The Sound Symbolic Patterns in Pokémon Move Names in Japanese

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Abstract

In recent years, we have witnessed a dramatically growing interest 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 those Pokémon characters with names having more voiced obstruents are generally stronger (Kawahara et al., 2018b). 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 (= 99%) move names are based on real words in Japanese. An additional experiment with nonce names shows that both of these effects are very robust. 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 shows that such non-arbitrary relationships can hold even when the set of words under consideration are mostly existing words (Shih & Rudin, 2019; Sidhu et al., 2019).

1 Introduction

In recent years, we have witnessed a dramatically growing interest in sound symbolism—stochastic yet systematic associations between sounds and meanings (for recent reviews, see e.g. Dingemanse et al. 2015; Kawahara 2019a; Lockwood & Dingemanse 2015; Sidhu & Pexman 2018). One standard assumption often taken for granted in modern linguistics is that the relationships between sounds and meanings are arbitrary (Hockett, 1959; Saussure, 1916). However, 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 judge words with [a] to be larger than words with [i] (e.g. [mal] vs. [mil]: 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 1996; Kawahara et al. 2008; Kubozono 1999b; Suzuki 1962; Uemura 1965 among others).

Against this theoretical background, Kawahara et al. (2018b) studied the names of more than 700 Pokémon characters (all of those which were available as of October 2016), and found that those Pokémon characters with longer names tend to be stronger, and those Pokémon names with more voiced obstruents also 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. (2018b) found, for example, that Pokémon characters with longer names tend to be stronger,

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[*] This paper grew out of an in-class project by the second author for the seminar taught by the first author at International Christian University (ICU) in Fall 2017. We are very pleased to have this opportunity to present this work, a product of an active in-class student-teacher interaction at ICU, for Hibiya-sensei. Portions of the paper were presented at the 2nd Asian Junior Linguistics (Dec 2017) (Suzuki, 2017), the 1st International Conference on Pokémonastics (May 2018), the 2nd International Symposium on Applied Phonetics (Sept 2018), and PhonoFesta 2019 (March 2019)—we thank the audience at these occasions for helpful questions, comments and suggestions. We are grateful to Donna Erickson and Stephanie Shih for constructive feedback on previous versions of the paper. This study is supported by the JSPS grant #17K13448 to the first author. All remaining errors are ours.

larger and heavier (e.g. *mirukarosu* vs. *himbasu*, the former of which is stronger).[1] Kawahara et al. (2018b) relates this observation to "the iconicity of quantity" in natural languages (Haiman, 1980), in which longer words are associated with larger quantity. Kawahara (2017) in a follow-up study, found a similar correlation between mora counts and spell levels in the Dragon Quest game series. This sort of iconic relationship between the length of names and the strength of their denotations has been understudied in natural languages, even in the studies of sound symbolism, and it is important to study how prevalent this pattern is in natural languages.

Kawahara et al. (2018b) also found that in addition to the effects of mora counts, the number of voiced obstruents in the Pokémon characters' names correlates 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 emit lower frequency sounds (Ohala, 1994). Alternatively, voiced obstruents evoke images of largeness because they involve expansion of the oral cavity during their production due to the well-known aerodynamic challenge to sustain vocal fold vibration with obstruent closure (Ohala, 1983; Ohala & Riordan, 1979; Proctor et al., 2010; Westbury, 1983). If these hypotheses are on the right track, it implies that sound symbolic meanings are derived from articulatory and/or acoustic characteristics of particular sounds, just like (some) phonological patterns which have their bases in the articulatory and acoustic properties of the sounds under question—this parallel makes sound symbolism an interesting topic to study from the perspective of theoretical phonology (Kawahara, 2019a).

