The sound symbolic patterns in Pokémon move names in Japanese*

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Abstract

In recent years, we have witnessed a growing body of interests in sound symbolism, systematic associations between sounds and meanings. A recent case study of sound symbolism shows that in Pokémon games, longer names are generally associated with stronger Pokémon characters, and moreover that those Pokémon characters with names having more voiced obstruents are generally stronger (Kawahara et al. 2018c). The current study examined the productivity of these sound symbolic effects in the names of the moves that Pokémon creatures use when they battle. The analysis of the existing move names shows that the effect of name length on attack values is robust, and that the effect of voiced obstruents is tangible. These sound symbolic patterns hold, despite the fact that most move names are based on real words in Japanese. An additional experiment with nonce names shows that both of these effects are very robust, with interesting inter-speaker differences. Overall, the current paper adds to the growing body of studies showing that the relationships between sounds and meanings are not as arbitrary as modern linguistic theories have standardly assumed. Uniquely, the current analysis of the existing move names also shows that such non-arbitrary relationships can hold even when the set of words under consideration are mostly existing words.

1 Introduction

In recent years, we have witnessed a growing body of interests in sound symbolism—stochastic and systematic associations between sounds and meanings (Dingemanse et al. 2015; Hinton et al. 2006; Lockwood & Dingemanse 2015; Sidhu & Pexman 2017). One standard assumption, often taken for granted in modern linguistics, is that the relationships between sounds and meanings are arbitrary (Hockett 1959; Saussure 1916). One typical argument raised in this regard is that if the relationships between sounds and meanings were fixed, all languages should use the same

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sound sequences to refer to the same denotations, and hence there should be no language variations (Locke 1689; Saussure 1916). This argument should be taken with caution, because languages use a different set of sounds; they are also susceptible to a different set of phonotactic restrictions (Shih et al. 2018; Styles & Gawne 2017). The set of denotations that are referred to in a particular language differs as well. For example, Japanese distinguishes "hot water" and "cold water", but English does not have a lexical item specifically designated for "hot water." Just because there are language variations does not mean there cannot be systematic relationships between sounds and meanings. At the same time, few linguists would object to the thesis that languages are systems that are capable of connecting sounds and meanings in arbitrary ways.

It is interesting, however, that many phonetic and psycholinguistic studies have identified systematic connections between sounds and meanings. One well-known example is the observation that speakers of many languages feel [a] to be larger than [i] (e.g. Berlin 2006; Newman 1933; Sapir 1929; Shinohara & Kawahara 2016; Ultan 1978). Another well-studied example is sound symbolic values of voiced obstruents in Japanese; these sounds are generally associated with images of largeness, heaviness, darkness, and dirtiness (e.g. Hamano 1986; Kawahara et al. 2008; Kubozono 1999b; Suzuki 1962; Uemura 1965 among others). An extensive cross-linguistic study by Blasi et al. (2016) shows that despite the apparent cross-linguistic variations, when one examines a set of basic vocabularies, there are certain sound symbolic tendencies that hold across many languages.

Sound symbolism is now becoming an important subfield in linguistic inquiry for several reasons. First, whether sounds and meanings have systematic relationships or not is fundamental when considering the overall architecture of grammatical theory. For example, in generative grammar, no direct relationships between sounds and meanings are usually posited (see Jackendoff 2002: 109-110),[1] and therefore sound symbolic relationships remain unexplained by these theories. However, some proposals maintain that it is possible—and in fact desirable—to use a formal grammatical model to capture patterns of sound symbolism (Alderete & Kochetov 2017; Kawahara et al. 2018b; Kochetov & Alderete 2011). Second, there have been proposals to the effect that mimicking real world attributes with different types of vocalization can be the origin of human languages. If this hypothesis is true, analyzing sound symbolic patterns—or iconicity in natural languages in general—may shed light on the origin of human languages (Berlin 2006; Haiman 2018; Perlman & Lupyan 2018; Ramachandran & Hubbard 2001). Third, some researchers argue that sound symbolism plays a non-trivial role in language acquisition, whether it is L1 (Asano et al. 2015; Imai et al. 2008; Imai & Kita 2014; Perry et al. 2018) or L2 (Kunihara 1971; Nygaard et al. 2009); generally, it has been observed by these studies that those items that follow sound symbolic principles are easier to learn and more frequently used by language learners. Finally, there is an

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[1]One clear exception is focus-related features, which are interpreted both by the semantic and phonetic components (Selkirk 1995).

increasing body of work that seeks to make use of sound symbolism in the context of marketing. Their general finding is that there are sounds that are "suitable" to convey particular images for brand products; such names that make sound symbolic sense are judged to be better, and possibly better remembered, by potential customers (e.g. Bolts et al. 2016; Coulter & Coulter 2010; Jurafsky 2014; Klink 2000; Peterson & Ross 1972; Yorkston & Menon 2004). This line of research has opened up a new domain of interdisciplinary research. In short, while sound symbolism did not receive much serious attention in linguistic studies until recently, there are good reasons to study sound symbolism from a linguistic point of view.

