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A Cross-Linguistic Study of Sound Symbolism in Children's Verb Learning

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A long history of research has considered the role of iconicity in language and the existence and role of nonarbitrary properties in language and the use of language. Previous studies with Japanese-speaking children, whose language defines a large grammatical class of words with clear sound symbolism, suggest that iconicity properties in Japanese may aid early verb learning, and a recent extended work suggests that such early sensitivity is not limited to children whose language supports such word classes. The present study further considers the use of sound-symbolic words in verb-learning context by conducting systematic cross-linguistic comparisons on early exposure to and effect of sound symbolism in verb mapping. Experiment 1 is an observational study of how English- and Japanese-speaking parents talk about verbs. More conventionalized symbolic words were found in Japanese-speaking parental input, and more idiosyncratic use of sound symbolism was found in English-speaking parental input. Despite this different exposure of iconic forms to describe actions, the artificial verb-learning task in Experiment 2 revealed that children in both language groups benefit from sound–meaning correspondences for their verb learning. These results together confirm more extensive use of conventionalized sound symbolism among Japanese speakers and also support a cross-linguistic consistency of the effect, which has been documented in the recent work. The work also points to the potential value of understanding the contexts in which sound–meaning correspondences matter in language learning.

Language is a symbol system, and most words point to their meanings by convention, not by some intrinsic similarity of the form to its referent (de Saussure, 1966). Yet many languages include some forms that are perceptually evocative of the meaning. In English, some words that are "iconic,"

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in this sense, are "bang," "clap," "splash," and "pop," as well as words of animal sounds (e.g., meow, woof-woof). These words are common in early child vocabularies. These word forms mimic the sounds associated with the referent. There are, however, a variety of ways through which the sound of a word may be "suggestive" of its meaning, by mimicking a sound itself (e.g., "pop"), by more metaphoric correspondences (e.g., "zig-zag"), by semantic–phonological associations (e.g., "quickness" is associated with front vowels such as "i"; for more details and universality, see Jesperson, 1933; Sapir, 1929). Given this diversity, sound-symbolic forms go by a variety of names and kinds such as "onomatopoeia," "idiophones," "expressives," "mimetics," and "phonaesthemes" (see Abelin, 1999; Bergen, 2004; Diffloth, 1976; Doke, 1935; Hamano, 1998; Hutchins, 1998; Martin, 1975; Samarin, 1970). This article concentrates on sound symbolism in the sense of conventionalized word forms of which phonological properties—or the motoric actions in making those sounds—evoke the meaning (but do not mimic a sound associated with the referent).

Sound Symbolism

One early study by Köhler (1947) used novel labels and nonsense shapes to study sensitivity to sound–meaning correspondences. In Köhler's study, English-speaking adults were asked to match two novel shapes (round or angular) to two nonsense words—*maluma* and *takete.* English-speaking adults chose *maluma* as the label for the round shape and *takete* as the label for the angular shape. More recently, Ramachandran and Hubbard (2001) found that 95% of English-speaking adults showed such systematic bias in a name–object matching task. In their study, adult participants matched *bouba* with a round, amoeboid shape and *kiki* with an angular figure (see also Holland & Wertheimer, 1964). They further speculated that the *bouba/kiki* phenomenon arises not only through language learning, but from cortical connections among contiguous cortical areas that blend the visual information of the nonsense shape (round or angular), the appearance of the speaker's lips (open and round, or wide and narrow), and the feeling of the phonemic inflection and movement (see also Hubbard, Arman, Ramachandran, & Boynton, 2005; Marks, 1978; Vetter & Tennant, 1967, for cross-modal discussion).

Consistent with this idea are analyses of the relation between phonological elements and meaning (Gomi, 1989; Hamano, 1998; Jesperson, 1933; Oda, 2000; Ohala, 1983). For example, vowel sounds differ systematically depending on the where the tongue is positioned. When pronouncing "tee," the tongue is more toward the front of the mouth than it is when pronouncing "tin." In contrast, when pronouncing "toot," the tongue is more toward the back of

the mouth than it is when pronouncing ''tin'' (Klink, 2000). Studies have shown a correlation between this front/back distinction and a variety of spatial/temporal dimensions—for example, adults tend to associate front vowels with smaller and faster events and back vowels with larger and slower events (Becker & Fisher, 1988; Birch & Erickson 1958; Newman, 1933; Sapir, 1929). Cross-linguistic studies also indicate sensitivity to sound–meaning correspondences. For example, when monolingual English-speaking adults were asked to sort words they heard in the Huambisan language into those naming birds and those naming fish, the adult participants could sort those foreign words at above-chance levels (Berlin, 1994). Other researchers have also asked whether adults are sensitive to conventionalized forms in other languages (Bolinger, 1950; R. Brown, 1958), and adult participants (e.g., English-speaking Americans), when asked to guess the meanings of words in Japanese, show agreement well above chance (Tsuru & Fries, 1933). These and many other studies with adults (R. W. Brown, Black, & Horowitz, 1955; Köhler, 1947; Kunihira, 1971; Maltzman, Morrisett, & Brooks, 1956; Nygaard, Cook, & Namy, 2009; Sapir, 1929; Tsuru & Fries, 1993) suggest a perhaps universal sensitivity to at least some sound–meaning resemblances.

A few studies provide evidence of sensitivity to sound–meaning correspondences in young children. Maurer, Pathman, and Mondloch (2006) tested 2.5-year-old children in a label–object matching task in which children were asked to match a novel shape to the corresponding name. Children matched rounder shapes to words containing the vowels ''ah'' or ''u'' such as in *bamu*, and sharp shapes to words containing the vowels ''i,'' ''ej,'' or ''^'' such as in *kuh-tay*. The children's response patterns suggest an expected correlation between certain shapes of objects and sound properties. In a study with much younger infants, Gogate and Bahrick (1998; also Gogate, 2010) showed 7-month-olds were sensitive to corresponding temporal synchronies in words and the labeled events. These findings suggest an early and perhaps universal sensitivity to sound symbolism.

Recent developmental evidence further suggests that these sound–meaning correspondences might help children learn new words (Imai, Kita, Nagumo, & Okada, 2008; Yoshida, 2003; Yoshida & Smith, 2003). One study by Imai et al. (2008) specifically examined the role of iconicity in the verb learning of Japanese-speaking children and documented the advantage of sound-symbolic arrangement that is made through constructing novel words. In the study, 3-year-old Japanese-speaking children successfully mapped novel sound-symbolic words to corresponding actions when the task context provided information about action and contextual cues—familiar motion type (e.g., different manners of *walking*) and having familiar *actors* (e.g., a person wearing a Winnie the Pooh costume) engaging in the target actions. Imai et al.'s (2008) focus on verb learning rather than noun learning may be

important. In Japanese, sound-symbolic words often convey sounds, modes, or aspects of action rather than object labels (Hamano, 1998; Hinton, Nichols, & Ohala, 1994). Moreover, in most languages (but see P. Brown, 2001; Tardiff, 1996; Tardiff, Gelman, & Xu, 1999), verbs appear harder to learn than nouns and are generally considered to be more abstract (less perceptually tangible) and thus are challenging for young learners (e.g., Gentner, 1982; Gentner & Rattermann, 1991; Gillette, Gleitman, Gleitman, & Lederer, 1999; Medin & Ortony, 1989; Rosch, 1973). Thus, sound symbolism that evokes the action along with familiar contents of events together may help verb learning by directing attention to relevant spatial and temporal aspects of events.

