

RESEARCH PAPER

# Sound symbolism in Brazilian Portuguese Pokémon names: Evidence for cross-linguistic similarities and differences

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Several studies in linguistics and related disciplines have been extensively exploring sound symbolism, systematic associations between sounds and meanings. Against this theoretical development, research on Pokémon names has shed new light on cross-linguistic similarities and differences in sound symbolic patterns, using similar experimental stimuli across different target languages. A recent experimental study has demonstrated that Brazilian Portuguese speakers sound-symbolically signal evolution when naming Pokémon characters: post-evolution Pokémon characters tend to receive longer names with more voiced obstruents, while pre-evolution characters tend to receive shorter names with fewer voiced obstruents. Other recent studies showed that in Japanese and English, sound symbolism can also signal differences in Pokémon type: evil-looking characters tend to be associated with voiced obstruents, while flying-type characters tend to have names with sibilants. Integrating the insights offered by these two lines of previous studies, the current paper examines whether Brazilian Portuguese speakers are sensitive to these type-related sound symbolic associations. To improve upon previous studies, we used a free-naming task in order to give participants freedom to create new names. This experiment corroborated the associations between voiced obstruents and evil-type characters, but not the association between sibilants and flying-type characters. A follow-up experiment with a forced-choice paradigm, the same method used in earlier work, also failed to reveal systematic connections between sibilants and flying-type characters. These results indicate that this association may not be universal, contrary to the claim made in previous studies.

**Keywords:** Brazilian Portuguese; sound symbolism; Pokémon names; sibilants; voiced obstruents; task effects

## Introduction

There has been a growing body of recent research which has established systematic and iconic associations between sound and meaning across different languages (e.g., Blasi et al. 2016; Dingemanse et al. 2013; Dingemanse et al. 2015 among many others; see Lockwood & Dingemanse 2015 for a recent review). This body of studies casts doubt on the claim that the sound-meaning relationship is fundamentally arbitrary, as proposed by Saussure's (1916) influential work. A substantial body of these emerging studies have explored the nature of sound symbolism, the long-held notion (see Plato, *Cratylus*: 427a) that some sounds may be more suitable than others to name or summon perceptual categories such as shape, speed, size, or brightness.

The current amount of evidence in favor of sound symbolism has shifted the question from *whether* sound symbolism exists in natural languages to *how* it coexists with arbitrariness in language (Lockwood & Dingemanse 2015). It moreover fostered research on how sound symbolism contributes to first and second language acquisition (Imai & Kita 2014; Imai et al., 2008; Nygaard et al. 2009), its role in communication and the origins of human language (Perlman & Lupyan 2018; Perniss & Vigiliocco 2014) as well as potential parallels between sound symbolic mappings and phonological alternation patterns (Alderete & Kochetov 2017; Kawahara 2020a). As a consequence, studying the relationship between sound and meaning is becoming increasingly relevant for theoretical linguistics. While patterns of sound symbolism had not been seriously studied in the theoretical linguistics literature until very recently, the situation is rapidly changing (Kawahara 2020b). This paradigm shift is evidenced by the growing number of journals in general linguistics that have recently published papers on sound symbolism (e.g., Alderete & Kochetov 2017; Dingemanse et al. 2016 in *Language*, Kawahara 2020a in *Phonology*; Kawahara et al. 2018 in *Phonetica*; D’Onofrio, 2014 in *Language and Speech*). In order to understand how linguistic systems work, we should not ignore the fact that there is some degree of iconicity among existing words in the lexicon of natural languages (D’Anselmo et al. 2019; Perry et al. 2015; Winter et al. 2016). Experimental studies of sound symbolism using nonce words also reveal patterns that are very similar to the results of other phonology-related tasks (e.g. Kawahara 2020a). Overall, these emerging observations call for more work devoted to integrate sound symbolism in linguistic theories (Alderete & Kochetov 2017; Kawahara 2020a, b; Kumagai 2019; Jang 2020; Shih 2020). The current paper contributes to this growing research enterprise, by offering a new set of data from Brazilian Portuguese, a language that is heavily underrepresented in this research program.

More specifically, this paper reports on two experiments that use Pokémon names to explore sound symbolic patterns in Brazilian Portuguese (henceforth, BP). Specifically, we address what type of semantic concepts can be represented by sound symbolic associations in BP, and whether these patterns are comparable to those that are found in Japanese and English. Although sound symbolism has attracted much attention in linguistics, psychology and cognitive science, targeting various languages (Dingemanse et al. 2015; Imai & Kita 2014; Sidhu & Pexman 2018), there is a dearth of studies on this topic in the Lusophone scientific community. Only a few studies have examined sound symbolism in Portuguese (reviewed in Section 2); their results showed some intriguing trends regarding how BP speakers encode sound symbolism in their language, and how these patterns compare to those found in other languages. In the present study, we continue to compare sound symbolic patterns in BP with those in other languages. We hope that our results can serve as a stepping stone for fostering more research on sound symbolism within the field of Portuguese linguistics, thereby filling a gap in this ever-growing body of literature.

The rest of the paper is developed as follows. In the next section, we review core findings on sound symbolism and some theories that explain why we expect some sound symbolic patterns to be both universal and language-specific at the same time. In Section 2, we justify our methodological choice by reviewing the research advantages of using Pokémon names to study sound symbolism. Then we briefly review what we currently know about sound symbolism in BP (Section 3) before presenting the specific hypothesis tested (Section 4). In Sections 5 and 6 we describe two experiments which were designed to test specific sound symbolic patterns in BP.

## 1. Universality and language-specificity in sound symbolism

Some of the most famous studies on sound symbolism are probably the ones that show associations between linguistic sounds and the physical properties of an object. In many languages, low/back vowels are associated with large objects, while high/front vowels

tend to evoke smallness (Berlin 2006; Newman 1933; Sapir 1929; Shinohara & Kawahara 2016, among others). Another well-replicated finding is that voiceless obstruents are more likely to be used to name angular shapes, while sonorant consonants are preferably associated with round objects, a well-known observation now widely known as “the *takete-maluma* effect” or more recently, “the *bouba-kiki* effect” (Ramachandran & Hubbard 2001; Hollard & Wertheimer 1964; Maurer et al. 2006; Nielsen & Rendall 2013; Fort et al. 2014; but see Styles and Gawne 2017). Recently, studies have also shown that various other semantic concepts can be conveyed by sound symbolism, including speed (Cuskley 2013), precision (Maglio et al. 2014), darkness (Asano & Yokosawa 2011) and color (Moos et al. 2014, Cuskley et al. 2019).

Assessing the universality of these sound symbolic patterns is one of the most actively debated topics in the field, with a number of studies suggesting that some sound symbolic patterns are shared by speakers of typologically different languages (e.g., Blasi et al. 2016; Kawahara 2020b; Shih et al. 2018; Shinohara & Kawahara 2010). Sound symbolic patterns that seem ubiquitous pose the interesting question of why some sounds, and not others, have specific sound symbolic values across different languages. Why do voiceless stops, but not other phonemes, evoke angular shapes in so many languages, and why are larger objects associated specifically with low vowels, but not with high ones? Offering a definitive answer to these questions is beyond the scope of the present paper. However, laying out some hypotheses entertained by previous studies helps us situate the current experimental studies within a larger theoretical context, which we turn to now.

