How Russian speakers express evolution in Pokémon names II: The effects of contrastive palatalization and name length[*]

Abstract

A previous experiment found that Russian speakers tend to judge names with [Ca] to be more suitable for larger, post-evolution Pokémon characters than names with [Ci]. This result raised a new question regarding whether it is the vowel quality difference or consonant palatalization due to [i] that affected the responses. The current experiment compared three conditions ([Ca] vs. [C^ja] vs. [Ci]) and found that names with [C^ja] were judged to be least appropriate for post-evolution characters, suggesting the important role of phonemic palatalization. The current experiment additionally showed that Russian speakers tend to judge longer names to be more suitable for post-evolution characters.

1 Introduction

1.1 Background

The idea that the relationships between sounds and meanings are in principle arbitrary (Hockett 1959; Saussure 1916/1972) had been a very widely accepted idea in modern thinking about languages. However, there is a rapidly growing body of studies showing that there can be systematic correspondences between sounds and meanings (e.g. Dingemanse et al. 2015; Lockwood & Dingemanse 2015 among many others). To take a very famous example, for many speakers, nonce word [mal] sounds bigger than nonce word [mil], suggesting that the vowel [a] tends to

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be associated with large images whereas the vowel [i] tends to be associated with small images (Sapir 1929). When such sound-meaning associations are modulated via iconicity between sounds and meanings, those relationships are referred to as "sound symbolism" (Hinton et al. 1994).[1]

Studying sound symbolic connections is now considered to be an important topic for linguistic inquiry and cognitive science more broadly, since such connections may guide language acquisition processes to non-trivial degrees (Imai & Kita 2014; Maurer et al. 2006; Nielsen & Dingemanse 2021; Nygaard et al. 2009), and they may also bear on the question of how human languages may have originated and evolved (Cuskley & Kirby 2013; Johansson et al. 2021; Perlman & Lupyan 2018; Vinson et al. 2021). The importance of studying sound symbolic patterns for formal phonological theories has also been recently advanced by various researchers (Alderete & Kochetov 2017; Jang 2021; Kawahara 2020; Kumagai 2019; Shih 2020). Finally, practical application of sound symbolism for areas of research beyond linguistics and cognitive science, such as marketing, food science and sports science, is also actively explored (Klink 2000; Klink & Wu 2014; Pathak & Calvert 2020; Shinohara et al. 2016). It is probably fair to say that the number of studies on sound symbolism—and related topics, including iconicity and ideophones—is exponentially growing in the last few decades (see Nielsen & Dingemanse 2021). The current study can be situated as a case study of this fast-growing research enterprise on sound symbolism.

One sub-paradigm that emerged in this research enterprise on sound symbolism is what is now known as "Pokémonastics" (Shih et al. 2019)—studies of sound symbolism using Pokémon characters (Kawahara et al. 2018 *et seq.*). Pokémon is a famous game franchise initially released by Nintendo Inc in 1996, where players collect fictional creatures called Pokémon. As of October 2022, there are about 900 such characters. In the Pokémon world, some of these characters evolve into a different character (e.g. *Pikachu* becomes *Raichu*), and generally speaking, Pokémon characters get larger, heavier and stronger when they evolve. Kawahara et al. (2018) found that two linguistic factors—the number of voiced obstruents contained in the names and the name length—are significant predictors that distinguish pre-evolution characters and post-evolution characters.

Expanding upon Kawahara et al. (2018), subsequent studies have shown that several sound symbolic patterns are at play when we analyze Pokémon names in various languages (see Kawahara 2021 for a review). There are many advantages of this research paradigm, for which we would like to refer readers to recent papers like Kawahara & Breiss (2021) and Kawahara et al. (2021). One advantage that we would like to highlight here, however, is that in Pokémonastics, we can compare sound symbolic patterns across different languages (Shih et al. 2019). To that end, the lan-

[1] Sound symbolism is sometimes also referred to as the "bouba-kiki" effect, due to a widely-cited article by Ramachandran & Hubbard (2001) (see also Ćwiek et al. 2022). However, we would also like to make it clear that the "bouba-kiki" effect is a specific instance of a more general notion of sound symbolism, and as such these two should be not equated.

guages that have been analyzed in this framework include Cantonese, English, Japanese, Korean, Mandarin and Russian (Shih et al. 2019). Furthermore, experiments using non-existing names and non-existing Pokémon character pictures have been conducted targeting native speakers of Brazilian Portuguese (Godoy et al. 2020), English (Kawahara & Breiss 2021), Japanese (Kawahara & Kumagai 2019) and Russian (Kumagai & Kawahara 2022). The current experiment is a direct follow-up of Kumagai & Kawahara (2022), a Pokémonastic study using nonce words with Russian speakers. In this paper, we report an experiment which addresses some questions that were left unanswered in that study.