Conventionalized Sound Symbolism

Some languages (although there are debates; see Diffloth, 1994; Kita, 1997, 2001; Matisoff, 1994; Noma, 1998) seem to have more conventionalized iconic forms than others. Japanese, Korean, Basque, African, Tamil, Swedish, and Austronesian are often characterized as showing a *pervasive use* of sound-symbolic words (Abelin, 1999; Ibarretxe-Antunano, 2010; Lee, 1992; Samarin, 1970; Sohn, 1999; Wiltshire, 1999). Japanese has a specific syntactic category of mimetics—many of the words classified into this category have sound properties, and perhaps also the motor actions of producing them, that are evocative of their meaning (Gomi, 1989; Hamano, 1998; Kita, 1997, 2001; Oda, 2000; Tsujimura & Deguchi, 2007; Yamaguchi, 1986; see Imai et al., 2008, for a full review). Some properties of Japanese mimetics particularly relevant to the present study were analyzed by Oda (2000) and Hamano (1998) and are called *gitai go.* This particular Japanese class includes sound properties that connote *soundless* situations such as consequential appearance, aspect, tactile, and other perceptual sensations. For example, *fuwa-fuwa* means "soft and feathery." These forms, like many iconic forms, are reduplicative, and Oda showed that both adult English speakers and Japanese speakers were at least somewhat sensitive to the meaning implications of these forms. According to Oda's analysis, the regularities in Japanese mimetics are sufficiently systematic and they are productive—that is, Japanese speakers systematically make up new forms.

Early sensitivity to conventionalized mimetic forms in other languages has not been systematically studied, and thus, the positive effect of sound symbolism in verb learning demonstrated by Japanese-speaking children (Imai et al., 2008) raises some questions. First, the Japanese children in Imai et al.'s (2008) study could have been showing sensitivity to the sound-symbolic properties of their own language, and if so, this sensitivity might be derived though their experience with this particular language from which the terms were derived. Or the sensitivity could also be more generally

available to all young learners. Second, if this effect may be derived though their experience with this particular language, what did their early input look like? Are they receiving more iconic input than children whose language does not support the special word class? Third, the effect could be enhanced by the task-specific information—target action was somewhat familiar (e.g., a version of walking) and familiar actor (e.g., well-known animal)—which may make the task easier than actual verb learning. As noted earlier, verb learning has been considered relatively difficult due to the perceptually ambiguous meaning property, and thus the task involving a familiar actor engaging in a familiar action type may not be a sufficient case for representing the case of verb learning.

A recent study (Kantartzis, Kita, & Imai, 2011), reported after the completion of the present experiments provides the first evidence on the cross-linguistic generalizability of the sensitivity and provides the first evidence to support the cross-linguistic consistency in the effect by testing 3-year-old English-speaking children in the United Kingdom. The study used the procedure from Imai et al.'s study (2008). Experimenters presented English-speaking children with a familiar actor (e.g., a person wearing a Winnie the Pooh costume) engaging in one variant of walking (e.g., quick small steps with a quick arm movement), accompanied by a novel word. The task for the English-speaking children was to generalize the novel word to a new instance in which a different actor (e.g., a person wearing a rabbit costume) walked in the same manner as the first actor. In the study with Japanese-speaking children (Imai et al., 2008), the children benefited from using novel sound-symbolic words that are derived from Japanese sound-symbolic words. In Kantartzis et al.'s study, English-speaking children also performed better with novel sound-symbolic verbs derived from Japanese mimetics than novel verbs, replicating Imai et al.'s (2008) findings. This is the first and only evidence suggesting that the early sensitivity is independent of specific language experiences. One contribution of the present study is a replication of this cross-language comparison within the same experiment. In so doing, the present study provides evidence not just on whether young learners of both English and Japanese are sensitive to the mimetic forms that are derived through Japanese but whether that sensitivity might be greater in Japanese children, a question that can only be directly answered by a within-experiment comparison and which is important to understanding how and whether specific language experiences may influence young children's sensitivity to sound symbolism. The study is specifically designed to compare how mimetic forms may help children interpret a novel word as referring to an action rather than to the actor or to some holistic combination of actor and action. A tendency to map novel verbs to novel objects and actors has been indicated in both studies of Japanese- and

English-speaking children (Imai, Haryu, & Okada, 2005; Kersten & Smith, 2002; Kersten, Smith, & Yoshida, 2006).

The main and novel contributions concern the second and third questions raised above. The second question concerns the nature of the input. One reasonable assumption is that Japanese-speaking children have more experience *in general* with sound-symbolic forms *as well as more experience with specific kinds of mimetics* than do English-speaking children. These assumptions make the sensitivity displayed by English-speaking children to Japanese-like mimetics more compelling in that they imply that this sensitivity is independent of specific language experiences. Given the theoretical importance of this conclusion, Experiment 1 tested this assumption by examining how English-speaking and Japanese-speaking parents talk about novel action events to their children.

The third question concerns how potent the effect of sound symbolism might be on early verb learning, and specifically whether it is sufficient to direct children's attention to a novel action in a context in which previous research (Imai et al., 2005; Kersten & Smith, 2002; Kersten et al., 2006; Maguire et al., 2002) has indicated that children often do not map the novel verb to an isolated action. The previous studies with Japanese-speaking children (Imai et al., 2008) and English-speaking children (Kantartzis et al., 2011) used familiar actors performing various manners of walking. The familiarity of the actor and the resemblance of the actions to a known lexical category may have helped the children isolate the action as the referent of the novel verb. Past research suggests that young children have a strong tendency to map novel verbs to objects in the scene—rather than the action alone—and to do so particularly when those objects are novel (Kersten & Smith, 2002; Kersten et al., 2006). Accordingly, Experiment 2 provides a strong within-experiment test of English- and Japanese-speaking children's sensitivity to Japanese-style mimetics by asking whether the sound similarity, relative to more arbitrary verb forms, specifically helps children map the novel verb to a novel action rather than to the novel actor doing the action.

In sum, the two experiments make systematic comparisons of young learners of English and young learners of Japanese in: 1) their exposure to forms of sound symbolism in how parents talk about actions; and 2) their ability to map novel verbs to novel actions without possible support of a familiar actor in an artificial verb-learning experiment.

EXPERIMENT 1

The goal of Experiment 1 is to empirically document English and Japanese parents' use of iconicity in talking about actions. The parent participants

were asked to describe action events to children and were free to do so in any way they chose.

Mimetic forms were expected to be common in the Japanese parents' descriptions of actions. These mimetic forms are not syntactically verbs, but they are commonly used as verbs in conjunction with ~*suru*/*shita*/*shinai* (do, did, don't) and consequently yield a supply of words with which to refer to actions (Akita, 2006; Tsujimura, 2006; Miyaji, 1978, called the usage "stative formal verbs," and Nagashima, 1976, used "D-verbs"). For example, *dondon* (mimetic) *suru* refers to a jumping motion and *kurukuru* (mimetic) *suru* refers to making circles. Although English does not have forms of this kind, it could be the case that English-speaking parents also use sound-symbolic forms, though perhaps fewer conventionalized words ("pop," "smash") and more nonwords (whoosh, pakety-pakety, etc.) when talking about actions. It is important to answer this question because the goal of comparing English-speaking and Japanese-speaking children in the verb-learning experiment in Experiment 2 is based on the assumption that Japanese-speaking children have more experience with mimetic forms in this context.

Method

Participants

The monolingual parents of 15 English-speaking children between the ages of 2;6 and 3;5 ($M = 3;2$, $SD = 6.18$ months; 9 females and 6 males) and the monolingual parents of 15 Japanese-speaking children between the ages of 2;5 and 3;4 ($M = 3;2$, $SD = 6.13$ months, 8 females and 7 males) participated. All families in both conditions were middle class, college educated, and recruited through advertisement in the community. Because there has been so little work in this area with a cross-linguistic approach, parental input was examined across a relatively broad range of children's development to observe any language differences that might be stronger at the same, earlier, or possibly later developmental period. The English-speaking parents were tested in Bloomington, IN, and Houston, TX. The Japanese-speaking parents were tested in Niigata and Ôsaka, Japan. The observations took place in a small, isolated testing room in the lab and in day care centers.

Stimuli

All the instructions and stimuli were presented on a video. There were four object functions (see Figure 1): putting rings on a pole, winding up a tape measure, sprinkling glitter in a cup, and spinning a sand toy.