A common explanation for the apparent universality of sound symbolic associations is that sound symbolism is grounded in articulatory and acoustic properties of the speech signal. To the extent that speakers of different languages share the same articulators and speak in the same physical environment, the default expectation is that sound symbolic patterns should be shared by speakers of different languages. Ohala (1994), for example, argues that sound symbolic patterns associated with pitch—high-pitched sounds are associated with small images, while low-pitched sounds are associated with large images—may be grounded in the general physical principle that relates the shape of the vocal tract with its resonating frequency: “high resonances are typical of short vocal tracts which, in turn, are indicative of a small vocalizer; and conversely, low resonances of a larger vocalizer” (p. 333). If anatomy and physics play a role in defining sound symbolic associations, then it should not come as a surprise that some patterns are uniformly observed across different languages.

However, recent findings have also revealed cross-linguistic variations in some sound symbolic patterns as well. Speakers of different languages may even show sound-meaning mappings in opposite directions. This is what Saji et al. (2013) found, for example, when they asked Japanese and English speakers to name the action depicted in 70 locomotion videos. In both languages, affricates were associated with manners of motion, but in different ways; /tʃ/ was associated with light and fast motion in Japanese, while the same sound was associated with heavy and non-energetic motion in English. Cross-linguistic variations were also reported by Perry et al. (2015), who identified differences on how English and Spanish speakers rated verbs in their native language: verbs were rated as more iconic in English than in Spanish. Finally, even the well-known *bouba-kiki* effect, reported to hold in various languages, failed to replicate in Songe, a Bantu language, and in Syuba, a Nepalese language (Styles & Gawne 2017).

These disparities between languages may be related to cross-linguistic differences in phonotactics, restrictions on what sounds or sound sequences are allowed in each language. Styles and Gawne (2017) point out that in Songe and Syuba the words used as stimuli in the *bouba-kiki* experiment were phonotactically illegal, which could be

the cause of failure to replicate this effect in these languages. Saji et al. (2013) argue that, unlike in English, [tʃ] in Japanese is not phonemic and instead occurs just as the result of palatalization, which may explain why speakers of these languages show different sound-meaning associations. As for the different iconicity ratings for verbs in Spanish and English, typological differences between verb semantics might have played a role: unlike English, Spanish is a verb-framed language according to Givón's (1995) typology, in which manners of verbal actions are not directly encoded in the verbs themselves.

These explanations have a common theme: while there may be some universal bases for sound symbolic patterns, likely grounded in the physiological and physical properties of our speech, these sound symbolic associations interact with other linguistic properties. This idea is in line with the Sound Symbolism Bootstrapping Hypothesis (Imai & Kita 2014), one of the most influential hypotheses on sound symbolism to date. This hypothesis postulates that, initially, children have access to all sound symbolic correspondences grounded in iconic relationships between the acoustics/articulatory properties of sounds and their iconic meanings; however, they retain during their development just those that are compatible with their language's phonotactics and grammar. In this theory, the universality is the default expectation, but it accommodates room for language-specificity.

All in all, assessing the universality and language-specificity of sound symbolic patterns is a prerequisite for delving into the roots of the sound symbolic phenomenon, and the role it may play in linguistic organization. To that end, recently, a research paradigm dubbed Pokémonastics (Shih et al. 2018) has used Pokémon names to study sound symbolic associations across different languages. This approach not only allows for a quantitative examination of sound symbolism, as there are many Pokémon characters, but also has the advantage of having a fixed set of denotations across languages. Given this, we can examine how these creatures are named across different languages, thereby enabling an efficient cross-linguistic comparison of sound symbolism (Shih et al. 2018). As will be reviewed in detail in the next section, this research paradigm also allows us to address the question of which semantic attributes can be denoted by sound symbolism.

## 2. Sound Symbolism in Pokémon Names

Pokémon is a game franchise by Nintendo in which players battle using their collection of fictional monsters. These monsters, called Pokémon (truncation of [poketto monsutaa] 'pocket monster'), have a number of attributes, which include strength, evolution, height and weight. The first work on Pokémonastics analyzed the Japanese Pokémon names and found that size-related attributes (weight and height), strength and evolution are all positively correlated with the number of voiced obstruents (e.g., /b, d, g, z/) contained in their names, as well as with these names' phonological lengths (Kawahara et al. 2018).

Subsequent analyses examined whether similar patterns hold for Pokémon names in other languages including English, Korean, Russian, Mandarin, and Cantonese (Shih et al. 2018). Results show that some sound symbolic associations are present in different languages, but the way they manifest themselves or the extent to which they follow these patterns can be language-specific. The positive correlation between phonological length and some size/evolution parameters, for example, was found across all the target languages; simply put, the longer the name, the stronger the Pokémon tends to be in all of these languages, which is arguably a reflection of a more general sound symbolic principle, namely, "the iconicity of quantity" (Haiman 1980). However, which unit of phonological length showed this correlation varied across languages. In Japanese, for



instance, there was a correlation between mora<sup>1</sup> counts and evolution; in English, on the other hand, this correlation was found to be best characterized in terms of the number of segments (Shih et al. 2018; see also Kawahara & Moore 2021). In other cases, strong correlations found in one language were present in other languages, but with smaller effect size. For instance, voiced obstruents were strongly correlated to heavier Pokémon in Japanese, but the correlation was weaker in English; Kawahara and Kumagai (2019a) experimentally confirmed this observation.

Finally, some sound symbolic patterns were decidedly language-specific, and these differences may be caused by the fact that languages differ in how they code sound symbolic associations, and/or due to cross-linguistic differences in their phonological organization. For instance, Japanese, but not English, shows a positive correlation between evolutionary stage and the number of labial consonants, while English (but not Japanese) showed a strong correlation between vowel quality and weight/size parameters. Mandarin and Cantonese use tonal features, which are phonologically not contrastive in other languages, to signal differences in evolutionary status and power.

These exploratory analyses by Shih et al. (2018) point to the existence of arguably universal sound symbolism that holds across various languages, and offer a partial answer to the question of what may cause cross-linguistic differences in these sound symbolic patterns. However, there remain non-negligible caveats with these analyses. First, their corpora are restricted to existing Pokémon names. Second, the results remain silent about how speakers might name new characters. To this end, a number of experimental studies have investigated names that people create or choose for new Pokémon characters, which were not in the original franchise.

These experiments have shown that native speakers of English (Kawahara & Moore 2021; Kawahara & Breiss, 2021), Japanese (Kawahara & Kumagai 2019a), and BP (Godoy et al. 2019) do indeed employ sound symbolic patterns related to Pokémon's physical attributes. The results replicate trends found in previous corpus studies, but with some language-specific similarities and differences. For instance, the effect of voiced obstruents to symbolically represent size/evolutionary status was stronger in Japanese than in English or in BP; on the other hand, phonological length correlated positively with evolutionary status in all three languages.

