

The sound symbolic patterns in Pokémon move names in Japanese*

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. 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. 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.

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1 Introduction

In recent years, we have witnessed a (dramatically) growing interest in sound symbolism—stochastic and systematic associations between sounds and meanings (for recent reviews from slightly different perspectives, see Akita 2015; Dingemanse et al. 2015; Hinton et al. 2006; Lockwood & Dingemanse 2015; Nuckolls 1999; Sidhu & Pexman 2017; Svantesson 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 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 different sets of sounds and they are susceptible to different sets 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 lexically distinguishes “hot water” and “cold water,” but English does not have a lexical item specifically designated for “hot water.” Hence, just because there are language variations does not mean there cannot be systematic relationships between sounds and meanings (Shih et al. 2018). 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. In particular, arbitrariness grants languages immense expressive power that allows us to express many different things in many different ways (Hockett 1959).

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 (see also Johansson & Zlatev 2013, Ultan 1978 and Wichmann et al. 2010 for studies of sound symbolism in actual vocabulary items).

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), 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 for-

mal grammatical model such as Optimality Theory (Prince & Smolensky 1993/2004) and MaxEnt Grammar (Hayes & Wilson 2008) to capture patterns of sound symbolism (Alderete & Kochetov 2017; Kawahara et al. 2018b; Kochetov & Alderete 2011). Alderete & Kochetov (2017) demonstrate that some phonological alternations (e.g. affrication and palatalization) are motivated by sound symbolic principles, and these alternations interact with other phonological constraints in a single grammatical system. Kawahara et al. (2018b) argue that as long as generative phonology is a function that maps one representation (e.g. underlying forms) to another (surface forms)—as it in fact has been—there is nothing that prevents us from using the same formalism to model the mapping from representation in one modality (i.e. sound) to representation in another modality (i.e. meaning). In other words, the grammatical architecture that phonologists have been using for decades can be applied to formalize sound symbolic patterns at no additional costs.

Another aspect of sound symbolism which makes it interesting for theoretical phonologists is the observation that at least some sound symbolic patterns operate at the level of distinctive features rather than individual segments. For example, secondary palatalization in Japanese mimetic words expresses “uncontrolledness” (Hamano 1986), and this generalization can be captured using distinctive features such as [palatal] (Alderete & Kochetov 2017) or [-anterior] (Mester & Ito 1989). This sound symbolic pattern operates at the featural level, because consonants at all places of articulation can be affected by it (although there is a preference toward targeting coronal consonants). To take another example, Kumagai & Kawahara (2017) point out that almost all diaper names in Japanese contain [p] and/or [m]; when asked to produce new diaper names, Japanese speakers tend to use *all* types of labial consonants more often than when they are asked to come up with new names for adult cosmetics. This result suggests that the sound symbolism at issue operates at the level of a distinctive feature—[labial]—rather than at the level of individual segments. In other words, sound symbolism shows patterns of feature-based generalizations, just like “normal” phonological patterns (Albright 2009; Finley & Bedecker 2009). As we will observe, one sound symbolic pattern that is examined in this study also involves a class of sounds that is phonologically/featurally defined—i.e. voiced obstruents, or a set of [-son, +voice] segments.

Third, 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 how human languages may have emerged and evolved (Berlin 2006; Cabrera 2012; Haiman 2018; Perlman & Lupyan 2018; Perniss & Vigiliocco 2014; Perniss et al. 2010; Ramachandran & Hubbard 2001).

Fourth, 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; Kantartzis 2011; Perry et al. 2018) or L2 (Bankieris & Simner 2015; Kantartzis 2011; 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. Sound symbolism may thus provide a partial answer to the question of why human children acquire languages so quickly—a fundamental question that theoretical linguists attempt to answer.

Fifth, sound symbolism can be considered as a specific instance of general cross-modal (or cross-sensory) correspondences, in which sensation in one modality has correspondences with sensation in another modality (see Sidhu & Pexman 2017 and Spence 2011 for informative reviews; see Bankieris & Simner 2015 for an empirical study exploring the relationship between sound symbolism and synaesthesia). There has been a growing body of interest in these cross-modal perception patterns in cognitive science (Sidhu & Pexman 2017; Spence 2011). Therefore, engaging with systematic linguistic analyses of sound symbolism would facilitate more extensive interdisciplinary communication between linguists and other cognitive scientists.