FIGURE 1 Actions and stimuli used for Experiment 1. (Color figure available online.)

Procedure

Each parent and child pair was taken into the testing room and asked to watch and follow the instructions on the TV screen. The video started as the experimenter left the room. The instructions on the video told participants that they would watch demonstrations, each of which would show a person engaging in an action with a toy. After each demonstration, parents were asked to select the same toy from a nearby box and teach their child how to do the same action, while encouraging the child to perform the action (see Table 1A for English instruction and Table 1B for Japanese instruction). This procedure was repeated for the four different demonstrations. The parents' instructions were audio recorded.

Coding and Reliability

The audio recordings of parents' instructions were first transcribed for all the phrases used for instructing children. (Sentences that were not about the action or object—for example, "Good job," or "That's not nice"—were ignored). Every word within the instructive sentences was coded in terms of the words used to refer to the target actions. Then, among these words, coders identified sound-symbolic words that were of two kinds. If a word

TABLE 1A
The Instruction Used in Experiment 1 for English-Speaking Parents

There will be four different demonstrations on videotape. When the videotape indicates, "START," then you should use the same object to teach your child how to do the same action, then let him/her perform the action. When a beep sound occurs, the videotape will indicate "END." Stop your work and pay attention to the screen again—there will be the second demonstration on the screen. Repeat the same procedure. There will be four segments for you to show your child.

TABLE 1B
The Instruction Used in Experiment 1 for Japanese-Speaking Parents

４つのデモンストレーションがビデオテープでテレビの画面に映し出されます。初めに１番目のデモンストレーションが映し出されます。ビデオの中で、「スタート」のサインが出ましたらまず、ビデオで使われているおもちゃと同じおもちゃを使ってどうやってデモンストレーションと同じ動作をするのかをお子さんに教えてください。その後お子さんにその動作をさせてみてください。「ピッ、ピッ、ピッ」という音が終了の合図になります。動作をやめて、画面に注目してください。２番のデモンストレーションがテレビに映し出されます。先と同じ要領で進めて下さい。合計４つのデモンストレーションが映し出されます。

was a regular word form found in the language (e.g., "bang" or "zig-zag" in English), then the word was classified as "a conventionalized mimetic." If a word was an idiosyncratic parental invention, then the word was classified as "invented sound word" (e.g., *chugi-chugi* for ratcheting forward the tape measure). If a parent uttered a sound (and/or a word) that mimicked the sound of the event, then the word/sound was classified as a "sound effect" (e.g., lip smacking, tongue clacking to mimic the rackety sound of the spin toy, or "zeeeeeee" to mimic the sound of the tape measure when it is pulled out). Because parents often repeated the same form many times in the demonstration of an action, only types (not tokens) of action were scored for analysis. The coding was done by two trained coders; native-English speakers coded the English transcripts, and native-Japanese speakers coded the Japanese transcripts. Reliability was determined by having a bilingual-speaking coder who is fluent in both languages code 25% of the trials that were randomly selected. The bilingual coder agreed with the two original coders in their categorical judgments on more than 93% of these judgments (94% for Japanese and 92% for English); Cohen's kappa coefficient of observer agreement suggested strong reliability (.73, standard error = .14).

In addition to the above experimenter-defined categories of iconicity, naïve adult speakers of the two languages were asked to indicate whether they thought the word was iconic in their own languages. This was done for all the *conventionalized mimetic forms* and all the conventional *verbs* that were transcribed. Adult judgments were collected from 10 English-native speakers and 10 Japanese-native speakers who judged only transcripts in their own language. The instructions were as follows: "I will be reading you a list of simple verbs. I would like you to answer, yes or no, whether the sound of the word itself feels as if it represents the action. For example,

you might feel that the sound of the word *saunter* suggests a slow wavy path.'' These data provide converging evidence for the coding of verbs in the two languages as iconic. These judgments will be referred to as the ''adult judgments'' in reporting the results below.

Results

Sound-Symbolic Words

Table 2 shows that Japanese-speaking parents produced conventionalized mimetic forms on almost every trial (96.70% of the trials); English-speaking parents rarely produced such conventionalized forms (11.67% of the trials). Among the conventionalized mimetic forms produced by Japanese-speaking parents, 76% of the words were judged as iconic in the adult judgments by Japanese-native adults, and 16% of the words were judged to be noniconic. The words produced by the English-speaking parents that were coded as conventionalized mimetic forms were judged to be iconic 100% of the time by the English-speaking adults in the adult judgment study. These adult judgments confirm our coding, and the results indicate what might be expected: Speakers of Japanese with many conventionalized mimetic forms in their language use such forms more than do speakers of English. Appendix A provides a complete list of mimetic forms used by parents.

Sound effects were relatively common in the productions of both English-speaking and Japanese-speaking parents, occurring on 35.00% and 65.00% of the demonstrations, respectively. Invented word-like forms were not commonly produced by either group of parents (1.67% by English-speaking parents and 13.33% by Japanese-speaking parents). Thus, English-speaking parents do sometimes use sound to aid attention to actions.

TABLE 2
Summary of Iconic Referring Used (Number of Types) by Parents in Four Sessions

	Conventionalized	*Invented*	*Sound effect*
Japanese			
Total	58.00	8.00	39.00
M	3.87	0.53	2.60
%	**96.67%**	**13.33%**	**65.00%**
English			
Total	7.00	1.00	21.00
M	0.47	0.07	1.40
%	**11.67%**	**1.67%**	**35.00%**

Note. The bolded values represent the percentage of coded types for three kinds of mimetic and iconic forms.

An analysis of variance for a 2 (language: English, Japanese) × 3 (iconicity type: conventionalized, invented, and sound effect) was conducted on the *numbers* of trials (not proportions) on which each type of iconic form was produced. The analysis yielded a main effect of language, $F(1, 28) = 25.80$, $p < .00$, a main effect of iconicity type, $F(2, 56) = 33.39$, $p < .00$, and an interaction of language and iconicity type, $F(2, 56) = 18.23$, $p < .00$. Post-hoc comparisons testing the effect of language on iconicity types (Tukey's hsd, $\alpha = .05$) revealed that all types were produced absolutely more by Japanese-speaking parents than by English-speaking parents (conventionalized, $t(28) = 7.31$, $p < .00$; invented, $t(28) = 2.62$, $p < .05$; and sounds effect, $t(28) = 2.06$, $p < .05$), but that the magnitude of the differences was greater for conventionalized and invented forms than for sound effects (conventionalized, $ES = .66$; invented, $ES = .20$; sound effect, $ES = .13$). Subsequent analyses in which children were split by age into older and younger groups yielded no age group effects within either language. It is perhaps not surprising that conventionalized iconic forms are greater for Japanese- than English-speaking parents, but the finding that invented forms and sound effects are as well suggests that all kinds of iconicity—at least when talking about actions—may be more common in the speech of Japanese- than English-speaking parents, a fact critical to understanding the significance of English-speaking children's greater or lesser sensitivity to sound-symbolic forms than Japanese-speaking children.

In sum, the results suggest strong differences in the experiences of English and Japanese-speaking children: English-speaking children hear many fewer iconic forms—of any kind—than do Japanese-speaking children.

Verbs

However, before one accepts this conclusion, it is important to consider the actual verbs offered by the two sets of parents. Many standard words that are often considered to be arbitrary may have sound properties suggestive of meaning. For example, across many different languages, words connoting "little"—*kleine* (German), *petite* (French), *piccola* (Italian), and *mikros* (Greek)—have front vowel sounds for the initial syllable (R. Brown, 1958). Within English, Bolinger (1950) documented that roughly half of all English words that begin with *gl* have a visual connotation (e.g., glance, glitter, gleam, glow). Accordingly, the verbs used by English-speaking parents in the present study could have iconic elements. All the verbs used by the English-speaking parents are provided in Appendix B along with the adult judgments of their iconicity. There were a total of 93 English verbs used to refer to the actions (76.90% of total words used to refer to actions, as some of these references were adverbs or prepositions, e.g., "faster" or "down").

