How Russian speakers express evolution in Pokémon names: An experimental study with nonce words*

Gakuji Kumagai[1] & Shigeto Kawahara[2]
Kansai University[1] & Keio University[2]

Abstract

Sound symbolism, systematic and iconic relationships between sounds and meanings, is now a topic that is very actively explored by linguists, psychologists and cognitive scientists. As a new research strategy to study the nature of sound symbolic connections across different languages, a number of scholars have started using Pokémon names, a research paradigm that is now dubbed "Pokémonastics." The previous Pokémonastics studies have experimentally explored how the evolution status is symbolically expressed by native speakers of English, Japanese and Brazilian Portuguese. Building on these studies, the current experiment examined the sound symbolic knowledge of Russian speakers, and found that they are more likely to associate large, post-evolution Pokémon characters with names containing voiced obstruents than with names containing voiceless obstruents, and that they are also more likely to associate post-evolution characters with names containing [a] than with names containing [i]. The experiment also revealed that Russian speakers are less likely to associate post-evolution characters with names having labial consonants than with names having coronal or dorsal consonants. Overall, the current results show that Russian speakers generally have knowledge of sound symbolic associations that is similar to that of English, Japanese and Brazilian Portuguese speakers, suggesting that some sound symbolic patterns hold robustly across multiple languages.

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1 Introduction

1.1 Background

The idea that the relationships between sounds and meanings are in principle arbitrary (Saussure 1916/1972) had been a 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). 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). Studying sound symbolic connections is now considered to be an important topic for linguistic inquiry and cognitive science, as such connections may guide language acquisition processes to non-trivial degrees (Imai & Kita 2014; 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; Perlman & Lupyan 2018). The importance of studying sound symbolic patterns for formal phonological theories has also been recently implicated 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 and sports science, is also actively explored (Klink 2000; Klink & Wu 2014; 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).

Against the background of this theoretical development, Kawahara et al. (2018) initiated a research program, now dubbed "Pokémonastics" (Shih et al. 2019), in which researchers explore the nature of sound symbolic connections in natural languages by studying Pokémon names. The first Pokémonastics study explored sound symbolic patterns that hold among the existing Pokémon names in Japanese, and found that several parameters—such as weight, height and strength—correlate with the number of voiced obstruents contained in the names as well as the name lengths quantified in terms of mora counts (Kawahara et al. 2018). Subsequent studies have extended the scope of target languages, by analyzing existing Pokémon names and by conducting experiments using nonce names. Building upon these previous studies, this paper reports a new experimental study of Pokémonastics with Russian speakers, exploring what kinds of sound symbolic connections Russian speakers make when they are asked to express the evolution status in the Pokémon universe.

While there are several research advantages of using Pokémon names to study sound symbolic connections in natural languages, as recently summarized by Kawahara & Breiss (2021) and Kawahara et al. (2021), we would like to reiterate one distinct advantage here, which is that the set of denotations is fixed across languages in the Pokémon universe. Such is usually not the case in natural languages, as languages can differ in the set of references to which they assign a name. Japanese, for example, needs to distinguish "young sister" from "old sister," and there is no age-neutral term which corresponds to the English word "sister." While this sort of complication is not insurmountable as we study sound symbolism using existing words (e.g. basic vocabulary) from a cross-linguistic perspective (Blasi et al. 2016; Johansson et al. 2020; Wichmann et al. 2010), it does increase analytical flexibility, i.e., researcher degrees of freedom (Roettger 2019). On the other hand, using Pokémon names allows us to circumvent this complication altogether, because no matter which language we analyze, the set of denotations (i.e. the set of Pokémon characters) is fixed. In short, allowing us to explore cross-linguistic similarities and differences in a systematic fashion is one distinct forte of the Pokémonastics research paradigm (Shih et al. 2019). To this end, Shih et al. (2019) analyzed sound symbolic patterns in the Pokémon lexicons of several languages, including Cantonese, English, Japanese, Korean, Mandarin and Russian.