The use of Pokémon characters to study sound symbolism by way of experiments has several research advantages. The large corpora created by previous studies allow for systematically controlled cross-linguistic studies (Shih et al. 2018), which is a non-trivial advantage of using Pokémon names, since languages can differ in terms of the set of denotations that are assigned a name. A controlled comparison across languages is made possible by the fact that these studies used the same experimental stimuli (i.e. the same set of pseudo-Pokémon pictures). Therefore, the Pokémonastics paradigm is useful for tackling two questions we intend to address in this paper: (1) what type of semantic concepts can be sound-symbolically represented, and (2) which of these symbolic associations holds across different languages.

To address our first question, we examined what type of concepts can be coded using sound symbolism. As pointed out by Kawahara & Kumagai (2019b) and Sidhu & Pexman (2018), size and shape are two of the most well-studied patterns in sound symbolism, with

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<sup>1</sup> Moras and syllables are both prosodic counting units that can be used to measure the phonological length of words. Moras and syllables are indistinguishable in many cases; i.e., light CV syllables contain one mora. However, heavy syllables, e.g., those that contain long vowels or geminates, contain two moras. In Japanese, mora is demonstrably the most psycholinguistically salient counting unit (Otake et al. 1993), and thus it is unsurprising that mora counts showed good correlations with various Pokémon attributes in the language.

findings that have been replicated across different languages (Berlin 2006; Newman 1933; Shinohara & Kawahara 2016; Ramachandran & Hubbard 2001; Hollard & Wertheimer 1964; Maurer et al. 2006; Nielsen & Rendall 2013 among others), including BP (Godoy et al. 2017; Silva and Bellini-Leite 2019). However, a natural question that arises is whether more abstract concepts, like *justice* and *freedom*, can be signaled by way of sound symbolism (Lupyan & Winter 2018). In general, the question of which semantic concepts can be symbolically represented is an understudied question in the general sound symbolic research. We believe that this question can best be addressed through more empirical case studies, and we hope that our studies contribute toward this goal.

This question is addressed within the Pokémonastics paradigm by investigating which sound symbolic patterns—if any—speakers use to signal Pokémon types. These types divide Pokémon characters into groups with common characteristics regarding the element or concept they represent (flying, water, fire, psychic, etc.), and the initial analyses (Hosokawa et al. 2018) found that the evil and the fairy type characters in Japanese were named in the original franchise with names that contained, more voiced obstruents and more labial consonants, respectively. Kawahara & Kumagai (2019b) and Kawahara et al. (2020) followed up on these initial studies with a series of experiments that suggest that Japanese speakers use sound symbolism to signal several Pokémon types.

The findings by Kawahara & Kumagai (2019b) and Kawahara et al. (2020) were later replicated with English speakers (Kawahara et al. submitted). These studies open up a new opportunity to address which sound symbolic patterns are universal and which are language-specific (see above, as well as Iwasaki et al. 2007 and Saji et al. 2013 for language-specific symbolic associations), a topic of study that, as reviewed above, may shed light on how sound symbolism develops during language acquisition (Imai & Kita, 2014; Kantartzis 2011), what role it might have played in language evolution and communication (Perlman & Lupyan, 2018) and what the physiological and physical roots of these associations are (Morton 1994; Ohala 1994). With these general questions in mind, we ask whether sound symbolic associations related to Pokémon types can be replicated with native speakers of BP. We reiterate at this point that studies of sound symbolism are flourishing in general, but currently only a handful of studies target BP. We feel that this gap should be filled.

### 3. Sound Symbolism in Brazilian Portuguese

To the best of our knowledge, there are only a few studies on sound symbolism in Portuguese. Apart from corpus-based research on ideophones in regional dialects of BP (Cruz & Fernandes 2004), and acoustic and perceptual analysis of speech expressivity (Madureira & Camargo 2010), few experimental studies have tested the perception or production of sound symbolism. Similar to many languages, behavioral and physiological experiments have shown that speakers of BP are sensitive to sound/shape symbolism while reading or listening to linguistic stimuli (Godoy et al. 2017; Silva & Bellini-Leite 2019). In general, sonorants like /m, l/ are associated with round shapes, while voiceless plosives such as /t, k/ are associated with angular and jagged images. Similarly, Wiseman and Van Peer (2003, see Aryani et al. 2013) show that BP speakers tend to associate nasal sounds with sad feelings and plosives with happiness when asked to produce fantasy words associated with emotions experienced at funerals and weddings. This study implies that concepts as abstract as sadness and happiness, not just size or shapes, can be symbolically represented.

Within the Pokémonastics paradigm, Godoy et al. (2019) report that BP speakers use sound symbolic patterns to signal the evolutionary status of Pokémon characters. Their study, using both production and comprehension tasks, suggests that BP speakers are similar to Japanese (Kawahara & Kumagai 2019a) in that they use vowel quality,

phonological length and voiced obstruents to symbolically signal pre- and post-evolution Pokémon characters. BP speakers associate/produce names with fewer syllables and with the high vowel /i/ to refer to pre-evolution creatures, while associating names containing more syllables and the low vowel /a/ with post-evolution Pokémon. Additionally, this study showed that BP speakers associate the voiced obstruents /b, d, g, v, z, ʒ/ to larger, post-evolution characters. Because post-evolution characters tend to be larger and heavier, these trends are related to semantic concepts about physical properties, namely, size and shape. To date, no study investigated whether BP speakers use sound symbolism to signal differences in Pokémon types. This is the focus of the present paper.

By expanding on previous findings about sound symbolism within the Pokémonistics paradigm, the present study contributes to the field in a number of ways. First, it expands on what is known about the universality (and language-specificity) of the sound symbolic associations attested in other languages. A more indirect contribution is that by revealing sound symbolic mappings made by BP speakers, we can contribute to delving into the role of sound symbolism in communication and in first and second language acquisition. In order to do this, we need to discover which sound symbolic patterns are present in a target language. In addition, we explore some general methodological issues related to how sound symbolism can and should be tested. In the next section, we outline the two specific symbolic associations investigated in the current study. To the best of our knowledge, none of them has been tested in any dialect of Portuguese.

#### **4. Sound symbolic patterns tested in the current study**

The current study tested two sound symbolic associations. The first is the connection between evilness and voiced obstruents, and the second is the association between sibilants and the idea of flying/air. In this section, we review what is known about these sound symbolic connections, and what issues will be addressed in our research.

##### **4.1 Voiced-obstruents and evil Pokémon**

Studies on Japanese (Kawahara et al. 2018; Kawahara & Kumagai, 2019a; Kawahara & Kumagai 2019b), English (Kawahara & Kumagai 2019a; Kawahara & Breiss, 2021), and BP (Godoy et al. 2019) have shown that voiced obstruents are used to signal evolutionary status in Pokémon characters. Based on corpus analysis and data from free naming experiments and forced-choice tasks, these studies found that post-evolution Pokémon characters have a higher probability of receiving names with voiced obstruents when compared to their pre-evolution pair. However, an additional sound symbolic pattern evoked by voiced obstruents remains to be tested with BP speakers.

Following previous studies showing that villainous characters' names tend to include voiced obstruents in Japanese (Kawahara 2017; Kawahara & Monou 2017), Hosokawa et al. (2018) reported that evil-looking Pokémon characters have a greater likelihood of having voiced obstruents in their names than other characters (see also Uno et al. 2020). This observation was later confirmed by two experimental studies that focused on Japanese and English. Kawahara & Kumagai (2019b) employed a forced-choice task with nonce words and reported that Japanese speakers chose words with voiced obstruents to name evil-looking Pokémon above chance level. This effect was also tested with English speakers in two experiments reported in Kawahara et al. (submitted). In both tasks, English speakers preferred names with voiced obstruents for villainous Pokémon characters.