Against this theoretical background, a recent study by Kawahara et al. (2018c) has found that there are sound symbolic patterns in Pokémon names in such a way that those Pokémon characters with longer names tend to be stronger. Pokémon is a game series which was originally released in 1996 by Nintendo Inc., and has subsequently been popularized in several media formats across the world. In Pokémon games, as of 2016, there were more than 700 fictional characters, each of which was specified for its strength, size and weight. Kawahara et al. (2018c) found, for example, that Pokémon characters with longer names tend to be stronger, larger and heavier in terms of their official strength parameters (e.g. *mi-ru-ka-ro-su* vs. *hi-m-ba-su*, the former of which is stronger).[2] Kawahara et al. (2018c) relates this observation to the "quantitative iconicity principle" in natural languages, in which longer words are associated with larger quantity (Dingemanse et al. 2015; Haiman 1980, 1984, 2018). Kawahara (2017), in a follow-up study, found a similar correlation between mora counts and spell levels in Dragon Quest game series. This sort of iconic relationship between the length of names and the strength of its denotation has been underdocumented in natural languages, even in the studies of sound symbolism (modulo the abovementioned studies[3]), and it is important to study how prevalent this pattern is in natural languages.

Kawahara et al. (2018c) also found that in addition to the effects of mora counts, voiced obstruents in the Pokémon characters' names correlate with the characters' strength parameters; for example, *garagara* is stronger—and again, larger and heavier—than *karakara*. This sound-symbolic relationship is arguably based on the correlation between heaviness/largeness and voiced obstruents, which itself may have an acoustic (Ohala 1994) or articulatory (Shinohara & Kawahara 2016) basis. Voiced obstruents may be associated with images of largeness because they characteristically involve low frequency energy (Chodroff & Wilson 2014; Kingston & Diehl 1994; Kingston et al. 2008; Stevens & Blumstein 1981); those sounds with energy in low frequency ranges imply large objects, because everything else being equal, large objects omit lower frequency sounds (Ohala 1983b, 1994). Alternatively, voiced obstruents evoke images of largeness because they involve

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[2]Mora is the counting unit that is demonstrably most salient in Japanese (Kubozono 1999a; Labrune 2012; Otake et al. 1993). A (C)V light syllable counts as one mora; A CVC syllable counts as two moras. In what follows, we will use mora counts as a measure of name length, as mora count is what is deployed by the previous study that the current study builds upon (Kawahara et al. 2018c).

[3]Most of these studies focus on ideophones, which are undoubtedly more sound symbolic than other lexical items.

expansion of the oral cavity during their production due to the well-known aerodynamic challenge to sustain vocal fold vibration with obstruent closure (Ohala 1983a; Ohala & Riordan 1979; Proctor et al. 2010; Westbury 1983).

Several follow-up studies demonstrated via experimentation that these two sound symbolic relationships found in the existing Pokémon names are productive in that they can be reproduced in experiments with Japanese speakers, including those who are not very familiar with Pokémon (Kawahara & Kumagai 2019; Kawahara et al. 2018a; Kumagai & Kawahara 2019).

Building on these observations, this paper tests whether the same sound symbolic patterns hold in the names of the moves that Pokémon characters use during their battles, in addition to the names of Pokémon characters themselves. It would be of interest to examine move names, because most move names are based on real words in Japanese (about 99%; see below for actual examples). Sound symbolic effects are expected to show up more clearly in nonce words than in real words, because after all, in real words, the relationship between sounds and meanings can largely be arbitrary (Hockett 1959; Saussure 1916) (though cf. Blasi et al. 2016 who found sound symbolic effects in basic vocabularies of many languages). On the other hand, it could be the case, as discussed by Kawahara et al. (2018c), that sound symbolic principles may affect the choice of real words; for example, there is a possibility that Pokémon designers choose, consciously or unconsciously, longer words to express stronger moves. Alternatively, they can assign stronger values to those moves with longer names.

The results of the current investigation show that similar patterns found in the previous studies on Pokémon (Kawahara et al. 2018c; Kawahara & Kumagai 2019) also hold in the names of Pokémon moves, further supporting the role of sound symbolic relationships in Pokémon naming patterns. More generally, the current study provides another case in which there is a non-arbitrary relationship between sounds and meanings. Also, as discussed by Shih et al. (2018), studying sound symbolism using Pokémon characters has a distinct virtue of being able to use the universe in which the set of denotations is fixed. This nature of the Pokémon universe makes the cross-linguistic comparison easier; the current paper therefore, like Kawahara et al. (2018c), opens up a research opportunity for cross-linguistic comparison of sound symbolism. In addition, we believe that the fact that this paper, as well as the previous studies on Pokémon names, uses data from a popular game series, makes it useful for popularizing linguistics.

2   Analyses of existing move names

In Pokémon games, Pokémon characters fight with each other using "moves". Usually, Pokémon characters can use multiple moves; e.g. *Pikachuu* can use, among others, *denkoo sekka* "very fast attack" and *hoppe surisuri* "cuddling with cheeks". Generally, the moves that Pokémon characters

use are specified for their numerical attack values. For example, *a-a-mu-ha-m-ma-a* "arm hammer" has the attack value of 100, whereas *a-i-su-bo-o-ru*'s "ice ball" attack value is 30 ("-" represents a mora boundary). We started by analyzing existing move names to examine whether the two sound symbolic patterns found in Kawahara et al. (2018c) also hold.

2.1   Method

In some cases, these attack values are not specified; for example, the class of moves which affects the opponent's status are not specified for their attack values. Also, there are cases in which attack values are not determined in absolute terms; e.g., a move whose attack value is twice as much as the attack value of the move that the opponent uses. Such cases were excluded from the current analysis. Move names that contain numerical values and alphabet letters in the names (e.g. *10-manboruto* "100,000 volt" and *V-genereeto* "V-generate"), of which there were four, were also excluded. Since there were two moves whose attack values were above 200, whereas many of the other moves have attack values around or lower than 100 (mean = 74.6, SD = 32.4), these two data points were excluded as outliers. There was only one item that is 2 mora long (*awa* "bubble"), which was excluded. The remaining N was 390. Most move names are based on real words in Japanese. The only non-existing names that we identified were *borutekkaa*, *akuu(setsudan)*, *rasutaa(kanon)*, *rasutaa(paaji)*, and *huruuru(kanon)*. Voiced geminates (i.e. long consonants) were counted as one token of voiced obstruents. Since a Shapiro-Wilk normality test reveals no deviation from normality for the distribution of attack values ($W = 0.97, n.s.$), no transformation was applied to the data.