For Russian, which is the language that we explore in the current experiment, Shih et al. (2019) found that the numbers of both coronal and dorsal consonants positively correlate with the weight of Pokémon characters; on the other hand, they did not find robust effects of other potential factors, such as vowel quality or consonant voicing.[1] Extending upon the analyses of existing names by Kawahara et al. (2018) and Shih et al. (2019), several experimental studies using nonce words have also deployed the Pokémon universe to explore sound symbolic knowledge that speakers of various languages have, including English (Kawahara & Breiss 2021; Kawahara & Moore 2021), Japanese (Kawahara & Kumagai 2019; Kumagai & Kawahara 2019) and Brazilian Portuguese (Godoy et al. 2020).

These experimental studies have largely focused on the notion of evolution[2]—in the Pokémon world, characters can evolve into different creatures, and when they do, they tend to become larger, heavier and stronger, and they are assigned a new name. These previous experimental studies have identified intriguing cross-linguistic similarities in terms of the sound symbolic associations that speakers of different languages make to express the evolution status. For example, speakers of all three languages find names with voiced obstruents to be more suitable for post-evolution characters than names with voiceless obstruents. This sound symbolic pattern may have its roots in the sound symbolic connection between voiced obstruents and largeness, which may have phonetic bases. Since voiced obstruents are characterized by low frequency energy during their constriction intervals as well as in their surrounding vowels (Kingston & Diehl 1994), their acoustic profiles

[1]The Russian Pokémon names are generally transliterations from the English Pokémon names. English and Russian nevertheless show different sound symbolic patterns in their Pokémon lexicons, and loanword adaptation processes may play a non-trivial role in yielding that difference. See Shih et al. (2019).

[2]Another semantic dimension that is actively explored via experimentation is the Pokémon types. See Kawahara et al. (2021) and references cited therein for research on this topic. This paper does not address the issue of whether Russian speakers can symbolically express Pokémon types, which requires a new set of experiments.

may symbolically imply that they are produced by a large sound source, because low frequency energy is resonated in a large resonating chamber (Ohala 1994). Alternatively, voiced obstruents may be associated with large images because of the expansion of the oral cavity that is necessitated during their articulation (Ohala 1983).

Another cross-linguistically robust finding is that speakers of all these languages find names with [a] to be more suitable for post-evolution characters than those names with [i]. This finding reflects a very well-known sound symbolic effect in which [a] is judged to be larger than [i] (Sapir 1929), presumably because [a] has low fundamental frequency and second formant frequency (Whalen & Levitt 1995). Again, the physics tells us that [a] is produced by a large sound source, whereas [i] is produced by a small sound source (Ohala 1994). Alternatively, the large image that is associated with [a] may arise from a wide oral aperture that is observed during the production of this vowel (Sapir 1929).

The aim of the current experiment is to build upon these previous studies and expand the scope of Pokémonastics by studying what kinds of sound symbolic connections Russian speakers may make. Recall from the discussion above that allowing us to perform a controlled cross-linguistic comparison is one research advantage of Pokémonastics (Shih et al. 2019); therefore, we were particularly interested in testing the sound symbolic patterns that were identified in the previous experimental Pokémonastics studies which were conducted with speakers of other languages (Godoy et al. 2020; Kawahara & Breiss 2021; Kawahara & Moore 2021; Kawahara & Kumagai 2019; Kumagai & Kawahara 2019). We nevertheless tested a few additional hypotheses, one of which is motivated by a sound symbolic pattern that was found to hold in the existing Pokémon names in Russian, i.e., the effects of place of articulation (Shih et al. 2019).

1.2 The current experiment

To this end, the current experiment tested four specific hypotheses, listed in (1).

(1) The hypotheses tested in the current experiment

- a. Names that contain coronal and dorsal consonants are judged to be more appropriate for post-evolution characters than names with labial consonants.
- b. Names that contain voiced obstruents are judged to be more appropriate for post-evolution characters than names with voiceless obstruents.
- c. Names that contain [a] are judged to be more appropriate for post-evolution characters than names with [i].
- d. Names that contain [r] (a trill) are judged to be more appropriate for post-evolution characters than names with [l].

The first hypothesis was motivated by the sound symbolic patterns that hold in the existing Pokémon names in Russian. Shih et al. (2019) show that those characters which contain more coronal and dorsal consonants tend to be heavier. Since evolved characters are generally heavier in the Pokémon universe, we recast our hypothesis in terms of the evolution status, so that our results can be compared with the previous Pokémonastics experiments, which mainly explored sound symbolic patterns that are associated with the evolution status.