Finally, there is an 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, we build on a recent case study reported in Kawahara et al. (2018c), which has found that there are sound symbolic patterns in Pokémon names. They 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. (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).¹ 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 2015; Dingemanse et al. 2015; Haiman 1980, 1984, 2018; Mattes 2017). Kawahara (2017), in a follow-up study, found a similar correlation between mora counts and spell levels in Dragon Quest

¹Mora 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 and a CVV 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 builds upon (Kawahara et al. 2018c).

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 studies²), 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 emit lower frequency sounds (Ohala 1983b, 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 1983a; 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.

Several studies followed up on Kawahara et al. (2018c) and 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 et al. 2018a; Kawahara & Kumagai 2019; 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).³ 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). On the other hand, it could be the case, as discussed

²Most of these studies focus on the analysis of ideophones, which are undoubtedly more sound symbolic than other lexical items (see Akita & Dingemanse (to appear) and Dingemanse 2018 for recent reviews of the studies on ideophones). They also tend to focus on specific constructions like reduplication, in which reduplicated words denote larger quantity, and emphatic lengthening, in which lengthening of segments as in an expression like *it is sooooo long* denotes stronger commitment by the speaker to the proposition expressed (Dingemanse 2015; Dingemanse et al. 2015; Kawahara & Braver 2014; Mattes 2017).

³There are a handful of names that contain ideophones; e.g. *hoppe suri-suri* and *piyo-piyo panchi*. However, the majority of the names does not.

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. Further, 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, since as discussed above, languages differ in terms of the sets of the denotations to which they refer. The current paper therefore, like Kawahara et al. (2018c), 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. Moreover, these projects on Pokémon names turn out to be useful teaching resources in introductory phonetics/linguistics classes (Kawahara to appear; MacKenzie 2018).

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. *Pikachu* 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-genereto* “V-generate”), of which there were four, were also

excluded. Since two moves had attack values 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.⁴ The only non-existing names 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. 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 (cf. distributions of Pokémon characters’ weight and size, which are right skewed: Kawahara et al. 2018c).

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.

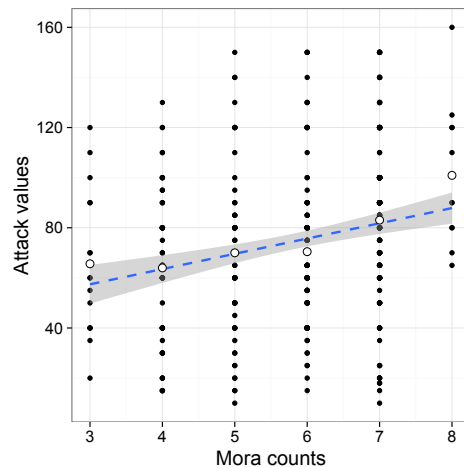


Figure 1: The correlation between attack values and mora counts. The white dots represent the averages in each condition. The linear regression lines, with their 95% confidence intervals, are shown as dashed lines.

⁴For example, *Pikachu*’s moves include *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.

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-çi-o-ki] (60)	[i-wa-na-da-re] (75)	[ka-e-N-ho-o-ça] (90)
[çi-no-ko] (40)	[φu-mi-tsu-ke] (65)	[ta-ki-no-bo-ri] (80)	[he-do-ro-we-e-bu] (95)
7 mora	8 mora		
[a-i-a-N-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)		

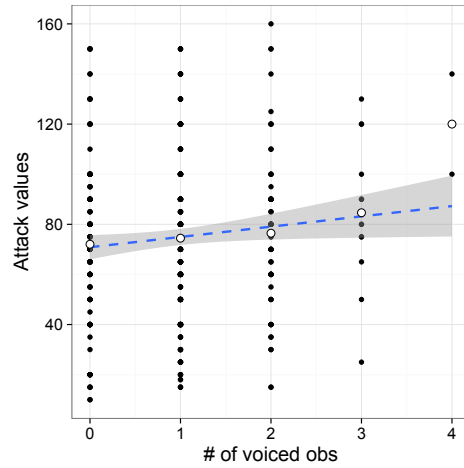


Figure 2: The correlation between attack values and the number of voiced obstruents.