2.2   Results and discussion

Figures 1 and 2 show the correlation between attack values on the one hand and mora counts in the names and the number of voiced obstruents on the other. The white dots represent the average values in each condition, showing general positive correlations between the two dimensions. Some representative examples are shown in Tables 1 and 2, respectively.
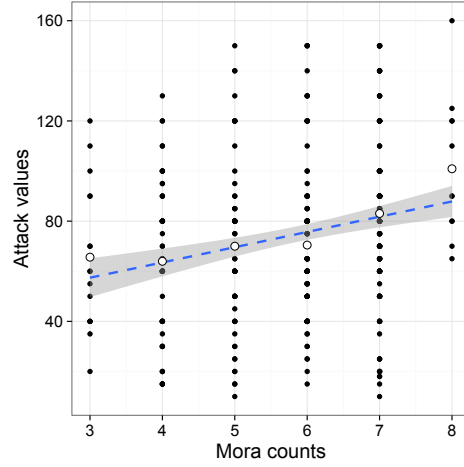
Figure 1: The correlation between attack values and mora counts. The white dots represent the averages in each condition. The linear regression lines, with their 95% confidence intervals, are shown as dashed lines.

Table 1: Some representative examples of Figure 1. The attack values are shown in parentheses.

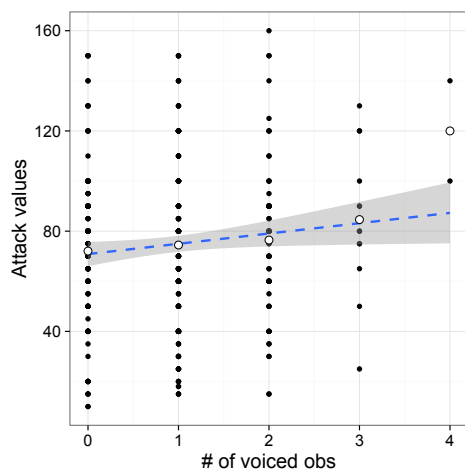| 3 mora	4 mora	5 mora	6 mora
[i-ka-ri] (20)	[o-ɕi-o-ki] (60)	[i-wa-na-da-re] (75)	[ka-e-ɴ-ho-o-ɕa] (90)
[çi-no-ko] (40)	[ɸu-mi-tsu-ke] (65)	[ta-ki-no-bo-ri] (80)	[he-do-ro-we-e-bu] (95)
7 mora	8 mora		
[a-i-a-ɴ-he-d-do] (100)	[so-o-ra-a-bu-re-e-do] (125)		
[u-d-do-ha-m-ma-a] (120)	[pu-ri-zu-mu-re-e-za-a] (160)		

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Figure 2: The correlation between attack values and the number of voiced obstruents.

Table 2: Some representative examples of Figure 2. The attack values are shown in parentheses.

0 voi obs	1 voi obs	2 voi obs
[ko-na-ju-ki] (40)	[a-ku-ro-**b**a-t-to] (55)	[**d**o-ku-**z**u-ki] (80)
[mi-ne-u-tɕi] (40)	[i-wa-na-**d**a-re] (75)	[ri-i-ɸu-**b**u-re-e-**d**o] (90)

3 voi obs	4 voi obs	
[**g**o-o-su-to-**d**a-i-**b**u] (90)	[**b**u-re-i-**b**u-**b**a-a-**d**o] (120)	
[ta-ma-**g**o-**b**a-ku-**d**a-ɴ] (100)	[**g**o-d-**d**o-**b**a-a-**d**o] (140)	

Statistically, the slope of the linear regression line is significantly different from zero in Figure 1 ($t(388) = 6.09, p < .001$); the slope in Figure 2 is also positive and significantly different from zero ($t(388) = 1.95, p < .05$), though this effect seems much weaker than that of mora counts. As anticipated above, these results should not be taken for granted, given that most move names are based on real words.[4] The results imply that those who named these move names, whether consciously or not, were deploying sound symbolic principles when choosing words for move names.

However, a multiple regression analysis with both mora counts and the number of voiced obstruents as independent variables shows that only the main effect of mora count is significant ($t(386) = 2.69, p < .01$), but not the main effect of voiced obstruents ($t(385) = -0.55, n.s.$) or their interaction ($t(385) = 0.78, n.s.$). It does not seem to be the case that the effects of voiced

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[4]For example, *Pikachuu*'s moves include *denki-shokku, denkoo-sekka, feinto, supaaku, hoppe-surisuri, hooden, tatakitsukeru, 10manboruto, wairudo-boruto, kaminari, mezameru-pawaa, kawara-wari, kara-genki, rinshoo, ekoo-boisu, chaaji-biimu, boruto-chenji, kaminari-panchi, ibiki, aian-teeru, kiai-panchi, hatakiotosu*, and others.

obstruents hold independently of the effects of mora counts, unlike the patterns of Pokémon characters' names (Kawahara et al. 2018c). It may be the case that since those names that contain several voiced obstruents have to be long, what we are observing in Figure 2 may be a spurious correlation.