For 50 (53.80%) of conventional verbs, the adult judgers consistently maintained that these verbs were not iconic to their meaning. However, there were 22 English verbs (23.40% of verbs used) for which more than 50% of the English-speaking adults said they were iconic, including *drop, sprinkle*, and *twist*. The 51 unique Japanese verbs (32.70% of total words used to refer to actions) used by the Japanese parents were also judged as to their iconicity. Naïve Japanese speakers all agreed that 41 verbs (80.40% of verbs used) were not iconic. There were 4 verbs for which more than 50% of the adults agreed that they were iconic, and these included *kuttsuku* (stick), *hipparu* (pull), *nobasu* (extend), and *tobu* (fly). The results from the English-speaking adults—and the potential individual differences in English speakers' sensitivity to iconicity—are interesting in their own right. This sensitivity—even given very subtle forms of iconicity as in *twist*—suggests form-meaning correspondences across different languages (Nygaard et al., 2009). However, for the present study, these analyses support the general conclusion that Japanese-speaking children experience more iconic word-like forms (not conventionalized verbs) than do English-speaking children in talk about actions. This is the main question of interest for the present article.

Summary

The results from Experiment 1 make three useful points. First, and most critical for the present study, the results overall suggest that Japanese-speaking children are exposed to more iconicity in conversations about action events than are English-speaking children, a result consistent with previous discussions of the perhaps special role of iconicity in Japanese (Hamano, 1998; Oda, 2000). Second, the adult judgments suggest that Japanese speakers more clearly partition mimetic from noniconic means of talking about actions, perhaps because mimetics offer an explicit and clear case of iconicity. Third, they suggest perhaps "hidden" iconicity in English verbs in that at least some naïve English speakers perceive many of these verbs as having sounds evocative of their meaning.

The main results set the stage for Experiment 2: Are Japanese-speaking children who experience more mimetic forms in talk about actions better able to use subtle sound–meaning correspondences in an artificial verb-learning task where both agent and action are completely novel? An affirmative answer would suggest the importance of language experience in attention to iconicity. Or are learners of both languages equally able to use sound–meaning correspondences and make use of them in mapping words to the relevant aspects of action events? Or, even if Japanese-speaking children show an advantage, are English-speaking children nonetheless sensitive to iconicity in a verb-learning task in which children are known to have difficulty in

isolating the action? The answers to these questions will present an important extension of the two prior separate studies of Japanese- and English-speaking children (Imai et al., 2008; Kantartzis et al., 2011) by providing information on whether the greater experience with the use of sound-symbolic forms to refer to actions results in greater sensitivity to those forms in a novel verb-learning task or whether the degree of young children's sensitivity is relatively immune to specific language history.

EXPERIMENT 2

In this experiment, children participated in an artificial verb-learning task that followed the structure of the tasks used by Kersten and Smith (2002), Kersten et al. (2006), Imai et al. (2005, 2008), Yoshida (2003), and Yoshida and Smith (2003). The novel words were either verbs for which sound properties were (by adult judgment) arbitrarily related to the actions or mimetic-like forms. The novel arbitrary forms were invented by interviewing 10 adult native speakers of English and Japanese (for natural sound properties) and testing their form-to-action mappings such that the selected verb forms were not consistently mapped by speakers of either language to either action. These novel mimetic forms were invented following the principles for Japanese as proposed by Oda (2000) such that the sensory-motor properties of *producing the sound* (the feel of the tongue, teeth, and articulatory act) were reminiscent of the action to which the word referred. Thus, the mimetic forms were explicitly derived to favor Japanese in this experiment, thereby providing a strong test of the non-language-specific nature of the hypothesized sound–meaning correspondences (see Hamano, 1998; Oda, 2000; Hamano, 1998 for the full analysis).

Japanese mimetics, like many iconic forms across languages (see Oda, 2000) are reduplicative in nature, and Oda showed that both adult English speakers as well as Japanese speakers were at least somewhat sensitive to the meaning implications of these reduplicative forms. Thus, in the present study, the novel forms used Oda's principles of phonological–action correspondences and were reduplicatives (because the repetition of the sounds may be critical to their perception). In particular and consistent with earlier analyses of mimetics, the mimetic form created to refer to a sliding motion began with the sound "s," which both Oda and Hamano (1998) proposed indicated a smooth aspect to the action. The mimetic form created to refer to a sudden hop began with the sound "b," a forceful explosive aspect proposed to suggest popping actions (Hamano, 1998; Oda, 2000). The syllables containing the representative sound unit (*shug* and *bing*) were repeated twice (*shugshug* and *bingbing*) to yield the two novel mimetics used in the experiment (also see Figure 2).

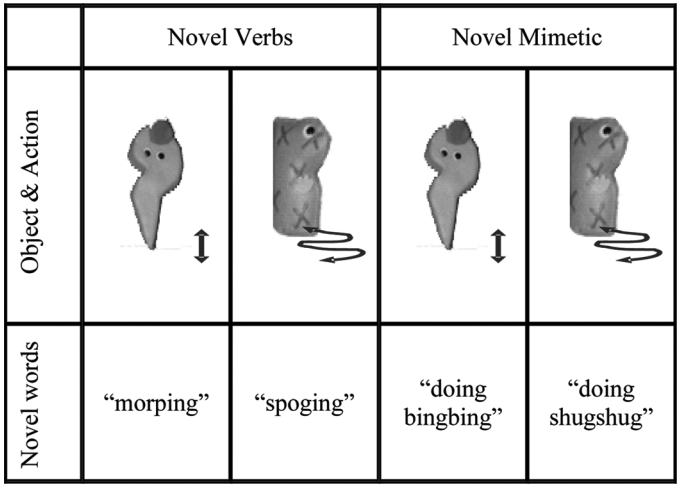

FIGURE 2 Stimuli objects and accompanied actions and novel words used to label the actions in the training trials are depicted. (Color figure available online.)

Again, these are *novel* mimetics for both Japanese-speaking and English-speaking children; however, the structure of these forms, the principles on which they were built, derive from analyses of the Japanese language, and thus, if they should favor any group of children, they favor the Japanese-speaking children. After the main experiment, results in a series of follow-up studies that examine the role of reduplication and the sentence frame are presented.

Method

Participants

The participants were 32 monolingual, 2- to 4-year-old, English-speaking children ranging in age from 2;1 to 4;0 ($M = 3;0$; 16 females and 16 males) and 32 age-matched, monolingual, Japanese-speaking children ranging in age from 1;11 to 3;11 ($M = 2;11$; 14 females and 18 males). Children in each language group were randomly assigned to either the Verb condition or the Mimetic condition.

This age range was chosen because past research indicates that this is the period during which children start showing successful word mapping in these kinds of tasks (Kersten & Smith, 2002; Kersten et al., 2006). The English-speaking children were tested in Bloomington, IN. The Japanese-speaking children were tested in Niigata, Japan.

Stimuli

The action events were videos of puppets performing intransitive actions. The novel mimetic forms were *shugshug* and *bingbing*, and the novel arbitrary forms were *morping* and *spogging*. In a preliminary check on the sound–meaning correspondences we developed, 10 adult native-English speakers and 10 adult native-Japanese speakers were asked to match the words to the actions used in the experiment. The adults were given a mimetic word orally then were presented with video showing two different actions from which to choose. Each adult made judgments for the two target mimetic words, each of which were tested with two different types of puppets demonstrating the actions, therefore generating four judgments per adult judge. Ninety-two percent of adult judgments matched the mimetic forms to the experimentally designated corresponding action (17 of the judges made this expected matching pattern 100% of the time). The same procedure was used to test the novel arbitrary forms (*morping* and *spogging*) with a new sample of 10 adult native-English speakers and 10 adult native-Japanese speakers. Matching performances (word to intended action) were at chance level for both groups. The English carrier phrases are provided below. The Japanese sentences are provided in Appendix C. Because Japanese mimetics are presented with a ''do-like'' verb, we used this construction in English as well to make the mimetic conditions in the two languages as comparable as possible. Again, this decision might be viewed as favoring the Japanese children, which works for finding evidence for the hypothesis of cross-linguistic consistency of the sensitivity.

