Can Speakers Recruit Sound Symbolic Cues in Novel Korean Ideophones to Distinguish Manner of Motion?

Kathryn R. Slusarczyk

Dr. Kristen Syrett

Rutgers University

Abstract

Traditionally, linguists agree that the meaning of a word is only arbitrarily connected to what it sounds like. For instance, the sounds that make up the word “dog” don’t give any explicit indication as to what the word “dog” actually means. However, the phenomenon known as sound symbolism allows for sounds at a word’s segmental level to indicate some sense of a word’s meaning. Although we typically glean meaning from different cues, previous research on this phenomenon reveals that both adults and children can employ sound symbolism to determine meaning for unknown words. In Imai et al 2008, 4yr olds acquiring either English or Japanese demonstrated an ability to determine meaning for a set of novel sound symbolic Japanese verbs in a forced choice pointing task. Participants’ cross-linguistic ability to determine meaning from these phonological cues does not seem to be dictated only by the prevalence of sound symbolic words in a participant’s native language. The Korean language contains a class of words known as ideophones, similar to English adverbs, in which every ideophone follows a strict set of phonological rules that makes them all sound symbolic. The current study examines how English speakers and Korean speakers interpret a set of novel Korean ideophones in a forced choice pointing task. When shown two videos of the same action being performed with different speed and/or range of motion, participants are given a novel ideophone and asked to match it to either variation. We expected to see that English speaking adults and children, while unfamiliar with Korean phonological rules, could determine meaning from sound symbolic cues encoded in these novel Korean ideophones. However, we found that English speakers were unable to determine meaning from these cues in the current study. Though these results suggest that speakers are not sensitive to sound symbolic cues consistent with the phonology of a non-native language, we consider how a modified task may yield different results.

Acknowledgements

I would like to thank the Department of Linguistics at Rutgers University, New Brunswick, for an exciting and challenging four years of learning, and the opportunity to complete an Honors Thesis. I'd also like to thank Gahyun Yoo for lending her voice to my work, and her father Jae Choon Yoo for translation assistance at all times of the day. Thank you to Professor Hee Chung Chun and Professor Young-Mee Cho of the Department of Asian Languages and Cultures- your support and insight into the world of translation has been invaluable. I'd like to award the biggest high-five and a thank you to my colleagues at the Rutgers Laboratory for Developmental Language Studies, for all of your hard work and spot-on constructive criticism. Ilana and Talia, it's been an honor to work with such incredibly dedicated and supportive women. My sincerest thanks go to my advisor Dr. Kristen Syrett, for her guidance and constant words of encouragement even in the toughest of times.

1. Introduction

How do speakers of any language determine the meaning of a word? Is there anything about how the word "dog" sounds which indicates that a "dog" is a furry, four-legged creature, who also happens to be man's best friend? Children acquiring any language must engage in word learning processes to build a lexicon. Though it may sound easy, word learning is a complex process that involves all sorts of linguistic input: everything from syntactic information to semantic cues (Fisher et al., 2010; Gleitman, 1990; Syrett & Arunachalam, 2018). Thanks to recent research, we have learned that a phenomenon known as sound symbolism appears to be just one way in which children are able to determine meaning for unknown words. (Imai et al., 2008; Imai et al., 2015; Jo and Ko, 2018; Parault and Schwanenflugel, 2006). While sound symbolism is certainly not our primary indicator of word meaning, it can have a role in word learning for children in the midst of language acquisition (Imai et al., 2008; Jo and Ko, 2018) as well as for adults encountering unknown words (D'Anselmo et al., 2019; Dingemanse et al., 2016; Parault and Schwanenflugel, 2006). Evidently, we have the ability to pick up on the common sound symbolic cues of unknown languages (D'Anselmo et al., 2019; Dingemanse et al., 2016; Tzeng et al., 2016), suggesting some cross-linguistic or universal understanding of certain sound symbolic cues.

In the remainder of the introduction, we examine previous research on sound symbolism, addressing research that utilizes both novel and real words in the assessment of participant responses to sound symbolic cues. We also look at evidence for cross-linguistic understandings of some sound symbolic cues, and the prevalence of sound symbolic words in non-English languages, focusing primarily on Korean ideophones. Finally, we consider the effect and role of sound symbolism in word learning tasks and establish our own tasks.

2. Background

2.1. Sound Symbolism

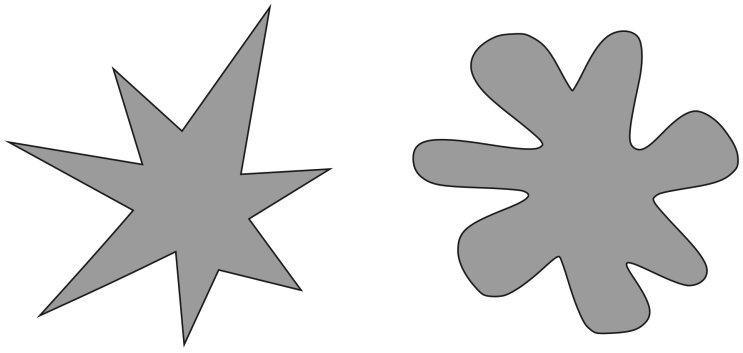
Sound symbolism, also referred to as phonological iconicity (Schmidtke et al., 2014), is the concept that the relationship between a sound and that sound's meaning is not entirely arbitrary, as previously posited by de Saussure (1959). Instead, the sounds of a word can non-arbitrarily indicate some sense of a word's meaning (D'Anselmo et al., 2019; Parault and Schwanenflugel, 2006; Schmidtke et al., 2014). In English, numerous examples of sound symbolism can be found in the category of onomatopoeia, such as with words that mimic animal sounds (e.g., *cuckoo*) or colliding objects (e.g., *bang*) (Schmidtke et al., 2014). While sound symbolism appears to be present throughout the world's languages (Parault and Schwanenflugel, 2006), some languages have much richer inventories of sound symbolic words (Dingemanse et al., 2016; Schmidtke et al., 2014). Some Sub-Saharan African languages, East Asian languages, and Native American languages even have entire categories of sound symbolic words, used to describe sounds, motions, feelings, and textures (Kwon, 2018; Schmidtke et al., 2014). These categories of sound symbolic words are discussed further in **2.3**.

As sound symbolism appears to be present across languages, recent research has turned to demonstrating subjects' abilities to map meaning onto linguistic form even across linguistic cues in their non-native languages. Previous works on participants and their perceived meaning of non-native sound symbolic words have referred to these abilities as cross-linguistic understandings of sound symbolic cues (D'Anselmo et al., 2019; Dingemanse et al., 2016; Tzeng et al., 2017; Imai et al., 2008).

2.2 Evidence

In some of the earliest research on sound symbolism, Köhler's (1929) work showed that we have some ability to match sounds to figures based on audible phonological cues within unknown words. Kohler showed participants two shapes: a spiky jagged shape and a curvy round shape, similar to those below in **Figure 1**. He then asked participants to determine which shape was "*takete*" and which shape was "*maluma*." Participants overwhelmingly matched novel word "*takete*" with the spiky jagged shape, and novel word "*maluma*" with the curvy round shape. Kohler's work has been a basis for further investigation into the perception of specific phonemes (as in specific vowels and consonants) as sound symbolic cues (Imai et al., 2008; Ramachandran and Hubbard, 2001), though these cues appear to vary somewhat by language (D'Anselmo et al., 2019; Dingemanse et al., 2016). Recent investigation into sound symbolism has utilized both novel (Imai et al., 2008) and non-native words (Dingemanse et al., 2016; Tzeng et al., 2017) in investigating subjects' abilities to identify word meaning based only on sounds (Parault and Schwanenflugel, 2006).