These results show a correlation between negative images and voiced obstruents, which was already known outside the Pokémonistics paradigm in Japanese linguistics (Hamano 1998, Kubozono 1999). As Kawahara et al. (2008) point out, *doro-doro* and *toro-toro*, for example, are both Japanese ideophones that mean “thick liquid”, but only *doro-doro* has

the additional, negative meaning of “muddy-like”. Similarly, *pocha-pocha* and *bocha-bocha* both refer to the state of falling liquids, but only the latter conveys negative meanings. Experimental work has also found that Japanese speakers associate nonce words containing voiced obstruents with pictures of dirty objects (Kawahara et al. 2008, 2009), a trend that was also observed with English speakers (Shinohara & Kawahara 2009).

Uno et al. (2020) speculate that this association may be related to the articulatory challenge that is presented to speakers during the production of voiced obstruents (Ohala 1983; Proctor et al. 2010; Westbury & Keating 1986), assuming that articulatory difficulties can be associated with general negative<sup>2</sup> images (Kawahara 2017). In order to produce voiced obstruents, speakers need to resort to extra articulatory maneuvers, since the intraoral air pressure needs to be kept low in order to maintain vocal fold vibration, but this can be a challenge because the air flow keeps flowing into the oral cavity. In fact, some languages lack voiced obstruents altogether, arguably due to this articulatory challenge (Ohala 1983). It would not be too surprising if this articulatory burden results in negative images. In the context of Pokémon, this negativity would then result in being used in the names of villainous characters. At the moment, the correlation between articulatory challenge and negative images is more of a speculation than a well-established hypothesis, but testing this association in languages other than Japanese or English (as we do in this paper) can contribute to addressing the generality of this cross-modal connection.

BP distinguishes voiced obstruents /b, d, g, v, z, ʒ/ from their voiceless counterparts /p, t, k, f, s, ʃ/. If the association between evilness and voiced consonants has its roots in the aerodynamic (i.e. physical) challenges that these sounds present (Kawahara 2017; Uno et al. 2020), we may expect that BP speakers would also make productive use of voiced obstruents in their language to name evil-looking Pokémon characters.

#### 4.2 Sibilants and flying

The association between the act of flying and sibilants (e.g., /s, ʃ, z/) has not been extensively investigated by studies on sound symbolism, but this connection was implied in some ancient texts (Kawahara et al. 2020). The Upanishads, ancient Sanskrit texts, state that sibilants represent the sky and the wind (in opposition to the fire or the earth, for example). Similarly, Socrates, in Plato’s *Cratylus* (227), argues that [s] and [z] are appropriate for words referring to concepts related to the wind and the air, because their production requires heavy breathing.

The fact that texts from such different traditions point to a similar symbolic association motivated Kawahara et al (2020, submitted) to investigate the sound symbolism between voiceless sibilants and flying-type Pokémon.<sup>3</sup> Their result shows that English and Japanese speakers prefer to choose nonce words with sibilants (specifically, /s/ and /ʃ/) to name flying Pokémon. A possible explanation of this observation is the large amount of oral airflow involved during the production of sibilants (Mielke 2011), which would be iconically mapped onto the image of wind and flying (Kawahara et al. 2020, submitted). Although these studies have reported this symbolic connection in two different languages (i.e. Japanese

<sup>2</sup> An anonymous reviewer asked whether “negative” is too vague a semantic property to have a single sound symbolic representation. We agree, to the extent that negativity can evoke slightly different concepts in different contexts, which could, in turn, trigger specific (and distinct) sound symbolic associations. Here, we are intentionally using this vague terminology to encompass all findings that shows that a negative characteristic—e.g. being a villainous character in a videogame (Hosokawa et al. 2018; Uno et al. 2020) or being an object with a dirty appearance (Shinohara & Kawahara 2009). Previous studies on sound symbolism have shown that all of these concepts are commonly associated with names containing voiced obstruents.

<sup>3</sup> Voiced sibilants were not included in their study because they may be associated with other sound symbolic meanings.



and English), we know of no other experimental or corpus study that has looked at this association in other languages. In the two experiments described in the following sections, we investigate whether BP speakers also associate /s/ and /ʃ/ with flying Pokémon.

## 5. Experiment 1

Experiment 1 tested the voiced obstruents-evil and the sibilants-flying associations in a population of BP speakers. We addressed whether BP speakers use the same sound symbolic associations observed in the previous experiments that targeted Japanese and English speakers. Additionally, we employed a free naming task, instead of a forced-choice task. Variations of forced-choice tasks were used by Kawahara and Kumagai (2019b) and Kawahara et al. (2020, submitted) to investigate sound symbolism in Pokémon types. Although this paradigm is extensively used in sound symbolism research (see Lockwood and Dingemanse (2015) for a review), it may overestimate sound symbolic effects in some settings (Aveyard 2012, Westbury et al. 2018). For this reason, we used a task that allowed participants to create their Pokémon names without many constraints with regard to which phonemes they could use. This task was previously used in Pokémonastics research by Kawahara & Kumagai (2019a) and Godoy et al. (2019), but here it is used to investigate whether different types can also be symbolically signaled.

### 5.1 Task and Stimuli

Participants were asked to name new Pokémon characters using Portuguese-sounding names in a free-naming task paradigm. The experimental stimuli consisted of a list with 20 pictures, 10 of which represented flying Pokémon characters, and 10 represented evil Pokémon. Most flying characters were bird-like creatures with wings, and none of the evil-looking Pokémon had wings or any other characteristic that would evoke the act of flying. The illustrations used in the experiment were drawn by digital-artist toto-mame<sup>4</sup> and were identified as looking like genuine Pokémon characters. **Figure 1** shows two examples of pictures used in the experiment.

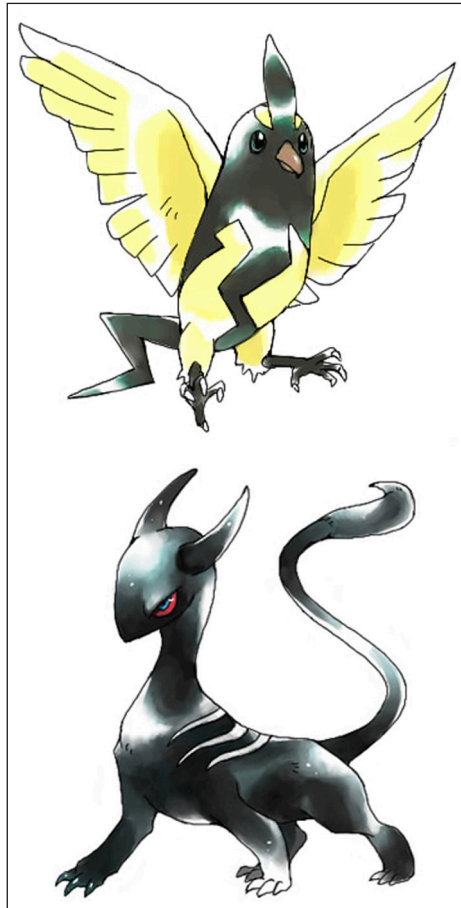
### 5.2 Procedures and Participants

The invitation to participate in the experiment was circulated through posts shared on social media, and participants completed the experiment at home. Eighty-six native speakers of BP took part in the experiment after giving their formal consent.<sup>5</sup> Participants were instructed to name the characters with a Portuguese-sounding name, but were also asked not to use existing words in Portuguese or other languages. They were also asked to avoid using prefixes and suffixes in BP and also avoid Pokémon names already used by the original @Nintendo franchise. They completed a practice trial before the experiment. At no moment during the instructions nor main trials were participants asked to pay attention to the Pokémon type depicted in the pictures; therefore, they were naive to the fact that this was the variable we were testing in this experiment. This is another novel aspect of this experiment, departing from the previous studies that we are building upon (Kawahara et al. 2020, submitted). Participants saw one Pokémon at a time, so they could not compare characters while creating their names. The written responses were recorded through the *GoogleForms* platform.

