



Teaching phonetics through sound symbolism

Shigeto Kawahara

Keio University, Japan
kawahara@icl.keio.ac.jp

Abstract

Teaching introductory phonetics classes can be challenging for several reasons. One reason is that students are introduced with many new concepts such as place of articulation, manner of articulation, and the obstruent/sonorant distinction. Remembering these classification terms can be overwhelming and/or boring. Another challenge is that while many students taking phonetics classes are humanity major students who often do not like mathematics, understanding phonetics does require basic background in mathematics and physics. In this paper, I summarize my pedagogical attempt to lower the psychological boundary of students against learning these concepts by making use of sound symbolism in introductory phonetics class [1]. Analyses of sound symbolic patterns can be presented using materials that students are familiar with (e.g. Disney characters and Pokémon monsters), so that the students feel that classification terms that phoneticians use are “real”. Furthermore, since some sound symbolic patterns are demonstrably grounded in the articulatory and acoustic natures of particular sounds, we are able to teach some important articulatory and acoustic principles. Finally, statistical analyses of the Pokémon dataset, which emerged from this teaching strategy, help us illustrate some important statistical skills.

Keywords: pedagogy, sound symbolism, sonorants, voiced obstruents, labiality, Pokémon(istics), statistics

1. Introduction

Teaching introductory phonetics classes can be challenging, and as far as I can see, there are several reasons for this:

- There are many concepts and classification terms (*a.k.a.* natural classes) that have to be taught in introductory classes (e.g. place of articulation, sonorants, voiced obstruents). Students may feel overwhelmed, thinking that

they have to remember all of these terms and classifications.

- Understanding phonetics requires familiarity with basic physics and mathematics (e.g. aerodynamics and Fourier transformation, the latter of which requires understanding of trigonometry).
- Understanding phonetic experiments requires familiarity with statistics.

In this paper I outline my teaching strategy to overcome—or at least lessen—this challenge by making use of sound symbolism in introductory phonetics class (see [1] for an introductory phonetics book written in this spirit, though it is in Japanese). We can analyze sound symbolic patterns using materials that are “fun,” or at least those that the students are very familiar with (like Disney characters and Pokémon monsters). Therefore, using sound symbolism has a distinct virtue of convincing students that phonetic concepts that we deploy in phonetic research are something “real”. Moreover, since sound symbolic patterns are demonstrably grounded in some articulatory and acoustics principles, we can teach many important concepts in phonetics, which we would have to cover in “regular” phonetics classes anyway. Finally, statistical analyses of the Pokémon dataset, which emerged from this teaching strategy, help us illustrate some important statistical skills.

While I do not have quantitative evidence that teaching phonetics through sound symbolism is efficient (or more efficient than the “regular” methodology), my personal impression is that students generally enjoy learning phonetics through sound symbolism. At the very least, it helps attract students’ interests. The evidence comes from the fact that a number of students have taken up their own projects on sound symbolism building on my lectures and/or my book [1], many of which are discussed in this paper.

2. An overview

To give an idea of what can be taught through sound symbolism, given below in (1) are a list of sound symbolic patterns that I use in class. Natural classes which can be taught with these examples are bolded.

(1) Examples of sound symbolic patterns, and natural classes that can be taught with them

a. **Front vowels** are more often used for crackers' names than **back vowels**; **back vowels** are more common than **front vowels** for ice cream names ([2], see also [3]).

b. Female names with stressed **back vowels** tend to be judged to be more attractive than those with **front vowels**; male names with stressed **front vowels** tend to be judged to be more attractive than those with **back vowels** [4].

c. **Low vowels** tend to be judged to be larger than **high vowels** (e.g. [5]). **Back vowels** tend to be judged to be larger than **front vowels** (e.g. [6]).

d. **Sonorants** tend to be associated with images such as roundness, accessibility and femaleness; **obstruents** are often associated with angularity, inaccessibility and maleness ([7] *et seq.*).

e. **Voiced obstruents** are associated with images of largeness, heaviness and strength [8, 9].

f. **Labial consonants** are associated with images of babies and innocence [10].

