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Honors Thesis: Sound Symbolism and Size Perception

I. Introduction

Sound symbolism is an association found in languages across cultures that specific phonemes suggest certain perceptual meanings (Sidhu, 2018). Small object for example, are often paired to words with front vowels, while large object are labeled with words consisting of back vowels as shown in past studies (Sapir, 1929; Ramachandran and Hubbard, 2001). Dimension of meanings that sound symbolism can convey involves size, heaviness, roundness, and height (Sapir, 1929; Walker and Parameswaran, 2018; Köhler, 1929; Ramachandran and Hubbard, 2001; Sweeney et al., 2012). Suggesting the evidence of iconic word structure, sound symbolism is often referred to in the debate of whether the origin of language leans towards arbitrariness or iconicity (Cuskley, 2013). In the past decades, attitude in cognitive science on sound symbolism has therefore shifted from being dismissing to intensively exploring it as an important piece of puzzle to language evolution. Nonetheless, it is noteworthy that aspects of sound symbolism other than evolution and development are equally important. For instance, the mechanism behind provides new insight to neuronal mappings of sensory motor inputs and phonetic representation (Ramachandran and Hubbard, 2001), while mental imagery is shown to be interfered by sound symbolism (Maglio et al., 2014).

The two most well-known sound symbolism effects were both demonstrated by the correlation between object appearance and choice of name (Sidhu, 2018). The first one is the mil/mal effect. The research shows that when participants are asked to pair shapes with

nonwords, most would associate larger shape with low/back vowels such as in mal, and smaller shape with high/front vowels as in mil (Newman, 1933; Sapir, 1929). On the other hand, the maluma/takete effect, also called the bouba/kiki effect, demonstrates that when people are asked to name shapes differing in roundness and sharpness, most would assign certain phonemes according to the sharpness/roundness of the shape. (Köhler, 1929; Ramachandran and Hubbard, 2001). These studies provide rich information and evidence shape appearance can modify choices for names. But few studies have looked into the reverse direction as for whether word labels can also influence perception and memory of shape.

Bidirectionality is a feature of cross modal correspondence (Simner, 2013). Directionality of sound symbolism is thus an interesting question to explore. Whether the result shows uni- or bidirectional effect, it will contribute greatly to the current theoretical basis and mechanism of sound symbolism. Cross modality studies done by Sweeney et al. (2012) show visual-auditory correspondences by playing speech sounds like “wee” and “woo” result in participants recognizing ovals with either shorter or taller height. While the author argues that mouth shapes correlate with sounds and that sounds can affect memory of height (Sweeney et al., 2012), this experiment provides no solid evidence that sound symbolism is a part of cross modality — especially since the sounds in the experiment are presented as pre-task irrelevant interference instead of word labels associated/assigned with the object. If sound symbolism is indeed a demonstration of cross modal correspondence, more understandings about sound symbolism can be gained from similar studies done on cross modality as the above. Therefore, one of the goals of our research intends to look into whether sound symbolism features bidirectional effect between perception and names.

One experiment that demonstrate the possible reversal effect from labels to perception shows that size of an imaginary shape was shown to be affected by English accent, in which

the more fronted /u/ pronunciation of nonwords leads to people to imagining a smaller shape (Shibata, 2018). Nonetheless, it is unknown as to whether the effect also takes place in real object perception.

From a broader point of view, past research has shown evidence that language in general affects cognition in terms of categorizing sensory information and organizing mental images. For example, color terms can set boundaries for the continuous color spectrum and affect a person's ability to discriminate between shades of color (Winawer et al., 2007; Goldstein et al., 2009). Additionally, labeling object with their simple, generic names decreases memory performance; participants in Lupyan's (2008) studies more often fail to recognize basic level labeled furniture than those that are not. These studies show that the meaning behind language, more specifically, the meanings of terms and the use of them across language can result in perceptual differences. Additionally, Maglio (2014) proposed that front vowels evoke low-level construal contrary to that back vowels induce high-level construal. In his studies, participants are prone to divide a city into more sections in fine details when given a city name consisting of front vowels as opposed to back vowels. This research, similar to the cases of mil/mal, bouba/kiki effect, shows sound symbolism's impact on categorical process (Newman, 1933; Sapir, 1929; Köhler, 1929; Ramachandran and Hubbard, 2001). Although one step closer than research previously listed above in revealing cognitive influence specifically from the word labeling aspect of language, it is crucial to note that language is not confined to defining the boundaries of categories.