Several studies followed up on Kawahara et al. (2018b) and demonstrated via experimentation that the 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 et al., 2018a; Kawahara & Kumagai, 2019a; Kumagai & Kawahara, 2019). Exploration of sound symbolism targeting other languages followed these studies: Shih et al. (2019) present an extensive cross-linguistic analysis of existing Pokémon names in Cantonese, English, Japanese, Korean, Mandarin and Russian; Kawahara & Moore (2019) address the productivity of the sound symbolic patterns in the English Pokémon names found by Shih et al. (2018); Godoy et al. (2019) examine sound symbolic patterns in Brazilian Portuguese using an elicitation and a forced choice task.

Building on these studies, this paper tests whether we find sound symbolic patterns in the names of the moves that Pokémon characters use during their battles, just as in 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 (1) below for actual examples).[2] 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 is generally arbitrary (Hockett, 1959; Saussure, 1916). On the other hand, it could be the case, as discussed by Kawahara et al. (2018b), 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. A number of recent studies have in fact shown that sound symbolic effects are tangible in real words (even setting aside ideophones) (Shih & Rudin, 2019; Sidhu & Pexman, 2015; Sidhu et al., 2019; Sidorov et al., 2016), and the current study can be situated as a further case study along this line.

The results of the current investigation show that similar patterns found in the previous studies on

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[1] Mora is the prosodic counting unit that is demonstrably most salient for Japanese speakers (e.g. Kubozono 1999a; Labrune 2012; Otake et al. 1993—though see Kawahara 2016 for the role of syllables in speech production and perception in Japanese). A (C)V light syllable counts as one mora; a (C)VC syllable and a (C)VV syllable count 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 directly builds upon (Kawahara et al., 2018b).

[2] There are a handful of names that contain ideophones, which are generally more sound symbolic than other, prosaic words (Akita & Dingemanse, 2019); e.g. *hoppe surisuri* "cuddling with cheeks" and *piyopiyo panchi* "piyo-piyo punch." However, the majority of the move names do not contain any ideophonic expressions.

Pokémon (Kawahara et al., 2018b; Kawahara & Kumagai, 2019a) also hold in the names of Pokémon moves, further supporting the role of sound symbolic relationships in Pokémon naming patterns, although the effect of voiced obstruents was weak at best. More generally, the current study provides another case in which there is a non-arbitrary relationship between sounds and meanings. Further, as discussed by Shih et al. (2018, 2019), studying sound symbolism using Pokémon 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, since languages differ in terms of the sets of the denotations to which they refer.[3] The current paper therefore, like Kawahara et al. (2018b), opens up a new, useful testing ground 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. This is evidenced by the fact that this research has been featured in several popular magazine articles.[4] Relatedly, these projects on Pokémon names turn out to be useful teaching resources in introductory phonetics/linguistics classes (Kawahara, 2019b; MacKenzie, 2018). This last point is supported by the fact that this paper grew out of an in-class project by the second author, who was an undergraduate student at the time when this project started. Hosokawa et al. (2018) is another example in which undergraduate students explored sound symbolic natures of Pokémon names, and revealed hitherto unnoticed sound symbolic generalizations.

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, *aamuhammaa* "arm hammer" has the attack value of 100, whereas *aisubooru*'s "ice ball" attack value is 30. We started by analyzing existing move names to examine whether the two sound symbolic patterns found in Kawahara et al. (2018b) also hold.

2.1 *Methods* The target of the analysis was the set of move names available as of November 2017. The original data set was retrieved from the following website: `https://tinyurl.com/y6tddkkw` (last access, Oct. 2019). 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 two moves had attack values above 200, whereas most 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.[5] Most move names are based on real words in

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[3] This is true only to the extent that Pokémon is available in that language. However, even if Pokémon names are not available in a particular language, we can run an elicitation study to examine how Pokémon creatures/moves would be named in that language. For an example of this sort of study which elicited Pokémon characters' names from Brazilian Portuguese speakers, see Godoy et al. (2019).

As Kazuko Shinohara reminded us (p.c.), studies by Berlin (1994, 2006) are important precedents in terms of this research strategy. He explored the names of the rails and the tinamous—both of them are birds—in 17 different languages. In this work too, the set of denotations under exploration was fixed first, and a cross-linguistic comparison was conducted to examine how these denotations are named.