The second and third hypotheses were motivated by the previous experimental studies of Pokémonastics reviewed above, instead of the findings of the analysis of existing Pokémon names in Russian by Shih et al. (2019). Recall that given nonce words, speakers of three different languages—English, Japanese, and Brazilian Portuguese—tended to associate names with voiced obstruents and those with [a] with post-evolution characters (Godoy et al. 2020; Kawahara & Breiss 2021; Kawahara & Kumagai 2019; Kumagai & Kawahara 2019), and we were interested in testing whether the same patterns hold for Russian speakers. As discussed above, these sound symbolic associations have plausible phonetic bases, and as such, it would not be too surprising if Russian speakers also exhibit these associations.

The final hypothesis was initially motivated by an intuition that our native informant shared with us. She found that names with a trill may be more suited to express evolvedness in Russian than names with a lateral. The phonetic motivation that lies behind this intuition may have been that since trills involve multiple tapping gestures (Iskarous & Kavitskaya 2010), these repetitions of gestures may have been iconically mapped to the image of large quantity, plausibly via “the iconicity of quantity” (Haiman 1980)—i.e. plainly put, “more is larger”.[3] Such large image of trills may have in turn been associated with large, post-evolution characters. Since this contrast between trills and laterals was never tested in the previous Pokémonastics studies, we included this condition in the current experiment, as it may potentially expand the inventory of sound symbolic patterns that can be studied in the Pokémonastics research.

2 Methods

In the current experiment, within each trial, the participants saw a visual presentation of one non-existing name and were asked to judge whether that name is more suited for a pre-evolution char-

[3]Trilling may also be associated with inherently long phonetic duration—Iskarous & Kavitskaya (2010) show that longer phonetic realizations of /r/ tend to be associated with full trilling in Russian. Moreover, in other languages such as Buginese, Italian and Madurese (Cohn et al. 1999; Payne 2005), trills are phonologically long in that they are geminate counterparts of a non-trill rhotic.

From the perspective of sound symbolism too, there is a sense in which trills may be associated with large quantities; for a connection between trills and the frequentative aspect, see Flaksman (2018). See also Winter et al. (2021) for a sound symbolic connection between trills and tactile sensation of roughness, which seems to hold robustly across many different languages, although this latter connection may be different from what is explored in the current experiment.

acter or a post-evolution character.

The data, analysis code, and Bayesian posterior samples are available at `https://osf.io/j8brn/`. The R markdown files also contain visual illustrations of posterior distributions and conditional effects as well as posterior predictive checks.

2.1 Stimuli

The current experiment consisted of two sets of stimuli. In the first set, three factors (consonant place of articulation, consonant voicing, and vowel quality) were fully crossed. Place of articulation consisted of a three-way contrast between labials, coronals, and dorsals. Consonants were either voiced or voiceless. Vowels were varied between [a] and [i]. This fully crossed design allowed us to address the additional question of whether or not sound symbolism functions in a cumulative way (Kawahara & Breiss 2021; Klink & Wu 2014), i.e. whether each factor can contribute to sound symbolic judgments independently of other factors, or whether one particular salient factor determines the sound symbolic value of the whole name.

In the second set of stimuli, we tested the difference between a trill and a lateral, which was again crossed with the [a] vs. [i] difference. In both sets of the stimuli, the target sounds always appeared in the first syllable of the stimuli, because word-initial syllables generally convey strong sound symbolic effects (Adelman et al. 2018; Kawahara et al. 2008; Klink & Wu 2014). Three items were prepared within each cell by making use of different pseudo-suffixes (i.e. [-mal], [-sma], [-lfa] in the first set and [-sim], [-xen], [-fos] in the second set). All the stimuli were disyllabic and nonce words in Russian. There were 36 items in total for the first set and 12 items for the second set. The actual lists of stimuli appear in Tables 1 and 2. The full stimulus lists shown in the Russian orthography are available as a supplementary material in the osf repository.