1.2 The current experiment

Sound symbolic relationships between [a] and largeness on the one hand and [i] and smallness on the other have long been known in the studies of sound symbolism, at least since the seminal experimental work on sound symbolism by Sapir (1929).[2] The same sound symbolic patterns have been identified by the previously mentioned Pokémonastic studies—post-evolution characters, which tend to be larger, are more likely to be associated with names containing [a] than with names containing [i] in Brazilian Portuguese, English and Japanese (e.g. Godoy et al. 2020; Kawahara & Breiss 2021; Kumagai & Kawahara 2019).[3] Kumagai & Kawahara (2022) tested whether this result holds with native speakers of Russian, and indeed they found that names that contained [Ca] are more likely to be associated with post-evolution characters than names that contained [Ci], which seemed to be in line with the previous studies, both within and outside of Pokémonastics.

However, this result opened up one new question. Since Russian consonants are palatalized before [i] (e.g. Padgett 2003), it was not clear from the results of Kumagai & Kawahara (2022) alone, whether it is the vowel quality difference (i.e. [a] vs. [i]) or consonant palatalization due to [i] that is responsible for the result. In the current experiment, therefore, we attempted to tease apart these two possibilities by comparing [Ca] vs. [C^{j}a] vs. [Ci].[4] Of particular interest is the sound symbolic value of contrastive palatalization ([C^{j}a]), which has not been tested in previous Pokémonastic experiments.

The current experiment tested another factor, which was not addressed by Kumagai & Kawahara (2022), but the one which has been found to hold across different languages in previous Pokémonastics experiments, i.e. the effects of name length. In all the languages that were experi-

[2]In fact, Socrates already pointed out these sound symbolic connections in the dialogue Cratylus, which was presumably written around the mid or late 5th century BC.

[3]Pokémon has several parameters like weight, height, type, speed, friendliness, etc. The current study focuses on the evolution status, which is closely linked to larger size and weight. This property is what many other Pokémonastic studies have studied as well. See Kawahara (2021) for a review of studies on other properties of Pokémon characters.

[4]Although consonants before [i] are palatalized, we only mark palatalization in the [C^{j}a] condition in this paper in order to highlight the fact that this condition involves *contrastive* palatalization.

mentally studied, longer names tend to be more likely to be associated with larger, post-evolution characters than shorter names (Godoy et al. 2020; Kawahara & Kumagai 2019; Kawahara & Breiss 2021), and it thus seemed important to us to examine how generalizable this association is across languages. The sound symbolic association at issue appears to be a very straightforward iconicity effect—the longer, the larger, a.k.a. "the iconicity of quantity" (Haiman 1980; see also Dingemanse et al. 2015). What is interesting, however, is the observation by Shih et al. (2019) that what counts as "length" might differ across languages; e.g. Japanese seems to rely on mora counts to measure length, whereas English appears to deploy segments, and for Brazilian Portuguese, syllable counts seem to be most important (Godoy et al. 2020). Our experiment thus aimed to test (1) whether the iconicity of quantity holds in the context of Pokémonastics experiments in Russian, like in other languages that have been previously tested, and (2) if so, what unit would serve as the best measure for length in Russian.

2 Method

2.1 Stimuli

All the experimental stimuli were non-existing words in Russian, all conforming to Russian phonotactic restrictions. The stimuli were all disyllabic. The stimulus structure of the current experiment had two fully-crossed factors. One factor was the comparison between [Ca] vs. [C^{j}a] vs. [Ci] (the last of which involves predictably palatalized consonants). The critical syllables were placed in the initial syllables of the stimuli, which are known to be psycholinguistically prominent (e.g. Hawkins & Cutler 1988; Nooteboom 1981) and are also known to play an important role in sound symbolism (Adelman et al. 2018; Kawahara et al. 2008, though see also Shinohara & Uno 2022). This factor was included to see whether it is the vowel quality difference or the effect of consonantal palatalization that is responsible for sound symbolic judgments of Pokémon names by Russian speakers. The quality of the consonants in the first syllables (p, v, m, n, r) as well as the quality of second syllables (da, ga, za, zhe, che) were controlled across the three conditions.[5]

