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Sound (Symbolic) Patterns in Pokemon Names: Focusing on Voiced Obstruents and Mora Counts

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Abstract

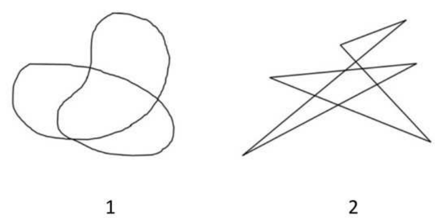
This paper presents a case study of sound symbolism, cases in which certain sounds tend to be associated with particular meanings. The current study uses the corpus of all pokemon names available as of October 2016. This paper explores the effects of voiced obstruents and mora counts in Japanese pokemon names, and reveals that both of them impact pokemon characters' size, weight, strength parameters, and evolution levels. In particular, the number of voiced obstruents in pokemon names positively correlates with size, weight, evolution levels, and general strength parameters, except for speed. We argue that this result is compatible with the Frequency Code Hypothesis proposed by Ohala. The number of moras in pokemon names positively correlates with size, weight, evolution levels and all strength parameters. Multiple regression analyses show that the effects of voiced obstruents and those of mora counts hold independently of one another. Not only does this paper offer a new case study of sound symbolism, it provides evidence that sound symbolism is at work when naming proper nouns. In general, the materials provided in this paper should be useful for undergraduate education in linguistics and psychology to attract students' interests, as pokemon is very popular among current students.

Introduction

This paper offers a new case study of sound symbolic patterns, in which particular sounds tend to be associated with particular meanings or images (e.g. [1–8] and many others). Although language is a system which can in principle combine any phonotactically permissible sound sequences to any meanings (the thesis of arbitrariness: [9, 10]), there are some systematic exceptions. For example, voiced obstruents (/b/, /d/, /g/, /z/) are often associated with "heaviness" and "largeness", and these associations have been shown to hold for English speakers [11] as well as for Japanese speakers [2, 12–15] and Chinese speakers [13].

It has also been demonstrated that sound symbolism can affect naming patterns [7, 12, 15–19]. For example, Köhler's classic study [17] shows that, given a pair of a round object and an angular object (see Fig. 1), people tend to associate *maluma* with the former and *takete* with the latter (see [15, 20–24] for follow-up studies of this effect). In a similar situation, a round object is more likely to be associated with *bouba* than with *kiki* [7, 14, 25–27]. Berlin [16] argues that sound symbolism is operative when naming animals and insects in many languages that he studies—for example, animals that move slowly tend to be named with sounds with low frequency energy (such as labial consonants and nasal consonants). The experiment reported in Perfors [18] reveals that English male names with stressed front vowels are judged to be more attractive than those with back vowels, but English female names with stressed back vowels are judged to be more attractive than those with front vowels. All of these studies indicate that the choice of sounds in naming patterns is not entirely random, but rather governed, at least partially, by some sound symbolic principles.

Fig 1. Schematic illustration of *maluma* and *takete* figures. A pair of a round object and an angular object; the former is more likely to be named *maluma*/*bouba* and the latter is more likely to be named *takete*/*kiki*. Taken from [12], inspired by [17].



Building on this research tradition, we ask whether there are any sound symbolic effects in Japanese pokemon names (cf. [28]). Pokemon started as a video game in 1995 by Nintendo, and has been very popular in Japan and many other countries (see the Wikipedia article: `https://en.wikipedia.org/wiki/Pokémon` for details). As of 2016, there are more than 700 pokemon characters in total, and this is the target of the current study. The current corpus-based study suggests that there are indeed some systematic patterns in pokemon characters' names, which can be considered to be sound symbolic. More specifically, we show that the number of voiced obstruents in pokemon names positively correlates with pokemon character's size, weight, evolution levels, and general strength parameters, except for speed. The number of moras in pokemon names positively correlates with size, weight, evolution levels and all strength parameters.