2.2 Procedure

The experiment was conducted online using SurveyMonkey. Participants agreed to participate in the experiment by reading through a consent form. The participants were told that some Pokémon characters undergo evolution, and when they do so, they tend to get bigger, heavier, and stronger. One stimulus name was presented per each trial and the participants were asked 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.[4] The order of 48 stimuli was randomized per participant. After the experiment, the participants were asked whether they were native speakers of Russian, whether they had studied sound symbolism before, and whether they

[4]Since the stimuli were presented in written orthography and since they were non-sense words, we were unable to control for effects of stress.

Table 1: The first stimulus set.

[a]	*labial*	*coronal*	*dorsal*
vls	pamal	tamal	kamal
	pasma	tasma	kasma
	palfa	talfa	kalfa
vcd	bamal	damal	gamal
	basma	dasma	gasma
	balfa	dalfa	galfa
[i]	*labial*	*coronal*	*dorsal*
vls	pimal	timal	kimal
	pisma	tisma	kisma
	pilfa	tilfa	kilfa
vcd	bimal	dimal	gimal
	bisma	disma	gisma
	bilfa	dilfa	gilfa

Table 2: The second stimulus set.

	trill	*lateral*
[a]	rasim	lasim
	raxen	laxen
	rafos	lafos
[i]	risim	lisim
	rixen	lixen
	rifos	lifos

had participated in any Pokémonastics experiments before. They were also asked how familiar they were with the Pokémon game using a 7-point scale. In the given scale, 7 was labeled "Never touched it," 4 was labeled "so so," and 1 was labeled "Pokémon is my life." Other points on the scale had no labels.

2.3 Participants

The responses were collected using a snow-balling sampling method via word of mouth. A total of 849 speakers completed the online experiment without any monetary compensation. Data were excluded if they reported that they were a non-native speaker of Russian or if they had studied sound symbolism or participated in a Pokémonastics experiment before (N=124). The data from the remaining 725 speakers entered in the subsequent statistical analyses. Among them, 421 of them were male, 294 of them were female and 10 chose not to report their gender. The age breakdown was as follows: 140 (18-19 yrs old), 357 (20-29 yrs old), 176 (30-39 yrs old), 36 (40-49 yrs old), 13 (50-59 yrs old) and 3 (60+ yrs old). Since there were no apparent effects of age or gender, and since we had no prior reasons to expect that these factors would impact the results (see Kawahara et al. 2020), we will not consider these factors in further detail.

2.4 Analyses

We fit a Bayesian mixed effects logistic regression model to analyze each data set. In both models, we included all the fixed factors as well as their interactions. Bayesian analyses have several advantages over more traditional frequentist analyses, which we do not review in detail here (see e.g. Franke & Roettger 2019 and Kruschke & Liddell 2018 for accessible tutorials). It suffices to note here that Bayesian analyses take prior information and the data under consideration to yield posterior distributions for each parameter that we are interested in. One straightforward heuristic to interpret the results of Bayesian regression analyses is to examine the 95% Credible Interval (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% CrI contains 0, we conclude that the effect is not very meaningful. Moreover, in Bayesian logistic regression models, if a CrI is fully contained in [-0.18, 0.18], we can take that result to support a null effect (Kruschke & Liddell 2018; Makowski et al. 2019).[5] We should note, however, that in Bayesian analyses, we can go beyond the "significant vs. non-significant" dichotomy usually embraced in frequentist analyses, and directly explore the degrees of (un-)certainty of the estimates we are interested in.

The analyses were implemented using R (R Development Core Team 1993–) and the `brms` package (Bürkner 2017). In the current analyses, the random structure included a free-varying intercept and slope for participants associated with all the fixed factors and their interactions.[6] The binary-coded dependent variable was whether the response was pre-evolution character or post-evolution character. The default priors in `brms` were used. 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 chains mixed successfully. See the R markdown files in the osf repository for complete details.

[5] This is a region that can be considered to be practically equivalent to 0, i.e. Region Of Practical Equivalence (a.k.a. ROPE) of β=0. In frequentist analyses, we are never able to "conclude the null" (Gallistel 2009). In Bayesian framework, on the other hand, we can distinguish cases that support the null effect from those cases that are not conclusive.

