Sound symbolism and theoretical phonology

Abstract

A received wisdom in modern linguistic theories is that the relationships between sounds and meanings are generally arbitrary. However, there is a growing body of evidence suggesting that in some cases sounds and meanings have systematic relationships—patterns known as "sound symbolism." Yet most of these studies are conducted by psychologists, cognitive scientists or cognitive linguists, and currently, only a few theoretical phonologists pay serious attention to sound symbolism. This paper reviews major studies on sound symbolism in order to show that sound symbolism can be an interesting topic of exploration for theoretical phonologists. This paper also argues that insights gained by phonological research can shed light on some important issues in the studies of sound symbolism. I thus hope that this paper is informative for both theoretical phonologists and researchers who work on sound symbolism.

1 Introduction

One of the standard assumptions often taken for granted in modern linguistic theories is the arbitrariness of signs—the relationship between sounds and meaning is arbitrary. While this thesis was already known since the time of Plato's *Cratylus*, Saussure (1916) perhaps played a key role in establishing this thesis at the center of modern linguistic theories. Also influential was Hockett (1959), who pointed out that the arbitrariness of signs is one design feature that distinguishes human languages from other animal communication systems. Language is undoubtedly a system that is capable of associating sounds and meanings in arbitrary ways, which allows it to have immense expressive power (Lupyan & Winter 2018). Nevertheless, there are cases in which systematic associations between sounds and meanings hold; these patterns are known as "sound symbolism." One well-known example is the observation that speakers of many languages feel nonce words containing [a] (e.g. [mal]) to be larger than those containing [i] (e.g. [mil]) (Berlin 2006; Newman 1933; Sapir 1929; Shinohara & Kawahara 2016; Ultan 1978). Another well-known case is the *takete-maluma* effect (Köhler 1947), in which names with obstruents tend to be associated with angular shapes, while names with sonorants tend to be associated with round shapes (Sidhu et al.

2019). These sound symbolic effects are observed in experimental settings as well as in terms of statistical skews in the lexicon (see the overview papers cited below).

This rise of interests in sound symbolism is partly evidenced by the number of recent overview articles on sound symbolism, each written from a slightly different perspective (Akita 2015; Dingemanse et al. 2015; Hinton et al. 2006; Lockwood & Dingemanse 2015; Nuckolls 1999; Perniss et al. 2010; Sidhu & Pexman 2018; Spence 2011; Schmidtke et al. 2014; Svantesson 2017). Given that so many overview papers already exist, why am I writing another overview paper? That is because none of these papers are directed at theoretical phonologists. Nevertheless, I believe that studying sound symbolism can offer important insights into the architecture of phonological—or more generally, grammatical—knowledge, and also that phonological studies have much to offer for the studies of sound symbolism.

It is helpful to start this discussion by considering why sound symbolism has generally been considered as residing outside the realm of theoretical phonology. To the extent that phonological knowledge is about what speakers know about the sound structure of their native language, if systematic connections between sounds and meanings exist, then, exclusion of sound symbolism from a topic of phonological inquiry is not clearly motivated.[1] But then why was sound symbolism not actively studied in theoretical linguistics?[2] Of course the influences by Saussure and Hockett must have been non-negligible. Another possible reason may be that generative linguistic theories do not, or did not, accept probabilistic tendencies as belonging to competence—it is, or was, believed that grammars should only make a dichotomous, grammatical vs. ungrammatical distinction (Schütze 1996). However, we now have an extended body of evidence showing that phonological knowledge is (or at least can be) stochastic (Boersma & Hayes 2001; Hayes & Londe 2006; Pierrehumbert 2001; Zuraw & Hayes 2017), and several grammatical models have made it possible to model stochastic phonological knowledge (Coetzee & Pater 2011). This rise of new stochastic grammatical models removed one challenge that prevented us from exploring stochastic sound symbolic patterns (Kawahara et al. 2019).

[1] I do acknowledge, however, that there are general disagreements regarding what the domain of phonological inquiry should be. de Lacy (2009), for example, excludes loanword adaptation patterns and phonotactic patterns from topics of phonological inquiry, while both of these receive extensive attention from other phonologists. Some researchers are more willing to accept "external evidence" (Churma 1979)—e.g. language game patterns or rhyming patterns—for phonological argumentation than others (Ohala 1986).