Figure 1



In D'Anselmo et al.'s (2019) work on sound symbolism, adult subjects demonstrated an apparent understanding of sound symbolic cues across a sample of unknown words including nouns, adjectives, and verbs of non-native languages. In a forced choice task, experimenters

asked 215 Polish or Italian speakers to listen to words pronounced in four different languages (Finnish, Japanese, Swahili, and Tamil), and then guess the correct meaning of the word when presented with three choices of words in their native language. This study found that participants did perform above chance in determining meaning from sound symbolic cues, with particularly significant results for items from Finnish and Japanese. This apparent cross-linguistic understanding of similar sound symbolic cues may indicate some universality to the perception of these cues in speakers of different natural languages. However, these results also suggest that there is some aspect of the sound symbolic cues found in Finnish and Japanese that make their sound symbolic words easier to detect than similar cues in Swahili or Tamil, at least for Italian and Polish speakers. In addition, participants performed significantly better at guessing the meaning of verbs and nouns than with adjectives; this result may indicate yet another factor that influences the ability of certain speakers to pick up on sound symbolic cues common in other natural languages.

In recent work in language acquisition, Imai et al. (2008) found that children can use sound symbolic cues from constructed novel verbs in word learning. Jo and Ko (2018) also found that Korean-speaking mothers tend to strengthen the acoustic saliency of sound symbolic words for younger children by increasing variance in fundamental frequency, intensity, and word length. This variance, along with a significantly higher frequency of sound symbolic words used in speech directed at young children, indicates Korean-speaking mothers' awareness of some role that sound symbolism plays in language acquisition. The higher frequency of sound symbolic words in child-directed speech from Korean-speaking mothers is particularly aided by the existence of an entire category of adverb-like words known as ideophones (Jo and Ko, 2018).

2.3 Ideophones

Though the English language makes use of sound symbolic cues, it does not contain a category of words known as ideophones. This entire category of sound-symbolic words exists in a variety of Sub Saharan African, East Asian (including the Korean language), and Native American languages (Lockwood et al., 2016; Schmidtke et al., 2014). These words are often called ideophones, mimetics, or expressives, likely due to slight differences between the categories in varying languages. The current work will refer to them primarily as ideophones, largely following the decision of previous researchers who have labeled the Korean category of these sound-symbolic words to be ideophones. In investigation of subjects' perceptions of sound symbolic ideophones, Dingemanse et al. (2016) found that adult speakers who were presented with ideophones from five different natural languages also demonstrated a sensitivity to sound symbolic cues. In Korean, the category of ideophones is rich in iconicity (Kwon, 2018). There is an entire website dedicated to a list of Korean ideophones, all of which are in some way sound symbolic. As this word category in Korean provides such a rich variety of sound symbolic cues, the primary focus of the current work will be on perceptions of novel constructed around the Korean phonological rules of the word category, as done with verbs and Japanese phonological rules in Imai et al. (2008).

2.4 Korean Phonology

Ideophones, though a thoroughly prolific and distinct category of word in the Korean language, follow the same vowel and consonantal phonological rules as other word categories in Korean. The exact number and classifications of phonemes in the Korean vowel inventory is somewhat controversial among Korean phonologists (Brown and Yeon, 2015; Lee, 1992). Though some versions of the Korean vowel inventory support a seven-distinct-vowel system,

other versions support as many as ten distinct vowels within the inventory. To maintain consistency through the current work, we will primarily follow the inventory and classifications provided by Young-Key Kim-Renaud's *Korean: An Essential Grammar* (2009). While every version of the Korean vowel inventory is subject to criticism from phonologists who endorse a different version, depending on a lower or higher number of distinct vowels, Kim-Renaud's vowel inventory & classification appear to be the most widely accepted and least criticized. Historically, literary and linguistic scholars in Korea have attempted to define the usage of vowels in Korea through the rules of a system called vowel harmony (Kwon, 2018). Though these usage rules have become less strict over time, the sound symbolic cues of Korean vowels are closely associated with categories of light (also called bright) vowels and dark vowels (Brown and Yeon, 2015; Kim-Renaud, 2009; Lee, 1992). For example, a pair of ideophones like bant̪ʂaʔbant̪ʂaʔ (반짝반짝) and bʌnt̪ʂʌʔbʌnt̪ʂʌʔ (번쩍번쩍) differ only by the recurring vowels [a] or [ʌ]. Both words mean something similar to "shine." However, as [a] is a light vowel, bant̪ʂaʔbant̪ʂaʔ (반짝반짝) is a more radiant, beautiful glittering. On the other hand, containing the dark vowel [ʌ], bʌnt̪ʂʌʔbʌnt̪ʂʌʔ (번쩍번쩍) is more of a gaudy, perhaps somewhat ruddy shine. There are countless pairs of Korean ideophones that employ these vowel differences as a tool to distinguish meaning (Kwon, 2018; Lee, 1992). Historically, these light or dark associations also indicated what kinds of vowels were permitted to be paired in the same words together, in accordance with Korean rules of vowel harmony (Brown and Yeon, 2015; Kwon, 2018). Within the light and dark categories, neither of the groups includes diphthongs or a number of simple vowels that are considered to be neutral (e.g. ŭ [ㅡ]and i [ㅣ]) (Kim-Renaud, 2009). Of the most non-controversial classifications of the Korean vowel inventory, examples of light monophthong vowels include ɛ (ㅐ), a (ㅏ), and o (ㅗ), and the category of dark

monophthong vowels includes ʌ (ㅓ), e (ㅔ), and u (ㅜ) (Brown and Yeon, 2015; Kim-Renaud, 2009; Lee, 1992).

While the Korean consonantal inventory is not split into light and dark categories similarly to Korean vowel classifications, they can be split into categories of strength according to certain phonological features: sonorant, plain, aspirated, and tense (Kim-Renaud, 2009). The following list of consonants in **Figure 2** is provided written IPA and Hangul. These consonants as written in Hangul may often be realized slightly differently depending on their syllable initial or final position (Lee, 1992), so some are listed with two IPA pronunciations. For the purpose of this work, sonorants and plain consonants are grouped as "weak consonants" and aspirated and tense consonants are grouped as "strong" consonants.

Figure 2

a. sonorant consonants: m (ㅁ), n (ㄴ), l (ㄹ), ɾ (ㄹ), ŋ (ㅇ)

b. plain consonants: b/p (ㅂ), d/t (ㄷ), s (ㅅ), tɕ (ㅈ), g/k (ㄱ)

c. aspirated consonants: p^h (ㅍ), t^h (ㅌ), $tɕ^h$ (ㅊ), k^h (ㅋ), h (ㅎ)

d. tense consonants: p͈ (ㅃ), t͈ (ㄸ), s͈ (ㅆ), tɕ͈ (ㅉ), k͈ (ㄲ)

3. Reduplication

Reduplication is prevalent across the entirety of Korean word categories, but even more so in the categories of onomatopoeia and ideophones (Lee, 1992). To return to our previous example, we can see reduplication in the forms of bantɕ͈aʔbantɕ͈aʔ (반짝반짝) and bʌntɕ͈ʌʔbʌntɕ͈ʌʔ (번쩍번쩍). Though both ideophones are often used in these reduplicated forms, Korean speakers are able to use just one foot of the ideophone as an adverb-like modifier. Using just the word bantɕ͈aʔ (반짝) in a sentence would be a completely reasonable way to refer to a similar

shine that bant͈ɕaʔbant͈ɕaʔ (반짝반짝) also refers too. However, the plain foot form of the word does seem to be somewhat less intense than the reduplicated form, as reduplication is commonly used as an intensifier of meaning (Brown and Yeon, 2015; Kim-Renaud, 2009; Lee, 1992). Other common phonological processes of the Korean language include resyllibification and consonant assimilation (Brown and Yeon, 2015; Kim-Renaud, 2009), though these are factors that may overcomplicate the following tasks. As will be shown in the section on linguistic stimuli construction, these processes were avoided for clarity of the task.