[6] The models did not include a free-varying random parameter for items, because item was a three-level factor and it does not seem appropriate to include a three-level random factor (see e.g. Snijders & Bosker 2011).

3 Results

Figure 1 shows the by-participant averages of each condition for the first set of stimuli, in which each dot represents each item. The y-axis represents the averaged post-evolution responses. First, comparing the three columns, we observe that labial consonants generally induced fewer post-evolution responses than coronal and dorsal consonants (overall averages: 0.35 vs. 0.39 vs. 0.40). Second, comparing the top panels and bottom panels, we observe that voiced stops induced more post-evolution responses than voiceless stops (0.43 vs. 0.33). Finally, within each panel, we can see that names with [a] induced more post-evolution responses than those with [i] (0.44 vs. 0.32).

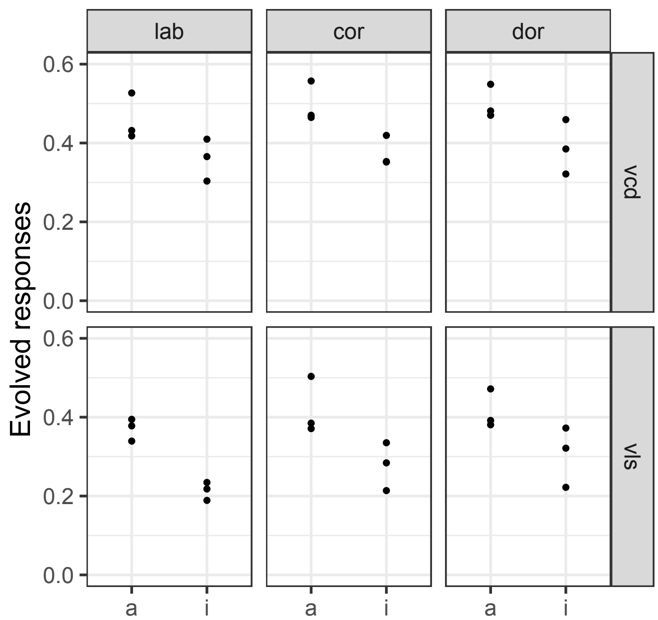

Figure 1: The results of the first set of stimuli. Each dot represents the average "post-evolution" responses for each stimulus item.

The model summary of the regression analysis for this data set appears in Table 3. The baseline condition is voiced, [a] and coronal. First, the coefficient for the vls vs. vcd comparison is negative and its 95% CrI does not include 0, indicating that voiceless consonants meaningfully lowered post-evolution responses with respect to voiced consonants. Second, [i] lowered post-evolution responses with respect to [a], and again its 95% CrI does not include 0. Third, there does not seem to be a substantial difference between dorsal consonants and coronal consonants. Since the 95% CrI of this coefficient estimate is fully contained in [-0.18, 0.18], this result supports the thesis that coronals and dorsals are practically equivalent (Kruschke & Liddell 2018; Makowski et al. 2019). Finally, there was a meaningful difference between labials and coronals, in such a way that labials lowered post-evolution responses with respect to coronals. In short, we observe that voiced obstruents and [a] tend to be associated with post-evolution characters, whereas labial consonants tend to be associated with pre-evolution characters.

Table 3: The model summary (the first set of stimuli).

	β	error	95% CrI
intercept	-0.06	0.07	[-0.19, 0.08]
vls (vs. vcd)	-0.39	0.07	[-0.53, -0.25]
[i] (vs. [a])	-0.60	0.08	[-0.76, -0.45]
dor (vs. cor)	0.02	0.07	[-0.11, 0.16]
lab (vs. cor)	-0.20	0.07	[-0.34, -0.06]
vls: [i]	-0.15	0.10	[-0.35, 0.04]
vls: dor	-0.04	0.10	[-0.23, 0.16]
vls: lab	-0.07	0.10	[-0.27, 0.12]
[i]: dor	0.06	0.10	[-0.12, 0.26]
[i]: lab	0.11	0.10	[-0.08, 0.31]
vls: [i]: dor	0.15	0.14	[-0.13, 0.42]
vls: [i]: lab	-0.32	0.15	[-0.61, -0.02]