There are a few reasons for using pokemon in order to explore sound symbolic patterns in naming patterns of proper names. First, there are more than 700 pokemon characters, as of October 2016, guaranteeing enough number of data points for a quantitative analysis. Second, each pokemon character has many numeric parameters, such as size, weight, and various strength parameters, which allows us to examine which parameters correlate with what kinds of sound properties. Third, most if not all current university students, in Japan and other countries, are familiar with pokemon, and this is a very catchy topic to use in introductory linguistics, phonetics, and psychology classes.

This paper focuses on the effects of voiced obstruents and mora lengths, but we by no means claim that these are the only sound symbolic patterns lurking behind the pokemon naming systems in Japanese—interested students and researchers are welcome to follow up on our case study. The coded dataset will be made available once the paper is accepted for publication.

One final caveat. Pokemon names do sometimes include real, existing words in

Japanese. For example, *hushigidane* consists of *hushigi* 'mysterious' and *tane* 'seed' (the first consonant of the second word becomes voiced by a morphophonological process called rendaku: [29,30].) Since real words do not often follow sound symbolic relationships (the thesis of arbitrariness: [9,10]), we expected that the effects of sound symbolism would not be perfect. Nevertheless, as with other cases of sound symbolism, there could be stochastic tendencies. Principles of sound symbolism may even possibly affect the choice of real words in pokemon naming, in such a way that their names represent their characteristics well, although this influence too would be stochastic, if present at all. We thus take a statistical approach using the large corpus of pokemon names.

Materials and Methods

Hypotheses tested

This paper focuses on two types of effects: the effects of voiced obstruents and those of mora length. Voiced obstruents include a set of sounds (/b/, /d/, /g/, /z/), which are produced with fairly strong constriction in the oral cavity—strong enough to result in aperiodic noise, frication or burst—accompanied with vocal fold vibration [31]. Moras are basic counting units in Japanese (much like syllables in English), which include a vowel (optionally preceded by a consonant), a coda nasal, and the first half of a geminate: [32–36]. For example, [to-o-kyo-o] 'Tokyo' contains four moras, [ho-n-da] 'Honda' contains three moras, and [po-k-ki-i] 'Pocky' contains four moras (here and throughout, "-" represents a mora boundary). Moras, rather than segments or syllables, are used in the current analysis, as the moras are arguably the most psycholinguistically prominent counting units for Japanese speakers ([37–39], though cf. [33,40]).

One reason to study the effects of voiced obstruents is that sound symbolic meanings of voiced obstruents are well-known in Japanese [2,13,15,41–43]. For example, there is a minimal pair in Japanese onomatopoetic words, *goro-goro* and *koro-koro*—both of these words represent the state of a rock rolling; however, the former implies that the rock is big and heavy. Kawahara [42] observes that *gandamu*, a giant robot (about 15 m and 7500 kilograms) in a science fiction series anime, would sound very funny if we turn the voiced obstruents into voiceless obstruents, i.e. *kantamu*. In fact, *kantamu* is used as a name for a parody character in the anime *Kureyon Shinchan*, and it is only as big as a 5-year old boy. These examples illustrate that there is a clear sense in which voiced obstruents are associated with large and heavy images in Japanese.

These associations may have a phonetic basis, which makes sense under the Frequency Code Hypothesis, proposed by Ohala [44,45]. In this theory, high frequency sounds imply small objects, whereas low frequency sounds imply large objects, which reflects the law of sound vibration. Acoustically, voiced obstruents are characterized by low frequency energy during their constriction [46–49] (known as "closure voicing" or "a voice bar"), as well as in their surrounding vowels, especially in their low f0 and low F1 [47,50–52]. The low frequency components of voiced obstruents would lead to large images, according to the Frequency Code Hypothesis, and everything else being equal, heavy images. (See also [13,15,42] for an articulatory explanation of why voiced obstruents may be considered to be large, which is based on the oral cavity expansion due to the aerodynamics of voiced obstruents: [53]).