After completing the experiment, participants were asked if they had any previous knowledge of sound symbolism and if they had previously participated in other Pokémonastics experiments. One participant was excluded from the analysis below because they answered positively to one of these questions.

<sup>4</sup> For other Pokémon pictures drawn by this artist, see <https://t0t0mo.jimdo.com> (last access, August 2020).

<sup>5</sup> Both experiments described in this study were approved by the Ethics Committee at the Federal University of Rio Grande do Norte under protocol 13923519.4.0000.5537.



**Figure 1:** Example of flying (top) and evil (bottom) Pokémon used in Experiment 1; pictures were presented individually.

### 5.3 Dataset and Exclusion Criteria

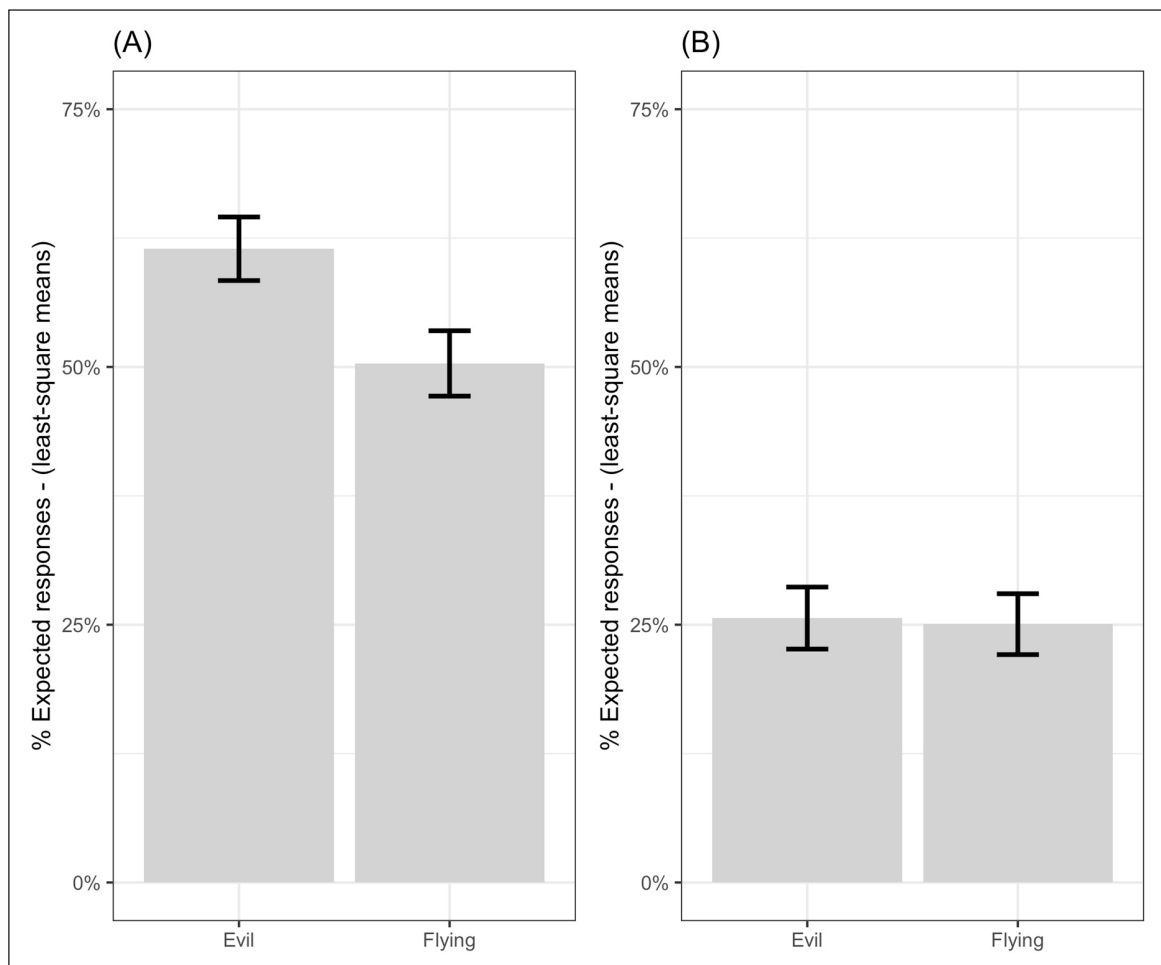
Prior to the data analysis, we established some criteria to exclude observations and participants that did not conform to the instructions. All 1,700 names were assessed by two independent delegates. When they disagreed in their judgment, one referee (first author of this paper) decided whether data should be excluded. The first criterion for exclusion was phonotactics. Names that used foreign-looking orthography and/or violated BP phonotactics were excluded because it was not possible to infer the intended pronunciation.<sup>6</sup> Following Godoy et al.'s (2019) procedure, this includes names with double vowels and double consonants in any position (e.g., “Nicoo”), names with syllabic structures not available in BP (e.g. “Garranr”), and names ending with any consonant other than “s”, “r”, “m”, “n” and “x”. We also excluded names with “w” in syllable onset (e.g., “Wilge”) because it is not possible to tell whether the intended pronunciation was /w/ or /v/. Names that used a blend of words (e.g., “barasouro” – barata = cockroach; besouro = beetle) and names that used Portuguese words, even if they did not have any relation with the depicted Pokémon (e.g., “bola” = ball; “pencil” = lápis), were also excluded. Finally, we excluded data from 33 participants because more than 50% of their responses fell in at least one of the exclusion

<sup>6</sup> In Brazil, the Pokémon franchise uses the English names for their characters (e.g., Bulbasaur, Psyduck, Charmander). This practice may have encouraged the use of foreign-sounding names in the current experiment, which had to be excluded from our analysis, because we are interested in the patterns of BP, not in English. In fact, some participants reported they had a hard time thinking about Portuguese-sounding names because they were used to associating Pokémon to foreign names.

criteria. The final dataset<sup>7</sup> included 738 observations from 48 participants, and was phonologically transcribed using SILAC (Oushiro 2018), an automated grapheme-to-phoneme transcription tool. This was done because the voiced and voiceless sibilants [z] and [s] can be both represented by the letter “s” depending on the orthographic context they occur. All the analyses were based on the phonological transcription of the data.