[4] Here are the four examples: (1) *Wired*, March 2017 (`http://wired.jp/2017/03/02/pokemon-sound/`); (2) *Keio University Newspaper*, July 2017 (`http://www.jukushin.com/archives/28130`); (3) *Kodomo-no Kagaku* ("Science for kids"), June 2019; (4) *Ketoru*, Oct. 2019.

[5] We note that this N is very large for a sound symbolic analysis of existing names. Some studies used 40 items out of the Swadesh list (Blasi et al., 2016; Wichmann et al., 2010), which itself consists of only 200+ items. Johansson & Zlatev (2013) analyzed more than 100 languages, but they focused on only deictic expressions, of which there are not many items. Johansson (2017) analyzed 28 antonym pairs. Pitcher et al. (2013) studied 112 male names and 151 female names. We hasten to add, though, that these studies involve cross-linguistic comparisons, and hence the Ns cannot and should not be directly compared. See also Shih et al. (2019) for discussion on how large the Pokémon universe is, compared to

Japanese. For example, *Pikachuu*'s moves include:

(1) *denki-shokku, denkoo-sekka, feinto, supaaku, hoppe-surisuri, hooden, tatakitsukeru, 10-manboruto, 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. As far as we can tell, the only non-existing names in our whole dataset were *borutekkaa*, *akuu(setsudan)*, *rasutaa(kanon)*, *rasutaa(paaji)*, and *huruuru(kanon)*, accounting for only 1% of the data. Voiced geminates (i.e. long consonants) were counted as one token of voiced obstruents. A Shapiro-Wilk normality test reveals no deviation from normality for the distribution of attack values ($W = 0.97, n.s.$)—see Figure 1; hence, no transformation was applied to the data (cf. distributions of Pokémon characters' weight and size are right skewed, and thus require log transformation: Kawahara et al. 2018b).

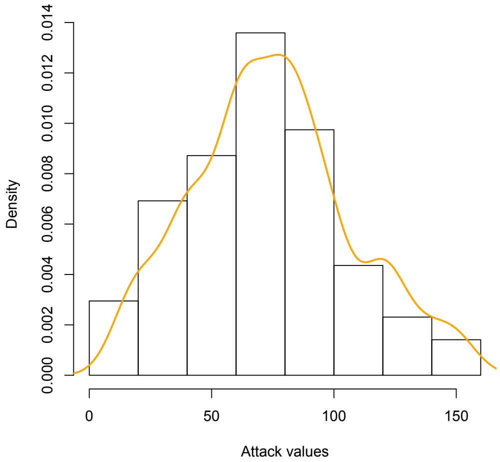

Figure 1: The distribution of attack values.

2.2 *Results and discussion* Figures 2 and 3 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. Here and throughout, "-" indicates a mora boundary.

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the sets of words that are often analyzed in other sound symbolism studies.

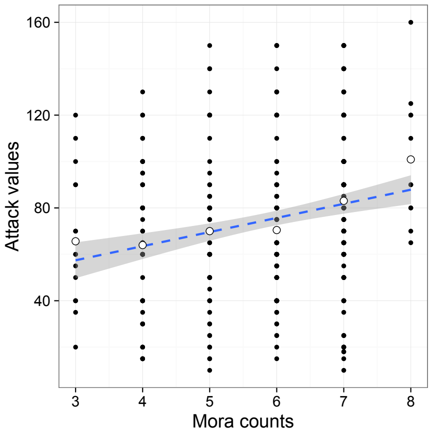

Figure 2: The correlation between attack values and mora counts. The white dots represent the averages in each condition. The linear regression line, with their 95% confidence intervals, is shown as a dashed line.

Table 1: Some representative examples of Figure 2. The attack values are shown in parentheses. “-” indicates a mora boundary.