I expand on some of these examples in further detail below.

3. Case study I: The sonorant/obstruent distinction

One phonetic classification for which I find sound symbolism to be helpful is the sonorant/obstruent distinction. While this distinction can be taught based on some phonetic principles (e.g. sonorants are those that do not involve substantial rise in intraoral air pressure to the extent that spontaneous voicing is possible [11]), students have to face the disjunctive definitions; i.e. sonorants include nasals, liquids and glides, whereas obstruents include stops, affricates and fricatives. When I was an undergraduate student, I did not enjoy having to remember these disjunctive definitions. Nor did I enjoy taking a midterm with a

question like, “which of the following is not an obstruent?”

Sound symbolism offers one solution to this problem. Köhler's classic study [7] and its subsequent research (e.g. [12]) show that names with sonorants (e.g. *maluma*) are often associated with round shapes, while names with obstruents (e.g. *takete*) are associated with angular shapes (Figure 1).



Figure 1: A pair of a round object and an angular object. Based on [12], itself inspired by [7]. The former tends to be associated with names with sonorants (e.g. *maluma*), whereas the latter tends to be associated with names with obstruents (e.g. *takete*).

Some students already find these associations interesting, but what often attracts their interests more is Perfors's study [4]. In her study, she put the pictures of her friends on hotornot.com with different names, and explored whether attractiveness rating changes depending on the names. The results show tendencies in such a way that female names with sonorants are judged to be more attractive, while male names with obstruents are judged to be more attractive. After I introduce this result in class, I encourage students to figure out how attractive their first names are, while making sure that they should not take the results too seriously.¹ This is a good practice for students to familiarize themselves with the sonorant/obstruent distinction.²

Perfors's experiment is attractiveness rating using English names. It has been shown for Japanese names too that boys' names are more likely to contain obstruents, whereas girls' names are more likely to contain sonorants [13]. I also discuss a follow-up study on Japanese maid names, which built on this observation about the distribution of obstruents and sonorants in Japanese names. The initial hypothesis was that, assuming that Japanese maids were trying to underscore their femaleness with their names, the maid names would contain sonorants more frequently than “non-maid” names. The actual analysis of a major maid café's member names shows that this hypothesis was wrong; maid names were no more likely to contain sonorants than non-maid names. It turned out, however, that the initial assumption—Japanese maids try to highlight their femaleness with their names—was wrong. After some fieldwork at a maid café, [13] reached a revised hypothesis: there are, broadly speaking, two types of maids, (1) “moe” type which approximately

means “cute,” “friendly” and “accessible”, and (2) “tsun” type, which means “cool,” “unfriendly” and “inaccessible” (Figure 2).



Figure 2: A “tsun” maid vs. a “moe” maid. Names with obstruents (e.g. *sataka*) tend to be associated with the former type; names with sonorants (e.g. *wamana*) tend to be associated with the latter type. The pictures are adapted from [1].

A judgment task with 10 working maids shows that names with sonorants (e.g. *wamana*) are indeed associated with moe maids and those with obstruents (e.g. *sataka*) tend to be associated with tsun maids. Usually, students enjoy a phonetic analysis of maid names.

Hironori Katsuda, currently a graduate student at UCLA, attended this lecture, and explored the sound symbolic effects of the sonorant/obstruent distinction in two new domains. First, he analyzed Takarazuka actresses’ names. In Takarazuka, all the actresses are female, but some play a male role, while others play a female role during their shows. It was therefore expected that Takarazuka players may try to convey their “Takarazuka-gender” through their names. As predicted, Katsuda’s analysis found that as shown in Figure 3, the more sonorants are contained in their name, the more likely that these names are used for female roles [14]. This result is a clear case in which the sound symbolic relationship between sonorants and females is playing a crucial role in naming.