The second factor was length, which consisted of short vs. long(onset) vs. long(coda). Compared to the short condition, the long onset condition had an extra onset consonant [s] in the word-initial position (e.g. *paza* vs. *spaga*), whereas the long coda condition had an extra coda consonant [l] in the first syllable (e.g. *paza* vs. *palzhe*). If segment counts play a role in determining the iconicity of quantity in Russian, both of the long conditions should show higher post-evolution responses than the short condition, and they should do so to a comparable degree. If moras are the crucial unit, then the long(coda) condition should show higher post-evolution

[5] *niba* was used instead of *nida*, because the latter is an existing word in Russian (albeit it being slightly obsolete proper noun).

responses than the other two conditions, assuming that Russian coda consonants are moraic. Finally, if syllables are the crucial counting unit in Russian, then there should be no differences between the three length conditions.[6]

The full list of stimuli appears in Table 1. There were 5 items in each cell. There were a total of $3 \times 3 \times 5 = 45$ items.

Table 1: The stimulus set used in the current experiment. The Cyrillic script representations of these stimulus items are available at the OSF repository, whose link is provided in footnote 7.

[Ca]	**short**	**long(onset)**	**long(coda)**
	paza	spaga	palzhe
	vache	svazhe	valza
	mada	smada	malga
	nazhe	snaza	nalche
	raga	srache	ralda
[C^{j}a]	**short**	**long(onset)**	**long(coda)**
	piaga	spiazhe	pialzhe
	viazhe	sviada	vialga
	miada	smiaza	mialza
	niaza	sniache	nialche
	riache	sriaga	rialda
[Ci]	**short**	**long(onset)**	**long(coda)**
	piga	spiche	pilche
	visa	sviza	vilza
	mizhe	smizhe	milzhe
	niba	snida	nilda
	riche	sriga	rilga

2.2 Procedure

The experiment was administered using SurveyMonkey (`https://surveymonkey.com/`). Participants agreed to participate in the experiment by first reading through a consent form. The instructions explained that some Pokémon characters undergo evolution, and when they do so, they tend to get bigger, heavier, and stronger. In the main trial session, one stimulus name was presented per each trial; the task of the participants was to choose whether the name was more appropriate for a pre-evolution name or a post-evolution name. The instructions as well as the stimuli were presented in the Cyrillic script, the standard orthographic system for Russian. The

[6] As an anonymous reviewer pointed out, in order to more reliably test the role of syllables, it would have been better to vary syllable counts as well, instead of relying upon a null effect. We agree, and we would like to pursue this task in future research.

order of 45 stimuli was randomized per participant using a randomization function of SurveyMonkey. Although the stimuli were presented to the participants in the Cyrillic orthography, we expected all the stimuli to have received stress in initial syllables, since in Russian, open word-final syllables do not receive stress (Crosswhite et al. 2003; Lavitskaya & Kabak. 2014).

2.3 Participants

The responses were collected using the Buy Response function, offered by SurveyMonkey. In order to take part in the experiment, the participants had to be a native speaker of Russian and they were not allowed to have studied sound symbolism before, or have participated in another Pokémonastic experiment before. The data from 150 native speakers of Russian were collected. Among them, 112 were males. The age breakdown, automatically analyzed by SurveyMonkey, was as follows: 16 (18-29 years old), 61 (30-44 years old), 60 (45-60 years old) and 13 (61+ years old). Since neither gender nor age groups impacted the results of a previous large-scale Pokémonastics experiment (Kawahara et al. 2020), we will not consider them further here.

2.4 Statistical analyses

We fit a Bayesian mixed effects logistic regression model, which included the two fixed factors as well as their interaction terms. The two fixed factors were (1) the vowel quality/palatalization difference ([Ca] vs. [C^{j}a] vs. [Ci]) and (2) the length difference (short vs. long(onset) vs. long(coda)). Bayesian analyses have several advantages over more traditional frequentist analyses, which we do not review in detail here (see e.g. Franke & Roettger 2019, Kruschke 2014, Kruschke & Liddell 2018 and Vasishth et al. 2018 for accessible tutorials). Bayesian analyses take prior information and the data obtained in the experiment to yield posterior distributions for each parameter that we would like to estimate. One straightforward heuristic to interpret the posterior distributions provided in the results of Bayesian regression analyses is to examine their 95% credible interval (often abbreviated as CrI) of each coefficient estimate—if this interval does not include 0, we can conclude that the effect is meaningful or credible. On the other hand, when a 95% credible interval contains 0, we conclude that the effect is not very robust. It is important to bear in mind, however, that with Bayesian analyses, we are not necessarily committed to a strictly dichotomous "credible" vs. "non-credible" distinction, as in a frequentist analysis (i.e. "statistically significant" vs. "non-significant"). This is because posterior estimates of a parameter in a Bayesian analysis can be directly interpreted as ranges of values that this estimate can take. Therefore, we can calculate, for example, how many posterior samples of a particular coefficient estimate are in the expected direction (i.e. positive or negative) to make informed decisions, an analytic strategy that we also actively deploy in the current paper, in addition to simply looking at the 95% CrIs.