3 moras	4 moras	5 moras	6 moras
[i-ka-ɾi] (20)	[ka-mi-tsu-ku] (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-ɾi] (80)	[he-do-ro-we-e-bu] (95)
7 moras	8 moras		
[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-ɾi-zu-mu-re-e-za-a] (160)		

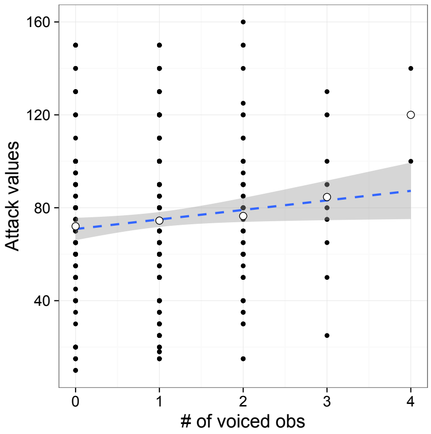

Figure 3: The correlation between attack values and the number of voiced obstruents.

Statistically, the slope of the linear regression line is significantly different from zero in Figure 2 ($t(388) = 6.09, p < .001$); the slope in Figure 3 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. To address

Table 2: Some representative examples of Figure 3. The attack values are shown in parentheses. The voiced obstruents are in bold letters.

0 voi obs	1 voi obs	2 voi obs
[ko-na-ju-ki] (40)	[a-ku-ɾo-**b**a-t-to] (55)	[**d**o-ku-**z**u-ki] (80)
[mi-ne-u-tɕi] (40)	[i-wa-na-**d**a-ɾe] (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-ɾe-i-**b**u-**ba**-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)	

the possibility that these correlations are solely driven by extreme values, Pearson correlation coefficients and their 95% confidence intervals were estimated using the bias-corrected and accelerated percentile (BCa) method (Efron & Tibshirani, 1993). In this bootstrap procedure, a correlation is calculated using a random sample with replacement, and this is repeated 1,000 times to calculate 95% confidence intervals. The calculation was implemented using R (R Development Core Team, 1993–) and `boot` package (Ripley, 2017).[6] The correlation coefficient between mora counts and attack values is 0.21, with its bootstrap 95% interval ranging from 0.08 to 0.30. The correlation between voiced obstruents and attack values is 0.12 with its bootstrap 95% confidence intervals ranging from 0.02 to 0.22. Neither of the 95% confidence intervals include 0, indicating that these correlations are not driven solely by extreme values.

As anticipated above, these results should not be taken for granted, given that most move names are based on real words. 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 ($t(386) = -0.55, n.s.$) or their interaction ($t(386) = 0.78, n.s.$). It does not seem to be the case that the effects of voiced obstruents hold independently of the effects of mora counts, unlike the patterns of Pokémon characters' names (Kawahara et al., 2018b). It may be the case that since those names that contain several voiced obstruents have to be long, what we are observing in Figure 3 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 as 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. (2018b) 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. The next section reports an experiment addressing this prediction.

Before reporting the experiment, we briefly address one alternative possibility which may explain the discrepancy between the current results and those of Kawahara et al. (2018b): it may be the case that we did not observe a clear effect of voiced obstruents in the move names due to the smaller N. To examine this possibility, we randomly sampled 390 tokens from Kawahara et al.'s (2018b) data (i.e. the set of Pokémon characters' names), and ran the multiple regression analysis with the same model structure. We reiterated this procedure 10 times, and in all iterations, the effect of voiced obstruents remained significant, at least at the $p < .01$ level.

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[6] We thank Eleanor Chodroff for sharing her script. The actual implementation of this analysis followed that of Chodroff & Wilson (2017).

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 clear 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 *Methods*

3.1.1 *Stimuli* 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.[7] This random name 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 occured word-initially, as this position is psycholinguistically most prominent (e.g. Hawkins & Cutler 1988; Nooteboom 1981; 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 in Japanese).