4. **Remaining Questions**

Upon this review of previous research, we believe that further research into sound symbolism could easily take advantage of the Korean word class of ideophones and its clear, strict phonological rules. Broadly, how do children and adults use sound symbolic cues in novel Korean ideophones to determine meaning? More specifically, can they use these cues to distinguish between events varied by manner of motion? If not, can they recruit these cues at all? If so, how do they prioritize input from vowel or consonantal categories? The Korean phonological system is well suited to this task, as the language provides strict sets of vowels and consonants that may help us understand how participants respond to this research.

In our investigation of sound symbolism through novel Korean ideophones and manner of motion, we suspect our research will result in one of three outcomes:

(1) Participants are able to pick up on the sound symbolic cues of novel Korean ideophones and use this information to differentiate between manner of motion, choosing faster/wider (max) actions for C_SV_D novel ideophones and slower/smaller (min) actions for C_WV_L novel ideophones.

(2) This may happen in tandem with hypothesis 1. Participants favor sound symbolic input from either vowels or consonants, and vary choice of action by the category of either the vowel

of consonant. This would result in majority min choices for light vowels and max choices for dark vowels, or min choices for weak consonants and max choices for strong consonants.

(3) Participants are unable to pick up on the sound symbolic cues within this set of novel Korean ideophones and perform at chance. Though we may hope for results as in (1) and (2), it is a very real possibility that English speakers are not receptive to sound symbolic cues as present in Korean phonology.

In the current study, we have designed three experiments to investigate whether speakers recruit sound symbolic cues in novel Korean ideophones to distinguish manner of motion. Experiment 1 was conducted to norm a set of novel Korean ideophones created for Experiments 2 and 3. Experiment 2 was conducted in both English and Korean, to evaluate adult responses in a forced choice paradigm that tested their response to a novel Korean ideophone. In Experiment 3, we run the above paradigm with three and five-to-seven year olds to evaluate the possible role of sound symbolism in novel word learning for children in the process of language acquisition.

5. Experiment 1: Norming Task

5.1. Participants

11 adult native speakers of Korean participated. They were recruited via social media and word of mouth among undergraduate students at two universities in Seoul, South Korea: Ewha Woman's University and Seoul National University. More information on recruitment is listed in **Appendix A**.

5.2. Linguistic Stimuli

A list of novel words was constructed for the purpose of tasks in Experiments 2 and 3. In Experiment 1, these words were separately normed with native speakers of Korean. The online task asked participants to judge each of these novel words in order to ensure that the two main

experiments used words that 'sounded Korean.' These novel words were first constructed based on the following criteria.

Based on Kim-Renaud's (2009) classifications of Korean consonants and vowels, two categories of consonants and two categories of vowels were identified and separated as shown in **Figure 3** below:

Figure 3

a. **weak (plain & sonorant) consonants:** /m/ (ㅁ), /n/ (ㄴ), /l/ (ㄹ), /ɾ/ (ㄹ), /ŋ/ (ㅇ), /b/ or /p/ (ㅂ), /d/ or /t/ (ㄷ), /s/ (ㅅ), /tɕ/ (ㅈ), /g/ or /k/ (ㄱ)

b. **strong (aspirated & tense) consonants:** /pʰ/ (ㅍ), /tʰ/ (ㅌ), /tɕʰ/ (ㅊ), /kʰ/ (ㅋ), /h/ (ㅎ), /p͈/ (ㅃ), /t͈/ (ㄸ), /s͈/ (ㅆ), /ts͈/ (ㅉ), /k͈/ (ㄲ)

c. **light vowels:** /ɛ/ (ㅐ), /a/ (ㅏ), /o/ (ㅗ)

d. **dark vowels:** /ʌ/ (ㅓ), /e/ (ㅔ), /u/ (ㅜ)

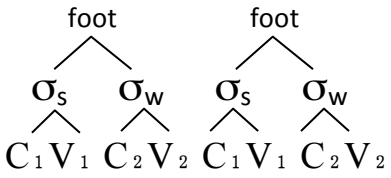
These categories were then combined to create four sound combinations of novel ideophones, as listed in **Figure 4**. For ease of reference, these pairs have been assigned abbreviations of $C_SV_{L,}$ $C_SV_{D,}$ $C_WV_{L,}$ $C_WV_{D,}$ and opposite pairs (strong consonants with light vowels or weak consonants with dark vowels) will also be referred to as mixed pairs.

Figure 4

a.	strong consonants / light vowels	= C_SV_L	Mixed Pair
b.	strong consonants / dark vowels	= C_SV_D	
c.	weak consonants / light vowels	= C_WV_L	
d.	weak consonants / dark vowels	= C_WV_D	Mixed Pair

All stimuli were constructed in the same form, as shown in **Figure 5,** without any coda consonants.

Figure 5: Phonological structure of the novel Korean words



We allowed for C_1 and C_2 to be the same or different consonants, while V1 and V2 were different vowels. Each novel word was four syllables, two syllables repeated, to imitate reduplication as it occurs in the Korean language. For example, novel ideophone *sasosaso* (사소사소) featured /*s*/, a weak consonant, in positions C_1 and C_2 , and the light vowels /*a*/ and /*o*/ in V_1 and V_2, respectively. The same female adult native bilingual speaker of English and Korean recorded all audio files for both the norming study and the following experiments. All audio was recorded on the same MacBook Pro (Retina, 15-inch, Late 2013), and the speaker was asked to maintain a neutral tone. Audio files were clipped and normalized to 67 dB in Praat. We recorded an initial set of sixty-four novel ideophones for the norming task; two were removed for similarity to existing Korean words, so sixty-two novel ideophones were included in the norming task.

5.3. Procedure

The experiment was administered on Qualtrics via an online link or QR code. Participants were told they would hear a series of recordings, and were asked to indicate whether the recording sounded like it could be a Korean word or not, rating the recording on a scale of 1 to 5. A rating of 1 indicated that "[this recording] definitely does not sound like [it could be a Korean word]" while a rating of 5 indicated that "[this recording] definitely sounds like [it could be a Korean word]". The Korean text for these instructions can be found in **Appendix B**. We used the term 'recording' instead of 'word', because the purpose of the task was for adult native speakers of Korean to determine whether or not the phonological string sounded like a word or not. Stimuli were presented in a pseudo-randomized order.

A brief training phase preceded the actual experimental trials. In this training, participants were asked to listen to and assess two real Korean ideophones, such as s͈ɯdams͈ɯdam (쓰담쓰담), which we predicted would elicit ratings at or near 5, as well as two English words featuring phonemes not included in the Korean phonological inventory, such as *flavorful*, which contains /f/ and /v/. Each participant then provided judgements for all sixty-two novel ideophones. Each trial had the structure shown in **Figure 6**. All instructions and accompanying texts written in Korean were reviewed and approved by a native Korean speaker with a background in linguistics. Screenshots of the Korean text shown via Qualtrics can be found in **Appendix B**.