[2] I do not have quantitive evidence for this claim, but Alderete & Kochetov (2017) say "it is fair to say that sound symbolism has never found a natural place in generative grammar" (p. 731). I note here that there have been phonological analyses of alternations that are demonstrably driven by sound-symbolic principles (section 2.1). A few monumental studies that examined sound symbolic connections from a linguistic point of view include Hinton et al. (1994) and Hamano (1996).

2 Phonology and sound symbolism

Some theoretical phonologists have started analyzing sound symbolism—in particular, alternation patterns that are caused by sound symbolic principles—as a part of their phonological inquiry. This section reviews some of these studies in order to show that studies of sound symbolism are not as irrelevant as broadly assumed in theoretical phonology.

2.1 Some alternations are motivated by sound symbolic principles

The first reason to study sound symbolism from the perspective of theoretical phonology is the emerging observation that some alternations appear to be motivated by sound symbolic considerations. In particular, Alderete & Kochetov (Alderete & Kochetov 2017; Kochetov & Alderete 2011) have shown that for example, palatalization found in Japanese baby talks (what they call "expressive palatalization") shows properties that are different from purely phonological palatalization processes. Phonological palatalization is assimilatory in nature, usually caused by (high) front vowels or palatal glides; on the other hand, expressive palatalization in Japanese does not require such a trigger, changing all /s/ in a target word into either [ʃ] or [tʃ] (e.g. /o**s**akana-**s**aɴ/ → [o**ʃ**akana-**ʃ**aɴ] or [o**tʃ**akana-**tʃ**aɴ] 'fish(-y)'. Second, affrication of fricatives never occurs due to purely phonological palatalization (Bhat 1978). Third, expressive palatalization shows place and manner asymmetries that are not shared by purely phonological palatalization. Fourth, expressive palatalization characteristically target all relevant consonants within a word, which is rare at best for purely phonological processes. Finally, expressive palatalization can create an otherwise illegal phonotactic sequence; e.g. /**s**en**s**e:/ 'teacher' can become [**tʃ**en**tʃ**e:], but [tʃe] is not a legal CV combination (Ito & Mester 1995). Expressive palatalization thus does not seem to be motivated by purely phonological considerations; instead, they appear to occur in order to express sound symbolic meanings.

These alternations driven by sound symbolic principles can interact with other phonological considerations within a single grammatical system. To illustrate, Kumagai (2019) shows that in Japanese nickname formation, /h/ is turned into [p] (e.g. /**h**aruka/ → [**p**aruru]). It is hard to consider this alternation to be caused by a purely phonological consideration, since [p] is at best a marked segment in the native phonology of Japanese (Ito & Mester 1995). He argues that this alternation is instead caused by a sound symbolic principle to express cuteness; indeed his experiment shows that [p] is judged to be cuter than any other consonants. Moreover, Kumagai (2019) has shown that this alternation interacts with an independently motivated phonotactic constraint that prohibits the [p...[+voice]] configuration (Kawahara 2018). See Jang (2019) for a similar case found in Korean baby talk, *Aegyo*. These observations have led these authors to propose that sound symbolic principles should be integrated with "core phonological grammar."

2.2 The role of distinctive features in sound symbolism

Another aspect of sound symbolism which makes it interesting for theoretical phonologists is the observation that some sound symbolic patterns operate at the level of distinctive features rather than individual segments. For example, secondary palatalization in Japanese mimetic words denotes, among other expressive meanings, "uncontrolledness" (Hamano 1996), and this generalization can be captured using distinctive features such as [palatal] or [-back]. This sound symbolic pattern operates at the featural level, because consonants at all places of articulation can be affected by it (although there is a preference toward targeting coronal consonants: Alderete & Kochetov 2009; Kochetov & Alderete 2011). Indeed, this mimetic palatalization pattern, despite its sound symbolic nature, has been analyzed by a number of theoretical phonologists (see Alderete & Kochetov 2017: 732).

To take an example from a sound-meaning association, Kumagai & Kawahara (2020) point out that almost all diaper names in Japanese contain [p] and/or [m] (e.g. [**m**a**m**ii**p**oko]); when asked to produce new diaper names, Japanese speakers tend to use *all* types of labial consonants more often than when they are asked to come up with new names for adult cosmetics. This result suggests that the sound symbolism at issue operates at the level of a distinctive feature—[labial]—rather than at the level of individual segments. Considering that the existing diaper names contain only [p] and [m] but not other labial consonants, the participants of their experiment seem to have shown feature-based generalizations, just as "normal" phonological patterns do (Albright 2009; Finley & Bedecker 2009).[3] This observation raises the possibility that phonological patterns and sound symbolic patterns can use the same set of vocabularies, i.e. distinctive features.