All the interaction terms, except for the three-way interaction term between vls: [i]: lab, showed 95% CrIs which include 0. The last interaction term indicates that the interaction between consonant voicing and the vowel quality is slightly different between labials and coronals. Setting aside this complicated interaction effect, the fact that the other interaction terms were generally not credible implies that the effects of the three factors—place of articulation, voicing and vowel quality—tended to be additive; i.e. they more or less contributed to post-evolution responses independently of one another, although we should bear in mind that since the CrIs for the interaction terms are not fully contained in [-0.18, 0.18], the current results do not unambiguously support the null effect for these interaction terms. At least, however, we can conclude that the current experiment does not provide strong evidence for non-additive interactions between the three factors. See Kawahara & Breiss (2021) who deployed a similar experimental design and obtained similar results with English speakers. See also the accompanying markdown file for precisely how many posterior samples for the interaction terms were contained in [-0.18, 0.18].

Figure 2 shows the results of the second set of stimuli, where each dot again represents the average "post-evolution" responses for each stimulus item. As was the case in Figure 1, the difference between [a] and [i] was apparent in that the former induced more post-evolution responses (0.57 vs. 0.49). The effect of the difference between a trill and a lateral was in the expected direction, but not very large in size (0.54 vs. 0.51).

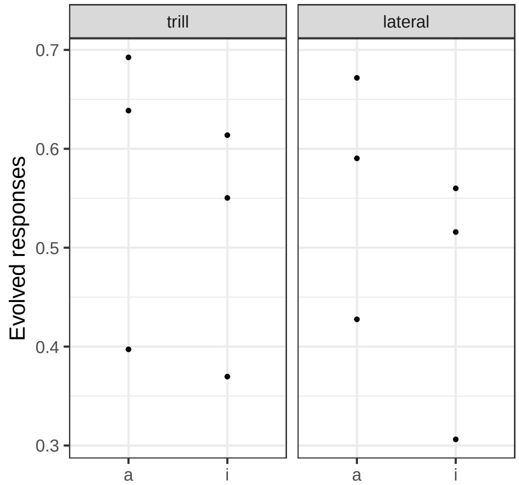

Figure 2: The results of the second set of stimuli. Each dot represents the average "post-evolution" responses for each stimulus item.

The model summary of the regression analysis for this date set appears in Table 4. The effect for the difference between the two liquids at the baseline level ([a]) was not credible. The 95% CrI for the interaction term includes 0, although its posterior distribution is leaning toward the positive values. The effect of [i] was unambiguously credible in lowering post-evolution responses compared to [a].

Table 4: The model summary (the second set of stimuli).

	β	error	95% CrI
intercept	0.29	0.06	[0.18, 0.39]
trill (vs. lateral)	0.06	0.07	[-0.06, 0.19]
[i] (vs. [a])	-0.47	0.07	[-0.60, -0.34]
[i]: trill	0.17	0.09	[-0.01, 0.35]

Since the 95% CrI for the interaction term is skewed toward positive (i.e. its lower bound is -0.01), we further explored how many posterior samples of this interaction term were positive, and found that 96.6% of them are positive. This implies that the effect of the trill vs. lateral difference is more pronounced in the [i]-condition than in the [a]-condition (overall averages: 0.58 vs. 0.56 in the [a]-condition and 0.51 vs. 0.46 in the [i]-condition). Since the slope estimate for the effect of trills in the [i]-condition can be expressed as the sum of the effect of trills and the interaction term in this design (see Franke & Roettger 2019 and Winter 2019: 143-143 for nice illustrations), we calculated the proportion of posterior probabilities of the sum of these two coefficients being positive. This analysis shows that 99.9% of them are positive, suggesting that there was an effect of trills in the context of [i]. In sum, trills were more likely to be associated with post-evolution characters than laterals, but this is the case only before [i]. We do not have a good explanation for why this complicated pattern holds (we discuss more on this point in the discussion section below).