Structure of Study Trials

Familiarization trials. The study session began with two familiarization trials. The purpose of these two trials was to make the task clear to children by using known verbs and clear examples. On the first familiarization trial, participants were shown a video of a doll sleeping on a bed. The experimenter said, ''Look! Do you see that? She is sleeping.'' Once participants agreed to this statement, the second animation was shown to them, which was of a bear jumping, and the experimenter asked, ''What about this one? Is this one sleeping?'' Participants who said ''no'' to this question were given positive feedback, but participants who said ''yes'' to the question, or did not respond were told, ''That one is not sleeping, that is jumping.'' The purpose of the familiarization trials was to illustrate the designed ''yes/no'' responses, and the training trials immediately followed these two familiarization trials.

Training trials. There were 24 training trials, each of which consisted of a 5-second-long video of the action paired with either a novel verb or mimetic.

Each child was shown two distinctive action events—the target event and the contrast event—each of which was labeled with a novel word (mimetic or verb). One event consisted of a yellow drop-shaped puppet "popping" up and down (see Figure 2). This event was paired with "This one is *morping*" in the Novel Verb condition and with "This one is doing *bingbing*" in the Novel Mimetic condition. The second training event consisted of a blue, square-shaped puppet gliding its body back and forth. This event was paired with "This one is *spogging*" in the Novel Verb condition and with "This one is doing *shugshug*" in the Novel Mimetic condition. The target event was presented 15 times, and the contrast event was presented 9 times throughout the task. The target events were presented more frequently than the contrast events to maximize children's exposure and learning of the target items; this was based on previous pilot studies of novel verb learning. On all training trials, both target and contrast, the action and corresponding label were provided; no questions were asked of the child, and thus, no feedback was provided.

Test trials. There were four test trial types: 1) the action and object match trials (AO)—these are identical to the original target training trials; 2) action match trials (A)—the target action is performed by the contrast puppet; 3) object match (O)—the target puppet performs the contrasting action; and 4) neither (N)—the contrast puppet performs the contrasting action (see Figure 3). Children were presented with each test event and were asked whether it was the case of a target event. For example, "Is this one *morping*?" in the Novel Verb condition and, "Is this one doing *bingbing*?" in the Novel Mimetic condition. The assignment of target and contrast verbs was counterbalanced across children. Each one of these four test trial types was repeated six times throughout the testing phase, which also included repetitions of training trials (see Figure 4). There were a total of 24 testing trials.

Procedure

Children sat at a distance of about 1.5 m from the television monitor. The children were instructed to watch events and to answer questions by responding "yes" or "no." The video was then started, and participants were presented with the familiarization trials. Following the familiarization trials, the first 5 training events (4 target trials and 1 contrast trial) were conducted. After these first 5 training trials, the 19 remaining training and 24 test trials were presented in a randomly determined order. In this way, continuous training and reminding of the name–action correspondences were provided during the testing phase. The total number of training and test trials was 48. Children who made the same responses ("yes" or "no") to all trials

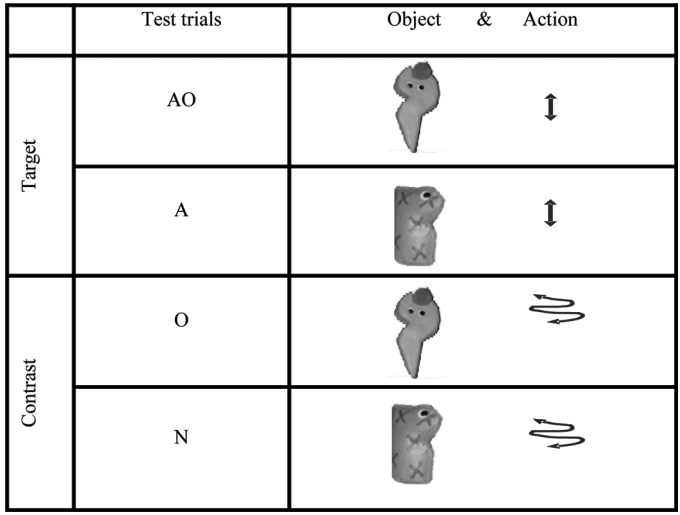

FIGURE 3 Stimuli objects and accompanied actions for the four test types: the action and object match trials (AO), action match trials (A), object match (O), and neither (N). (Color figure available online.)

($n = 4$) and children who made "yes" responses to AO (identical to original target training trials) less than 20% of the time ($n = 3$) seemed unlikely to have understood the task and so were replaced with additional children (five English-speaking children and two Japanese-speaking children) prior to the analysis.

Results

Figure 4A shows the mean proportion of "yes" responses on the four test trial types for the two language groups in the Verb and Mimetic conditions. The main results, as evident in the figure, are 1) Japanese-speaking children perform better—in the sense of saying "yes" to AO and A test trials but not O and N test trials—than English-speaking children do, on *both* the conventional verb forms and the mimetics; and 2) more critically, both Japanese- and English-speaking children perform better in the Mimetic than in the Verb condition, and this is particularly evident in comparing their "yes" responses to the A test trials, the test trials with the contrasting actor but the target action.

These main results are embedded within a set of two-way interactions as revealed by a 2 (language: English, Japanese) $\times$ 4 (test trial types: AO, A, O, and N) $\times$ 2 (condition: Mimetic, Verb), and age (as a continuous variable)

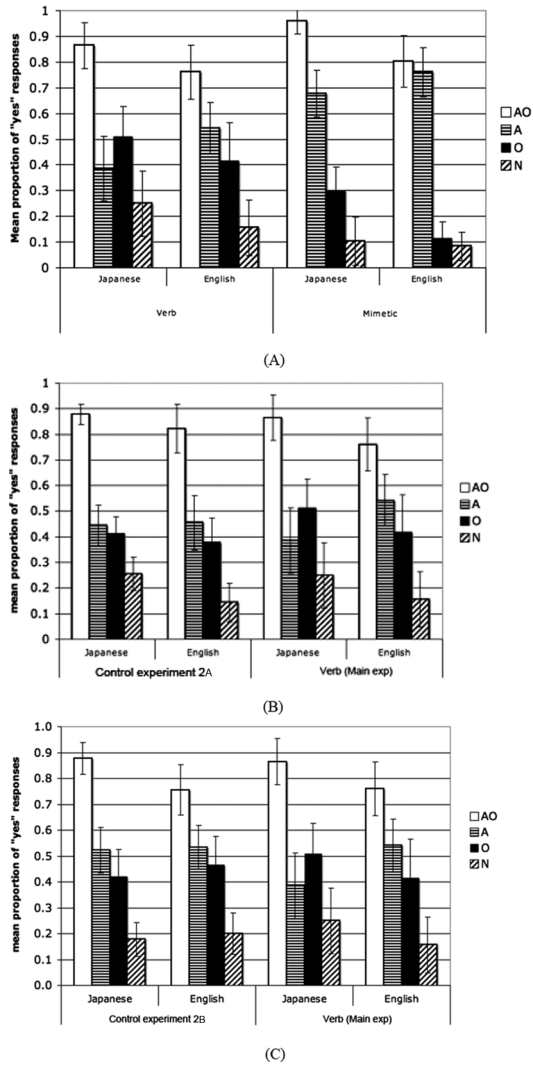

FIGURE 4 (A) Mean proportion of "yes" responses from English-speaking and Japanese-speaking children in the Novel Verbs and the Novel Mimetic conditions for four test trial types: the action and object match trials (AO), action match trials (A), object match (O), and neither (N); (B) Mean proportion of "yes" responses from English-speaking and Japanese-speaking children in Control Experiment 2A for four test trial types: the action and object match trials (AO), action match trials (A), object match (O), and neither (N); (C) Mean proportion of "yes" responses from English-speaking and Japanese-speaking children in Control Experiment 2B for four test trial types: the action and object match trials (AO), action match trials (A), object match (O), and neither (N).