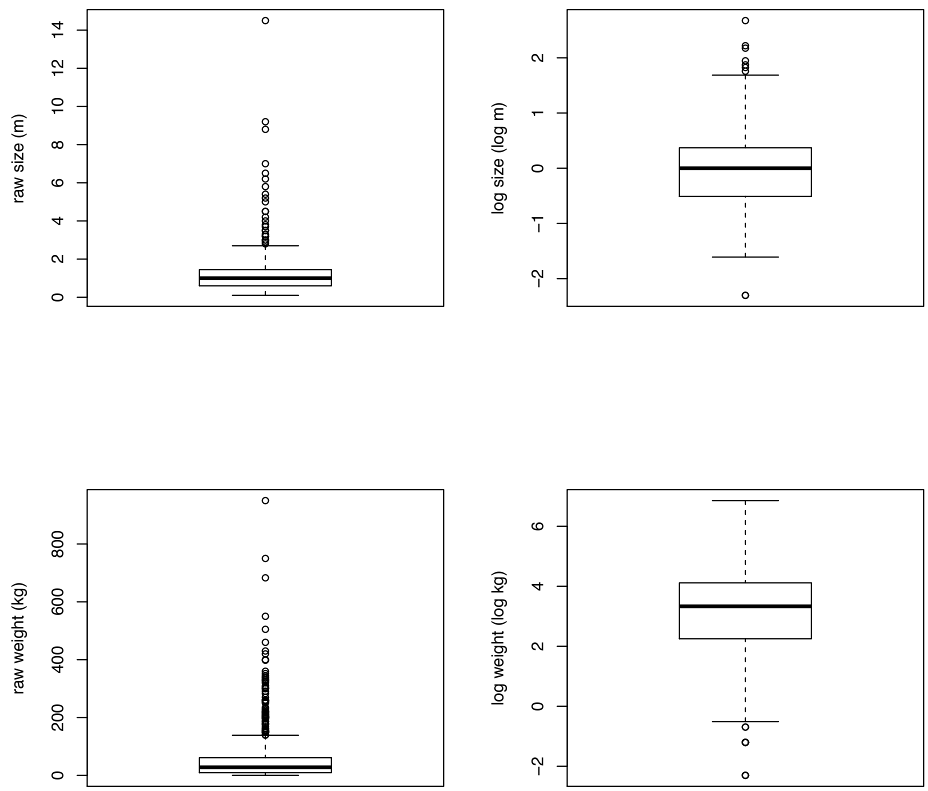
The effects of mora length came out during our data-mining stage. We noticed that those pokemons with more moras tend to have strong status parameters, heavy, and large. For example, *go-o-su-to* (5 moras) is stronger than *go-o-su* (4 moras). Also, *pichuu* was introduced as a weaker version of *pikachuu*; in this pair, the weakness was represented by the truncation of the second mora. We thus statistically examined the effects of mora counts of pokemon names. As far as we know, no previous studies have proposed sound symbolic relationships between word length on the one hand, and notions such as size and weight on the other. Therefore, this is a new and interesting hypothesis to test.

Analyses

For our analysis, we started with the corpus of the names of all the pokemon characters available in October, 2016. We excluded those pokemon names that are prefixed with *mega* 'mega'. These pokemons tend to be larger and heavier, and this prefix contains a voiced obstruent; to be conservative, we excluded those pokemon characters. Some of the same pokemon can have a suffix *mesu* 'female' or *osu* 'male', and these are excluded to avoid counting the same characters twice. There is one pokemon character with four voiced obstruents (*jiguzaguma*), which was excluded, because there is only one data point. After these exclusions, 715 pokemon characters remained.

Each pokemon character has their size (m) and weight (kg) specified. However, some pokemon characters are outstandingly large and/or heavy. For example, *guraadon* is 3.5 m and 950 kg. Since the distribution of these measures are heavily right skewed, we took the natural log of these measures, as illustrated in Fig. 2.