#### 5.4 Analyses and Results

To examine the hypothesized association between voiced obstruents and evil Pokémon, a script automatically counted whether there were occurrences of voiced obstruents (namely /b, d, g, v, z, and ʒ/) in each name. We used the lme4 package (Bates et al., 2015) to fit a mixed-effects logistic regression model. The model included Pokémon type (flying vs evil) as the main fixed predictor, the occurrence of voiced obstruents as a binomial response variable, and random intercepts for participants and items; random slopes were not included due to convergence issues. Model comparison showed that the Pokémon type was a significant factor in predicting the occurrence of voiced obstruents ( $\chi^2(1) = 6.94, p = 0.0084$ ). As shown in **Figure 2A**, the evil type had a greater chance of having voiced obstruents in their names than flying type ( $b = -0.45, z = -2.81, p = 0.0048$ , cf. **Figure 2A**).



**Figure 2:** Estimated rate of names containing voiced obstruents (A) or sibilants (B); error bars represent standard errors.

<sup>7</sup> The dataset is available from the corresponding author for research purposes only.

The same statistical procedures were adopted to analyze whether flying Pokémon increased the chances of having a sibilant in their name. Following Kawahara (2020, submitted), we limited our analyses to the occurrences of /s/ and /ʃ/ in each name. A mixed-effects logistic regression model was fit with the presence of sibilants as a binomial response variable, Pokémon type as the fixed predictor, together with random intercepts by participants and items. Model comparison showed that the Pokémon type was not a significant factor in predicting the presence of sibilants ( $\chi^2(1) = 0.0326$ ,  $p = 0.8568$ , cf. **Figure 2B**).

### 5.5 Discussion

Regarding the association between evil-looking Pokémon and voiced obstruents, our results suggest that BP speakers show patterns that are similar to the ones observed for English and Japanese speakers: there is a greater chance of employing voiced obstruents to name villainous characters. In addition to replicating this previous finding from English and Japanese in a new language (i.e. BP), our data offer additional contributions to our understanding on this topic. First, previous work on this issue in Japanese (Kawahara & Kumagai 2019b) and English (Kawahara et al. submitted) employed a series of forced-choice tasks, a paradigm that is known to potentially overestimate the effects of sound symbolism (Aveyard 2012, Westbury et al. 2018). The present study, however, used a free naming task, meaning that participants were not forced to choose between names with pre-specified phonological features. As a consequence, the current results suggest that the association between evil Pokémon and voiced obstruents is robust enough to emerge even when participants are mostly free to create their names.

Second, in the current experiment, the Pokémon pictures were not presented in pairs, an additional methodological difference compared to Kawahara & Kumagai (2019b) and one of the experiments in Kawahara et al. (submitted). The current result thus indicates that this sound symbolic association holds even when visual stimuli are presented in isolation, without the need to compare two or more possible referents. We believe that the current methodology, which is demonstrably more conservative than an oft-used two alternative forced-choice (2AFC) task, should be used in studies of sound symbolic patterns in other languages, which could strengthen the current findings and allow for future cross-linguistic comparison.

On the other hand, the use of a free-naming task and the presentation of a single Pokémon at a time may explain why we were not able to replicate the previous findings on the association between sibilants and flying Pokémon. The current results show that the probability of using /s/ and /ʃ/ did not change as a function of Pokémon type. This is at odds with previous studies in English and Japanese. It may be the case that BP speakers do not make such sound symbolic association at all, or that previous evidence for this sound symbolic pattern may be a by-product of the experimental task.

For their experiment in Japanese, Kawahara et al. (2020) employed a 2AFC task: participants saw simultaneously a flying and a non-flying Pokémon, along with two nonce names. Only one of these names contained sibilants, and the participant's task was to decide which name was more appropriate to each Pokémon. This task is widely used in research on sound symbolism, as was the case for the exploration of the *bouba-kiki* effect, a very well-known and influential observation in the sound symbolic research (Fort & Pepercamp 2014; Ramachandran & Hubbard 2001). To test the sound symbolic effect in English, Kawahara et al. (submitted) ran two experiments. In the first task, participants saw just one name with or without sibilants (e.g., "Sushen" or "Tutem") along with a flying and a non-flying Pokémon. Their task was to decide which Pokémon would better suit that name. Their second experiment used a 2AFC paradigm. In both studies, names with sibilants had a greater chance to be chosen as names for the flying Pokémon.



In all these experiments, participants had to make choices based on names previously created by the researchers with features they saw as representative of the effect they were about to test. In experiments using a 2AFC paradigm, the contrast between the pair of names may highlight phonological differences and overestimate the sound symbolic effect (see Westbury 2005 and Westbury et al. 2018 for related discussion). Previous studies have shown that increasing the number of choices to four in forced-choice tasks may decrease the chance of participants answering accordingly to the expected response (Aveyard 2012). Finally, in all the experiments reported by Kawahara et al. (2020) and Kawahara et al. (submitted), the flying aspect of the characters was highlighted by the fact that they were always presented in contrast with non-flying Pokémon. In the instructions, participants were told to pay attention to the fact that there were different types of Pokémon, and during the experimental trials, Pokémon were explicitly labelled as “normal Pokémon” and “flying Pokémon” (see an approximation of this experimental setting in **Figure 3**). This methodological procedure contrasts with the current experiment, in which participants saw one Pokémon at a time and were not explicitly instructed to pay attention to their type.

## 6. Experiment 2

The goal of Experiment 2 was to test if the association between sibilants and flying Pokémon reported by Kawahara et al. (2020, submitted) would also hold for BP speakers in a more controlled experimental setting, in which participants were directed to pay direct attention to different visual cues. To do so, we used a 2AFC task. This experiment would allow us to investigate if the lack of an effect for sibilants in Experiment 1 was due to methodological differences or to the fact that BP speakers, in general, do not reliably make the flying-sibilant association to the same degree that Japanese and English speakers do.

### 6.1 Task and stimuli

In order to make direct cross-linguistic comparison, this experiment followed closely Kawahara et al. (2020 and submitted, Experiment 2) and presented participants with 16 pairs of visual stimuli. Within each trial, participants saw a pair of Pokémon explicitly



**Figure 3:** Example of Figures used in Experiment 2; subtitles say “1. Flying-type, 2. Normal-Type”.

identified as belonging to flying and normal types (see **Figure 3**). As in the previous experiment, all pictures consisted of non-existing Pokémon characters drawn by artist *toto-mame*. Along with the pictures, participants also saw a pair of names. The participant's task was to decide which name better suited the flying Pokémon and which name was more appropriate for the non-flying character. Most of the flying type Pokémon characters were bird-looking creatures, and they all had wings.

**Table 1** lists the pair of names, which were adapted from the stimuli used by Kawahara et al. (submitted), with some minor modifications, in order to make them more suitable for BP speakers. We replaced syllables that would be pronounced as affricates in the non-sibilant condition (mainly occurrences of [tʃ] that could be read as [ti] or [tʃi] depending on the BP dialect, e.g. Tietam, Tiltin). Names in the sibilant condition had two sibilants, [s] and [ʃ]. Although the digraph “sh” is not common in Portuguese words, speakers of BP are familiar with it and can map it to the phoneme [ʃ] due to the popularity of English words such as “show” or “shampoo” in Brazil. These sibilants were replaced by [t] and [k] in the non-sibilant names because their articulation is close to [s] and [ʃ], respectively. Vowels and other consonants were controlled within each pair.