analysis of covariance of "yes" responses. More specifically, the analysis yielded interactions between trial type and condition, $F(3, 177) = 14.88$, $p < .00$; between trial type and language, $F(3, 177) = 4.75$, $p < .01$; and between trial type and age, $F(3, 177) = 2.93$, $p < .05$. There were no reliable main effects (which is not unexpected given optimal performance is "yes" on AO and A trials and "no" on O and N trials); the three-way interaction also did not approach significance. Post-hoc comparisons testing the effect of language on test trial types (Tukey's hsd, $\alpha = .05$) indicate that "yes" responses (with Mimetic and Verb conditions collapsed) on the A, O, and N test trials do not differ across the language groups, whereas they do differ on the AO test trial, $t(62) = -2.20$, $p < .05$. Overall, Japanese-speaking children said "yes" to AO items more often than English-speaking children. Post-hoc comparisons testing the effect of condition on test trial types (Tukey's hsd, $\alpha = .05$) indicate that "yes" responses on the AO and N test trials do not differ across the conditions; however, they do differ on the key trials, A and O test trials, $t(62) = 3.63$, $p < .01$, and $t(62) = -3.47$, $p < .01$, respectively. There are more "yes" responses on the A trials in the Mimetic condition than in the Verb condition and fewer "yes" responses on the O trials in the Mimetic than on the Verb condition. This result indicates that children are more likely to map the novel word form to the action—segregated from the actor—in the Mimetic than in the Verb condition. Although there was an interaction between trial types and age (a continuous variable), the overall correlation between the two variables was not strong ($r < .28$); in general, older children were more likely to say "yes" to A and AO trials compared with younger children and are less likely to say "yes" to O and N trials.

Both English- and Japanese-speaking children better mapped the verb to the action (independent of the actor) in the Mimetic than in the Verb condition. This conclusion is also supported by comparisons of "yes" responses to chance. For both English- and Japanese-speaking children, "yes" responses on A trials were above chance in the Mimetic condition: English, $t(15) = 4.04$, $p < .01$, and Japanese, $t(15) = 2.96$, $p < .05$). In the Mimetic condition, "yes" responses were below chance on O trials for both English and Japanese speakers, $t(15) = -9.12$, $p < .00$, and $t(15) = -3.34$, $p < .01$) respectively. Critically, for both language groups, "yes" responses on A and O trials in the Verb condition were at chance. See Table 3A for a summary of the comparisons to chance for all the trial types in each language broken down for each verb type.

In sum, mimetic forms help both English- and Japanese-speaking children equally and do so despite the differences in exposure to such forms and despite the fact the mimetic forms (and carrier phrases) used were derived from analyses of Japanese mimetics. Critically, and as evident in

TABLE 3A
Summary of the Comparisons to Chance for all Trial Types in Each Language Broken Down for Each Verb (Experiment 2)

Trial type	*Verb*	*Mimetic*
Japanese		
AO	**$t(15) = 6.14$, $p < .00$**	**$t(15) = 14.20$, $p < .00$**
A	$t(15) = -1.36$, $p = .20$	**$t(15) = 2.96$, $p < .05$**
O	$t(15) = 0.14$, $p = .89$	**$t(15) = -3.34$, $p < .01$**
N	**$t(15) = -3.0$, $p < .05$**	**$t(15) = -6.33$, $p < .00$**
English		
AO	**$t(15) = 3.74$, $p < .01$**	**$t(15) = 4.53$, $p < .00$**
A	$t(15) = 0.62$, $p = 5.44$	**$t(15) = 4.04$, $p < .01$**
O	$t(15) = -0.85$, $p = 4.11$	**$t(15) = -9.12$, $p < .00$**
N	**$t(15) = -4.77$, $p < .00$**	**$t(15) = -11.18$, $p < .00$**

Figure 4, the mimetic form—relative to the verb form—helps children learning both languages to *exclude* the identity of the actor as relevant to the novel word. This suggests that mimetics help isolate the action for young learners, and they do so to a comparable degree for children learning a language with such forms common in the language and for those learning a language with fewer such kinds of words.

FOLLOW-UP EXPERIMENTS

The conclusion from Experiment 2, however, also rests on the finding of a clear advantage of mimetic forms over arbitrary ones in the learning of novel labels for actions. Because the key outcome of Experiment 2 is that these sound–action correspondences might be independent of one's specific language experiences, the carrier frames in Experiment 2 were designed to follow the Japanese form closely (Kita, 1997; Tsujimura & Deguchi, 2007) and thus to favor Japanese children and the null hypothesis of no differences between the two groups of children. More specifically, the mimetic forms, but not the arbitrary ones, were presented in the context of "doing ____" in both languages. This is because mimetics in Japanese are not true verbs but are used as verbs with *suru* (do). This, however creates a possible confound for both language groups, in that the arbitrary forms are presented without an auxiliary, whereas the mimetic forms are presented with "doing." It is also possible that the key benefit of the mimetic form is not its sound symbolism but reduplication, which might (perhaps for reasons related to iconicity) suggest that the novel word is about a repeatable action.

Accordingly, control experiments were conducted to specifically rule out: 1) a role for the "doing" sentence frame, and 2) the possible role of repetition, both only used with mimetics in Experiment 2. Control Experiment 2A tested whether adding *doing* to a novel verb form (e.g., "doing morp") benefits performance in that condition, and Control Experiment 2B further tested whether reduplicating the verb benefits performance (e.g., "doing morp morp"). Control Experiment 2B specifically uses the identical sentence structure and repetition used for the Mimetic condition in the main study, and thus, the only the difference is the word sounds, therefore allowing the effect of sounds used in mimetic verbs.

Control Experiment 2A

Method

The participants were 15 monolingual, 2- to 4-year-old, English-speaking children ranging in age from 2;1 to 4;0 ($M = 3;1$; 8 females and 7 males) and 15 age-matched, monolingual, Japanese-speaking children ranging in age from 1;10 to 3;11 ($M = 2;12$; 6 females and 9 males).

All aspects of the follow-up experiments are identical to that of Experiment 2 including stimuli, familiarization trials, training trials, and testing trials. The only difference from Experiment 2 was the phrases used in the experiment. For training trials, "This one is doing _____ (*morp* or *spog*)" was used, and for testing trials, "Is this one doing *morp*?" was used. See Appendix C for Japanese sentences.

Results

Figure 4B shows the results. As is apparent, placing an arbitrary form in a construction with *doing* does not improve children's performances relative to the standard carrier phrases (the Verb condition); no reliable effects are found for language or condition, and there were no reliable interactions. See Table 3B for a summary of the comparisons to chance for all the trial types in each language.

Control Experiment 2B

Method

The participants were 15 monolingual, 2- to 4-year-old, English-speaking children ranging in age from 2;1 to 3;12 ($M = 3;1$; 6 females and 9 males) and 15 age-matched, monolingual, Japanese-speaking children ranging in age from 2;0 to 3;12 ($M = 3;0$; 8 females and 7 males).

TABLE 3B
Summary of the Comparisons to Chance for all Trial Types in Each Language (Control Experiment 2A)

Trial type	*Comparisons to chance*
Japanese	
AO	**$t(14) = 5.56$, $p < .00$**
A	$t(14) = -0.73$, $p = .48$
O	$t(14) = -1.37$, $p = .19$
N	**$t(14) = -2.95$, $p < .05$**
English	
AO	**$t(14) = 3.53$, $p < .01$**
A	$t(14) = -0.44$, $p = .67$
O	$t(14) = -1.32$, $p = .21$
N	**$t(14) = -4.90$, $p < .00$**

All aspects of the follow-up experiments are identical to that of Experiment 2 including stimuli, familiarization trials, training trials, and testing trials. The only difference from Experiment 2 was the phrases used in the experiment. For training trials, "This one is doing _____ (*morpmorp* or *spogspog*)" was used, and for testing trials, "Is this one doing *morpmorp?*" was used. See Appendix C for the Japanese sentences.