The reason for the lack of a robust effect of voiced obstruents may be that while it is easy for Pokémon designers to manipulate mora counts of the names, it is not so easy to manipulate the presence of voiced obstruents. For example, one can choose to use a long intensifier (e.g. *megaton*) to express strong move names, but one cannot remove a voiced obstruent ([g]) from that intensifier. We may not observe a clear effect of voiced obstruents in the set of existing move names because of this inflexibility.

To reconcile this result with that of Kawahara et al. (2018c) who found a clear effect of voiced obstruents in Pokémon characters' names, we next ran a judgment study using nonce names. If we artificially remove the inflexibility due to having to use real names, it is predicted that the effects of voiced obstruents would emerge.

3   Experiment

Most existing move names consist of real words in Japanese, whereas many Pokémon names are based on nonce words. This means that the Pokémon designers have less flexibility in making use of sound symbolism to express strength in the move names than in the characters' names. This lower flexibility may have resulted in the lack of the effects of voiced obstruents in the multiple regression analysis presented above. In order to address whether the effects of voiced obstruents would emerge given complete nonce words, a follow-up judgment experiment was conducted. The experiment was also intended to address whether the effects of mora counts hold for general Japanese speakers i.e. those who are not Pokémon designers.

3.1   Method

Table 3 provides a list of the stimuli. The experiment manipulated two factors: (1) the mora counts ranging from two moras to seven moras and (2) the presence of a voiced obstruent. Each condition had four items, all of which were created using a random name generator, which combines Japanese CV moras to yield new names (`http://bit.ly/2iGaKko`). This random generator was used in order to avoid the experimenters' bias in choosing the stimuli that they think would work prior to the experiment (Westbury 2005). For the names with a voiced obstruent, the voiced obstruent is placed word-initially, as this position is psycholinguistically most prominent (e.g. Brown & MacNeill 1966; Nooteboom 1981; Hawkins & Cutler 1988; see in particular

Kawahara et al. 2008 who show that voiced obstruents in word-initial position show stronger sound symbolic effects than those in word-medial position).

Table 3: The stimulus list for the experiment.

2 mora	3 mora	4 mora	5 mora	6 mora	7 mora
[su-tsu]	[ko-ɕi-me]	[ku-ki-me-se]	[ha-ku-te-ɕi-no]	[ju-ro-ka-mu-mo-ja]	[ho-mu-ki-mu-ro-ni-jo]
[ju-se]	[ju-ru-so]	[so-ha-ko-ni]	[ro-ta-ra-na-to]	[te-su-hu-re-ku-su]	[ɕi-ki-so-ku-na-ɕi-ja]
[ro-ɕi]	[se-sa-ri]	[ri-se-mi-ra]	[so-ka-ne-ni-re]	[mu-ku-ho-ro-ho-te]	[ha-mi-ɕi-na-ɕi-no-ri]
[jo-ni]	[re-to-na]	[ra-ɕi-ro-no]	[ru-ri-ha-me-ke]	[ra-ha-ri-ti-ru-tsu]	[ja-ho-ma-ri-ra-mi-nu]
[ze-ke]	[bu-ro-se]	[be-ni-ro-ru]	[bi-so-ɸu-sa-ta]	[gu-se-ɸu-ɕi-ra-mo]	[zu-su-ri-me-ja-wa-mo]
[za-me]	[go-se-he]	[bi-to-re-ni]	[da-ra-su-to-ki]	[go-na-ɸu-to-ko-so]	[bu-ku-su-ro-ne-tsu-ko]
[gu-ka]	[bo-ma-sa]	[za-ni-te-ja]	[de-mu-sa-te-he]	[do-ja-to-sa-mi-ta]	[so-na-ka-re-ne-ko-ho]
[gi-ke]	[bi-nu-ki]	[ga-ɕi-ke-ro]	[zu-to-tu-ri-su]	[da-na-ri-no-mi-ki]	[gu-ka-ne-ɕi-mo-ni-ri]

The experiment was distributed online using SurveyMonkey.[5] All the stimuli were written in the *katakana* orthography, which is the standard way to write nonce words in Japanese. Within each trial, the participants were presented with one name and asked to adjust a slider which ranged from 0 to 100. The participants went through three practice items before the main trial in order to familiarize themselves with the task. The order of the stimuli was randomized per participant. After the main experiment, the participants were asked several demographic questions. The participants were also asked how familiar they are with Pokémon games, using a 1 to 7 scale.

Since not all participants used a full range, each obtained score was standardized within each participant. Excluding those who were disqualified (e.g. some did not enter demographic information; some quit in the middle of the experiment), a total 86 native speakers finished the experiment.

3.2 Results and discussion

Figure 3 shows the correlation between judged attack values (standardized) and mora counts, separated by whether the stimuli contained word-initial voiced obstruents or not. The judged attack values were averaged over the 86 speakers. We observe that for both panels, there is a positive correlation between mora counts and judged attack values. We also observed that those names with voiced obstruents (right panel) were generally judged to be stronger than those names without a voiced obstruent (left panel).
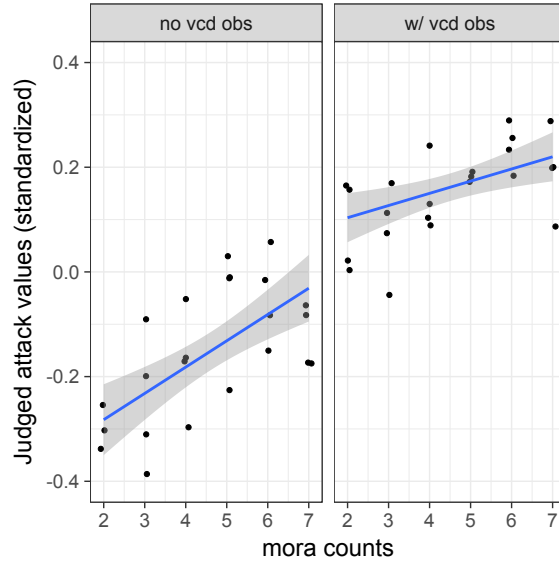
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[5] http://surveymonkey.com

Figure 3: The correlation between the judged attack values (standardized) and the number of mora counts. The judged attack values were averaged across all the participants. Randomly jittered by 0.075 to prevent the points from overlapping with each other.