Fig 2. Distribution of size and weight values. Boxplots illustrating the distribution of size (top) and weight (bottom) values. Raw values are shown in the left panels; log-transformed values are shown in the right panels.



Most pokemon characters undergo “evolution”. For example, *njoromo* becomes *njorozo* and then *njorobon*. We coded these evolution levels as 0, 1, 2, respectively. Pokemon came out in different series in different years, and 16 pokemon characters were introduced as “pre-evolution” version of an already-existing character—they are referred to as “baby pokemon”. For example, *pichuu* was added as the baby pokemon of *pikachuu*, whose evolved version is *raichuu*. In such cases, they are coded as -1, 0, 1, where the baby pokemon is coded as -1. Some pokemon characters do not simply undergo any evoluation, in which case they are coded as 0. Finally, each pokemon is also specified for its strength parameters, including HP, attack, defense, special attack, special defense, and speed. These measures were also used as dependent variables.

To summarize, the independent variables are (1) the number of voiced obstruents and (2) the number of moras in each pokemon names. The dependent variables are (1) size and weight, (2) evolution levels and (3) their strength parameters. Since both of the independent variables are non-continuous variables, we used non-parametric Spearman rank-sum correlation analyses (ρ) to examine the potential correlations between the dependent variables and the independent variables. When necessary, post-hoc comparisons were made using Wilcoxon signed-rank tests. All statistical calculations are computed using R [54].

Results and discussion

Voiced obstruents

Fig. 3 illustrates the effects of voiced obstruents on (log-transformed) size and weight values. The linear regression lines show that the correlations are positive. The positive correlations are significant in both cases ($\rho = 0.25, p < .001$ and $\rho = 0.28, p < .001$). These results support the hypothesis that in Japanese pokemon names, voiced obstruents imply largeness and heaviness. This conclusion is consistent with the previous studies of the images of voiced obstruents in Japanese [2, 12–15]. The results are also consistent with Frequency Code Hypothesis [44, 45], in which sounds with low frequency energy are considered to be large.

Fig 3. The effects of voiced obstruents on the size and weight. The size and weight values are log-transformed (the base = e). The linear regression line is superimposed. The strengths and significance of the linear correlation are tested by a non-parametric Spearman rank-based correlation test.

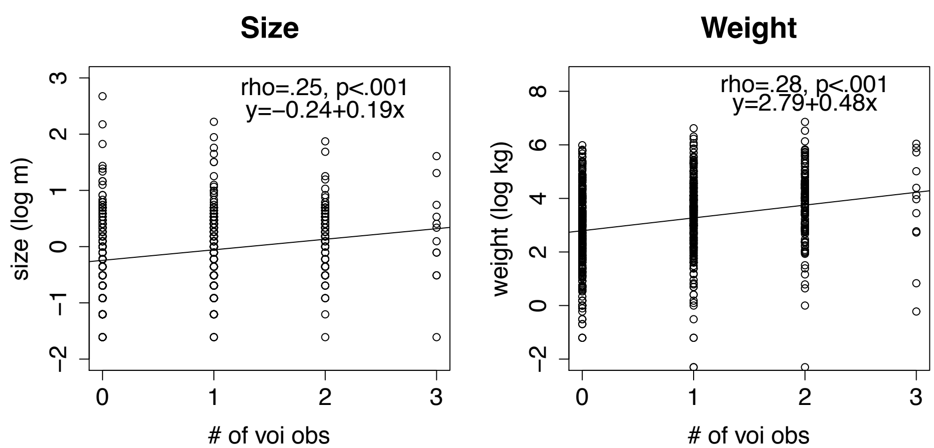


Fig. 4 illustrates the average number of voiced obstruents for each evolution level, with the error bars representing 95% confidence intervals. We observe that the more evolved a pokemon character is, the more voiced obstruent its name contains on average. The Spearman correlation is 0.22, which is significant at the $p < 0.01$ level. Post-hoc comparisons using non-parametric Wilcoxon signed-rank test shows that all the differences between the adjacent evolution levels are significant at $p < .001$ level as well. Indeed then, the more voiced obstruents a pokemon name contains, the more likely that it is used for a more evolved pokemon.