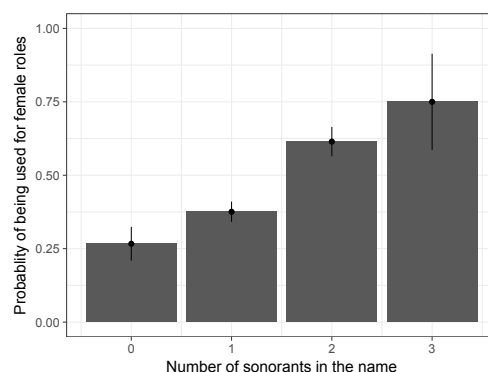


Figure 3: The correlation between the numbers of sonorants in the name and the probability of the names used for female roles in Takarazuka actresses’ names. Based on [14].

Second, Katsuda made an interesting observation that in AKB idol names, some syllables are reduplicated, and when reduplication occurs, the onset consonants are very often sonorants (e.g. [majuju] and [miruru]), and they are rarely obstruents. Katada conducted a thorough corpus research based on the wikipedia website specifically devoted to these idol groups (<https://48pedia.org/>), and found that in total, there were 900 sonorants in the corpus of AKB idol names, and 45 of them were targeted by reduplication (5%). On the other hand, only 7 out of 643 obstruents (1%) were targeted by reduplication. This difference is statistically significant, and shows that Japanese AKB idols are actively choosing to increase the number of sonorants in their nicknames [14].

Once students understand that the distinction between sonorants and obstruents is important when we analyze these naming patterns, I show them some waveforms of typical obstruents and sonorants. Obstruents’ aperiodic energy looks spikey, whereas sonorants’ waveforms look “round-ish,” as they involve periodic energy (Figure 4).

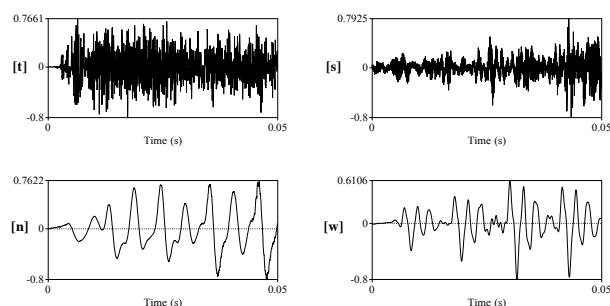


Figure 4: Waveforms of [t], [s] (top), [n], and [w] (bottom). The obstruents look spikey, whereas the sonorants look roundish [2, 12]. Adapted from [1].

While noting that a causality relationship is very hard to establish, one can entertain the possibility that this difference in acoustic representation may be a source of the sound symbolic effects reviewed in

this section [2, 12]. In this way, students can learn the acoustic differences between sonorants and obstruents.

4. Case study II: Voiced obstruents

The sound symbolic values of voiced obstruents are very intuitively clear to Japanese students, and there are indeed many examples that can illustrate them. Voiced obstruents, known as *dakuon* “muddy sounds” in the Japanese literature, are generally associated with images of largeness, heaviness, and darkness, among others.

One case study that I use in class is the comparison between human names and monster names in the “Urutoraman” TV series [15]. In common human names, voiced obstruents rarely appear (4%-6%), whereas in monsters names, voiced obstruents appear much more frequently: the exact percentages of names containing voiced obstruents vary across different series, but they range from 50% to 80%, which is very different from the distribution of voiced obstruents in human names. It is probably safe to conclude that the designers of this TV series are actively using voiced obstruents to express “monster-ness”.

Undergraduate students at the Tokyo University of Agriculture and Technology built on this observation and analyzed whether the distributions of voiced obstruents differ between villains’ names and non-villains’ names in English Disney character names [16]. They found that 44% of obstruents are voiced in villains’ names, whereas 36% of them are voiced in non-villain’s names, and that this difference is statistically significant. This study shows that the association between voiced obstruents and “evil-ness” holds in English, although its effect may be less robust than in Japanese.