Through our experiment, we would like to look into whether phonemic sensory property of a label itself, rather than the concept that it holds, can impact perception and memory. We aim to focus on the correlation between name label and size perception due to extensive

research done on the effect of size influencing name choices in the past (Newman, 1933; Sapir, 1929; Köhler, 1929; Ramachandran and Hubbard, 2001).

II. Method

Experiment 1.

Participants:

64 English monolingual participants were gathered through UCSD's SONA system. Students with documented reading disabilities that impact their performance in reading or memorizing words were excluded. Only students with normal or corrected to normal vision were allowed to participate. Students received course credits for their participation. 1 participant was excluded due to technical error.

Materials and Procedure:

A web page created in Javascript was used as the investigative tool. The page would display images and names within a controlled time limit as described below. There were 6 shapes used in total as stimuli (fig 1). Each shape were assigned two name labels, one being a large size label and the other a small size label, to be shown in two separate trials. A total of 24 trials were presented in random order. In each trial, participants would first be shown a shape along with its label. They would then be asked to memorize both the label and the shape in a 5 second time span. The shape and the label would then disappear from the screen simultaneously for another 5-second time span to prevent participants from using visual after image rather than memory. After the resting period ends, participants were asked to replicate the name and choose from two options of shape varying in size. Half the trials of both circles and squares were followed with larger than original versus smaller than original shape size. Participants were asked to pick one shape from this forced choice task that they think is the

one that appeared in the memory stage of trial. If participants could not correctly replicate the name of the shown shape, the specific trial would be excluded from data analysis.

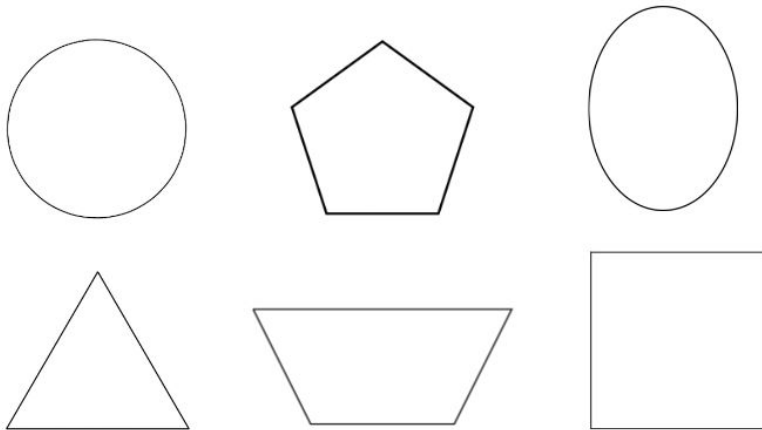


fig 1. Shape stimuli in experiment 1.

Experiment 2.

Participants:

64 English monolingual participants were gathered through UCSD's SONA system. Experiment 2 is a between participant design study, with 32 participants assigned to two groups. Students with documented reading disabilities that impact their performance in reading or memorizing words will be excluded. Only students with normal or corrected to normal vision were allowed to participate. Students receive course credits for their participation.

Material:

Experiment aims to test whether result would be similar when long term memory is employed instead of short term memory as in experiment 1. Shapes without conventionalized names from the database of font FE203 glyphs are assigned as stimuli to maintain a tighter control of confounds (fig 2), removing possibility of masking effect that could potentially arise from the original name of conventionalized-naming shapes (e.g. the name "circle" for

circle.) Some principles are followed while creating the label and shape stimuli. For the shapes, all of them has contour, filling area, and patterns as distinct to each other as possible. line-like, splatter dot like shapes are also removed as they could be viewed by participants as multiple shapes instead of one complete stimuli. A total of eight shapes are chosen as shape stimuli.

As for the names, all possible three letter nonword are generated for vowel /a/ and /i/, with the first and last letter being consonant and the second being vowel. The names were then filtered and picked according to the following three criteria: (1) They have no lexical neighbor related to size. For example, none should sound similar to “big” or “small.” (2) They have equal distance to each other in terms of orthography. (3) There is no significant difference in numbers of lexical neighbors between nonwords with /i/ and /a/. Experiment 2 is a between participant study, while order 1 group and order 2 utilizes the same set of shapes, the implied size label vowels assignment were the opposite to each other for each shape (e.g. /a/ for group 1, /i/ for group 2, both referring to the same shape.) Consonants would be assigned into pairs of templates, randomly assigning to the 8 shapes.



fig. 2 a total of 8 FE203 glyphs fonts are used as stimuli in experiment 2.