A linear mixed model with standardized judged attack values as the dependent variable, mora counts and the presence of voiced obstruents as the fixed independent variables, and speakers and items as random variables (both slopes and intercepts) was run (Barr 2013; Barr et al. 2013). The effect of mora counts was significant ($t = 6.18, p < .001$), and so was the effect of voiced obstruents ($t = 12.1, p < .001$). The interaction between these two factors was also significant ($t = -5.78, < .001$), because the correlation seems stronger for those items without a voiced obstruent ($r = 0.75$ vs. $r = 0.55$). Since the interaction term was significant, separate linear mixed models were run for data with no voiced obstruents and those with voiced obstruents. The effects of mora count was significant for the data with no voiced obstruents ($t = 5.08, p < .001$) and those with a voiced obstruent ($t = 4.76, p < .001$). We thus conclude that generally, both the effects of mora counts and voiced obstruents are robust.
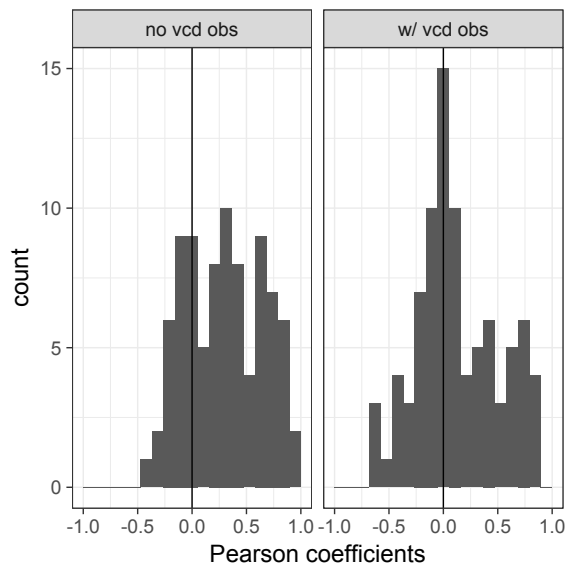
Figure 4: The distribution of Pearson correlation coefficients by participants.

A closer look at the individual data reveals, however, that not every participant showed these sound symbolic effects. Figure 4 shows the distribution of Pearson correlation coefficients between the judged attack values and the mora counts. In the no voiced obstruent condition, the majority of the participants showed a positive correlation between mora counts and the judged attack values; nevertheless, there are a handful of participants whose correlation is smaller than 0. For the condition with a voiced obstruent, there are a number of speakers whose correlations are negative. This analysis shows that not all speakers are sensitive to the sound symbolic effect of mora counts.

A natural hypothesis regarding where this inter-speaker variation comes from is familiarity with Pokémon games. Those who are familiar with Pokémon may have learned from the existing move names that there is a positive correlation between mora counts and attack values, and may have used that knowledge in the current experiment. To examine this hypothesis, Figure 5 shows the effects of familiarity with Pokémon on the correlation between mora counts and the judged attack values. Neither correlations are significant (no voiced obstruent: $r = 0.01, t = 0.12, n.s$; w/ voiced obstruent: $r = 0.18, t = 1.67, n.s.$).
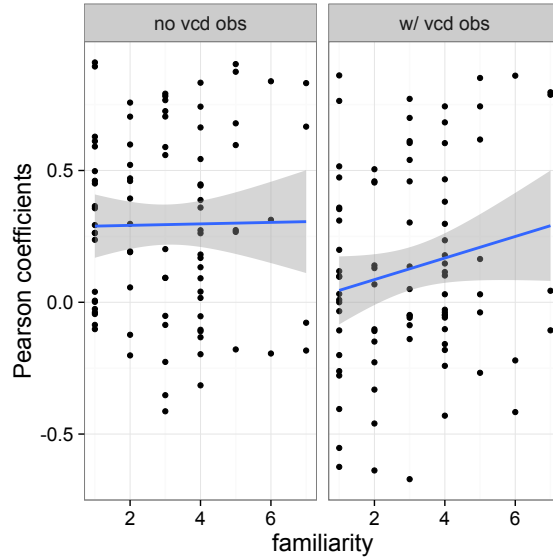
Figure 5: The effects of familiarity on correlation between mora counts and judged attack values.

This result implies that the effects of mora counts on judged attack values are sufficiently abstract, to the extent that one does not need to be exposed to Pokémon to possess this sound symbolic knowledge. It is possible that the sound symbolic effects of mora counts are learned from (some portion of) the Japanese lexicon (e.g. Dragon Quest's spell names: Kawahara 2017), but this knowledge is abstract enough so that it can be applied when the participants judge the attack values of nonce words in the context of Pokémon move names.