Fig 4. The average number of voiced obstruents for each evolution level. The error bars represent 95% confidence intervals. Ns are given at the top of each bar. N is small for the "-1" category, because it represents baby pokemon characters, which are not very common.

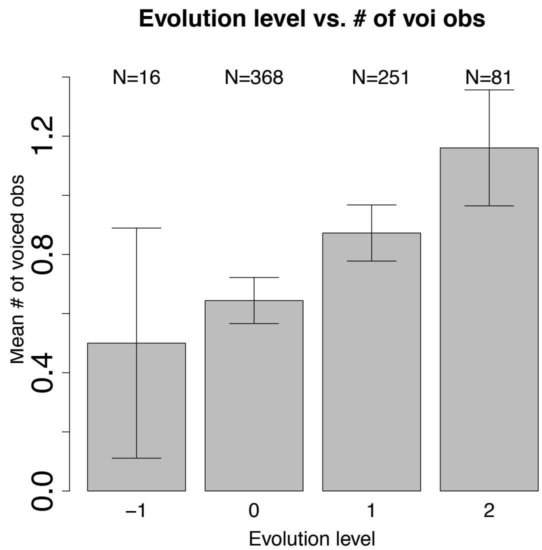


Table 1 shows a correlation vector between the number of voice obstruents on the one hand, and various strength parameters on the other. It shows that the number of voiced obstruents shows a significant correlation with HP, attack, defense, special attack, special defense, but not with speed. The lack of significant correlation with speed is particularly interesting—in the actual world, objects that are large and heavy move slowly; therefore, the presence of voiced obstruents may not result in higher strength parameter in terms of speed. Except for speed, however, the presence (and its number) of voiced obstruents make pokemon character stronger.

Table 1. A correlation vector with the number of voiced obstruents and various strength parameters. The first row represents Spearman rank-based coefficients ρ. The second row shows their p-values.

	HP	Attack	Defense	Special Attack	Special Defense	Speed
ρ	0.12	0.21	0.15	0.10	0.11	0.05
p-value	$< .01$	$< .001$	$< .001$	$< .01$	$< .01$	=0.15

Mora counts

Fig. 5 shows the correlation between the mora counts on the one hand and size and weight values on the other. It demonstrates that the higher the mora counts (i.e. the longer the name), the larger and heavier the pokemon character is. The positive correlations are both significant ($\rho = 0.36, p < .001$ and $\rho = 0.34, p < .001$). There are 2 data points for 2 moras and 6 moras; even excluding these two conditions, the correlations remain significant ($\rho = 0.35, p < .001$ and $\rho = 0.34, p < .001$). These results confirm our impressionistic observation during the data mining stage that pokemon characters with longer names are heavier and larger.

Fig 5. The effects of mora counts on the size and weight values. The positive correlations are significant at the $p < .001$ level, even excluding the 2-mora and 6-mora conditions.