2.3 Reconsidering the overall architecture of grammar

To the extent that sound symbolism should be integrated with core phonological grammar, it forces us to reconsider one of our fundamental assumptions regarding the overall architecture of grammatical theory. For example, in generative grammar, no direct relationships between sounds and meanings are usually posited—in the mainstream Chomskian models of grammar, there are no direct connections between PF and LF (Jackendoff 2002: 109-110). In such models, sound symbolic relationships remain unexplained.

However, some proposals maintain that it is possible—and in fact desirable—to use a formal grammatical model to capture patterns of sound symbolism. As discussed above, Alderete & Kochetov (2017) demonstrate that expressive palatalization patterns are motivated by sound symbolic principles. They thus proposed an analysis of expressive palatalization using Opti-

[3] This is not to say that all sound symbolic patterns operate using distinctive features (Akita 2015). However, not all phonological patterns can be neatly captured in terms of distinctive features either (Mielke 2008). This complexity may instantiate a parallel between phonological patterns and sound symbolic patterns. See section 3 for more examples.

mality Theory (Prince & Smolensky 1993/2004), with a set of violable constraints (EXPRESS(X)) specifying which sounds should be realized to express which meanings.

Kawahara et al. (2019) attempt to analyze sound symbolic connections themselves (rather than alternations triggered by sound symbolic considerations), and argue that as long as generative phonology is a function that maps one representation (e.g. underlying forms) to another (e.g. surface forms)—as it in fact has been—there is nothing that prevents us from using the same formalism to model the mapping from representation in one modality (i.e. sound) to representation in another modality (i.e. meaning). In other words, the grammatical architecture that phonologists have been using for decades can be applied to formalize sound symbolic connections at no additional costs. In this view, the phonological component and the semantic component are mediated by the same mechanism that mediates, for example, underlying representations and surface representations.

3 Common issues and shared interests

There are common issues that are addressed both by theoretical phonologists and those who study sound symbolism. My intention in this section is not to solve any of these issues, but to show that we have shared interests. By making these shared interests clear, it is hoped that insights gained in one domain of inquiry can shed light on questions that are addressed in the other. I also hope that these parallels pique phonologists' interests to study sound symbolism.

3.1 Phonetic naturalness

One continuing debate in phonological theory is to what extent phonological patterns are natural with respect to phonetic considerations. On the one hand, there is a group of proposals arguing that most if not all phonological patterns are phonetically motivated, and/or phonological representations contain detailed phonetic information (Hayes et al. 2004). On the other hand, some researchers argue that phonological systems should be completely void of phonetic substance (Reiss 2018). See Kingston (2019) for the most recent review on this debate. At the observational level, some phonological generalizations do seem to be motivated by phonetic considerations, setting aside the question of how this relationship should be encoded in synchronic grammar. For instance, voiced stops are generally considered marked compared to voiceless stops, because voiced stops present an aerodynamic challenge (Hayes & Steriade 2004). In order to maintain glottal vibration, there must be a sufficient transglottal airpressure drop; however, stop closure raises intraoral airpressure, and speakers need to expand their oral cavity to accommodate this aerodynamic challenge (Ohala 1983a). Many languages thus avoid voiced stops in favor of voicless stops, which seems to have its roots in the aerodynamic challenge.

Just like some phonological generalizations, some sound symbolic connections seem to be grounded in the articulatory or acoustic properties of the sounds at issue. This intuition was already expressed by Sapir (1929), a pioneering work on modern studies of sound symbolism: "the symbolic discriminations run encouragingly parallel to the objective ones based on phonetic considerations (p. 233)."[4] Jespersen (1922) and Sapir (1929) found that speakers generally judge [a] to be larger than [i], and attributed this observation to either the differences in the degrees of oral aperture, or the differences in their resonance frequencies (most likely their F2). To provide another example, voiced obstruents are often considered to be larger than voiceless obstruents by speakers of different languages (Newman 1933; Hamano 1996; Shinohara & Kawahara 2016), and it is not hard to imagine that this image of largeness is grounded in the expansion of the supralaryngeal cavity that is necessitated by the aerodynamic requirement that voiced stops present (Ohala 1983a). To provide another example, D'Onofrio (2014) shows that segments that involve lip gestures—such as [b] and [u]—are associated with round figures, in the context of studies of what is known as the *bouba-kiki* effect (Ramachandran & Hubbard 2001). It is again not hard to imagine that the lip rounding gesture of these sounds leads to the image of roundedness.