Finally, to examine the effects of voiced obstruents for each individual speaker, Figure 6 plots the distribution of averaged differences between data with voiced obstruents and those without voiced obstruents. The majority of speakers showed a positive difference, implying that the effects of voiced obstruents are very prevalent among the current participants. Figure 7 shows that the correlation between the effect sizes of voiced obstruents and familiarity with Pokémon is negative ($r = -0.38, t = 3.76, p < .001$). We do not have a good explanation as to why a negative correlation holds, but at least the results further support the conclusion reached above that the sound symbolic effects observed in this experiment do not arise from exposure to Pokémon.
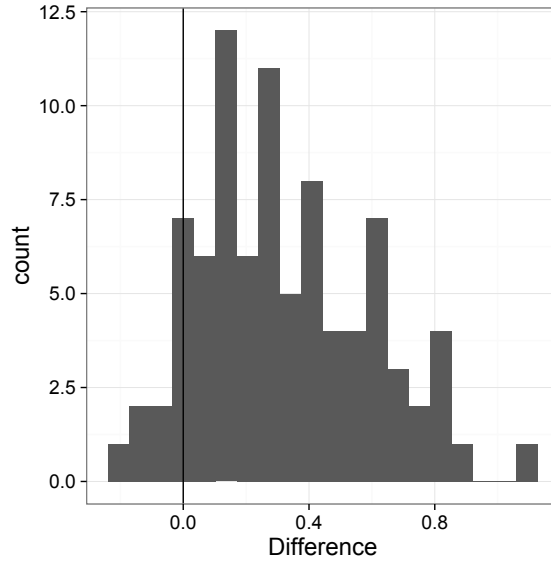
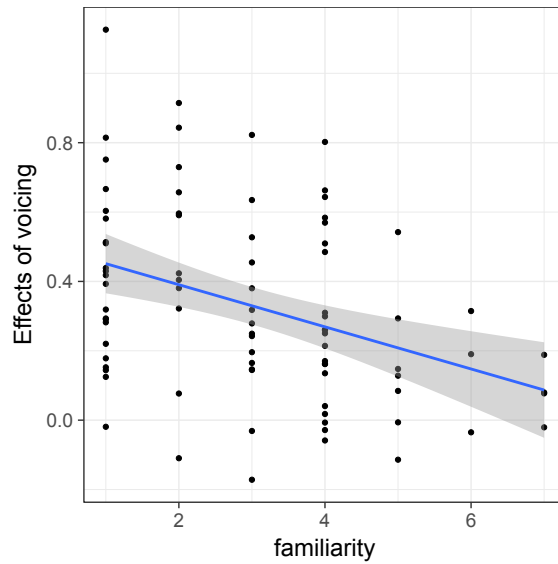Figure 6: The effect sizes of voiced obstruents by speaker.

Figure 7: The effect sizes of voiced obstruents by familiarity with Pokémon.

4 Overall conclusion

This study was an expansion of a previous case study of sound symbolism which shows that both voiced obstruents and mora counts increase Pokémon characters' strength parameters (Kawahara et al. 2018c). The empirical focus of the current paper was on the names of the moves

that Pokémon characters use when they battle. Since 99% of the move names are based on real words, we did not take it for granted that we would replicate the results of Kawahara et al. (2018c). The analysis of existing names shows a robust effect of mora counts, while the effect of voiced obstruents was less clear. A judgment experiment using nonce names, however, shows a very robust effect of voiced obstruents, as well as the effect of mora counts. The current case study thus constitutes yet another instance of non-arbitrary relationships between sounds and meanings. The current study can also be situated as a case study of the role of sound symbolism in brand naming. A growing body of work shows that there are certain types of sounds that are suited to express a particular brand type (e.g. Bolts et al. 2016; Coulter & Coulter 2010; Jurafsky 2014; Klink 2000; Peterson & Ross 1972; Yorkston & Menon 2004)—our current study shows that there are ways to phonologically express the strength of moves in the Pokémon world.

In previous studies of sound symbolism, little attention was paid to inter-speaker variation. Our by-participant analysis shows, however, that the degree to which participants are sensitive to the sound symbolic effects can vary extensively. Our further analysis shows that this variation does not arise from previous exposure to Pokémon, and it is yet to be shown where it comes from. In general, inter-speaker variation of sound symbolism is an understudied area of research, and it is hoped that future studies of sound symbolism should explore this issue in further depth.

One remaining question, which pertains to this general project on sound symbolic effects in Pokémon names, is whether the creators of Pokemon names and moves specifically intended to capture some sound symbolic relations. Tobin (2004) seems to suggest that this intension is explicit, at least in the translations of Pokémon names into French "Nintendo, aware of the importance of naming, translated the creatures' names into terms that artfully reflect the language and culture of French children...[T]he name effectively reflecting their essence and...their thoughts and feelings. The characters' names...convey a core characteristic of each culture" (p. 193). This implies that the use of sound symbolic effects in naming Pokémon characters is to some extent deliberate, at least in French translations. It also implies that the designers assume that general audience share the same sound symbolic effects, as otherwise it would be meaningless to apply these sound symbolic principles in Pokémon naming. This second implication is compatible with the results of the current experiment; most, if not all, Japanese participants were sensitive to the sound symbolic principle under question.

References

Alderete, John & Alexei Kochetov. 2017. Integrating sound symbolism with core grammar: The case of expressive palatalization. *Language* 93. 731–766.
Asano, Michiko, Mutsumi Imai, Sotaro Kita, Keiichi Kitaji, Hiroyuki Okada & Guillaume Thierry.

2015. Sound symbolism scaffolds langauge development in preverbal infants. *Cortex* 63. 196–205.

Barr, Dale J. 2013. Random effects structure for testing interactions in linear mixed-effects models. *Frontiers in Psychology* 4. 328.

Barr, Dale J., Roger Levy, Christoph Scheepers & Harry J. Tily. 2013. Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language* 68. 255–278.

Berlin, Brent. 2006. The first congress of ethonozoological nomenclature. *Journal of Royal Anthropological Institution* 12. 23–44.