Procedure:

Participants were located behind a computer screen for the experiment. The experiment is a one-hour study containing three sessions — training session, memory session, and testing block— followed by a questionnaire. During the training session, participants would see a pairing of shape and be asked to memorize them. Instantly afterwards, they would type in the name of the shape prompted by a blank text box. If they answer incorrectly, participants will receive an alert message asking them to type again alongside with the correct name. Each shape pairing is one trial. There are eight trials in a round. Participants would go through three rounds of training, with the trial order randomized within each round.

During the memory session, participants would again be asked to type in the name for each shape. However, if they enter in an incorrect name, the trials would be reset after the round, and they will have to go through the whole eight trials again. Participants would not be able to proceed onto the next session until they memorize all the pairings successfully. As for the testing block, participants would be asked to choose from two shape size choices, one larger and the other smaller, to indicate which size they think they memorized for each shape. The large and small choices takes turn to be on the left and right side, appearing twice for each side to check for consistency of participants' answer.

III. Potential Result Discussion

Result:

In experiment 1, there was a small but significant effect between vowel and size choice preference (fig 3). A set of generalized mix effect logistical regression models were used to analyze the data. Both models included the analysis of random effect subject and picture,

fixed effect of vowel, and where the larger shape choice was located. Additionally, for the second model, an analysis for interaction between the vowel and the left or right location of the larger shape choice was also included. Both models showed significant effect, while the latter one explained the data significantly better.

In experiment 2, there is no significant effect between vowel and size choice preference (fig 4). When participants in group order 1 and order 2 were analyzed separately, there was a significant effect in order 2 (fig 5). For order 1, there was an opposite of an effect showing, with vowel /a/ associated with more choices for the smaller shape. Nonetheless, since the way that the large label vowel and small label vowel was assigned in opposite order between group, the /a/ labeled shapes in group order 1 should be analyzed with /i/ labeled shapes in group order 2 (and the same goes with /i/ in group 1 and /a/ in group /2/), as they referred to the same sets of shapes. In this case, there was no significant effect when comparing the group results. Lastly, there were some cases of interactions for individual shape stimuli to the overall tendency of large or small choice (fig 6).

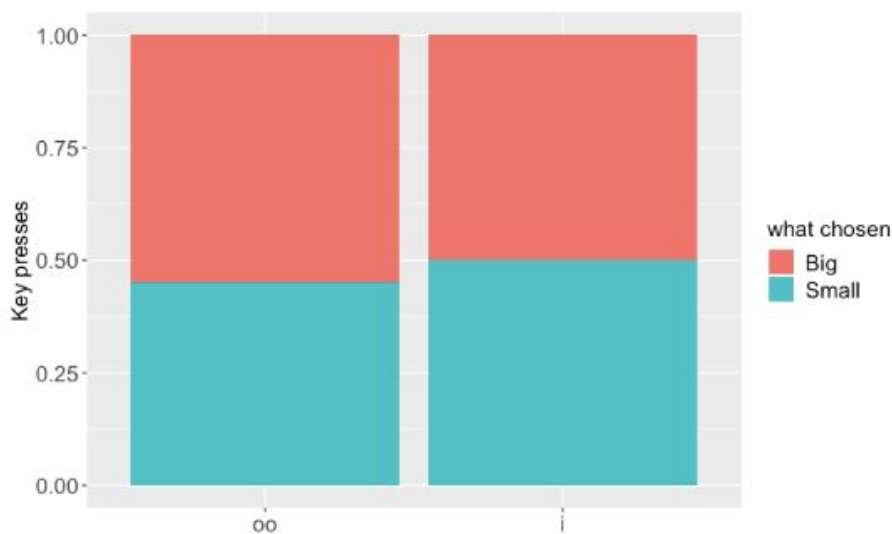


fig 3. experiment 1 result. The x-axis indicates the vowel paired to shape in nonword; the y-axis shows the percentage of choices for all participants. The filling shows which size choice is chosen by participants. Significant effect between sound symbolism and size perception and memory is found in experiment 1.