Figure 6. Trial structure for Experiment 1
FAMILIARIZATION PHASE

In Korean: You will now listen to [some] recordings. After listening to each recording, even if this [recording] does not exist [for real], please rate whether [it] sounds like Korean on a scale from 1 to 5. 1 [means] "does not sound like Korean at all" and 5 [means] "definitely sounds like Korean."

Let's practice!

An audio player on the top left side of the page allowed participants to hit play and hear: 사소사소// *sasosaso*
This audio could be played more than once, as needed.

In Korean: Please rate whether [this recording] sounds like Korean on a scale from 1 to 5. 1 means "Does not sound like Korean at all" and 5 means "Definitely sounds like Korean." [Please] choose a number below.

A slider allowed participants to choose options 1 through 5.

1 --------- 2 -------- 3 -------- 4 -------- 5

5.4. Results

We received responses from 11 Adult Korean speakers. (Data collection from overseas Korean speakers was disrupted by the early outbreak of the Novel Coronavirus.) Each participant passed control items, and provided a score for each of the sixty-two novel Korean ideophones. Twenty-two of the sixty-two items received an average score of below 3 (neutral), leaving forty items to feed into Experiments 2 and 3.

5.5. Discussion

In Experiment 1, our goal was to eliminate words that were not judged to be "Korean-sounding" by Native Korean speakers. Therefore, novel words which were rated an average above 3 "[Neutral]" (보통) and up to 5 "Definitely sounds like Korean" (매우 그렇다) on the provided scale of 1 to 5 were accepted as "Korean-sounding" for the purpose of determining novel ideophones to feed into Experiments 2 and 3. However, the number of events and conditions in Experiments 2 and 3 called for a total of forty-four novel Korean ideophones. Assuming that a larger response pool may have yielded a higher score for some of the discarded novel words, we reviewed several discarded novel ideophones with two additional native Korean speakers, and approved four ideophones for re-addition to Experiments 2 and 3. All approved novel ideophones can be found in **Appendix C**.

6. Experiment 2

6.1. Participants

There were two sets of participants: adult native Korean speakers[*] and adult native English speakers (N = 67). The Korean speakers were recruited via word of mouth among undergraduates at two universities based in Seoul, South Korea: Ewha Woman's University and Seoul National University. Additional Korean participants were recruited via an online platform, and offered some monetary compensation for their participation. The English speakers were recruited from a subject pool of undergraduate students at Rutgers University‐New Brunswick in New Jersey, who were taking intro-level classes in Linguistics or Cognitive Science.

[*] We have not yet been able to collect significant response data from Korean speaking adults, as data collection was disrupted by the global outbreak of the Novel Coronavirus.

6.2. Auditory Stimuli

The normed novel ideophones from Experiment 1 were fed into Experiment 2 to determine whether an apparent subphonemic sound-meaning correspondence observed in Korean can be recruited by both native Korean speakers and non-Korean (English) speakers in a word learning task, as it was by participants in Imai et al (2008) for a similar pattern in Japanese.

The same novel words were used in both the English and Korean versions of the experiments. All auditory files for both the English and Korean versions of the study were recorded by the same adult, who was a bilingual speaker of English and Korean. Speed and pitch of the recorded stimuli were carefully controlled to minimize any differences in prosody that could influence participants' responses. All audio was recorded on the same MacBook Pro (Retina, 15-inch, Late 2013), from three different quiet locations on the Rutgers, New Brunswick campus. While recording, the speaker listened to a metronome via metronomelonline.com to ensure that all recordings had a pace of about 90BPM. A researcher also coached the speaker to encourage a child-directed tone with consistent fluctuations in fundamental frequency between different recordings. All sound files were sliced and edited for length and normalized to 67 dB in Praat. Full lists of the auditory stimuli- including novel ideophones and complete test questions- can be found in **Appendix D**.

6.3. Visual Stimuli

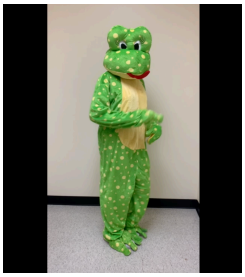
All visual stimuli were video recorded in a room with bare, light colored walls, using the same iPhone XS. Characters in the videos were research assistants dressed in adult-size animal costumes (cow, dog, duck, frog, pig). There were two types of trials: control trials, and test trials. The control trials were included to ensure that participants could make a choice between two distinct events that did not subtly differ in manner of motion (e.g., an animal dancing or partying in contrast to the same animal sleeping). These control events were also used as familiarization events in the first phase of the study. The contrast was always between two events where the same animal was the semantic agent and grammatical subject. Two examples are shown in **Figure 7** below.

Figure 7. Sample event contrast during test phase of two control trials for Experiment 2, with prompts in English

Where is the dog painting?	*Where is the cow sleeping?*

The contrast in the test trials was considerably more subtle, since the events portrayed the same event type (e.g., bending, jumping, twisting, etc.,) with the same animal, but differed in the manner of motion. We manipulated one or both of two parameters in each trial: speed (slow v. fast), and range of motion (minimal v. 'dramatic' movement). We used a metronome app when filming the events to precisely control for the pace of the action. Two examples are presented in **Figure 8**.

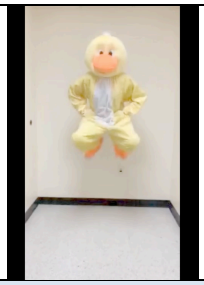
Figure 8. Sample manner of motion contrast with parameters of speed and range of motion manipulated during test phase of two test trials for Experiment 2, with prompts in English

Parameter: Speed		Parameter: Range of Motion	
			
*Where is the frog walking [**sasosaso**]?*		*Where is the duck jumping [**popapopa**]?*	

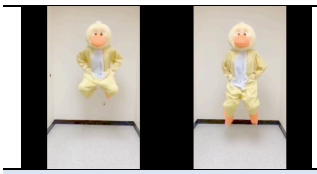
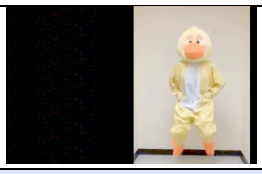
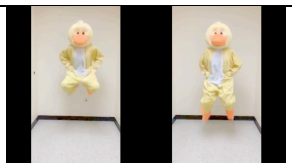
Videos were then edited and assembled into trials in iMovie. Target side, when applicable, was counterbalanced across all trials, and alternated regularly from trial to trial within the session. At test, participants were asked to select the side of the screen (L or R) where the target was located. Each trial had the same structure as shown in **Figure 9**. Participants were asked to watch and listen to the whole video, and they had the ability to play the video again as needed. A list of trial events, along with target sides and differences in manner of motion, can be found in **Appendix D**.