Another sound symbolic pattern that is tested by [16] is the distribution of bilabials in Disney characters’ names. A previous study [10] shows that many diaper names in Japanese contain either [p] or [m], or both (e.g. *mamiipoko*); further, an elicitation study shows that Japanese speakers use bilabial consonants more often when they are asked to come up with new diaper names than when they come up with adult cosmetic names. They attribute this result to the observation that bilabial consonants often appear in babbling (e.g. [17]), and hence they are associated with images of babies and/or innocence. [16] tested whether bilabial consonants are avoided in villains’ names because of this sound symbolic principle, and they found that this is indeed the case: bilabial consonants appear more frequently in non-villains’ names than in villains’ names.

Yet another study on the sound symbolic values of voiced obstruents was conducted by Atsushi Noto, a then graduate student at Tokyo Metropolitan University [18]. Noto analyzed the correlation between the numbers of voiced obstruents and attack values in “Yookai Watch” characters (Figure 5). The study found that there is no correlation between these two factors when all the names are taken into consideration (left panel); however, the study also found that once pre-existing names and those names that are based on pre-existing words are excluded, a significant positive correlation emerges (right panel). This study thus shows that overall, the relationship between sounds and meanings may look arbitrary, *a la* Saussure’s thesis [19], but sound symbolic effects may emerge in new ghost names.

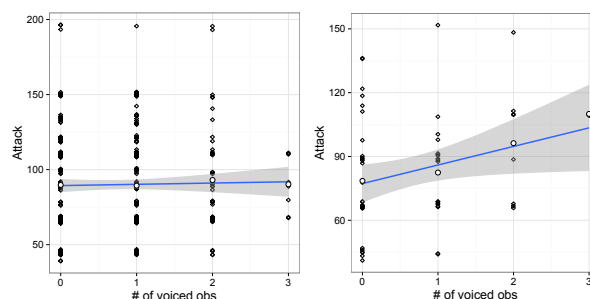


Figure 5: The correlation between the numbers of voiced obstruents in the names and attack values in “Yookai Watch” series. The left panel includes all the data; the right panel includes new ghost names specifically created for this series. Based on [18].

It has been asked whether the scope of the empirical targets of these abovementioned studies on Japanese names (“Urutoraman” series, “Yookai Watch” and as we will see below, “Pokémon”) is limited, because these TV series tend to be watched by boys. Although I believe that at least the last two series are also watched by girls, in order to address this concern more directly, I have explored villains’ names in the “Precure” (“Pretty Cure”) series, which primarily targets girls. As of 2018, Precure’s villain names contain one or more voiced obstruents 63% of the time ($N=196$); on the other hand, the names of the Precures themselves contain a voiced obstruent 40% of the time ($N=55$), and this difference is statistically significant ($\chi^2(1)=8.21$, $p < .01$). However, the probability of Precure’s names containing voiced obstruents is higher than “normal” Japanese girls’ names (4~6%); it may be that voiced obstruents invoke an image of strength, and the Precure designers are making use of this image of voiced obstruents, since Precure girls are fighters.

The sound symbolic value of voiced obstruents—especially their image of largeness—helps us to explain the aerodynamics of voiced

obstruents. In class, I raise the question of why voiced obstruents are associated with an image of largeness, and entertain the possibility that voiced obstruents are considered to be large, because they involve the expansion of the oral cavity (e.g. [20]). With this, students can learn that speakers face an aerodynamic challenge in order to maintain vocal fold vibration with obstruent constriction, and that speakers expand their oral cavity to solve this aerodynamic problem, making use of Boyle’s Law.