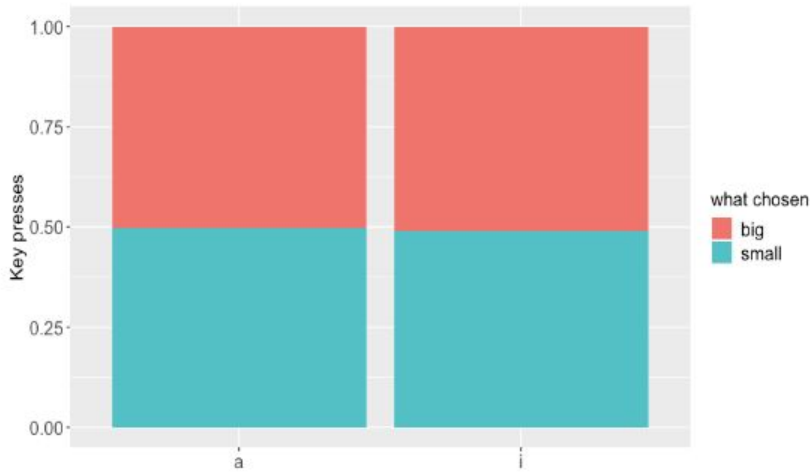


fig 4. experiment 2 result. The x-axis indicates the vowel paired to shape in nonword; the y-axis shows the percentage of choices for all participants. The filling shows which size choice is chosen by participants. No significant effect between sound symbolism and size perception and memory is found in experiment 2.

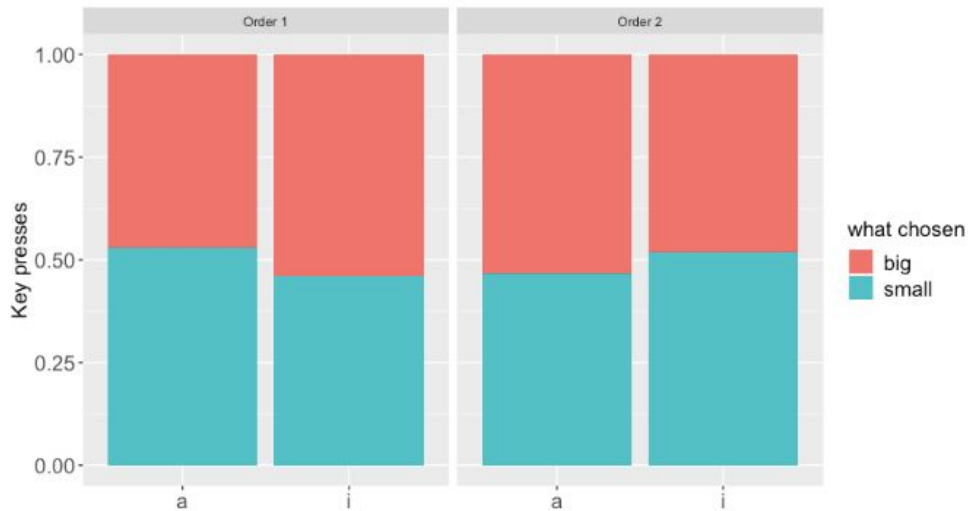


fig 5. experiment 2 separated analysis for order list 1 and 2. The x-axis indicates the vowel paired to shape in nonword; the y-axis shows the percentage of choices for all participants. The filling shows which size choice is chosen by participants. No significant effect between sound symbolism and size perception and memory is found when analyzed separately.

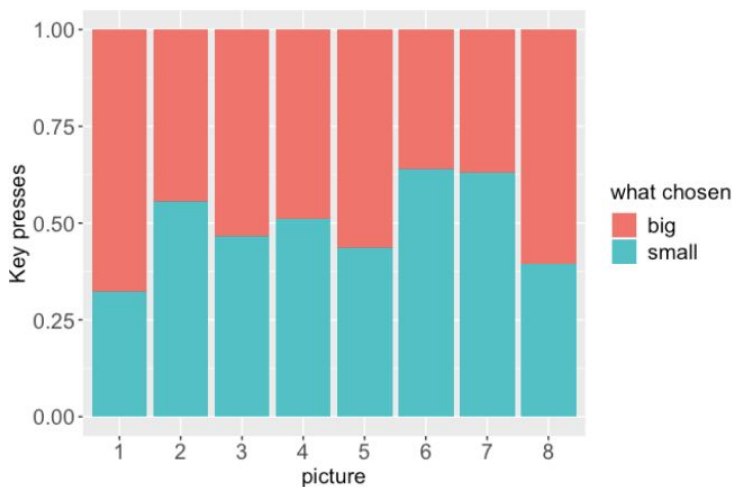


fig 6. Individual analysis of size choice preference from picture 1 to 8. The x-axis indicates each picture of shape; the y-axis shows the percentage of choices for all participants. The filling shows which size choice is chosen by participants. Patterns of preference are shown in individual shapes.