On the other hand, for some sound symbolic patterns, such phonetic motivations are not immediately clear. For example, it is well-known that English *gl-* sequence appears in many words that are related to the notion of "light" (e.g. *glitter, glow, gloam*). However, there are no phonetic reasons to expect that the sequence of *gl-* should be connected to the meaning of "light." Perhaps more interesting for phonologists is a case that parallels "crazy rules" (Bach & Harms 1972), phonological processes which go counter to what we expect from phonetic considerations. For example, in Korean, [ɑ] and [o] are symbolically smaller than [u] and [ʌ] (Garrigues 1995; Kim 1977). This pattern flouts an otherwise cross-linguistically common observation that high vowels are considered to be smaller than non-high vowels (Sapir 1929 *et seq*), and not only that, to the extent that this sound symbolism has its roots in the different degrees of oral aperture, it runs counter to what we expect from phonetic considerations. In other words, these sound symbolic connections in Korean are arguably phonetically crazy (see also Diffloth 1994).

In the phonology literature, there is a debate regarding whether phonetically crazy rules can be productive or not (Hayes et al. 2009; Kawahara 2008; Sanders 2003). Sometimes crazy rules turn out to be non-productive (Sanders 2003), or there is a learning bias against them (Hayes & WHite 2013; White 2014; Wilson 2006). In this connection it is interesting that Shinohara & Kawahara (2016) found that given nonce words, Korean speakers judge high vowels to be smaller than low vowels, contrary to what we expect from the lexical patterns. Similar results in which grammatical naturalness, which is demonstrably grounded in phonetic considerations, triumphs unnatural lexical skews are reported in some recent phonological studies (Jaroz 2017; Guilherme to appear—see

[4]This observation actually goes back to Socrates, who in *Cratylus* discusses relationships between sound symbolic meanings and phonetic properties of the sounds at issue.

also Berent et al. 2007).

3.2 Bases of representations—articulation or acoustics?

Another major debate in phonological theory is the phonetic bases of distinctive features.[5] Jakobson et al. (1952) first formalized distinctive features in terms of acoustic characteristics. On the other hand, the feature set deployed by Chomsky & Halle (1968) was primarily based on articulation. Since then, there has been a heated debate as to whether distinctive features—or phonological representations in general—should be defined based on articulation or acoustics/perception (see Kingston 2007 for a review).[6]

A similar debate arises in the context of studies of sound symbolism. Take the case of [a] being perceived as larger than [i], discussed above. Jespersen (1922) entertains two hypotheses regarding why [i] is considered to be small, one based on acoustics and one based on articulation: "[t]he reason why the sound [i] comes to be easily associated with small, and [u, o, a] with bigger things, may be to some extent the high pitch of the vowel...; the perception of the small lip aperture in one case and the more open mouth in the other may have also its share in the rise of the idea" (pp. 558-559). Ohala (1994) advocated a general theory of sound symbolic patterns, proposing what is now widely known as the Frequency Code Hypothesis. In this theory, sounds with high frequency energy (either f0 or F2) evoke images of smallness, since these sounds are generated by a small set of vocal folds (in case of high f0) or a small resonating chamber (in case of high F2). One argument for the acoustics-based explanation is that in some languages such as Twi, H-tone can represent something small, and there is nothing plausible in the articulation of H-tone that can be connected to the image of smallness (Ohala 1983b). Another argument for the acoustics-based explanation is that speakers of different languages are able to order their vowels in terms of how big they sound (Newman 1933), and the inverse of F2 is almost a perfect predictor for this judgment (Shinohara & Kawahara 2016).