5. Case study III: Pokémonastics

One general research project that has emerged from this teaching strategy outlined above is “Pokémonastics.”³ In summer 2016, I was teaching an intensive seminar at Tokyo Metropolitan University. The first day was the introduction to phonetic concepts using sound symbolism, and I was promising students that we were going to cover quantitative methods in linguistics—basic statistics using R—as well. At the beginning of the second day, Gakuji Kumagai, then a PhD student and now an active Pokémonastics researcher, presented a short research proposal, in which he observed that when Pokémon characters evolve, there are many cases in which the numbers of voiced obstruents in their names increase (e.g. *nyoromo* → *nyorozo* and *goosu* → *gengaa*). I was also informed by the students there that each Pokémon character has size and weight. We decided why not learn quantitative methods using this interesting dataset. On the third day of the intensive lecture, Atsushi Noto brought the complete data matrix of the Pokémon characters available at that time. This matrix also included how many voiced obstruents were included in each name.

We started by looking at the distributions of size and weight in Pokémon characters, which turn out to be very right-skewed (Figure 6, left). Log-transforming the data makes the distribution much closer to normal distribution (Figure 6, right). This material has been a great way to show students the importance of looking at the distribution of raw data first, and how log-transformation helps to remedy right-skewed data [21].

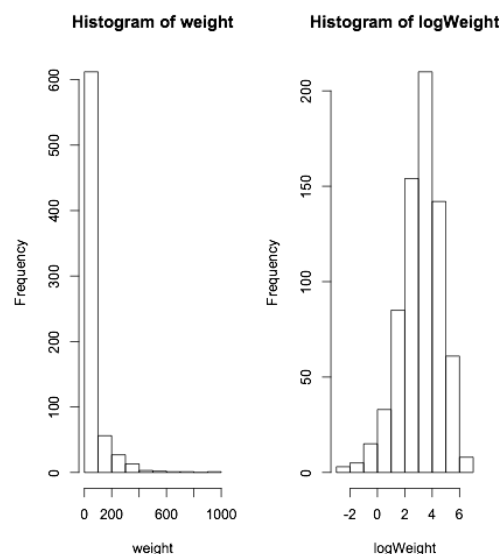


Figure 6: The distribution of weight values in the Pokémon dataset. The left panel is based on raw values; the right panel is log-transformed values. The raw data are right-skewed. Based on [21].

The Pokémon dataset also helps to illustrate the usefulness of log-log scales. The correlation between weight and size is not very clear in the raw data because of the presence of large-valued data points (Figure 7, left). However, the correlation becomes much clearer, once we use log-log scales (Figure 7, right).

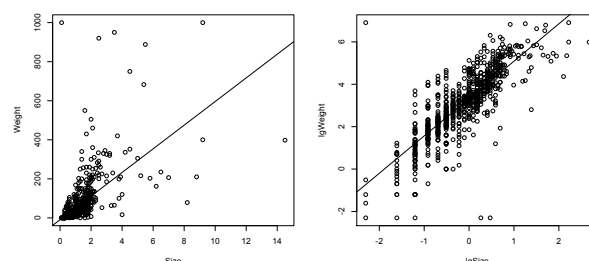


Figure 7: The correlation between size and weight in Pokémon characters. The left panel is the raw data; the right panel uses log-log scales.

Turning to the results of the Pokémonastics project, Figure 8 shows the correlation between the numbers of voiced obstruents and log-transformed weight (left) and size (right) [21].

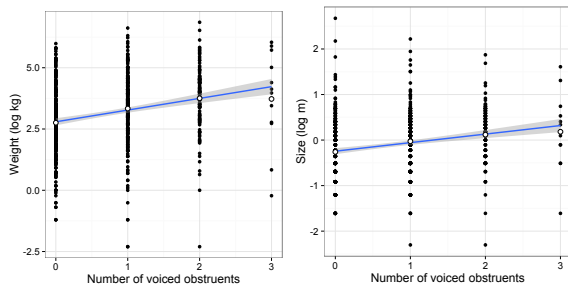


Figure 8: The correlation between the number of voiced obstruents and log-transformed weight (left) and size (right). Based on [21].