Significance of the findings:

This research is important for both theoretical discussion of sound symbolism and its application in real life. Whether the results end up supporting null or alternative hypothesis, both would add to the theoretical understanding of sound symbolism. It has been suggested that cross modal correspondence is a bidirectional process across modalities (Simner, 2013). If this experiment shows evidence of no significant difference in size choices between the two name label groups, the question of whether sound symbolism is a form of cross modality should be discussed. In contrast, if the result demonstrates association between size name labels and choices of shape size, this study adds to the currently lacking evidence that sound symbolism is a bidirectional effect.

In addition, the results will lead questions to the Baddeley's model of working memory currently in use. The model holds that working memory is composed of two systems: phonological loop and visual-spatial sketchpad (Baddeley and Hitch, 1974). Both visual and verbal system works individually. Thus, when people perform tasks that require separate modalities simultaneously, they would demonstrate similarly efficient performance as when they carry out the tasks separately (Baddeley et al., 1975). It is only when tasks compete using the same system will memory performance be decreased. If sound symbolism affects choices of shape size, result as such suggests that verbal information in fact can interfere with visual input during the memory encoding process.

Discussion

Significant effect of sound symbolism to shape size perception was present in experiment 1, while no significant effect is found in experiment 2. The main difference between the two experiments was the type of memory employed to perform the task. For experiment 1, since choice of label size was prompted within 5 seconds after exposure, short term memory was utilized in this case. As for experiment 2, all shape and name pairings were stored into long term memory before going into the size choice testing block. In terms of short term memory, the effect present in experiment 1 was comparable to the result in Sweeny's cross modality study on sound and shape perception. However, since most existing memory studies of cross modal correspondence was on short term memory, it was impossible to draw a valid comparison between the effect of sound symbolism to cross modal correspondence on size perception and memory.

It should be mentioned that one study (Hubbard 1993) did test on using long term memory of cross modal correspondence to prompt imagination of intensity of stimuli from different sensory domains. While the result was still incompatible due to its focus on solely the imagination domain, this study inspired some idea for future direction of studies of using name to first trigger participants to recollect shape in mind before making decision. Additionally, it was noteworthy that the significant effect seen in experiment 1 countered the argument of Baddeley's working memory model that visual and verbal modality operates separately and that doing two tasks from each of these two modalities would not interfere and decrease performance (Baddeley 1974). As shown here, memory from the phonological loop appeared to interact with and affect participants' visual sketchpad memory of the shape size.

Future direction:

Replicate the experiment to see whether the effect is robust would be a good start before proceeding onto further modification and extension of experiment design. If it turns out that the effect from experiment 1 and 2 are both robust, then such as the difference in the employed large label vowel, there are some differences between the designs of experiment 1 and 2 that could be unified in order to eliminate potential noises that could mask the effect. Next, an interesting question that could be asked would be: when provided with a slider bar that could increase/decrease shape size to recreate shape from recalling memory, will the effect persist? Or are relative choices and recognition indispensable factors for the effect? This is one potential direction to look into in the future. Additionally, it would be informative to test whether an effect would emerge if participants are prompted to recall shapes first in mind before seeing choices. Although in the current design of the experiment, participants are tested and made sure that they encoded name and shape pairs together, it is unknown as to whether they recall the pairings from verbal and visual memory together and if different ways of memory retrieval would make a difference. Thus, modification of the testing block could be implied in future studies to test on this aspect of memory effect. Lastly, it would also be interesting to test on the sharpness vs roundness dimension of shape features with similar tasks to see whether label to perception effect would also be evident.

Limitations:

One limitation of this experiment is that it only provides data from monolingual English participants. We therefore cannot make conclusion as to whether the result is an English only effect or likely a universal phenomenon. From another aspect, result of this research can suggest future studies on bilingual, multilingual, or other native language speakers. The other limitation lies within the forced-choice task design of the experiment. In

this research, we are limited from testing participants with recognition tests. We are thus unable to conclude whether recalling, which is also likely to occur in real life situation, will result in the same result as recognition. At the same time, we would be unable to know to what extent of a size alteration can take place if sound symbolism indeed show an impact. Similarly to the case of monolingual speakers, depending on the outcome, future research can be designed to test whether participants show effect—and to what degree of the impact—when asked to replicate shapes on their own.

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