Figure 9. Trial structure for Experiment 2 for test event 'duck jumping' (in English)

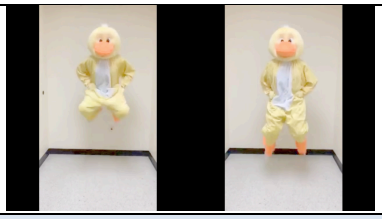
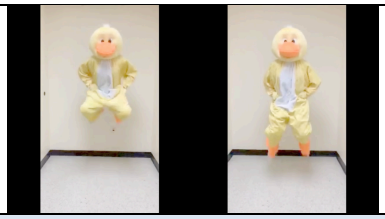
Familiarization Phase of Test Trial

	[blank]		[blank]		[blank]
3.5-4 sec	2.5 sec	5-6 sec	2.5 sec	5-6 sec	3.5-4 sec
Look at the duck! Hi, duck!	*Let's see the duck jumping.*	*Wow!*	*Let's see the duck again.*	*Yay!*	*Did you see that? They're different.*

Contrast Phase of Test Trial

			
5-6 sec	4-5 sec	4-5 sec	4-5 sec
Look!	*Now look over here!*	*Now look over there!*	*They're different!*

Test Phase of Test Trial

[blank]		[blank]	
1s	5-6 sec	1s	5-6 sec
	Where is the duck jumping ***[popapopa]****?*		*Where is the duck jumping* ***[popapopa]****?*

6.4. Procedure

Participants were invited to participate in a Qualtrics survey via either an online link or QR code. Some English speaking participants took the study online while at an in-person meeting with an experimenter, while others took the study online from various remote locations. There were four versions of the study for English speakers, and another four versions for Korean speakers. All participants saw the exact same visual stimuli events in the same order. Only the list of novel ideophones presented to each participant varied by list: participants in List 1 of the English version heard the same novel Korean ideophones as participants in List 1 of the Korean version, and so on. The overall experiment had the same structure in each version: a training session with three trials (examples shown in **Figure 7**), followed by a test session with 11 trials (examples shown in **Figure 8**). Control trials were also inserted after test trials 3, 6, and 9. In a binary forced choice paradigm, each trial required participants to view a video that featured an animal performing one action in two different manners of motion (as shown in **Figure 8**), and then listen to a question that asked them to choose one of the motions. Participants were then prompted to click to the next page, where they had to choose "Action on the **LEFT SIDE**" (**왼쪽에** 있는 동작) or "Action on the **RIGHT SIDE**" (**오른쪽에** 있는 동작).

Korean speaking participants participated primarily via the link on Qualtrics. They were asked to be sure they were in a quiet environment, and encouraged to use headphones if possible. Most English speaking participants were invited to participate via the link on Qualtrics from a reserved computer lab, where the usage of headphones was required and a quiet environment was provided. All response data was recorded via Qualtrics, and no paper response sheets were required.

6.5. Results

English speaking participants did not show any significant ability to use sound symbolic cues in distinguishing manner of motion. When presented with a trial where the manipulated manner of motion was speed, participants presented with a C_SV_D combination, who were expected to choose the faster motion, chose the faster motion at about chance- 54.8% of the time. Even participants with the opposite C_WV_L combination chose the faster motion at around chance- 57.4% of the time. Participants with mixed combinations performed similarly (max choice; C_SV_L: 58.7; C_WV_D : 56.9), and did not seem to show any preference for influence of vowels or consonants either. The results for events varied by range of motion were similarly not far from chance (max choice; C_WV_L: 46.8; C_WV_D: 53.2; C_SV_L: 67.7; C_SV_D: 53.2). Though the results for events varied by speed and range may hint at a participant preference for the max choice (max choice; C_WV_L: 64.5; C_WV_D: 69.4; C_SV_L: 67.7; C_SV_D: 69.4), there are still no significant results to report for our English speaking participants.

We have not yet been able to collect significant response data from Korean speaking adults, due to delays caused by the global outbreak of the Novel Coronavirus. Further data collection with Korean speaking participants via online platform Prolific is currently pending.

6.6. Discussion

The results of Experiment 2 demonstrate that English-speaking adults are unable to determine meaning from the sound symbolic cues in this task. We suspect that these results may be the cause of language differences, specifically in how movement is described in English and Korean. In English, there are a number of verbs used to describe similar motions. Jumping and hopping, for example, constitute very similar motions, though an English speaker could describe to you the subtle differences between a jump and a hop. In Korean, however, jumping and

hopping are both depicted by the same verb, (뛰다) and typically differentiated by an accompanying modifier- usually an ideophone that specifies the kind of motion that a verb is depicting. Korean speakers therefore place a lot of importance in the information that these modifiers provide. Even if English-speaking participants can glean some meaning from the sounds they hear throughout the study, they may be viewing the two actions shown in each event as too similar to distinguish from one another based on an unknown word.

These results also lead us to question of whether English speakers are even sensitive to the contrasts of Korean vowels and consonants, as some of these contrasts are not represented similarly in the phonology of the English language (Brown and Yeon, 2015; Kim-Renaud, 2009). Looking forward to data collection with Korean speaking participants, their responses may shed light on whether English speakers are unable to distinguish similar phonemes, whether these pairings of novel ideophones and events are merely not sound symbolic enough, or whether participants have an issue in distinguishing manners of motion as discussed above.

7. Experiment 3

Experiment 3 investigated whether the ability to recruit these same sound symbolic correspondences develops in childhood. Recall that previous research has shown that children can use sound symbolic cues in learning word meaning from both novel words and non-native words. While Imai et al. (2008) demonstrated that children acquiring Japanese are able to glean meaning from novel Japanese verbs, Tzeng et al. examined their ability to determine meaning from sound symbolic cues of non-native words from unknown languages. However, this study is the first to determine whether they can do so in Korean. Additionally, the current study used novel modifiers rather than novel verbs, as ideophones are more syntactically similar to English adverbs.

7.1. Participants

Given the results of Tzeng et al (2017), which showed that five- and seven-year-olds were significantly more proficient than three-year-olds in recruiting sound symbolic cues to meaning, we targeted both of these same two age ranges (three-year-olds and five- to six-year-olds) as a direct comparison to previous research. Three-year-olds and five- to seven-year-olds were recruited from local preschools and daycares in central New Jersey. The parents of all children who participated provided informed consent. In addition, the children provided their verbal consent to participate.

7.2. Stimuli and Procedure

The stimuli were the same as in those used for English speaking adults for Experiment 2. The difference was in the manner of presentation. Instead of presenting the stimuli online via a link, an experimenter assembled the trials into a PowerPoint file using the same individual iMovie clips as in the adult study. Children were presented the experiment individually in a quiet space in their school. An experimenter recorded responses by hand via paper response sheets.

Child participants were seated in front of a 17" Macbook Pro next to the experimenter. The experimenter explained that they were going to watch some videos and answer some questions about a few animal friends. The experimenter asked the child to look and listen carefully, and then played one video trial for the child. After children heard the question at the end of the video, they were encouraged to point at the screen's left or right side to indicate their choice, and the experimenter recorded this choice by hand on a paper response sheet. Responses were then entered into an Excel spreadsheet for analysis.

7.3. Results

Though we collected data from several child participants, data collection was interrupted by the global outbreak of the Novel Coronavirus. We are not yet able to report results.

8. General Discussion

In response to how we opened the paper: Can speakers recruit sound symbolic cues in novel Korean ideophones to distinguish manner of motion? The answer so far is no. These results lead us to a review of our previous hypotheses:

That (1) "Participants are able to pick up on the sound symbolic cues of novel Korean ideophones and use this information to differentiate between manner of motion, choosing faster/wider (max) actions for C_SV_D novel ideophones and slower/smaller (min) actions for C_WV_L novel ideophones." The results of our English-speaking participants in Experiment 2 suggest that this cannot be the case. By performing at chance, English speakers either (a) cannot pick up on the sound symbolic cues in our set of novel ideophones or (b) cannot employ these cues in distinguishing manner of motion. As mentioned before, either theory seems possible given language differences between English and Korean. In consideration of (a), though studies like D'Anselmo et al.'s (2019) work has shown that Polish and Italian speakers can detect sound symbolic cues in Finnish and Japanese, there seems to be little existing evidence for this detection between speakers of English and Korean. Recall that in Imai et al (2008), native speakers of English with no knowledge of Japanese recruited sound symbolic linguistic elements to learn novel Japanese verbs. Even given the numerous similarities between Japanese and Korean phonology, it may be wishful thinking to assume that results as in Imai et al.'s (2008) study in Japanese and English might suggest the possibility of yielding similar results in a study on Korean and English. In consideration of (b) (and mentioned in Discussion of Experiment 2),

differences in how the Korean and English languages utilize verbs may make it difficult for English speakers to differentiate actions that differ by subtle changes in manner of motion, rather than drastic changes that would require the usage of a different verb.