Regression analyses show that there is a positive effect of voiced obstruents on Pokémon size and weight. I have been using this example to illustrate how least squares regression analyses work in detail, and my feeling is that using Pokémon data lowers students' psychological boundary to learn the mathematics behind regression analyses. A very concrete advantage is that we can show students that with the Japanese Pokémon dataset, we are able to calculate how heavy one voiced obstruent is (i.e. 1.6 kg), and how big one voiced obstruent is (i.e. 1.2 m).

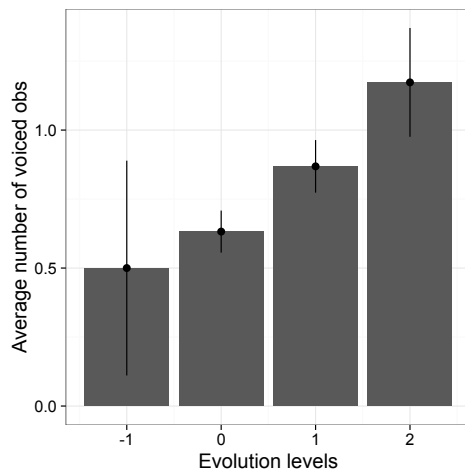


Figure 9: The average numbers of voiced obstruents for each evolution level. The error bars represent 95% confidence intervals. See [21] for how evolution levels are coded.

Figure 9 shows the average numbers of voiced obstruents contained in the Pokémon names for each evolution level. It turned out that Kumagai's initial hypothesis—Pokémon names are more likely to contain voiced obstruents for more evolved characters—was correct.

Not very surprisingly, this Pokémonastic research caught attention from several researchers and students alike. A group of researchers are now exploring the cross-linguistic comparison of sound

symbolic natures of Pokémon names in different languages, including English, Russian and Chinese (Mandarin and Cantonese) [22]. Using the Pokémon universe to study sound symbolism is not only fun, but has a distinct advantage of being able to use the set of denotations which is fixed across all the target languages (this is not the case in natural languages). The Pokémon universe also offers a set of denotations with quantitative data (e.g. weight and size, as mentioned above, as well as other parameters that become relevant during their battles). In May 2018, I organized the first international conference on Pokémonastics, which featured five different talks on the sound symbolic effects in Pokémon names.⁴

Students also followed up on the initial Pokémonastics study. Gakuji Kumagai was a graduate student when the Pokémonastics research project started; he since obtained his PhD and is now actively exploring how productive the sound symbolic patterns in Pokémon names are using experimental methodology with non-existing Pokémon characters (e.g. [23]). Michinori Suzuki, an undergraduate student at International Christian University, proposed in my class that we should analyze move names that Pokémon characters use when they battle. In addition to the analysis of existing move names [24], he has also performed a judgment study using nonce move names. The result of this study, which examined the effect of voiced obstruents as well as that of mora counts, is reproduced in Figure 10 [25].

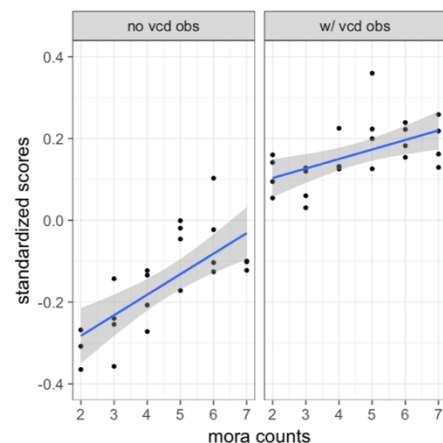


Figure 10: The effects of mora counts and the presence of voiced obstruents on judged attack values in Pokémon move names. The y-axis is averaged standardized scores. Based on on-going work with Michinori Suzuki and Gakuji Kumagai [25].