Results

Figure 4C shows the results. As is apparent, repeating an arbitrary form does not improve children's performances relative to the standard carrier phrases

TABLE 3C
Summary of the Comparisons to Chance for all Trial Types in Each Language (Control Experiment 2B)

Trial type	*Comparisons to chance*
Japanese	
AO	**$t(14) = 5.22$, $p < .00$**
A	$t(14) = -1.21$, $p = .25$
O	$t(14) = 0.82$, $p = .42$
N	**$t(14) = -2.94$, $p < .05$**
English	
AO	**$t(14) = 4.00$, $p < .01$**
A	$t(14) = 0.64$, $p = .54$
O	$t(14) = -0.77$, $p = .46$
N	**$t(14) = -3.96$, $p < .01$**

(the Verb condition); no reliable effects were found for language or condition, nor was an interaction of these effects found. See Table 3C for a summary of the comparisons to chance for all the trial types in each language.

Thus, these follow-up experiments—Control Experiments 2A and 2B—confirm that the better performance of both English-speaking and Japanese-speaking children with mimetic forms is due to the sound properties of the forms themselves, not the carrier sentence and not reduplication alone.

GENERAL DISCUSSION

The research makes two new contributions: First, Experiment 1 documents the differences in Japanese- and English-speaking children's experiences with sound symbolic forms in the context of talk about actions. Second, Experiment 2 for the first time directly compares, in a single experiment, Japanese- and English-speaking children's use of mimetics to map a novel verb to a novel action in the context of a novel actor. The results clearly show that the mimetic form helps children learning both languages to *exclude* the identity of the actor as relevant to the novel word. This suggests that mimetics help isolate the action as the relevant meaning. Mimetics, a common form found in speech to Japanese-speaking children in action contexts, helps *all* children map verbs to actions. Apparently, young learners of all languages are open to such form–meaning correspondences (also see Namy, 2001; Namy & Waxman, 1998, for early openness to gesture references).

Experiment 1 shows that languages differ in their use of iconicity; Experiment 2 shows that despite these differences in experiences of iconic forms, young children demonstrate some similar sensitivity to sound–meaning relations. Thus, iconicity appears to be universal—at least in its potential—in human language. For the 3-year-olds in the present study, phonological properties of mimetic forms in Japanese were shown to be exploitable by English-speaking as well as Japanese-speaking children. This is so despite the fact shown in Experiment 1, that there are there significant cross-linguistic differences in the *ways* in which English-speaking and Japanese-speaking adults use iconicity to describe actions. Children's sensitivity to these sound properties is also surprising in that the sound–meaning correspondences, though principled (Hamano, 1998; Oda, 2000), are at best subtle. Clearly, the surface forms of words can, in and of themselves, be related to meaning and do not necessarily operate only as symbols that point to meaning through convention. Instead, the articulatory and acoustic properties of phonemes may suggest meanings perhaps through the universal intersenory neural cross-activations suggested by Ramachandran and Hubbard (2001). These

findings with children extend the results found with adults that suggest cross-linguistic sound–meaning biases (Bolinger, 1950; R. Brown, 1958; R. W. Brown et al., 1955; Holland & Wertheimer, 1964; Kunihira, 1971; Nygaard et al., 2009; Ramachandran & Hubbard, 2001; Tsuru & Fries, 1933).

An interesting question for future research is the possible benefit of mimetic forms based on subtle evocative correspondences between sound and meaning and gesture systems—often known as the baby sign (Goodwyn, Acredolo, & Brown, 2000)—over arbitrary words. Theorists of sound symbolism (Arata, Imai, Okuda, Okada, & Matsuda, 2010; Kita, 2000) have suggested a fundamental relation between sound symbolism and gesture. The signs that comprise "baby sign" systems are not pantomimes and not fully iconic, but the forms of these gestures often seem to share some subtle relation to the meaning, one that may help children make the initial map between sign and the thing signified, just as mimetic forms appear to help verb learning. This idea again suggests that there may be an initial openness to different forms of referential symbols and a tendency to exploit multimodal indicators of meaning. Indeed, it has been suggested that younger children are more open to different referential systems including nonverbal gesture forms such as nonverbal sounds and picture (Campbell & Namy, 2003; Namy, 2001; Namy, Acredolo, & Goodwyn, 2000; Namy, Campbell, & Tomasello, 2004; Namy & Waxman, 1998). The early acceptance of different kinds of referential forms suggests the early openness even among different types of *verbal* references.

Although there is no evidence in the present experimental results, it also seems likely that experience with mimetic forms within a language would shape—at least to some degree—sensitivity to particular kinds of sound symbolism. This raises the possibility that older Japanese and English speakers might differ in their sensitivity to some mimetic forms and that young learners are open to this possibility and take greater advantage of sound symbolism, but as they learn their language, they become narrower in what they will accept as possible forms. This may generate a long-lasting openness for Japanese-speaking children and the earlier commitment to arbitrary forms (and conventionalized forms) among English-speaking children. Alternatively, the evocative aspects of some sound–meaning correspondences may not be ignorable even by speakers of languages that do not systematically incorporate that sound property. Moreover, there may be individual differences in speakers of languages such as English in sensitivity to and/or awareness of sound-symbolic forms. All this suggests the value of going beyond demonstrations of sensitivity to iconicity in language and pursuing the study of the different kinds of sound symbolism and developmental changes in sensitivity to specific forms given experience in a specific language.

Such a set of studies might reveal findings in sensitivity that parallel the developmental changes seen in the referential use of iconicity. Specifically, Namy's (2008) work on the initial sensitivity to iconic symbol systems suggests a possible curvilinear trend. Her study investigated the development of early recognition of iconic symbols by comparing 1-year-olds and 2-year-olds. This study suggests a developmental shift between early infants (12 to 18 months) and 2-year-olds in their recognition of iconic symbols: Younger infants did not benefit from an iconic gesture resembling the referents, but older children did, suggesting that sensitivity to cross-modal meaning correspondences—gesture to referent, sound to referent—might itself develop in infancy. Beyond this initial and perhaps non-language-specific development, sensitivity might be expected to become more language specific. Clearly, this conjecture requires further developmental studies, including ones that consider the effects of learning different languages. Such studies would provide new insights into children's developing notion of what counts as a word form in their language.

The present findings may also have implication for understanding early verb learning, which is generally characterized as difficult because of the relational nature of verb meanings (Gentner, 1982; Gentner & Rattermann, 1991; Gillette et al., 1999; Medin & Ortony, 1989; Rosch, 1973). The earlier studies by Imai et al. (2005) and Kantartzis et al. (2011) suggest that very subtle sound–meaning similarities may be enough to guide the attention of preschoolers to the relevant aspect of a relational event, and the current study further compared the sensitivity between monolingual Japanese- and English-speaking children with the least information about referents and confirmed that sound-symbolic words guide them to the verb interpretation by being suggestive of the action. As many have noted, learning verbs can be challenging in part because they often do not refer to meanings that are prepackaged by perception and conception (Gentner, 1978, 1982; Gentner & Boroditsky, 2001; Gentner & Rattermann, 1991). Instead, the learner has to find the relevant aspects of the scenes. Presumably, the noun advantage, as Gentner (1982) suggests, exists because of the ease of mapping noun forms to already prepackaged referents. Iconic forms may help verb learning because they aid in this particular problem by helping the learner segment and highlight relevant relational aspects of the scene. That is, the mechanism underlying the benefit of iconic forms may simply be that sound encourages attention to the relevant aspect of the action.