The statistical analyses were implemented using R (R Development Core Team 1993–) and the `brms` package (Bürkner 2017). Inspired by the open science initiative in linguistics (Winter 2019), all the analytical details as well as the Bayesian posterior samples are made available at the OSF repository.[7] The R markdown file also contains illustrations of the conditional effects and the posterior predictive checks. The baseline for the vowel quality/palatalization difference condition was set to be [Ca]. The baseline for the length condition was set to be the short condition. In the current analyses, the random structure included a free-varying intercept and slope for participants and items associated with the fixed factors and their interaction terms. The dependent variable was whether the response was pre-evolution character (coded as 0) or post-evolution character (coded as 1). As for prior specifications, for all β_1-coefficients, we deployed a Cauchy prior with scale of 2.5 (Gelman et al. 2018), whereas for the intercept, we used Normal(0, 1) weakly informative priors (Lemoine 2019). Four chains were run with 4,000 iterations for each chain and 1,000 warmups. All the $\hat{R}$-hat values associated with the fixed effects were 1.00 and there were no divergent transitions, indicating that the four chains mixed successfully.

3 Results

Figure 1 illustrates the overall results by plotting the average post-evolution responses for each stimulus item, in which each facet shows results from each length condition. First by looking within each facet, we find that the [C^ja] condition seems to show generally low post-evolution responses than the other two conditions, suggesting that contrastive palatalization may have caused small images, leading to low post-evolution responses.[8] Next, comparing across the three different facets, we find that short names tend to exhibit less post-evolution responses, suggesting that some sort of iconicity of quantity is at work. This tendency appears to be more prominent for the long condition with a coda consonant (the rightmost panel) than the long condition with an onset consonant (the middle panel).

Table 2 shows the results of the Bayesian regression model and Figure 2 is a visual representation of the distributions of the credible intervals for each estimated parameter, where thick bars represent the 80% credible intervals and thin bars represent the 95% credible intervals. Since all the 95% credible intervals—and in fact, the 80% credible intervals—of the interaction terms include 0, let us interpret the main effects. One clear effect is the comparison between [C^ja] vs. [Ca], whose 95% credible interval does not include 0. This result means that [C^ja] indued less

[7]`https://osf.io/eu6ky/?viewonly=69e6d2d718604c7694b55afc7691277e`.

[8]An anonymous reviewer asked if we observed any systematic patterns among the five consonants used in the first syllables (*p, m, n, v, r*). There appear to be no systematic or intriguing patterns, although we note that there is only one item for each consonant within each condition, so no conclusive statements can be made—for interested readers, an illustration of this post-hoc analysis is made available in the osf repository (see footnote 7 for the link).

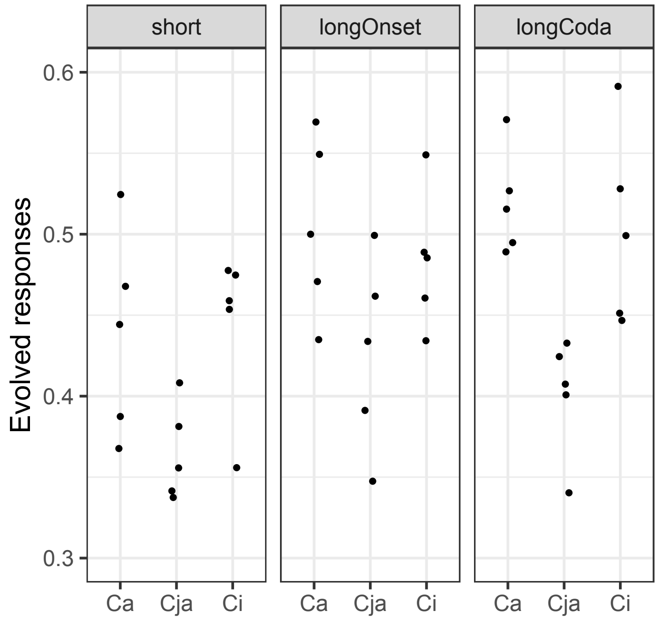

Figure 1: The results of the experiment. Each dot represents the average post-evolution responses for each stimulus item. Points are slightly jittered horizontally to avoid overlap.

post-evolution responses than [Ca]. On the other hand, the difference between [Ca] and [Ci] is not credible, with its 95% CrI more or less centering around 0. Taken together, these patterns imply that contrastive palatalization in the [C^ja] condition played a more prominent role in the current experiment than palatalization caused by [i].