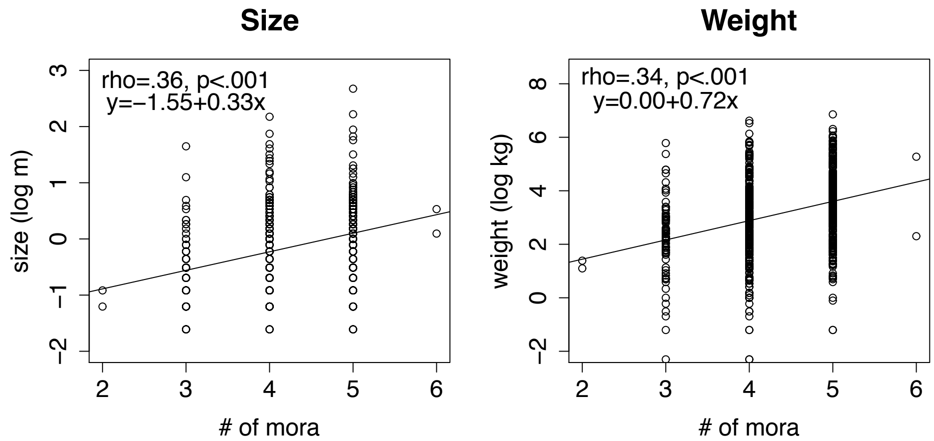


Fig. 6 illustrates the average number of moras for each evolution level. We observe that the more evolved a pokemon character is, the more moras its name contains. The Spearman correlation co-efficient is 0.38, which is significant at the $p < .001$ level. Post-hoc comparisons with non-parametric Wilcoxon test shows that all adjacent evolution levels are significantly different at the $p < .001$ level.

Fig 6. The average number of mora counts for each evolution level. The error bars represent 95% confidence intervals.

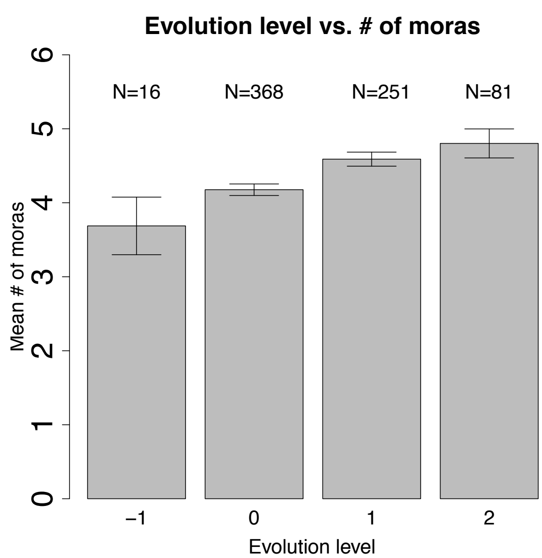


Table 2 shows the correlation vector with the number of moras on the one hand and the strength parameters on the other. It shows that all the correlations are significant at the $p < .001$ level. The results show that the longer the name, the stronger the pokemon character is in every respect.

Table 2. A correlation vector with the number of moras and strength parameters

	HP	Attack	Defense	Special Attack	Special Defense	Speed
ρ	0.26	0.27	0.29	0.20	0.25	0.15
p-value	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$	$< .001$

Why do these correlations hold? At this point we can only speculate, but the observation is clear: longer names represent larger size, larger weight, and higher strength parameters. It could be related to the previous observation that male names tend to be longer than female names in Japanese [55]. It would not be surprising if associations between longer names and masculinity lurks behind the results discussed in this section.

This tentative hypothesis makes one specific prediction about pokemon names in English, because in English, male names tend to be shorter than female names [56–58]: therefore, it would predict that in English pokemon names, shorter names are used for stronger pokemon characters. Testing this prediction offers an interesting line of follow-up study for a future study.

One remaining question about this observation is how general this sound symbolic relationship is—is it specific to pokemon names, or specific to proper names, or more generally operative in natural languages? We do not know of any studies which point out the correlation between word length and strengths, which may be a hint that it does not hold generally in natural languages. However, the names of magic in Dragon Quest (see the wikipedia article `https://en.wikipedia.org/wiki/Dragon_Quest` for details) series follow the same "longer-is-stronger" principle as the pokemon naming: in a series of three magic related to fire, *me-ra* (two moras) is the weakest, *me-ra-mi* (three moras) next, and *me-ra-zo-o-ma* (five moras) is the strongest; similarly, *gi-ra* (two moras) becomes *be-gi-ra-ma* (four moras) when it gets stronger, and *be-gi-ra-go-n* (five moras) when it is strongest. Ditto for *i-o* (two moras), *i-o-ra* (three moras), *i-o-na-zu-n* (five moras), although there are exceptions in this "longer-is-stronger principle" too; e.g. *be-ho-ma* (three moras) is stronger than *be-ho-i-mi* (four moras) and *ma-hya-do* (three moras) is stronger than *hya-da-i-n* (four moras). At any rate, this sort of stochastic sound symbolic relationships may hold in the domain of naming proper nouns, although this hypothesis needs further quantitative verification. Most if not all studies of sound symbolism assume that sound symbolic relationships are not limited to particular vocabulary domains (though cf. [1, 59, 60] for claims that they may), so it would be interesting if there can be a sound symbolic relationship specific to pokemon names or proper names. Whether there can be a domain restriction on where sound symbolic relations can hold is an interesting and important question that needs to be addressed in future studies.