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

0 voi obs	1 voi obs	2 voi obs
[ko-na-ju-ki] (40)	[a-ku-ro- ba -t-to] (55)	[do -ku-zu-ki] (80)
[mi-ne-u-tçi] (40)	[i-wa-na- da -re] (75)	[ri-i-φu- bu -re-e- do] (90)
3 voi obs	4 voi obs	
[go -o-su-to- da -i- bu] (90)	[bu -re-i- bu - ba -a- do] (120)	
[ta-ma- go - ba -ku- da -N] (100)	[go -d- do - ba -a- do] (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. To address 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 1987; 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.⁵ 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. 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 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. (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.

⁵The calculation was implemented using `boot` package (Ripley 2017) using R (R Development Core Team 1993–). 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 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.⁶ 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 is placed word-initially, as this position is psycholinguistically most prominent (e.g. Brown & MacNeill 1966; 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).

Table 3: The stimulus list for the experiment.

2 mora	3 mora	4 mora	5 mora	6 mora	7 mora
[su-tsu]	[ko-çi-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-çi-ja]
[ro-çi]	[se-sa-ri]	[ri-se-mi-ra]	[so-ka-ne-ni-re]	[mu-ku-ho-ro-ho-te]	[ha-mi-çi-na-çi-no-ri]
[jo-ni]	[re-to-na]	[ra-çi-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-ϕu-sa-ta]	[gu-se-ϕu-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-ϕu-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-çi-mo-ni-ri]

⁶http://sei-street.sakura.ne.jp/page/doujin/site/doc/tool_genKanaName.html

The experiment was distributed online using SurveyMonkey.⁷ 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 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

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

⁷<http://surveymonkey.com>

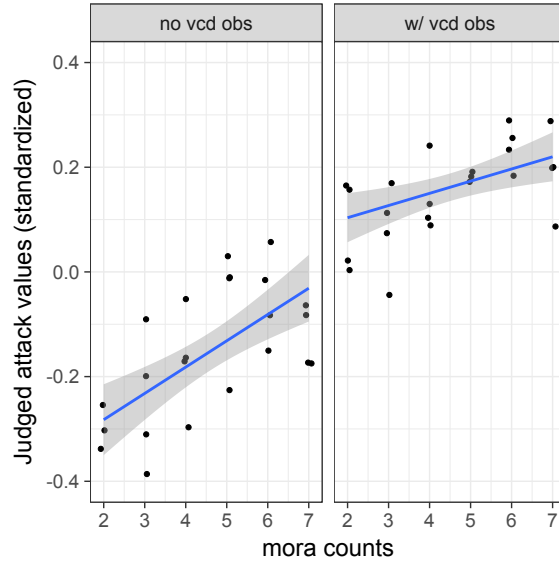


Figure 3: The correlation between the judged attack values (standardized) and the number of mora counts. The judged attack values were averaged across all the participants. The points are randomly jittered by 0.075 to prevent the points from overlapping with each other.

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 ($t = -5.78, p < .001$), because the correlation is 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 fit 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.

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 2017), just like (some) phono-

tactic knowledge may arise from statistics in the lexicon (Daland et al. 2011). To examine this hypothesis, Figure 4 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: $r = 0.18, t = 1.67, n.s.$), and this result is similar to what is observed in the previous experimental studies (Kawahara et al. 2018a; Kawahara & Kumagai 2019; Kumagai & Kawahara 2019).

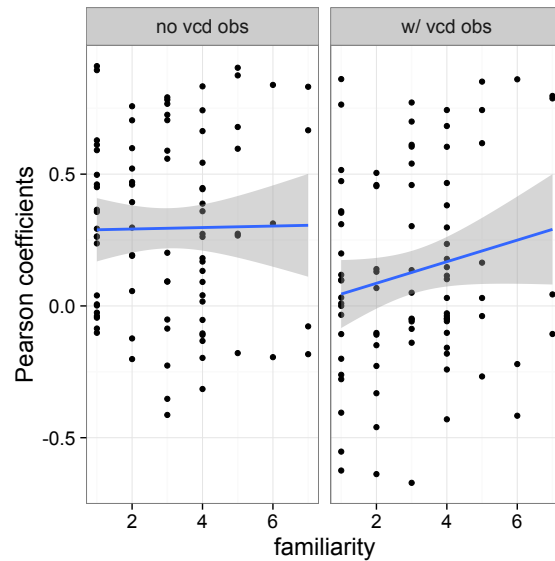


Figure 4: The effects of familiarity on correlation between mora counts and judged attack values.