Generally, students know more about Pokémon than I do, and they suggest many aspects of Pokémon that can be analyzed. One example is

move names that Suzuki Michinori has actually analyzed. Another example is their types; Pokémon characters are classified into different types (e.g. fire, water, poison). Together with the analysis of Disney names reviewed above, [16] presented an analysis of the sound symbolic effects of voiced obstruents in differentiating Pokémon types at the Pokémonastics conference. They show that evil characters' names are more likely to contain voiced obstruents than non-evil characters' names. My general feeling is that Pokémonastics classes can be very student-driven, because to repeat, students know more about Pokémon than I do. Some are very passionate about Pokémon, and they want to know more about the systematicity that may exist in their names.

6. Summary and conclusion

Using materials that are “fun”, sound symbolism allows us to teach students the following concepts:

- The distinction between sonorants/obstruents, and their acoustic differences.
- Voiced obstruents, and their articulatory nature.
- Vowels, and their articulatory characteristics.
- Labiality, and how labial consonants are acquired.
- Pokémonastics, and basic statistical skills.

I hasten to add that it is not the case that we can teach every important phonetic concept through sound symbolism; indeed, I follow up on the sound symbolism lectures with more “standard” phonetics lectures. Nor am I arguing that starting phonetics class with sound symbolism is the best approach. I have no quantitative evidence that teaching phonetics with sound symbolism is effective; it is merely based on my impression.

Teaching phonetics with sound symbolism can lower students' psychological boundary, primarily because the materials used in these analyses are what they are familiar with. Materials like Pokémon and maids are “fun stuff”, and they at least help attract students' interests.⁵ When it comes to Pokémon, students know more about it than I do, and they can/do suggest topics for new analyses (e.g. move names and type analyses). Several students have taken on their own projects on sound symbolism, and for now, this I believe is good evidence that teaching phonetics with sound symbolism is an effective approach.

7. Acknowledgments

I thank all the students (past and present) who complained to me how boring phonetics class can be. I also thank those who told me that learning phonetics with sound symbolism is fun; I am especially grateful to those who have taken up on their own projects on sound symbolism, whose names have been acknowledged in the main text. I would like to thank Gakuji Kumagai, Tomoko Monou and Kazuko Shinohara for collaborating with me on sound symbolism research, and also for trying to use sound symbolism in teaching linguistics classes and sharing their experiences with me. Donna Erickson offered detailed comments on a pre-final version of this paper, for which I am grateful. Students come up with new sound symbolic observations almost every semester, and hence the current paper should be taken as an interim report. This research on sound symbolism, including its pedagogical application, is supported by the JSPS grant #17K13448.

8. References

- [1] Kawahara, S. 2017. *Introducing phonetics through sound symbolism*. Tokyo: Hitsuzi Syobo.
- [2] Jurafsky, D. 2014. *The Language of Food: A Linguist Reads the Menu*. New York: W. W. Norton & Company.
- [3] Yorkston, E., Menon, G. 2004. A sound idea: Phonetic effects of brand names on consumer judgments. *Journal of Consumer Research*, 31:43-51.
- [4] Perfors, A. 2004. What's in a name?: The effect of sound symbolism on perception of facial attractiveness. In: Forbus, K., Gentner, D., Regier, T. (eds), *26th Annual Conference of the Cognitive Science Society*. Chicago, IL: Psychology Press.
- [5] Sapir, E. 1929. A study in phonetic symbolism. *Journal of Experimental Psychology*, 12:225-239.
- [6] Berlin, B. 2006. The first congress of ethnozoological nomenclature. *Journal of Royal Anthropological Institution*, 12:23-44.
- [7] Köhler, W. 1947. *Gestalt Psychology: An Introduction to New Concepts in Modern Psychology*. New York: Liveright.
- [8] Hamano, S. 1986. *The Sound-Symbolic System of Japanese*. Doctoral dissertation, University of Florida.
- [9] Newman, S. 1933. Further experiments on phonetic symbolism. *American Journal of Psychology*, 45:53-75.
- [10] Kumagai, G., Kawahara, S. 2017. How abstract is sound symbolism? Labiality in Japanese diaper

names [in Japanese]. *Proceedings of the 31st meeting of the Phonetic Society of Japan*, 49-54.