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-çi-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]	[çi-ki-so-ku-na-ɕi-ja]
[ro-çi]	[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-çi-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-çi-ke-ro]	[zu-to-tu-ri-su]	[da-na-ri-no-mi-ki]	[gu-ka-ne-ɕi-mo-ni-ri]

3.1.2 *Procedure* The experiment was distributed online using SurveyMonkey.[8] 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 judge how strong each move was (i.e. what its most appropriate attack value would be), using a slider which ranged from 1 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 ordinal scale, in which 1 was labeled "I have never played Pokémon," 7 was labelled "Pokémon is my life," and 4 was labelled "so so" (the other numbers were not labelled). Since not all participants used a full range, each obtained score was standardized within each participant.

3.1.3 *Participants* The experiment was advertised on SNS services and through word of mouth. Excluding those who were disqualified (e.g. some did not enter demographic information; some quit in the middle of the experiment), a total of 86 native speakers of Japanese finished the experiment.

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[7] `http://sei-street.sakura.ne.jp/page/doujin/site/doc/tool_genKanaName.html` (last access, July 2019)

[8] `http://surveymonkey.com` (last access, July 2019)

3.2 *Results* Figure 4 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 observe that those names with voiced obstruents (right panel) were generally judged to be stronger than those names without a voiced obstruent (left panel).

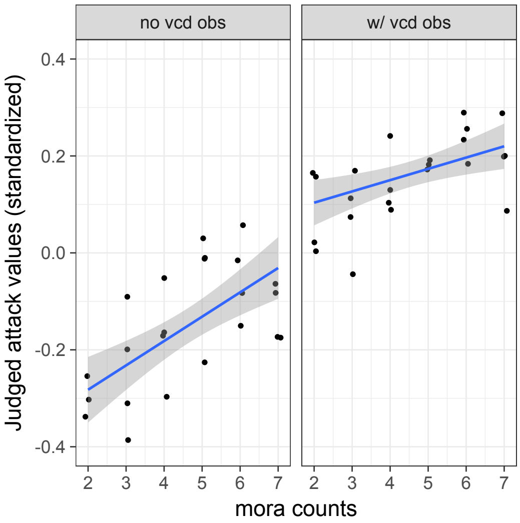

Figure 4: The correlation between the judged attack values (standardized) and the number of mora counts. The judged attack values were averaged across all the participants. The points are randomly jittered by 0.075 to prevent the points from overlapping with each other.

A linear mixed effect 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 was fit. Both slopes and intercepts of the random variables were included in the model (Barr et al., 2013). The analysis was implemented using R (R Development Core Team, 1993–), with `lme4` (Bates et al., 2017) and `lmerTest` (Kuznetsova et al., 2017) packages. The effect of mora counts was significant ($t = 6.30, p < .001$), and so was the effect of voiced obstruents ($t = 12.2, p < .001$). The interaction between these two factors was also significant ($t = -5.78, p < .001$), because the correlation is stronger for those items without a voiced obstruent than for those items with a voiced obstruent ($\rho = 0.79$ vs. $\rho = 0.60$). Since the interaction term was significant, separate linear mixed effect models were fit for data with no voiced obstruents and those with voiced obstruents. The effects of mora count were significant for the data with no voiced obstruents ($t = 13.19, p < .001$) and those with a voiced obstruent ($t = 2.95, p < .01$).[9] We thus conclude that generally both the effects of mora counts and voiced obstruents are robust.

3.3 *Discussion* One question that arises is to what extent the current results are driven by 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. If true, then the sound symbolic knowledge may have arisen from statistical learning from the lexicon (see Sidhu & Pexman 2018), just like (some) phonotactic knowledge can arise from statistics in the lexicon (Daland et al., 2011). 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 of the two correlations, tested using a non-parametric Spearman test, were significant (no voiced obstruent: $\rho = 0.00, n.s$; w/ voiced obstruent: $\rho = 0.13, , n.s.$), and this result is similar to what is observed in the

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[9] Since the model with random slopes failed to converge for the condition without a voiced obstruent, a simpler model with only random intercepts was interpreted.

previous experimental studies on Pokémon names (Kawahara et al., 2018a; Kawahara & Kumagai, 2019a).