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.

Next, an anonymous reviewer asked whether we can reduce this “sound symbolic knowledge” to a more domain-general mechanism that maps quantities in one cognitive domain to those in another cognitive domain (Marks 1978; Spence 2011), the ability which is demonstrably observed not only in humans but also in chimpanzees (Ludwig et al. 2011). We agree that the sound symbolic knowledge may be related to this general cognitive mechanism. However, we do not believe that the former can entirely be reduced to the latter. Our position, more specifically, is that the former is *grounded* in the latter.⁸

⁸This issue is reminiscent of a more widely discussed topic in the phonological literature: what is the relation-

Our reasoning is driven by the observation that Japanese and English differ in terms of how they linguistically realize the domain-general cross-modal mapping mechanism, at least in the context of Pokémon naming patterns. Shih et al. (2018) show that in the existing Pokémon names, in English it is *segment* counts⁹ rather than *mora* counts or *syllable* counts that matter in sound symbolism (more segments in the names imply heavier, stronger and more evolved Pokémon characters), whereas in Japanese the relevant measure is *mora* counts rather than *segment* counts. Kawahara & Moore (2018) confirmed this observation regarding English experimentally—English speakers generally associate larger Pokémon characters with names with more segments, but they do not associate larger characters with names with more syllables. These observations show that not all measures of phonological quantity are mapped onto image of largeness in the context of Pokémon naming patterns.

We would also like to point out that in other linguistic patterns, “the longer, the larger” principle does not always hold. In Japanese hypocoristics formation, for example, reduplication such as *miwa-miwa* from *miwa* invokes diminutive meaning. Mandarin shows the same association, and indeed in the context of Pokémon names too, reduplicated names imply those characters that are smaller and lighter (Starr et al. 2018). These examples show that linguistic mapping between phonological length and meaning can be more abstract than what the domain-general cross modal quantity mapping predicts.

We do not deny, however, that sound symbolic knowledge is *grounded* in the domain general mapping of quantity across different modalities, especially given the clear parallel between the iconicity of quantity in linguistic patterns and cross-modal mapping of quantity. We also admit that our argument is based on different—albeit related—datasets, and it is hoped that this issue will be resolved more directly in a follow-up study. There remains a possibility that what drove the current results may be the domain-general mapping principle rather than more abstract sound symbolic knowledge. Exploring the relationship between linguistic knowledge and domain-general cognitive knowledge is actually one of the fundamental issues in linguistic theorization, and analyzing Pokémon names may shed light on this important debate.

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.

ship between abstract phonological knowledge and phonetic constraints that speakers and listeners face in producing and perceiving speech? The relevant literature is too big to cover here, but Archangeli & Pulleyblank (2015) and Padgett (2015) offer informative reviews and discussion. Our use of the term *grounded* is much inspired by Archangeli & Pulleyblank (1994)—some phonological alternations and constraints are motivated by phonetic considerations, but they are nevertheless controlled by different modules of grammar.

⁹which is not to be confused with letter counts.

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.

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 world provides a unique universe in which the set of denotation is fixed across languages, and thus offers a nice testing ground for cross-linguistic comparison in sound symbolic studies (Shih et al. 2018). While cross-linguistic comparisons of Pokémon characters have already been conducted targeting English and Japanese (Shih et al. 2018), 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 shed light on the nature and role of sound symbolism in natural languages. Especially it would help us address the question of the universality and language-specificity of sound symbolic patterns in natural languages.

One remaining question, which pertains to this general project on sound symbolic effects in Pokémon names, is whether the creators of Pokémon 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 the general audience shares 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; Japanese speakers were sensitive to the sound symbolic principle under question.

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