Multiple regression analyses

Having established the effects of voiced obstruents and those of mora counts, we need to address one important question. Given that the effects of both voiced obstruents and mora counts are present, could it be the case that a longer word is more likely to contain voiced obstruents? In other words, are the effects of voiced obstruents and mora counts independent of one another? In order to address this question, multiple regression analyses were run. The independent variables are weight, size, evolution level, and total strength (the sum of all strength parameters except for speed). The dependent variables are the number of voiced obstruents and mora counts, and their interaction. Table 3 summarizes the results.

Table 3. Multiple regression results. The effects of voiced obstruents and mora counts are significant, but their interaction terms are not.

WEIGHT	Df	F	p-value
voiced obs	1, 712	53.2	$< .001$
mora counts	1, 712	71.7	$< .001$
interaction	1, 712	< 1	$= .82$
SIZE	**Df**	**F**	**p-value**
voiced obs	1, 712	36.7	$< .001$
mora counts	1, 712	75.1	$< .001$
interaction	1, 712	< 1	$= .69$
EVOL	**Df**	**F**	**p-value**
voiced obs	1, 712	42.3	$< .001$
mora counts	1, 712	99.3	$< .001$
interaction	1, 712	2.7	$= .10$
STRENGTH	**Df**	**F**	**p-value**
voiced obs	1, 712	23.7	$< .001$
mora counts	1, 712	69.9	$< .001$
interaction	1, 712	1.9	$= .16$

In all the regression models, the effects of voiced obstruents and those of mora counts are highly significant, but none of the interaction effects are. These results show that the effects of voiced obstruents and those of mora counts independently hold. In other words, the effects of voiced obstruents are present, regardless of the number of moras that a particular pokemon name contains.

Conclusion

In natural languages, sound symbolic relationships hold between sounds and meanings, although these relationships are only stochastic and not deterministic (i.e. the sound-meaning relationships can be arbitrary: [9,10]). Previous studies have shown that sound symbolic patterns are operative in naming patterns of proper names as well [7,12,14–19]. The current study adds to this body of the literature on the existence of sound symbolic relationships in proper names, using a new corpus of data.

This study is in no way comprehensive, and there are probably other sound symbolic factors that are present in pokemon names. We chose to analyze the effects of voiced obstruents and mora counts, as they seem to be very clearly present. But there are other factors that seem to be operative, such as vowel quality and the presence of long vowels. For example, it is cross-linguistically known that back and low vowels tend to be judged to be larger than front and high vowels [8,13,16,61–63]. It would be interesting to examine whether these sound symbolic effects of vowels are operative in pokemon names.

Another dimension in which this project can be extended is the analysis of pokemon names in languages other than Japanese. Since pokemon names are translated into many languages, including English, French, and Spanish, it provides a forum for cross-linguistic studies. We thus invite interested readers to follow-up on the current study.

Another task is to address whether the patterns identified in this paper are merely facts about the "pokemon lexicon", or whether these patterns are internalized by native speakers of Japanese. Testing this issue requires experimentation using new pokemon characters, which is in progress. Although we plan to test this issue with Japanese speakers, we also invite other researchers to test the same issue with other languages.

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