Japanese. Ms. Keio University, International Christian University, and Meikai University.

- [11] Chomsky, N., Halle, M. 1968. *The Sound Pattern of English*. New York: Harper and Row.
- [12] Kawahara, S., Shinohara, K. 2012. A tripartite trans-modal relationship between sounds, shapes and emotions: A case of abrupt modulation. *Proceedings of CogSci*:569-574.
- [13] Shinohara, K., Kawahara, S. 2013. The sound symbolic nature of Japanese maid names. *Proceedings of the 13th Annual Meeting of the Japanese Cognitive Linguistics Association*, 13:183-193.
- [14] Kawahara, S., Katsuda, H., Kumagai, G. 2018. Accounting for the stochastic nature of sound symbolism using maximum entropy model. Ms. Keio University, UCLA, & Meikai University.
- [15] Kawahara, S., Monou, T. 2017. Onshochoo-no gengokyoouiku-deno yuukooryoo-ni mukete: urutoraman-no kaijuumei-to onshoochoo. *Journal of the Phonetic Society of Japan*, 21(2):43-49.
- [16] Hosokawa, Y., Atsumi, N., Uno, R., Shinohara, K. 2018. Evil or not? sound symbolism in Pokémon and Disney character names. Talk presented at the 1st international conference on Pokémonastics.
- [17] Jakobson, R. 1941. *Kindersprache, Aphasie, und allgemeine Lautgesetze*. Uppsala: Almqvist & Wiksell.
- [18] Noto, A. 2017. Yookai watch-no naduke-ni mirareru onsyoochookouka-ni tsuite [sound symbolic effects in yookai watch naming patterns]. Ms. Tokyo Metropolitan University.
- [19] Saussure, F. de. 1916. *Cours de linguistique générale*. Paris: Payot.
- [20] Ohala, J. J., 1983. The origin of sound patterns in vocal tract constraints. In: MacNeilage, P. (ed) *The Production of Speech*. New York: Springer-Verlag, 189-216.
- [21] Kawahara, S., Noto, A., Kumagai, G. 2018. Sound symbolic patterns in Pokémon names. *Phonetica*, 75(3):219-244.
- [22] Shih, S. S., Ackerman, J., Hermalin, N., Inkelas, S., Kavitskaya, D. 2018. Pokémonikers: A study of sound symbolism and Pokémon names. *Proceedings of LSA*.
- [23] Kawahara, S., Kumagai, G. 2019. Expressing evolution in Pokémon names: Experimental explorations. *Journal of Japanese Linguistics*.
- [24] Suzuki, M. 2017. The sound symbolic patterns in Pokémon move names. Talk presented at Asia Junior Linguistics (AJL).
- [25] Kawahara, S., Suzuki, M., Kumagai, G. 2018. Sound symbolic patterns in Pokémon move names in

¹ I tell my students that one of my daughters has three obstruents and no sonorants in her name, but I still like that name.

² Perfors's study found stronger effects of the vowel backness distinction: male names are judged to be more attractive with stressed front vowels, whereas female names are judged to be more attractive with stressed back vowels. This too is usually mentioned in the in-class practice.

³ Although I am happy to claim that I originally initiated this research program, the name (Pokémonastics) is due to Stephanie Shih.

⁴ <https://1stpokemonastics.wordpress.com>

⁵ The Pokémonastics project was featured in a university student newspaper at Keio University (<http://www.jukushin.com/archives/28130>, last access 11/19/2018).