On the other hand, there are arguments in favor of the articulation-based explanation as well. One argument is the observation that deaf children can detect the sound symbolic values of their own speech and generally, these patterns are similar to the patterns observed for hearing people (Eberhardt 1940). Furthermore, the acoustics-based explanation leaves it unclear why F1 does not affect the images of size (at least not as much as F2)—[a] has higher F1 than [i], and therefore, if listeners deduce the sound symbolic values from F1, [a] should be smaller than [i]. Knoeferle et al. (2017) indeed show that stimuli with higher F1 led to higher size rating, contrary to the prediction of the Frequency Code Hypothesis. Finally, the connection between labial segments and round

[5] A similar debate exists in the phonetics literature regarding whether phonetic targets should be defined articulatorily or acoustically, and also regarding whether the object of speech perception is articulation or acoustics/auditory (Kingston 2007).

[6] Setting aside the view that phonological representations should completely lack phonetic substance (Reiss 2018).

shapes (D'Onofrio 2014) seems to be most straightforwardly explained in terms of articulation, not in terms of acoustics.

3.3 Universality and language-specificity

If sound symbolic patterns have their roots in their phonetic characteristics, one can imagine that sound symbolism is universal, shared across all human languages, as we share the same articulatory and perceptual systems. Therefore, the universality of sound symbolic patterns is one topic that is actively discussed. A parallel question—how universal is the phonological system—is one of the central questions in modern linguistic theories. In both research domains, to the extent that there *are* universals, a deeper question is what level of abstraction is necessary to establish those universals? (Akita 2015)

The universality of sound symbolism is approached in two ways. One is a cross-linguistic comparison, often using an experimental paradigm. Shinohara & Kawahara (2016), for example, used nonce word stimuli to explore the judgment of size associated with five different vowels, [i], [e], [a], [o], and [u], targeting speakers of Chinese, English, Japanese, and Korean. They found that speakers of all languages judged [a] to be larger than [i], hinting at the universality of this pattern (though see Diffloth 1994); on the other hand, Japanese speakers judged [o] to be larger than [a], whereas speakers of the other three languages showed the opposite pattern. The *takete-maluma* effect (Köhler 1947) has been shown to hold across many languages (Styles & Gawne 2017), but it fails in Songe (Rogers & Ross 1975) and Syuba (Styles & Gawne 2017). Based on a meta-analysis of the previous studies on the *takete-maluma* effect, Styles & Gawne tentatively propose that it fails to hold if the stimuli violate phonotactic restrictions of the target language. See also Bremner et al. (2013), Saji et al. (2019) and Shih et al. (2019) for recent discussion on this issue.

Another approach is to examine the behavior of pre-verbal infants. As reviewed more in detail in section 4.2, there is now a growing body of work showing that pre-verbal infants are sensitive to cross-linguistically prevalent sound symbolic patterns (Imai et al. 2008; Kantartzis et al. 2011; Maurer et al. 2006; Ozturk et al. 2013; Peña et al. 2011). On the other hand, there is evidence from acquisition studies showing that not all sound symbolic patterns may be universal. Forte et al. (2013), for example, failed to find an otherwise cross-linguistically robust *bouba-kiki* effect (Ramachandran & Hubbard 2001) in French infants. Iwasaki et al. (2007) found that native speakers of English without any L2 background on Japanese were able to guess the meanings of some sound-symbolic, onomatopoetic words, but not others, arguing that some sound symbolic patterns are universal while others are not. Building on these results, Imai & Kita (2014) hypothesize that "young children are sensitive to all possible sound symbolic correspondences that could appear in any language of the world, but only a subset of these correspondences are compatible with the phonological inventory and the existing words in the language the children are learning.

As they grow up, the sensitivity to the incompatible correspondences wanes, and adults maintain only the sensitivity to the compatible correspondences." This hypothesis may remind phonologists of Stamp's (1973) proposal that babies are borne with a set of universal, phonetically-motivated processes, and as they grow-up, they unlearn some of them and acquire language-specific rules.

3.4 Cumulativity

Yet another common issue is the question of *cumulativity*. In phonology, this issue is most actively discussed in the context of Optimality Theory (Prince & Smolensky 1993/2004) and its comparison with other related theories (Pater 2009; Zuraw & Hayes 2017): when a structure violates two independently motivated constraints, do the effects of these two constraints add up? Optimality Theory suggests that only the higher-ranked constraint matters, whereas other theories such as Harmonic Grammar, suggest that the expected outcome should be cumulative.