Finally, we would like to address the issue of to what extent the current results were affected by the participants' familiarity with Pokémon—our previous Pokémonastic experiments generally failed to show substantial correlations between familiarity with Pokémon and how sensitive the participants are to sound symbolic patterns (e.g. Kawahara & Moore 2021 and Kawahara et al. 2021; see also Godoy et al. 2020 and Kawahara & Kumagai 2019). In order to explore this issue in the context of the current experiment, we calculated the effect size of each sound symbolic connection in the following ways: (1) vowel = ($p(post|a)$-($p(post|i)$, (2) voicing = ($p(post|vcd)$-($p(post|vls)$, and (3) PoA = $\frac{(p(post|cor)+(p(post|dor)}{2}$-($p(post|lab)$, where $p(post|X)$ means "probability of post-evolution responses in the X condition" (we set aside the effect of trills because of its complex interaction with the vocalic factor). We then calculated the correlation between these measures and familiarity ratings obtained from each participant, using a non-parametric Spearman's test. The results appear in Figure 3, where each circle represents each participant. The familiarity ratings were reversed so that higher values represent higher familiarity.

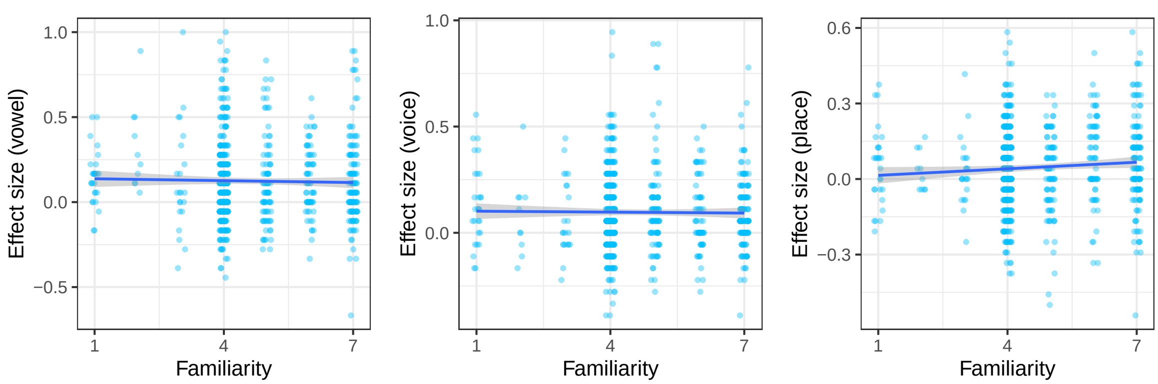

Figure 3: The correlations between the effect sizes and familiarity ratings obtained from each participant. Higher values on the x-axis represent more familiarity with Pokémon. Each circle, horizontally jittered by 0.1, represents each participant. The lines are linear regression lines.

Like in previous experiments, no substantial effects of familiarity were found. The correlation between the effect sizes of place and familiarity was positive and significant ($\rho = 0.09, p < .05$), but its magnitude was very small. The other two measures showed almost no correlations (vowel: $\rho = -0.02$ and voice: $\rho = 0.01$). It therefore seems safe to conclude that familiarity with Pokémon had no substantial impact on the current results.

4 Discussion

To summarize the main findings of the current experiment, Russian speakers found (i) names with [a] to be more suitable for post-evolution characters than names with [i], (ii) names with voiced obstruents to be more suitable for post-evolution characters than those with voiceless obstruents, (iii) names with labial consonants to be less suitable for post-evolution characters than those with coronal and dorsal consonants, and (iv) names with trills to be more appropriate for post-evolution characters than those with laterals, but only when they are followed by [i].

We find the first two findings to be very encouraging. Recall that these connections have been found in previous experimental Pokémonastic studies, targeting speakers of different languages, including English (Kawahara & Breiss 2021), Japanese (Kawahara & Kumagai 2019; Kumagai & Kawahara 2019) and Brazilian Portuguese (Godoy et al. 2020). The current results are all the more intriguing because these patterns are shown not to hold in the existing Pokémon names in Russian (Shih et al. 2019). It is thus likely that these sound symbolic patterns arose in the current experiment because of knowledge of sound symbolism that Russian speakers have, which may be phonetically grounded—voiced obstruents are judged to be large because of their low frequency energy; [a] is likewise judged to be large because it has low fundamental frequency as well as low second formant frequency (Ohala 1994).