That (2) "Participants favor sound symbolic input from either vowels or consonants, and vary choice of action by the category of either the vowel of consonant. This would result in majority min choices for light vowels and max choices for dark vowels, or min choices for weak consonants and max choices for strong consonants." The results of Experiment 2 very clearly showed that our participants made their choices at chance. Though there was a possibility that participants could make choices according to vowel or consonantal information even without behavior that supported hypothesis (1), this hypothesis appears to have been disproved as well. Also mentioned previously, there is a chance that English speakers are simply not sensitive to the differences in the specific vowels and consonants that make up our novel Korean ideophones. Though the two languages don't employ exactly the same sets of vowels, even Korean speakers see their vowels merge closer and become a bit more ambiguous as younger generations are brought up (Brown and Yeon, 2015). It's also especially difficult for English-speaking learners of Korean to master the differences between some consonants (Brown and Yeon, 2015), as there are no minimal pairs for some of these consonants in English. It's entirely possible that English speakers have difficulty picking up on the sound symbolic cues of Korean because they seem to sound different to English speakers.

That (3) "Participants are unable to pick up on the sound symbolic cues within this set of novel Korean ideophones and perform at chance." Again, as unlikely as it sounds given previous research on the cross-linguistic ability of speakers to detect meaning from sound symbolism in unknown words, our results might suggest that English speakers are simply unable to detect the

sound symbolic cues embedded in our set of novel Korean ideophones. Though this set was carefully created with Korean phonology in mind, it certainly doesn't reflect the true diversity of sound symbolic cues in natural Korean ideophones. Perhaps a study that utilizes natural ideophones, rather than constructed novel ideophones, may provide a set of words that has already been confirmed as sound symbolic by speakers of the Korean language.

Rather than accept that the speakers who participated in our study are outright unable to detect any sound symbolic cues, it's worth considering how to proceed with future research to narrow down why our English speakers responded in the ways that they did.

8.1. Suggestions for Further Investigation

Given the success of previous experiments in demonstrating speakers' abilities to distinguish meaning from sound symbolic cues, contained in both novel and unknown non-native words, we already have evidence that English speakers can detect at least certain sound symbolic cues in the right conditions (Imai et al., 2008; Köhler, 1929; Tzeng et al., 2017). In order to test our theory on English speakers' difficulty in distinguishing manner of motion, we have developed a fully English-phonologically based version of Experiment 2. By using a manner of motion word that is phonotactically licensed by the patterns we see in the English language, the results of this task may be able to help determine whether English speakers in Experiment 2 were affected the manner of motion aspect of the task. We are in the early stages of data collection with English speaking adults and have no results to report yet. Additionally, future research may benefit from a same/different perception paradigm in which Korean words are presented to English speakers to determine whether English speakers are able to differentiate words based on varied vowels or consonants.

Though data collection is not yet complete, preliminary data from adult English speakers presents a number of opportunities to improve and expand upon the current line of research. Even if English speakers can't recruit sound symbolic cues in novel Korean ideophones to distinguish manner of motion, their inability to do so might offer new insight into the limitations of using sound symbolic information.

References

Brown, L., & Yeon, J. (2015). *The Handbook of Korean Linguistics*. John Wiley & Sons.

D'Anselmo, A., Prete, G., Zdybek, P., Tommasi, L., Brancucci, A., & D'Anselmo, A. (2019). Guessing Meaning From Word Sounds of Unfamiliar Languages: A Cross-Cultural Sound Symbolism Study. *Frontiers in Psychology*, 10, 593–593.

Dingemanse, M., Schuerman, W., Reinisch, E., Tufvesson, S., & Mitterer, H. (2016). What sound symbolism can and cannot do: Testing the iconicity of ideophones from five languages. *Language*, 92(2), e117–e133.

Fisher, C., Gertner, Y., Scott, R.M. and Yuan, S. (2010), Syntactic bootstrapping. WIREs Cogni Sci, 1: 143-149. doi:10.1002/wcs.17

Gleitman, L. (1990). The Structural Sources of Verb Meanings, *Language Acquisition*, 1:1, 3-55, doi: 10.1207/s15327817la0101_2.

Imai, M., Kita, S., Nagumo, M., & Okada, H. (2008). Sound symbolism facilitates early verb learning. *Cognition*, 109(1), 54–65.

Imai, M., Miyazaki, M., Yeung, H., Hidaka, S., Kantartzis, K., Okada, H., … Imai, M. (2015). Sound symbolism facilitates word learning in 14-month-olds. *PloS One*, *10*(2), e0116494–e0116494. https://doi.org/10.1371/journal.pone.0116494

Jo, J., & Ko, E. (2018). Korean Mothers Attune the Frequency and Acoustic Saliency of Sound Symbolic Words to the Linguistic Maturity of Their Children. *Frontiers in Psychology*, 9.

Kim-Renaud, Young-Key. (2009). *Korean: An Essential Grammar.* London: Routledge.

Köhler, W. (1929). *Gestalt Psychology.* New York, N.Y: Liveright

Kwon, N. (2018). Iconicity correlated with vowel harmony in Korean ideophones, 9(1).

Lee, J. (1992). Phonology and sound symbolism of Korean ideophones. ProQuest Dissertations Publishing.

Lockwood, G., Dingemanse, M., & Hagoort, P. (2016). Sound-Symbolism Boosts Novel Word Learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *42*(8), 1274–1281. https://doi.org/10.1037/xlm0000235

Parault, S., & Schwanenflugel, P. (2006). Sound-symbolism: A Piece in the Puzzle of Word Learning. *Journal of Psycholinguistic Research, 35(4),* 329–351.

Ramachandran, V. S., and Hubbard, E. M. (2001). Synaesthesia–a window into perception, thought and language. *J. Conscious. Stud.* 8, 3–34.

Saussure, F. de. (1959). *Course in General Linguistics.* New York, NY: Philosophical Library. (Original work published 1922).

Schmidtke, D., Conrad, M., & Jacobs, A. (2014). Phonological iconicity. Frontiers in Psychology, 5, 80–80.

Syrett, K., & Arunachalam, S. (2018). *Semantics in language acquisition*. Amsterdam ;: John Benjamins Publishing Company.

Tzeng, C. Y., Nygaard, L. C., and Namy, L. L. (2017). The specificity of sound symbolic correspondences in spoken language. *Cogn. Sci.* 41, 2191–2220. doi: 10.1111/cogs.12474

Tzeng, C., Nygaard, L., & Namy, L. (2017). Developmental change in children's sensitivity to sound symbolism. *Journal of Experimental Child Psychology,* 160, 107–118.

Appendix A: Recruitment Information

Participants for Experiment 1 included 11 adult native speakers of Korean. One male-identified participant and ten female-identified participants took the study, and all were of Asian descent. Only one participant identified as using any dialect. Their response data was not excluded, as the dialect they identified as using (Gyeonggi-do) is closest to the standard Seoul dialect.

We recruited participants with this accompanying text in Korean:

한국어를 모국어로 구사하는 분들을 이 언어연구에 초대합니다. 어린이를 대상으로 한 10 분 정도 걸리는 단순하고 재미있는 활동입니다. 이연구에서는 어린이들이 듣게될 녹음을 들려주게 됩니다. 이연구에서는 어른들이 어떻게 반응할 것인가를 이해하고자 합니다. 참여하실 분들은 아래 클릭하세요. 참여해 주셔서 감사합니다.