## 6.2 Procedure and participants

The experiment was administered online using SurveyMonkey, and the link to the experiment was posted on social media. After reading the consent form and agreeing to take part in the experiment, participants were asked if they were native speakers of BP, if they had previous knowledge of sound symbolism and if they had already taken part in a Pokémonastics experiment. Then, they proceeded to name 16 pairs of Pokémon with the stimuli described in the previous section. The order of the stimuli was randomized per participant by SurveyMonkey.

A total of 145 native speakers of BP agreed to participate in the experiment. Fourteen were excluded because they had previous knowledge of sound symbolism and/or had taken part in other Pokémonastics experiments. Data from the remaining 131 participants resulted in a total of 2,096 observations.

**Table 1:** List of stimuli used in Experiment 2.

<b>Sibilant vs. Non-sibilant</b>
Sushem vs. Tutem
Sashal vs. Tatal
Seshom vs. Tetom
Sashoi vs. Tatoi
Soshol vs. Tokol
Sushal vs. Tukul
Sesham vs. Tetam
Sulshom vs. Tultom
Shushol vs. Kutol
Shashem vs. Katem
Shalsher vs. Kalter
Shosal vs. Kotal
Shushem vs. Kutem
Shashoi vs. Kakoi
Sheshom vs. Ketom
Shieshol vs. Kietol

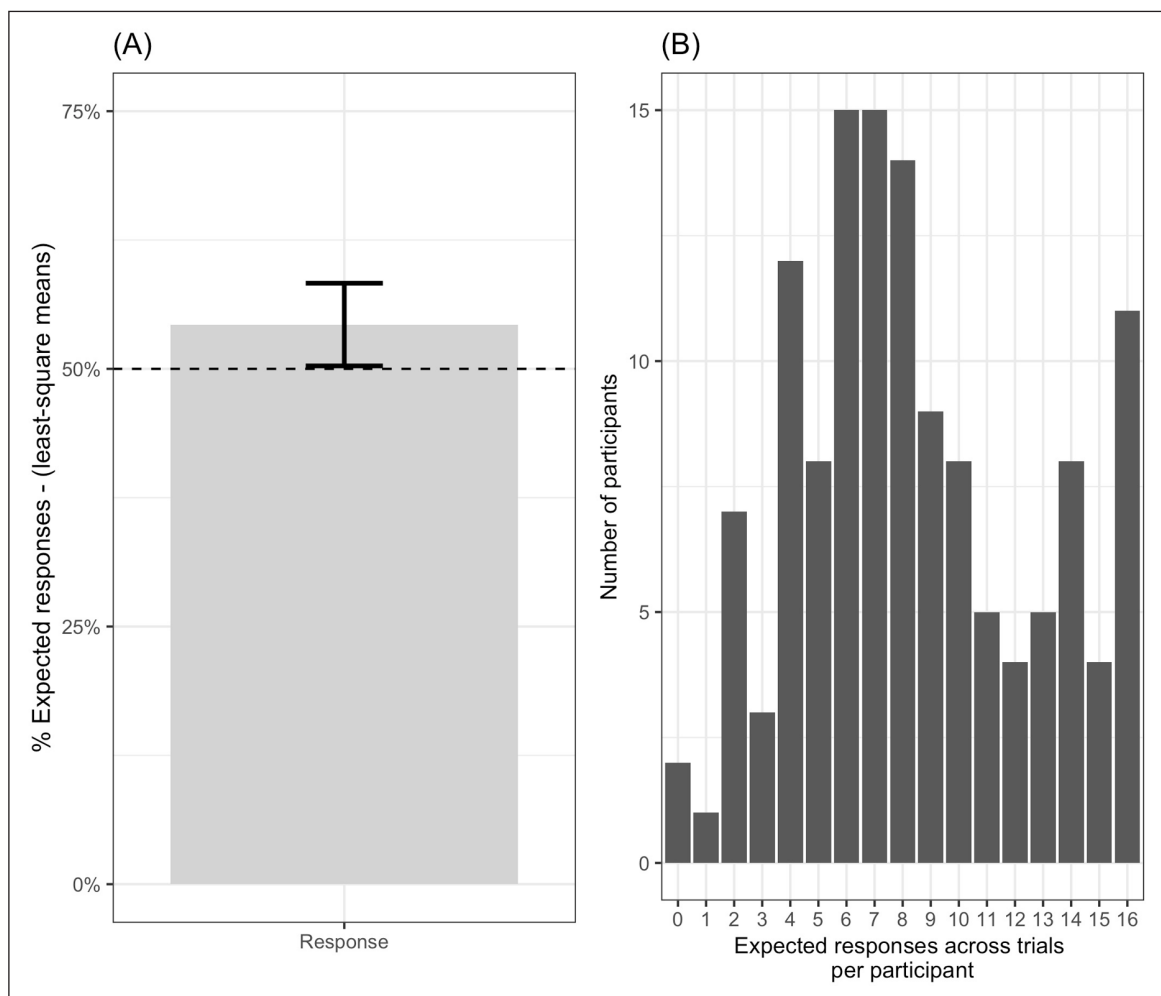
### 6.3 Analysis

Responses were coded binarily according to whether the participant's decision was expected or unexpected given our hypotheses. In total, 1,096 responses (52%) were expected and 1,000 (48%) were unexpected. To statistically assess whether responses were above chance level, we ran a mixed-effects logistic regression with items and participants as random factors and the binary response as the dependent variable. The model's coefficient showed that there was no significant tendency to choose names containing sibilants for flying Pokémon ( $b = -0.17, z = -1.06, p = 0.29$ ). **Figure 4** shows the total proportion of expected responses in the whole dataset (A) and distribution of expected per participant (B).

The second figure (B) shows that while the BP speakers in general did not make the sound symbolic connection under question, there were some who did make this sound symbolic association, as well as those who made the opposite choice. In other words, there was large inter-speaker variability.

### 6.4 Discussion

The results from Experiment 2, combined with results from Experiment 1, suggest that the general community of BP speakers do not reliably make the same sound symbolic associations employed by speakers of Japanese and English to name flying Pokémon. This is the case even when we use the same experimental paradigm employed by these previous studies.



**Figure 4:** Estimated rate of expected responses according to our hypothesis in Experiment 2 with error bars representing standard errors (A) and Distribution of the number of expected responses per participant (B).