Blasi, Damián, Søren Wichman, Harald Hammarström, Peter F. Stadler & Morten H. Christianson. 2016. Sound-meaning association biases evidenced across thousands of languages. *PNAS* 113(39). 10818–10823.

Bolts, G. Marilyn, G. Mangigian Mangigian & B. Molly Allen. 2016. Phonetic symbolism and memory for advertisement. *Applied Cognitive Psychology* 30. 1088–1092.

Brown, Roger & David MacNeill. 1966. The 'tip of the tongue' phenomenon. *Journal of Verbal Learning and Verbal Behavior* 5(4). 325–337.

Chodroff, Eleanor & Colin Wilson. 2014. Burst spectrum as a cue for the stop voicing contrast in American English. *Journal of the Acoustical Society of America* 136(5). 2762–2772.

Coulter, K.S. & R. A. Coulter. 2010. Small sounds, big deals: Phonetic symbolism effects in pricing. *Journal of Consumer Research* 37(2). 315–328.

Dingemanse, Mark, Damián E. Blasi, Gary Lupyan, Morten H. Christiansen & Padraic Monaghan. 2015. Arbitrariness, iconicity and systematicity in language. *Trends in Cognitive Sciences* 19(10). 603–615.

Haiman, John. 1980. The iconicity of grammar: Isomorphism and motivation. *Language* 56(3). 515–540.

Haiman, John. 1984. *Natural syntax: Iconicity and erosion*. Cambridge: Cambrdige University Press.

Haiman, John. 2018. *Ideophones and the evolution of language*. Cambridge: Cambrdige University Press.

Hamano, Shoko. 1986. *The sound-symbolic system of Japanese*: University of Florida Doctoral dissertation.

Hawkins, John & Anne Cutler. 1988. Psycholinguistic factors in morphological asymmetry. In J. A. Hawkins (ed.), *Explaining language universals.*, 280–317. Oxford: Basil Blackwell.

Hinton, Leane, Johanna Nichols & John Ohala. 2006. *Sound symbolism, 2nd edition*. Cambridge: Cambridge University Press.

Hockett, Charles. 1959. Animal "languages" and human language. *Human Biology* 31. 32–39.

Imai, Mutsumi & Sotaro Kita. 2014. The sound symbolism bootstrapping hypothesis for language acquisition and language evolution. *Philosophical Transactions of the Royal Society B: Biological Sciences* 369(1651).

Imai, Mutsumi, Sotaro Kita, Miho Nagumo & Hiroyuki Okada. 2008. Sound symbolism facilitates early verb learning. *Cognition* 109. 54–65.

Jackendoff, Ray. 2002. *Foundations of language: Brain, meaning, grammar, evolution*. Oxford: Oxford University Press.

Jurafsky, Dan. 2014. *The language of food: A linguist reads the menu*. New York: W. W. Norton & Company.

Kawahara, Shigeto. 2017. Sound symbolism in spell names in dragon quest series. *Journal of the Phonetic Society of Japan* 21(2).

Kawahara, Shigeto, Miwa Isobe, Yukino Kobayashi, Tomoko Monou & Reiko Okabe. 2018a. Acquisition of sound symbolic values of vowels and voiced obstruents by Japanese children: Using a pokémonastics paradigm. *Journal of the Phonetic Society of Japan* 22(2).

Kawahara, Shigeto, Hironori Katsuda & Gakuji Kumagai. 2018b. Accounting for the stochastic nature of sound symbolism using maximum entropy model. Ms. Keio University, UCLA, & Meikai University.

Kawahara, Shigeto & Gakuji Kumagai. 2019. Expressing evolution in Pokémon names: Experimental explorations. *Journal of Japanese Linguistics* .

Kawahara, Shigeto, Atsushi Noto & Gakuji Kumagai. 2018c. Sound symbolic patterns in Pokémon names. *Phonetica* 75(3). 219–244.

Kawahara, Shigeto, Kazuko Shinohara & Yumi Uchimoto. 2008. A positional effect in sound symbolism: An experimental study. In *Proceedings of the Japan Cognitive Linguistics Association 8*, 417–427. Tokyo: JCLA.

Kingston, John & Randy Diehl. 1994. Phonetic knowledge. *Language* 70. 419–454.

Kingston, John, Randy Diehl, Cecelia Kirk & Wendy Castleman. 2008. On the internal perceptual structure of distinctive features: The [voice] contrast. *Journal of Phonetics* 36. 28–54.

Klink, Richard R. 2000. Creating brand names with meaning: The use of sound symbolism. *Marketing Letters* 11(1). 5–20.

Kochetov, Alexei & John Alderete. 2011. Scales and patterns of expressive palatalization: Experimental evidence from Japanese. *Canadian Journal of LInguistics* 56(3). 345–376.

Kubozono, Haruo. 1999a. Mora and syllable. In Natsuko Tsujimura (ed.), *The handbook of Japanese linguistics*, 31–61. Oxford: Blackwell.

Kubozono, Haruo. 1999b. *Nihongo-no onsei: Gendai gengogaku nyuumon 2 [Japanese phonetics: An introduction to modern linguisitcs 2]*. Tokyo: Iwanami Shoten.

Kumagai, Gakuji & Shigeto Kawahara. 2019. Pokémon-no naduke-ni okeru boin-to yuuseisogaion-no kouka. *Gengo Kenkyu [Journal of the Linguistic Society of Japan]* 155.

Kunihara, Shirou. 1971. Effects of the expressive force on phonetic symbolism. *Journal of Verbal Learning and Verbal Behavior* 10. 427–429.