Table 2: The model summary.

	β	error	95% CrI
intercept	-0.39	0.20	[-0.77, 0.00]
[Ci] (vs. [Ca])	0.03	0.19	[-0.34, 0.39]
[C^ja] (vs. [Ca])	-0.42	0.20	[-0.81, -0.04]
long coda (vs. short)	0.43	0.22	[0.00, 0.86]
long onset (vs. short)	0.33	0.21	[-0.09, 0.76]
[Ci]:LongCoda	-0.10	0.27	[-0.62, 0.43]
[C^ja]:LongCoda	-0.27	0.26	[-0.79, 0.25]
[Ci]:LongOnset	-0.14	0.26	[-0.65, 0.36]
[C^ja]:LongOnset	-0.03	0.27	[-0.56, 0.50]

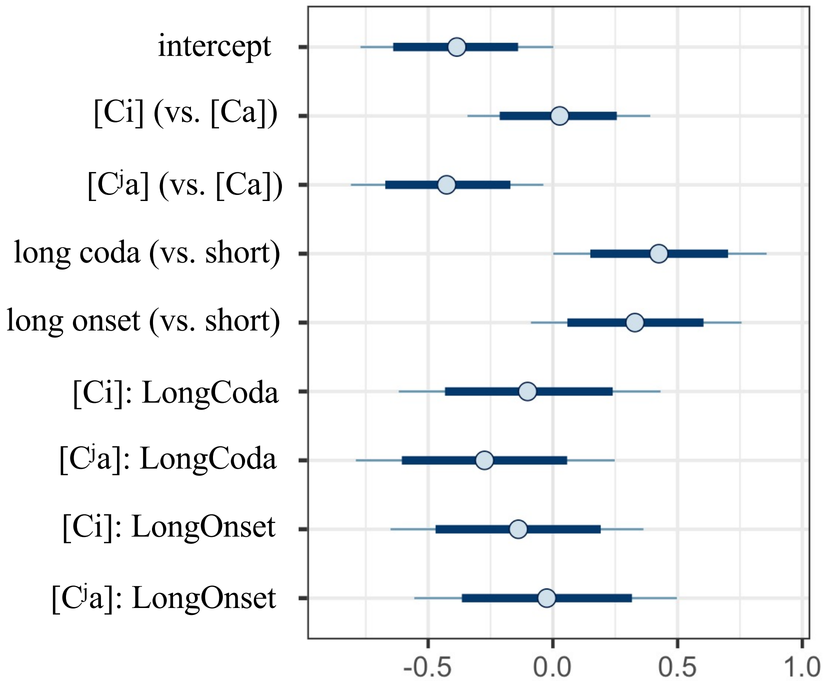

Figure 2: A visual representation of the 80% credible intervals (thick bars) and the 95% credible intervals (thin bars) of each estimated parameter.

For the length factor, the comparison between the short condition and the long coda condition is credible, as its 95% credible interval distributes above 0. Since its lower bound is 0, we also calculated how many posterior estimates are above 0 for this coefficient, and found that 97.6% of them are above 0 (i.e. $p(\beta > 0) = 0.976$). On the other hand, the comparison between the short condition and the long(onset) condition does not seem to be as robust (i.e. its 95% credible interval includes 0), although the long(onset) condition tended to show more post-evolution responses—93.9% of the posterior estimates were positive for this coefficient.

An anonymous reviewer suggested that a direct comparison between the two long conditions would thus be informative. Explicitly noting that this is a post-hoc comparison,[9] In short, long names having an extra consonant were judged to be more suitable for post-evolution responses, and coda consonants show clearer tendency compared to onset consonants.