This failure to replicate the previous studies on other languages (Kawahara et al. 2020, submitted) is nonetheless interesting, as some sound symbolic associations may indeed be language-specific (Saji et al. 2013). According to Imai and Kita (2014), sound symbolic associations may scaffold language acquisition, and the set of sound symbolic connections made available to infants may initially be innate and universal. As they acquire their native language, however, speakers of different languages may lose some of these associations depending on how the phonological inventory of their native language is organized. This is in line with the findings that children are more sensitive than adults to sound symbolism in foreign languages (Kantartzis 2011), and that the phonological status of phonemes in different languages can explain differences in how sound symbolism is coded (Saji et al. 2013; Tyler et al. 2014). As a consequence, the fact that BP speakers do not show the same sound symbolic pattern as Japanese and English speakers is not at odds with the general research enterprise on sound symbolism; it instead forces the field to think carefully about possible explanations that can accommodate these differences.<sup>8</sup>

Kawahara (2020b) entertains the possibility that those sound symbolic patterns that have a phonetic basis may be universal, because speakers of different languages share the same articulatory system and speak in the same physical world. In previous studies (Kawahara et al. 2020, submitted), the sibilant/flying association was argued to be arising from how sibilants are produced: since the production of sibilants requires a large amount of oral airflow (Mielke 2011), this would evoke the concept of wind and, by extension, flying. What our results show is that even those sound symbolic associations that have a plausible phonetic basis can fail to replicate in a certain language. The reason why this happens remains an open question to be answered in future follow-up studies, but we offer some possible explanations here, to be empirically tested in future research.

Following previous research that show cross-linguistic differences in sound symbolism (Saji et al. 2013; Styles & Gawne 2017), the main candidate to explain the different results in BP is phonotactics. However, in Portuguese, like in English and Japanese, sibilants can occur in syllable onset, as in our experimental stimuli, which rules out the hypothesis that the effect is not observable in BP due to phonotactics violation. Moreover, [s] and [ʃ] apparently share a similar phonemic status in all three languages, as they are not merely allophonic variations that occur in specific contexts. This would appear to discourage the hypothesis that the lack of an effect for sibilants in BP was driven by these sounds having a different phonological status in this language. A more viable explanation would be that the manner of production of these sounds could differ in these languages, or that how these sounds are used in actual words is different. Acoustic analysis and corpus-based research of existing words in BP would be necessary to test these hypotheses.

Alternatively, it could also be the case that sibilants are more strongly associated to other meanings in BP. In this paper and in the previous studies on the sound symbolism of sibilants, we argued for an association between these sounds and the property of a Pokémon being able to fly. However, it is possible that this association is mediated by other semantically related concepts, like lightness (as opposed to heaviness) or speed. BP speakers can have a stronger preference to associate sibilants to these related meanings, but fail to associate these meanings to the concept of flying creatures.

Finally, another interesting course of future research would be to explore individual differences in sound symbolism in further depth. This is an underexplored topic (see

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<sup>8</sup> Relatedly, Style & Gawen (2017) discuss the possible effect of general publication bias, due to which “failed maluma/takete experiments remain hidden away in “file drawers” of linguistics and psychology departments across the globe.” This is another reason why we believe that the current results should be reported, despite its negative results.



Kawahara et al. 2020), but previous research has found that speakers show differences on how prone they are to make sound symbolic associations (e.g. Drijvers et al. 2015). Two participants of our second experiment mentioned that they associated sibilants with flying Pokémon, and we note that 11 participants (out of 145) associated sibilants to flying Pokémon in all of the 16 stimuli (against just two who chose the non-sibilant name for flying Pokémon for all stimuli, see **Figure 4B**). In this scenario, one may ask whether this symbolic association was perhaps one “lost” by most BP speakers, following Imai & Kita’s (2014) hypothesis, but maintained by some. If that is the case, this association should be available to infants who are still acquiring BP. The issue of interspeaker variability in terms of sensitivities to sound symbolism is an understudied topic in the sound symbolism research, and our results invite further exploration on this matter.

## 7. Conclusion

The experiments reported in this paper were designed to test whether BP speakers use sound symbolism to signal differences in Pokémon type and whether these symbolic patterns are similar to ones employed by Japanese and English speakers. The first experiment suggests that the association between voiced obstruents and evil Pokémon holds in BP, as it does in other languages. This association was observed even in a free-naming task format. The results are in line with the hypothesis that the articulatory/aerodynamic challenge imposed by the production of voiced obstruents could be mapped to negative images (Kawahara 2017), although the precise mechanism that connects articulatory challenges and negative images is yet to be explored in further depth.

On the other hand, neither of our experiments replicated the sibilant-flying association reported by previous studies. Rather than presenting these results as a counter-argument to sound symbolism, we take this pattern as being in line with work that suggests that some sound symbolic association may be language-specific (Imai & Kita 2014; Saji et al. 2013). The results imply that, although sound symbolic patterns with a phonetic basis may generally be universal, as hypothesized by previous studies (e.g., Kawahara 2020b), there are some counter-examples, such as those reported here. The current failure to replicate may be due to an assortment of reasons: the manner of production of sibilants can be different across languages, other sound symbolic associations may be more available in different languages, and/or individual differences affect how sensitive some speakers are to sound symbolic patterns. Testing these possibilities provides an avenue for future empirical research.

Finally, another issue that also merits future attention is the generalizability of our findings. The Pokémonastics paradigm has been used to test sound symbolism in other languages, and is well-suited for cross-linguistic studies. However, it is not suited to explore how sound symbolism works for other vocabulary items outside of the Pokémon world. Currently, there is evidence that the lexicon of a language carries some degree of iconicity. Experimentally, this is attested by the high iconicity ratings some words receive (Winter et al. 2016, Perry et al. 2015) and by the fact that people can correctly pair antonyms in an unfamiliar language (D’Anselmo et al. 2019; Tzeng et al., 2017). Corpus-based research also shows that across thousands of languages, basic vocabulary items (specially property words and body parts) show similar associations with specific sounds (Blasi et al. 2016).

With this said, the sound symbolic patterns that we are studying in the Pokémon world are the same as those that are motivated/observed/studied in the context outside of this world. As reviewed above, the sound symbolic nature of voiced obstruents has been well-known in Japanese. The connection between flying and sibilants was mentioned by Socrates and the Upanishads, long before the Pokémon universe came into being. Thus, while we should exercise some caution in generalizing our current findings beyond the Pokémon universe, we are fairly optimistic that we are tapping into the general linguistic knowledge.

One of the most ubiquitous sound symbolic patterns in languages is the association between the idea of smallness and the high front vowel /i/. This pattern was observed in studies that used Pokémon names and targeted BP (Godoy et al. 2019), and it is also attested in the corpus research mentioned previously as well as by many experimental studies outside the Pokémonastics paradigm (see Shinohara & Kawahara (2010) for a review). “The longer the stronger principle” in the Pokémon universe, which is active across all the languages studied so far, is likely to be a reflection of a sound symbolic principle that is otherwise known as “the iconicity of quantity” (Haiman 1980). Therefore, we believe that the results within the Pokémonastics paradigm are indeed mirroring more general trends in sound symbolism.

To summarize, there is a rapidly growing body of interest in sound symbolism among several different languages, but not much in BP. We hope the current study stimulates further research on sound symbolism in BP and other Portuguese dialects in South America, Asia, Africa and Europe. Comparison of sound symbolism across dialects, and different languages, is an interesting study in itself, but perhaps even more so, because these types of studies also bear upon important issues that crucially underlie the architecture of linguistic systems.

### Additional File

The additional file for this article can be found as follows:

- **Supplementary File 1:** Datasets and code from Experiments 1 and 2 are available at a git repository. DOI: <https://doi.org/10.5334/jpl.257.s1>

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### Competing Interests

The authors have no competing interests to declare.

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