Labrune, Laurence. 2012. *The phonology of Japanese*. Oxford: Oxford University Press.

Locke, John. 1689. *An essay concerning human understanding*. London: MDCC.

Lockwood, Gwilym & Mark Dingemanse. 2015. Iconicity in the lab: A review of behavioral, developmental, and neuroimaging research into sound-symbolism. *Frontiers in Psychology* doi: 10.3389/fpsyg.2015.01246.

Newman, Stanley. 1933. Further experiments on phonetic symbolism. *American Journal of Psychology* 45. 53–75.

Nooteboom, Sieb. 1981. Lexical retrieval from fragments of spoken words: Beginnings vs. endings. *Journal of Phonetics* 9. 407–424.

Nygaard, Lynne C., Alison E. Cook & Laura L. Namy. 2009. Sound to meaning correspondance facilitates word learning. *Cognition* 112. 181–186.

Ohala, John J. 1983a. The origin of sound patterns in vocal tract constraints. In Peter MacNeilage (ed.), *The production of speech*, 189–216. New York: Springer-Verlag.

Ohala, John J. 1983b. The phonological end justifies any means. In S. Hattori & K. Inoue (eds.), *Proceedings of the 13th International Congress of Linguists*, 232–243. Tokyo: Sanseido.

Ohala, John J. 1994. The frequency code underlies the sound symbolic use of voice pitch. In Leane Hinton, Johanna Nichols & John J. Ohala (eds.), *Sound symbolism*, 325–347. Cambridge: Cambridge University Press.

Ohala, John J. & Carol J. Riordan. 1979. Passive vocal tract enlargement during voiced stops. In Jared. J. Wolf & Dennis H. Klatt (eds.), *Speech communication papers*, 89–92. New York: Acoustical Society of America.

Otake, Takashi, Giyoo Hatano, Anne Cutler & Jacques Mehler. 1993. Mora or syllable? Speech segmentation in Japanese. *Journal of Memory and Language* 32. 258–278.

Perlman, M. & G. Lupyan. 2018. The potential for iconicity in vocalization. *Scientific Reports* .

Perry, Lynn K., Marcus Perlman, Bodo Winter, Dominic W. Massaro & Gary Lupyan. 2018. Iconicity in the speech of children and adults. *Developmental Science* 21(3).

Peterson, Robert A. & Ivan Ross. 1972. How to name new brand names. *Journal of Advertising Research* 12(6). 29–34.

Proctor, Michael I., Christine H. Shadle & Khalil Iskarous. 2010. Pharyngeal articulation differences in voiced and voiceless fricatives. *Journal of the Acoustical Society of America* 127(3). 1507–1518.

Ramachandran, V.S. & E. M. Hubbard. 2001. Synesthesia–a window into perception, thought, and language. *Journal of Consciousness Studies* 8(12). 3–34.

Sapir, Edward. 1929. A study in phonetic symbolism. *Journal of Experimental Psychology* 12. 225–239.

Saussure, Ferdinand de. 1916. *Cours de linguistique générale*. Paris: Payot.

Selkirk, Elisabeth. 1995. Sentence prosody: intonation, stress, and phrasing. In John A. Goldsmith (ed.), *The handbook of phonological theory*, 550–569. Cambridge, Mass., and Oxford, UK: Blackwell.

Shih, Stephanie S., Jordan Ackerman, Noah Hermalin, Sharon Inkelas & Darya Kavitskaya. 2018. Pokémonikers: A study of sound symbolism and Pokémon names. *Proceedings of LSA* 2018.

Shinohara, Kazuko & Shigeto Kawahara. 2016. A cross-linguistic study of sound symbolism: The images of size. In *Proceedings of the Thirty Sixth Annual Meeting of the Berkeley Linguistics Society.*, 396–410. Berkeley: Berkeley Linguistics Society.

Sidhu, David & Penny M. Pexman. 2017. Five mechanisms of sound symbolic association. *Psychonomic Bulletin & Review* 1–25.

Stevens, Kenneth & Sheila Blumstein. 1981. The search for invariant acoustic correlates of phonetic features. In Peter Eimas & Joanne D. Miller (eds.), *Perspectives on the study of speech*, 1–38. New Jersey: Earlbaum.

Styles, Suzy J. & Lauren Gawne. 2017. When does maluma/takete fail? two key failures and a meta-analysis suggest that phonology and phonotactics matter. *i-Perception* 1–17.

Suzuki, Takao. 1962. Oninkookan to igibunka no kankei ni tsuite–iwayuru seidakuon tairitsu-o chuushin toshite. *Gengo Kenkyu [Journal of the Linguistic Society of Japan]* 42. 23–30.

Tobin, Joseph. 2004. *Pikachu's global adventure: The rise and fall of pokémon*. Durham: Duke University Press Book.

Uemura, Yukio. 1965. Onsei-no hyoushousei-ni tsuite [On the symbolic aspects of sounds]. In *Gengo seikatsu*, 66–70. Tokyo: Honami Shuppan.

Ultan, Russell. 1978. Size-sound symbolism. In Joseph Greenberg (ed.), *Universals of human language II: Phonology*, 525–568. Stanford: Stanford University Press.

Westbury, C. 2005. Implicit sound symbolism in lexical access: Evidence from an interference

task. *Brain and Language* 93. 10–19.

Westbury, John R. 1983. Enlargement of the supraglottal cavity and its relation to stop consonant voicing. *Journal of the Acoustical Society of America* 73. 1322–1336.

Yorkston, Eric & Geeta Menon. 2004. A sound idea: Phonetic effects of brand names on consumer judgments. *Journal of Consumer Research* 31. 43–51.