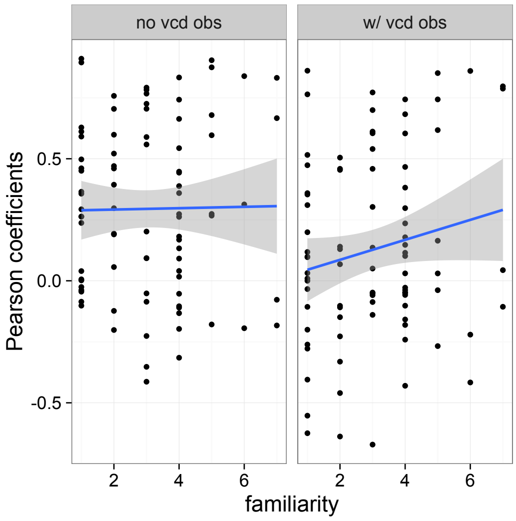

Figure 5: The effects of familiarity on correlation between mora counts and judged attack values.

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 shows the correlation between familiarity with Pokémon and the effect sizes of voiced obstruents (differences between the averages of the two conditions). The correlation turned out to be negative and significant ($\rho = -0.34, p < .01$). 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.

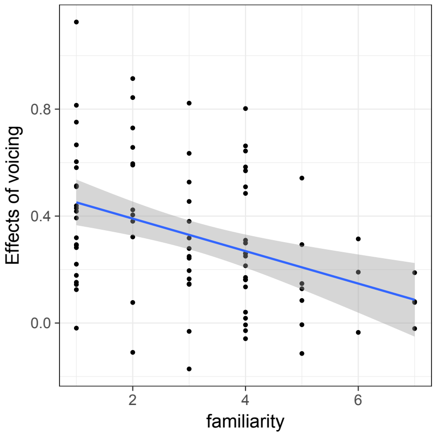

Figure 6: The effect sizes of voiced obstruents plotted by familiarity with Pokémon.

4 Overall conclusion

The current study built on a previous case study of sound symbolism which shows that both voiced obstruents and mora counts increase Pokémon characters' strength parameters (Kawahara et al., 2018b). 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. (2018b). Just like some recent studies revealing sound symbolic patterns in existing names (Sidhu & Pexman, 2015; Sidhu et al., 2019; Sidorov et al., 2016; Shih & Rudin, 2019), we found some positive effects. 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, on the other hand, shows a 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. Jurafsky 2014; Klink 2000; Yorkston & Menon 2004)—our current study shows that there are ways to phonologically express the strength of moves in the Pokémon world.

The current study opens an opportunity for future work, which is to analyze the role of sound symbolism in Pokémon move names in other languages. As stated in the introduction, the Pokémon universe provides a unique universe in which the set of denotations is fixed across languages, and thus offers a nice testing ground for cross-linguistic comparison in sound symbolic studies (Shih et al., 2018, 2019). While cross-linguistic comparisons of Pokémon characters have already been conducted targeting English, Japanese and several other languages (Shih et al., 2019), no studies have yet analyzed move names from a cross-linguistic perspective. Analyzing Pokémon move names—both existing move names as well as nonce move names in an experimental setting like the current study—would further shed light on the nature of sound symbolism in natural languages.[10]

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[10] One concrete line of future research that we find promising has been suggested by Seunghun Lee (p.c., November 2019). In Korean ideophones, tense consonants function as an intensifier, and we observe greater intensity when the laryngeal feature appears twice than when it appears only once (McCarthy 1983, citing Martin 1962); e.g. [pancak] < [panc'ak], [p'ancak] < [p'anc'ak] 'glittering.' Examining this pattern in depth may help us address the issue of the cumulative nature of sound symbolism—the question of whether two instances of a segment causes stronger images than one instance (e.g. Kawahara & Kumagai 2019b; Thompson & Estes 2011), an issue that is shared by many practicing theoretical phonologists (Kawahara, 2019a), especially in the context of comparing Optimality Theory (Prince & Smolensky, 1993/2004) and other weight-based theories (e.g. Pater 2016; Zuraw & Hayes 2017).

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