Early exposure to Japanese may help verb learning in that language through the use of mimetics. This may not mean that children learning English are at a disadvantage in early verb learning relative to Japanese (although they may be; Choi & Gopnik, 1995; Tardif, 1996). Rather, the attention-directing aspect of mimetic forms may also be realized in other

ways by English-speaking parents, for example, through gestures and touch. Consistent with this idea, O'Neill, Topolovec, and Stern-Cavalcante (2002) studied the role of tactile and deictic gestures in children's novel adjective learning. In their study, children were taught novel adjectives (e.g., spongy) pertaining to a target toy, accompanied by a relevant descriptive (and thus iconic) gesture (e.g., squeezing) or by a point gesture. Children then chose a toy from test sets consisting of a matching property and nonmatching property toy. Children presented with the descriptive gesture chose the toy with the matching property significantly more often than children who learned the word through the point gesture (see also Goldin-Meadow, 1993, 1997, for the related advantage of gestures in learning relevant meanings). It seems that iconicity, through gesture or sound, may work by highlighting the relevant *relational* components. It is perhaps, then, not surprising that Japanese uses mimetics to talk about actions rather than to label objects because attention-directing aspects of iconicity may particularly benefit the learning of more relational meanings. In this context, one wonders if English-speaking parents, who rarely use iconic forms, gesture more with their hands when talking to their children about actions rather than objects. Kita's (2000) proposal of a close representational relation between mimetic forms and iconic gestures suggests that this might well be the case.

The evidence and the discussion so far are about the benefit of form-meaning correspondences. But this raises a paradox. If form-meaning correspondences help learning, why aren't languages more iconic? Why are they so overwhelmingly made up of arbitrary forms? One possibility is that although iconicity helps learning, it hurts some other more important functions of language. The work of DeLoache (1987, 1991) makes clear that too much iconicity is not good for learning symbols. In her work, she has shown that children face great difficulty learning when a form and the meaning are too much alike (e.g., using a small toy standing for the same toy, but in a larger size). Thus, it may not be by accident that mimetic forms in languages such as Japanese are only vaguely evocative of the meaning. Complementary points have been also made in terms of the advantage of arbitrariness in learning. Gasser (2004) used computational simulations and demonstrated that arbitrariness in language becomes necessary as the number of words to be acquired increases. This learning advantage for arbitrary form-meaning relationships has been discussed in terms of how the arbitrary form-meaning pairings optimize the space of possible pairings due to the lack of semantic constraints and thus help the learning of a large vocabulary, and significance of such computational power for arbitrary form-meaning relationships for category formation has also been proposed (Yoshida, 2003).

Clearly, there is more to be understood about what makes a good symbol system and why language has the properties it does. Languages in general

are arbitrary symbol systems, but most (if not all) have pockets of iconic forms. These are never direct or obvious pantomimes; they are thus somewhat distant from their meanings but not purely arbitrary either.

The present results point to the potential value of attempting to understand the contexts in which sound–meaning correspondences matter in language learning. The lexical class of mimetics offers Japanese-speaking parents a ready-made solution for how one uses sounds to point iconically to meanings, and they do so through sound–meaning correspondences that appear to be cross-linguistically available. This broader benefit of iconicity for children's word learning is apparently conventionally incorporated into some languages such as Japanese but may more generally be an important component of all human communication.

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APPENDIX A

Japanese

Conventionalized	Invented	Sound Effect
ガラガラ	クークークー	ウィーン
キラキラ	クリクリ	ギュー
キレイキレイ	シャラシャラ	キュッ
クシュクシュ	シュルンシュルン	グー
グリグリ	スリースリー	シャー
クルクル	トルトル	ジュー
グルグル	パパ パパ	ジュワー
クルッ	フィー	タタタタ
コロコロ		パチッ
コロン		パッパ
サラサラ		パッパッパ
ジャー		ビー
ストン		ピッピー
ズルズル		ピピピピ
ドボン		ヒュー
トントン		ビュー
パーッ		ヒューン
パラパラ		ビューン
バラバラ		ブー
パンパン		ブーン
ピョーン		フアー
ペトペト		ブイーン
		プシュ
		プチ
		ブブブ
		ブルン
		プン
		ポコ
		ポン

English

Conventionalized	Invented	Sound Effect
beep	wicka wicka	ssssshhh
Roar		tshhhh
wee		woo
clunk		wooh
		oooo
		whooom
		crrrank
		ouuuut
		pooooouuur
		Puuuuulling
		Roooooll
		rouuuund
		tuuuuuurn
		wiiiind
		droooooop
		Roooll

APPENDIX B

JAPANESE			*ENGLISH*			
Verb types	*English translation*	*Token*	*Verb types*	*Token*		
Kashitemorau	Borrow	2	ask	1	pour	21
Mottekite	Bring	1	bet	1	pull	37
Yonde	Call	1	bring	3	put	36
Detekuru	Come	13	can	74	rain	1
Shita	Did	5	catch	2	reach	2
Suru	Do	48	clean	1	reel	6
Otosu	Drop	4	close	6	remember	2
Nobashite	Extend	8	come	13	roll	24
Ochita	Fell	3	could	2	rub	1
Owatta	Finished	1	crank	2	said	2
Tobu	Fly	1	curl	5	say	7
Totte	Get	14	do	280	see	54
Kashite	Give	3	drop	30	set	12
Itte	Go	5	dump	1	shake	2
Motte	Hold	17	find	1	should	7
Shitteru	Know	5	finish	2	show	13
Sasete	Let	4	fix	1	sift	1

(*Continued*)

APPENDIX B
Continued

JAPANESE			*ENGLISH*			
Verb types	*English translation*	*Token*	*Verb types*	*Token*		
Mite	Look	38	found	1	sit	7
Maneshite	Mimic	2	get	50	spill	1
Akeru	Open	10	go	93	spin	13
Asobu	Play	3	got	1	sprinkle	8
Hippatte	Pull	26	grab	1	start	2
Irete	Put	72	guess	1	stick	4
Maite	Reel	26	hang	2	stop	6
Totte	Remove	1	happen	1	stretch	3
Modoshite	Return	1	have	16	stuck	2
Hashiru	Run	5	help	2	suppose	3
Itta	Said	1	hold	35	take	8
Mita	Saw	4	hope	1	teach	1
Itte	Say	2	keep	3	tell	2
Mitakotoaru	Seen	2	know	11	think	18
Misete	Show	3	lay	1	time	2
Suwatte	Sit	8	let	50	told	1
Kobosu	Spill	6	lift	14	touch	1
Tatte	Stand	1	like	167	try	42
Sutaato	Start	2	listen	6	turn	24
Kuttsuku	Stick	5	look	48	twist	2
Sutoppu	Stop	34	made	2	unwind	1
Totte	Take	10	make	5	use	8
Oshiete	Teach	1	mean	3	wait	12
Itte	Tell	1	measure	2	want	55
Itta	Told	2	move	5	wash	3
Sawaru	Touch	9	need	2	watch	76
Yattemite	Try	86	open	5	wind	31
Mawashite	Turn	36	pay	1	wipe	2
Wakatta	Understood	6	pick	2	work	1
Tsukau	Use	2	play	10	93	966
Matte	Wait	8				
Shitai	Want	11				
Arau	Wash	1				
Mitete	Watch	36				
51		596				

APPENDIX C

Japanese sentences used for Experiment 2 and the follow-up experiments:

Experiment 2

Verb Condition

これは　モベッテ いるよ
これは　ソクッテ いるよ

Q: これは　モベッテ いますか？

Mimetic Condition

これは びんびんしているよ
これは しゅがしゅがしているよ

Q: これはびんびんしていますか？

Follow-Up Experiments

Control Experiment 2A (doing + verb)

これはモベルをしているよ
これは ソクルをしているよ

Q: これはモベルをしていますか？

Control Experiment 2B (doing + verb × 2)

これはモベルモベルをしているよ
これは ソクルソクルをしているよ

Q: これはモベルモベルをしていますか？