 3-year-olds (range = 37-47 months; $M = 43.1$ months) participated. Two other children were tested but excluded from the final sample.

Materials and procedure. Five of the six novel mimetics used in Experiments 1b-3 were used: *batobato, chokachoka, hyaihyai, nosunosu*, and *tokutoku*. For each mimetic, two actions that either sound symbolically matched or did not match with the mimetic were selected. In the test phase, the incorrect (same-object) test event had better sound-symbolic match with the mimetic than the correct (same-action) test event (see Figure 1 for a sample). The mean adult ratings for sound-symbolic match with the mimetic were significantly

higher for the incorrect test events than correct test events for both Japanese speakers (correct events, $M = 2.0$, $SD = 0.64$, incorrect events, $M = 5.7$, $SD = 0.62$, $t\,(14) = 16.88$, $p < .001$, $d = 4.36$) and for English speakers (correct events $M = 3.7$, $SD = 0.90$, incorrect events $M = 4.4$, $SD = 0.95$, $t\,(20) = 3.49$, $p < .01$, $d = 0.76$). The procedure was the same as in Experiment 3.

5.2. Results and Discussion

Unlike the 3-year-olds who were taught a sound-symbolically matching mimetic verb in Experiment 3, the 3-year-olds in this experiment failed to generalize the newly taught non-matching mimetic verb (44% correct, $t\,(14) = -.721$, $p > .1$). The performance of the children hearing non-matching mimetic verbs differed significantly from that of the children who were taught matching mimetic verbs in Experiment 3 (82%), $t\,(30) = 3.435$ $p < .001$, $d = 1.216$. These results suggest that (1) the 3-year-olds who were taught the sound-matching mimetic verb were actually engaging verb generalization and that their success in verb generalization cannot be attributed to the process of simple sound-action matching while watching the two test video clips; (2) it was not mere prosodic property of mimetic verbs that fostered verb generalization when children were taught sound-symbolically matching mimetic verbs.

III. General Discussion

This research provided important implications for issues concerning sound symbolism as well as for theories of word learning. First, while previous empirical research mostly demonstrated the phenomena in the domain of shape, this research provided evidence for potentially universal sound symbolism in the domain of actions, by demonstrating that the sound symbolism underlying novel mimetics is detectable by adults who have no knowledge of Japanese as well as Japanese children as young as 2.5-years of age who could not have been exposed to the novel mimetics used in the study.

Second and more importantly, we provided evidence that sound symbolism plays a facilitative role in learning of action names in 3-year old children (See also Yoshida & Smith, 2006 for related results). In a number of studies, novel

verb generalization (in the face of a change of the object) has been found to be difficult for 3-year-old or younger children across different languages (Imai et al., 2005, 2006; Kersten & Smith, 2004; Maguire et al., 2002). This seems to be largely due to the fact that action, which verbs typically refer to, unfolds over time and is ephemeral, but objects, which nouns typically refer to, are stable over time and perceptually individuated. The sound symbolism in the mimetic verbs may help children isolate the action out of the various components of an event, and highlight it. This allows children to overcome the "grip" of objects in word learning, and select the action as the invariance relevant for verb meaning. In this sense, sound symbolism bootstraps acquisition of action names.

The current study along with Maurer et al.'s (2006) suggests that 2.5 year olds may already have universal sound symbolism, possibly through cross-activation of motor, auditory, and visual areas in the brain (Ramachandran & Hubbard, 2001). Although 2.5-year-olds could not take advantage of the sound symbolism in verb generalization, it does not mean that sound symbolism is not helpful in word learning at all in children at this age. Rather, it is most likely that the process of extracting invariance of the action event is cognitively too demanding only with a single exposure to the association between the verb and the action for 2.5-year-olds.

The results of this research have opened a door to a number of extremely interesting questions for future research. For example, do children come to word learning with an expectation that the sound of words and their referents have some meaningful relation, and does this expectation change developmentally? Whether children's expectation of a relation between meaning and sound is limited to particular word class such as mimetics or ideophones, or whether they assume the sound-meaning relation for all types of words, and whether their expectation is universally shared or language-specific, are other interesting topics for future investigation.

Acknowledgements

We thank Etsuko Haryu and Sachiyo Kajikawa for stimulating discussions and for Vicky Muehleisen for her thoughtful comments on earlier version of the paper. We also thank Alex Lievesley, Mamiko Arata and Izumi Honda for their help in data collection.

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