Trans: *We invite native Korean speakers to take this language study. It's a simple and fun activity designed for children that takes about 10 minutes. In this study, you will hear recordings made for children. With this study, we want to understand how adults will react to these recordings. If you would like to participate, please click below. Thank you for participating.*

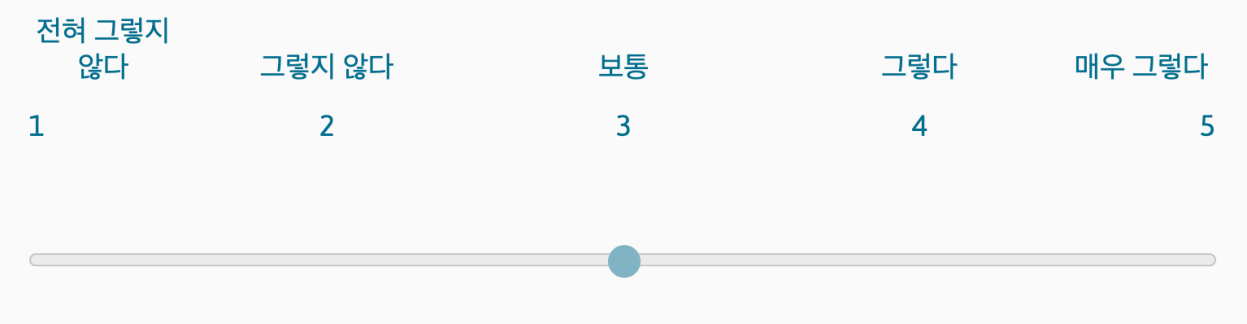
Appendix B: Korean Text for Experiment 1

The Korean text for each target item in Experiment 1 was as follows:

들은 것은 실제로 존해하지 않아도 한국어처럼 들리는지 여부를 1 에서 5 로 판단해 주십시오. 1 은 "전혀 한국어처럼 들리지 않는다"이고 5 는 "확실히 한국어처럼 들린다"입니다. 아래에서 번호를 선택하십시오.

Trans: *Even if this [recording] does not exist [for real], please rate whether it sounds like Korean on a scale from 1 to 5. 1 [means] "does not sound like Korean at all" and 5 [means] "definitely sounds like Korean." Please choose a number below.*

The slider, which allowed participants to make their choices, appeared as follows:



The text for each slider number was as follows:

Number	**1**	**2**	**3**	**4**	**5**
Korean Text	전혀 그렇지 않다	그렇지 않다	보통	그렇다	매우 그렇다
English Translation	Does not sound like Korean at all	Does not sound like Korean	[Neutral]	Sounds like Korean	Definitely sounds like Korean

Appendix C: Complete lists of novel words for Experiments 2 and 3

LIST 1	LIST 2	LIST 3	LIST 4
사소사소	서수서수	카꼬카꼬	처꾸처꾸
sasosaso	sʌsusʌsu	kʰakʲokʰakʲo	tɕʰʌkʲutɕʰʌkʲu
수서수서	뽀카뽀카	꾸꺼꾸꺼	소사소사
susʌsusʌ	pokʰapokʰa	kʲukʲʌkʲukʲʌ	sosasosa
짜초짜초	쩌추쩌추	소새소새	수네수네
tɕʲatɕʰotɕʲatɕʰo	tɕʲʌtɕʰutɕʲʌtɕʰu	sosɛsosɛ	sunesune
추커추커	새소새소	서세서세	초자초자
tɕʰukʰʌtɕʰukʰʌ	sɛsosɛso	sʌsesʌse	tɕʰotɕatɕʰotɕa
사새사새	세서세서	쪼빠쪼빠	뚜뻐뚜뻐
sasɛsasɛ	sesʌsesʌ	tɕʲopatɕʲopa	tʲupʲʌtʲupʲʌ
머부머부	빠쪼빠쪼	뻐쭈뻐쭈	새사새사
mʌpumʌpu	patɕʲopatɕʲo	pʌtɕʲupʲʌtɕʲu	sɛsasɛsa
꼬파꼬파	퍼투퍼투	매로매로	무버무버
kʲopʰakʲopʰa	pʰʌtʰupʰʌtʰu	mɛromɛro	mupʌmupʌ
푸터푸터	로매로매	버무버무	까포까포
pʰutʰʌpʰutʰʌ	ɾomɛromɛ	pʌmupʌmu	kʲapʰokʲapʰo
내모내모	네주네주	하토하토	허쭈허쭈
nɛmonæmo	nedʒunedʒu	hatʰohatʰo	hʌtɕʲuhʌtɕʲu
포파포파	퍼푸퍼푸	마보마보	거메거메
pʰopʰapʰopʰa	pʰʌpʰupʰʌpʰu	mabomabo	kʌmekʌme
푸퍼푸퍼	매보매보	루너루너	파포파포
pʰupʰʌpʰupʰʌ	mɛpomɛpo	ɾunʌɾunʌ	pʰapʰopʰapʰo

Appendix D: Events appearing in Experiments 2 and 3

Table i shows the training & control events in the order they were shown to participants. For each event, the table includes the animal actor, the action shown on the left side of the screen, and the action shown on the right side of the screen. Target actions are highlighted in a light green to show counterbalancing of sides on which the correct target item was placed. All videos for Experiments 2 and 3 can be found online at https://tinyurl.com/fullclips.

Table i: Training & Control Trials

	Animal	**Action shown on left side**	**Action on shown on right side**
Training 1	Dog	Painting	Eating cake
Training 2	Cow	Pushing toy truck	Sleeping
Training 3	Duck	Sitting on a chair	Sitting on the floor
Control 1	Frog	Painting	Pushing toy truck
Control 2	Pig	Eating	Dancing at a party
Control 3	Pig	Playing a trumpet	Playing a guitar

Table ii shows the corresponding questions asked for each of the events in Table i. English and Korean versions are included.

Table ii: Training & Control Questions

	Question- English	**Question- Korean**
Training 1	Where is the dog painting?	그림을 그리고 있는 강아지가 어디 있어요?
Training 2	Where is the cow sleeping?	자고 있는 소가 어디 있어요?
Training 3	Where is the duck sitting on a chair?	의자에서 앉아 있는 오리가 어디 있어요?
Control 1	Where is the frog playing?	놀고 있는 개구리가 어디 있어요?
Control 2	Where is the pig eating?	밥을 먹고 있는 돼지가 어디 있어요?
Control 3	Where is the pig playing a guitar?	기타를 치고 있는 돼지가 어디 있어요?

Below, table iii shows information for the test trial events, in the order they were shown to participants. The information for each trial includes the animal performing the actions, the English verb, the Korean verb (with objects in parentheses if required), as well as how the difference in manner of motion was shown on each side. Differences in speed are noted by left and right sides labeled "slower" and "faster," while differences in range of motion are labeled "bigger" and "smaller." Events that differed by both speed and range of motion are labeled by "slower/smaller" and "faster/bigger." Though some events do not have target sides when paired with C_SV_L or C_WV_D mixed ideophones, events with target sides were counterbalanced.