We note, however, that the fact that [i] induced fewer post-evolution responses may at least in part be affected by certain aspects of Russian phonology: [i] causes palatalization of the preceding consonants (Padgett 2001) and palatalized consonant can, as is the case with many other languages, denote diminutive meanings (Alderete & Kochetov 2017); e.g. [l^jal^ja] is the child word meaning "baby" or "doll" (Shih et al. 2019). Since palatalized consonants are known to evoke small/diminutive connotations across different languages (e.g. Alderete & Kochetov 2017; Ultan 1978), it would be interesting to explore whether it is either [i] or palatalization (or both) that causes images of smallness in Russian (and other languages, for that matter). A follow-up experiment is necessary to tease apart the effects of [i] and those of palatalized consonants by comparing three conditions: [C^ji], [C^ja] and [Ca].

Our third finding—that labial consonants were less likely to be associated with post-evolution characters, compared to coronal and dorsal consonants—may have arisen as a result of inferences from the pattern in the existing Pokémon names in Russian (Shih et al. 2019). An alternative possibility, which is not incompatible with this first explanation, is that labial consonants may inherently invoke small and cute images (Kumagai & Kawahara 2020), because labial consonants are those that are observed in babbling and early speech i.e. those sounds that are prototypically produced by babies (Jakobson 1941). This sound symbolic effect has been observed with Japanese speakers (Kumagai & Kawahara 2020) as well as with English speakers (Kawahara & Moore 2021), another case of cross-linguistic similarity that we find very intriguing.

It is not immediately clear why the sound symbolic effect of trills was limited to a particular vocalic environment. It is possible that trills in word-initial positions may not realize as prototypical trills, possibly for an aerodynamic reason (Solé 2002, though see also Iskarous & Kavitskaya 2010), so that its effect is small and can only be detected in a certain vocalic environment. It is not still clear, however, why the [i]-context specifically modulated the effects of trills. This puzzle may be related to how the phonetic realizations of trills in Russian are affected by various phonological and phonetic factors. Taking such phonetic factors into consideration, however, makes the current result even more puzzling, because palatalized trills are not canonically realized with multiple tapping gestures, but instead are often realized as simple taps (Iskarous & Kavitskaya 2010). If multiple tapping gestures (i.e. full trilling) were to be associated with large image by way of the iconicity of quantity (Haiman 1980), we would expect the sound symbolic value of [r] to be less pronounced in the [i]-context, contrary to the current results. Overall, therefore, the sound symbolic values of trills, or lack thereof, should be tested in follow-up experiments with stimuli containing trills in different positions as well as other vocalic environments.[7]

The three sound symbolic patterns that we identified in the first set of the stimuli (place of articulation, voicing and vowel) seem to generally function in a cumulative fashion—each factor tended to contribute to the post-evolution responses in an additive way, instead of a particular segment determining the sound symbolic value of the whole names. This finding adds to some recent findings that sound symbolic patterns generally function in a cumulative way (Kawahara 2020; Kawahara & Breiss 2021; Klink & Wu 2014).

To conclude, Russian speakers may share sound symbolic knowledge that has been shown to hold with speakers of other languages: they are more likely to associate voiced obstruents and the vowel [a] to large, post-evolution characters, compared to voiceless obstruents and [i]. They are also less likely to associate labial consonants with post-evolution characters than coronal and dorsal consonants. The experiment also found an effect of trills, although its effect was found only in a limited vocalic environment, which is at this point very puzzling. The current experiment also raised several other questions that should be addressed in future research, the most important of which is perhaps to tease apart the effects of consonant palatalization and the effects of [i]. Overall, the current experiment has at least succeeded in expanding the scope of the Pokémonastics paradigm, which is suited to explore the cross-linguistic nature of sound symbolic patterns in natural languages.

[7] Another topic that we would like to explore in future experimentation is to more directly test the effects of the iconicity of quantity (Haiman 1980), by way of varying name lengths. We would expect that longer names (e.g. those with more segments) are more likely to be associated with larger post-evolution characters. This effect holds in the existing names of Russian Pokémon names (Shih et al. 2019) and is also observed robustly across languages in previous Pokémonastic experiments (Godoy et al. 2020; Kawahara & Breiss 2021; Kawahara & Kumagai 2019).

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