[9]For a possible peril of (re-)running statistical tests after the results have been seen and analyzed, see Kerr (1998) and Simmons et al. (2011), as well as Chambers (2017) we reran a Bayesian analysis with the long(onset) and [Ci] as the new baseline conditions while keeping other analytical details the same as the above-mentioned regression (which can be checked in the markdown file at the osf repository). This new analysis found that the coefficient for the long(coda) condition being positive, with respect to the long(onset) condition, at the baseline level is $p(\beta > 0) = 0.74$. Therefore, we conclude that there is modest evidence that coda consonants are more likely to induce post-evolution responses than onset consonants.

4 Discussion

To summarize the results, we found that at least for Russian speakers, contrastive palatalization is an important factor that reduces post-evolution responses. This may be because in Russian, palatalized consonant can, as is the case with many other languages, denote diminutive meanings (Alderete & Kochetov 2017); e.g. [$l^j a l^j a$] is the child word meaning "baby" or "doll" (Shih et al. 2019) (see e.g. Czaplicki et al. 2016 and Hamano 1998 for a similar pattern in Polish and Japanese, respectively). This we believe is a new empirical finding, at least within Pokémonastics.

However, we did not identify a clear difference between [Ca] and [Ci]. On the one hand, this result may be related to a more general observation about sound symbolism that consonants are more important than vowels in determining the sound symbolic values of words (Fort et al. 2015; Ozturk et al. 2013). It also shows that *contrastive* palatalization is more important than palatalization caused by [i]. On the other hand, it is not compatible with the result of Kumagai & Kawahara (2022), who did find a difference between these two conditions. We need to admit that the difference between the two experiments remains a mystery.

Recall that the quality of the consonants in the initial syllables as well as the quality of the second syllables were controlled across the three critical conditions in the current experiment, and hence we cannot attribute the lack of difference between [Ca] and [Ci] to these factors. At this point, we can only speculate that the failure to observe a difference between [a] and [i] was due to a task effect—since the names with contrastive palatalization were prominent in the experiment—possibly because of its diminutive meaning in Russian phonology—this may have reduced the difference between [Ca] and [Ci]. In future experiments, it may be worth re-examining the difference between [a] and [i] using a head-to-head experimental paradigm, in which participants are asked to directly compare nonce names containing [a] and those containing [i], as deployed in previous Pokémonastics studies such as Kawahara & Kumagai (2019) and Kawahara & Moore (2021) (see Daland et al. 2011 and Kawahara 2015 for task effects in phonological judgment experiments). It may also be worth exploring whether we would observe a sound symbolic difference between [a] and [i] in Russian outside the context of Pokémon names.

For the length effect, we found that longer names tend to be judged to be more suitable for larger, post-evolution characters, and this was more clearly observed when long names contained an extra coda consonant than when they contained an onset consonant. First of all, this general result is compatible with the previous experiments which found similar effects in other languages, in which longer names tend to be associated with post-evolution characters (Japanese: Kawahara & Kumagai 2019; English: Kawahara & Breiss 2021; Brazilian Portuguese: Godoy et al. 2020), supporting the role of the iconicity of quantity in sound symbolism (Dingemanse et al. 2015; Haiman 1980).

Moreover, this result raises the possibility that Russian speakers may resort to mora counts, in addition to segment counts, when they measure the length of names, at least in the context of sound symbolic judgments, to the extent that we can assume that coda consonants, not onset consonants, are moraic (Hayes 1989; Zec 1995, though see also Topintzi 2010) in Russian.[10] Regardless of whether we can attribute the current results to the effects of moras, we find it interesting that the Russian pattern slightly differs from that of English, where the number of segments is what seems to have mattered (Kawahara & Breiss 2021; Shih et al. 2019). The possible asymmetry between onset consonants and coda consonants is a new discovery, again at least within Pokémonastics. We acknowledge, however, that our results regarding the difference between onset consonants and coda consonants is not entirely clear-cut. Future studies with more stimulus items, ideally using a more variety of consonants in addition to onset [s] and coda [l], are hoped for to explore this difference in further depth.

In conclusion, the current experiment found two new factors that crucially impact the sound symbolic judgments of Russian speakers: contrastive palatalization and the iconicity of quantity, the latter of which is triggered more clearly by coda consonants. These are new findings, at least as far as Pokémonastics studies go, and thus add new pieces of our knowledge regarding how sound symbolism works in natural languages.

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[10]In Russian nouns, word-final syllables with a coda consonant tend to attract stress, whereas word-final syllables ending with a vowel do not (Crosswhite et al. 2003; Lavitskaya & Kabak. 2014), which probably suggests that coda consonants in Russian do indeed make syllables heavy (i.e. coda consonants are moraic).

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