Table iii: Test trials

	Animal	**English Verb**	**Korean Verb**	**Left Side**	**Right Side**
Test 1	Frog	Walk	걷다	Slower	Faster
Test 2	Pig	Kick	(발로) 차다	Bigger	Smaller
Test 3	Duck	Wave	(손을) 흔들다	Slower/ Smaller	Faster/ Bigger
Test 4	Frog	Run	달리다	Faster	Slower
Test 5	Dog	Bend	(허리를) 굽히다	Smaller	Bigger
Test 6	Cow	Knock	두드리다	Slower/ Smaller	Faster/ Bigger
Test 7	Duck	Shake	(몸을) 떨다	Faster	Slower
Test 8	Dog	Clap	(박수를) 치다	Smaller	Bigger
Test 9	Cow	Dance	(춤을) 추다	Faster/ Bigger	Slower/ Smaller
Test 10	Duck	Jump	뛰다	Bigger	Smaller
Test 11	Cow	Twist	(몸을) 비틀다	Slower/ Smaller	Faster/ Bigger

Table iv: List 1 Questions

	Question- English	Question- Korean	Target Side
Test 1	Where is the frog walking sasosaso?	사소사소 걷고 있는 개구리가 어디 있어요?	Left
Test 2	Where is the pig kicking susʌsusʌ?	발로 수서수서 차고 있는 돼지가 어디 있어요?	None
Test 3	Where is the duck waving tɕ̈atɕʰotɕ̈atɕʰo?	손을 짜초짜초 흔들고 있는 오리가 어디 있어요?	None
Test 4	Where is the frog running tɕʰukʰʌtɕʰukʰʌ?	추커추커 달리고 있는 개구리가 어디 있어요?	Left
Test 5	Where is the dog bending sasɛsasɛ?	사새사새 허리를 굽히고 있는 강아지가 어디 있어요?	Left
Test 6	Where is the cow knocking mʌpumʌpu?	머부머부 두드리고 있는 소가 어디 있어요?	None
Test 7	Where is the duck shaking k̈opʰak̈opʰa?	꼬파꼬파 몸을 떨고 있는 오리가 어디 있어요?	None
Test 8	Where is the dog clapping pʰutʰʌpʰutʰʌ?	푸터푸터 박수를 치고 있는 강아지가 어디 있어요?	Right
Test 9	Where is the cow dancing nɛmonæmo?	내모내모 춤을 추고 있는 소가 어디 있어요?	Right
Test 10	Where is the duck jumping pʰopʰapʰopʰa?	포파포파 뛰고 있는 오리가 어디 있어요?	None
Test 11	Where is the cow twisting pʰupʰʌpʰupʰʌ?	푸퍼푸퍼 몸을 비틀고 있는 소가 어디 있어요?	Right

Table v: List 2 Questions

	Question- English	**Question- Korean**	**Target Side**
Test 1	Where is the frog walking sʌsusʌsu?	서수서수 걷고 있는 개구리가 어디 있어요?	None
Test 2	Where is the pig kicking pokʰapokʰa**?**	발로 뽀카뽀카 차고 있는 돼지가 어디 있어요?	None
Test 3	Where is the duck waving tɕ̈ʌtɕʰu tɕ̈ʌtɕʰu**?**	쩌추쩌추 손을 흔들고 있는 오리가 어디 있어요?	Right
Test 4	Where is the frog running sɛsosɛso**?**	새소새소 달리고 있는 개구리가 어디 있어요?	Right
Test 5	Where is the dog bending sesʌsesʌ**?**	세서세서 허리를 굽히고 있는 강아지가 어디 있어요?	None
Test 6	Where is the cow knocking paẗɕopaẗɕo**?**	빠쪼빠쪼 두드리고 있는 소가 어디 있어요?	None
Test 7	Where is the duck shaking pʰʌtʰupʰʌtʰu**?**	퍼투퍼투 몸을 떨고 있는 오리가 어디 있어요?	Left
Test 8	Where is the dog clapping ɾomɛɾomɛ**?**	로매로매 박수를 치고 있는 강아지가 어디 있어요?	Left
Test 9	Where is the cow dancing nedʒunedʒu**?**	네주네주 춤을 추고 있는 소가 어디 있어요?	None
Test 10	Where is the duck jumping pʰʌpʰupʰʌpʰu**?**	퍼푸퍼푸 뛰고 있는 오리가 어디 있어요?	Left
Test 11	Where is the cow twisting mɛpomɛpo**?**	매보매보 몸을 비틀고 있는 소가 어디 있어요?	Left

Table vi: List 3 Questions

	Question- English	**Question- Korean**	**Target Side**
Test 1	Where is the frog walking kʰaḵokʰaḵo?	카꼬카꼬 걷고 있는 개구리가 어디 있어요?	None
Test 2	Where is the pig kicking ḵuḵʌḵuḵʌ**?**	발로 꾸꺼꾸꺼 차고 있는 돼지가 어디 있어요?	Left
Test 3	Where is the duck waving sosɛsosɛ**?**	소새소새 손을 흔들고 있는 오리가 어디 있어요?	Left
Test 4	Where is the frog running sʌsesʌse**?**	서세서세 달리고 있는 개구리가 어디 있어요?	None
Test 5	Where is the dog bending tɕ̬opatɕ̬opa**?**	쪼빠쪼빠 허리를 굽히고 있는 강아지가 어디 있어요?	None
Test 6	Where is the cow knocking p̬ʌtɕ̬up̬ʌtɕ̬u**?**	뻐쭈뻐쭈 두드리고 있는 소가 어디 있어요?	Right
Test 7	Where is the duck shaking mɛɾomɛɾo**?**	매로매로 몸을 떨고 있는 오리가 어디 있어요?	Right
Test 8	Where is the dog clapping pʌmupʌmu**?**	버무버무 박수를 치고 있는 강아지가 어디 있어요?	None
Test 9	Where is the cow dancing hatʰohatʰo**?**	하토하토 춤을 추고 있는 소가 어디 있어요?	None
Test 10	Where is the duck jumping mabomabo**?**	마보마보 뛰고 있는 오리가 어디 있어요?	Right
Test 11	Where is the cow twisting ɾunʌɾunʌ**?**	루너루너 몸을 비틀고 있는 소가 어디 있어요?	None

Table vii: List 4 Questions

	Question- English	**Question- Korean**	**Target Side**
Test 1	Where is the frog walking tɕʰʌk̟utɕʰʌk̟u?	처꾸처꾸 걷고 있는 개구리가 어디 있어요?	Right
Test 2	Where is the pig kicking sosasosa**?**	발로 소사소사 차고 있는 돼지가 어디 있어요?	Right
Test 3	Where is the duck waving sunesune**?**	수네수네 손을 흔들고 있는 오리가 어디 있어요?	None
Test 4	Where is the frog running **t** tɕʰotɕatɕʰotɕa**?**	초자초자 달리고 있는 개구리가 어디 있어요?	None
Test 5	Where is the dog bending t̟upʌt̟upʌ**?**	뚜뻐뚜뻐 허리를 굽히고 있는 강아지가 어디 있어요?	Right
Test 6	Where is the cow knocking sɛsasɛsa**?**	새사새사 두드리고 있는 소가 어디 있어요?	Right
Test 7	Where is the duck shaking mupʌmupʌ**?**	무버무버 몸을 떨고 있는 오리가 어디 있어요?	None
Test 8	Where is the dog clapping k̟apʰok̟apʰo**?**	까포까포 박수를 치고 있는 강아지가 어디 있어요?	None
Test 9	Where is the cow dancing hʌt̟ɕuhʌt̟ɕu**?**	허쭈허쭈 춤을 추고 있는 소가 어디 있어요?	Left
Test 10	Where is the duck jumping kʌmekʌme**?**	거메거메 뛰고 있는 오리가 어디 있어요?	None
Test 11	Where is the cow twisting pʰapʰopʰapʰo**?**	파포파포 몸을 비틀고 있는 소가 어디 있어요?	None