A similar question arises in the context of sound symbolism. For instance, some studies show that two instances of the same segment can evoke a stronger image than one instance (Hamano 2013; Kawahara & Kumagai 2019; Thompson & Estes 2011). D'Onofrio (2014) moreover shows that in the *bouba-kiki* effect, several phonetic/phonological features matter in determining the perceived roundness/angularity of visual images (e.g. vowel backness, voicing, and place of articulation), and that these effects are cumulative. Kumagai & Kawahara (2019) show via a nonce-word study that Japanese speakers prefer to use low vowels and voiced obstruents for the names of evolved Pokémon characters; while each of these effects is observed independently, when combined in one stimuli, their effects are cumulative. Based on these observations, they present an analysis using Maximum Entropy Grammar (Goldwater & Johnson 2003), analogous to the phonological analyses presented in Zuraw & Hayes (2017).

4 Additional potential benefits

There are additional benefits that phonologists can gain from studying sound symbolism. Some of them may be considered to be only sociological, having little to do with pursuit of truth, but they can potentially contribute to the development of phonology as a field by attracting interests from students and researchers in other fields. Due to space limitation, the discussion in this section needs to be brief; see the other overview papers cited in section 1 for further details.

4.1 Addressing the origin of human languages

First, some researchers propose that mimicking real world attributes with different types of vocalization contributed to the origin of human languages (Berlin 2006; Cabrera

2012; Haiman 2018; Perlman & Lupyan 2018; Perniss & Vigiliocco 2014; Perniss et al. 2010; Ramachandran & Hubbard 2001). A recent study by Perlman & Lupyan (2018), for example, shows that speakers are able to communicate as many as 30 different meanings by way of iconic vocalizations, well above the chance level; moreover, vocalizations which were judged to be more iconic were learned faster. They conclude that "[t]his newly emerging understanding of iconicity as a widespread property of spoken languages suggests iconicity may also have played an important role in their origin. An intriguing possibility is that many of the now arbitrary words in modern spoken languages may have originated from the innovation of iconic vocalizations." If this hypothesis is true, analyzing sound symbolic patterns might shed light on how human languages may have emerged and evolved.

4.2 The role of sound symbolism in language acquisition

Some researchers argue that sound symbolism plays a non-trivial role in language acquisition (Asano et al. 2015; Imai et al. 2008; Kantartzis 2011; Perry et al. 2018). In the context of first language acquisition, Maurer et al. (2006) demonstrate that 2.5 year old children are sensitive to sound-symbolic associations. Even more strikingly, Peña et al. (2011) show that this sensitivity is detectable as early as 4 month old neonates. These observations have led to the general hypothesis that sound symbolism may aid the first language acquisition process (Imai & Kita 2014).

A partial support of this theory comes from the observation that Japanese care takers use more sound-symbolic, onomatopoetic words to infants and children than to adults (Fernald & Morikawa 1993). Sound symbolism may thus provide a partial answer to the question of why human children acquire languages so quickly—a fundamental question that theoretical linguists attempt to answer. In addition, it has been observed that, in the context of L2 acquisition too, those items that follow sound symbolic principles are easier to learn and more frequently used by language learners (Kunihara 1971; Nygaard et al. 2009).

4.3 Tighter connections with cognitive science

Sound symbolism is now considered as a specific instance of general cross-modal correspondences, in which sensation in one modality has correspondences with sensation in another modality (Bankieris & Simner 2015; Sidhu & Pexman 2018; Spence 2011). There has been a growing body of interest in these cross-modal perception patterns in cognitive science, exploring not only the relationship between sounds and meanings, but also the relationships between sounds and cognitive patterns in other modalities (such as vision and taste). Therefore, engaging with systematic linguistic analyses of sound symbolism would have the potential to facilitate more extensive interdisciplinary communication between phonologists and other cognitive scientists. Two questions

addressed in this research that are of particular interest to theoretical linguists are: (1) is sound symbolism/synesthetic connection innate or acquired, and (2) are sound symbolic connections deducible to a domain-general synesthetic mechanism? (Akita 2015: sec. 4.3)

4.4 Sound symbolism and branding

There is an increasing body of work that seeks to deploy sound symbolism in the context of marketing. Their general finding is that there are sounds that are "suitable" to convey particular images for brand products; such names that make sound symbolic sense are judged to be better, and possibly better remembered, by potential customers (Bolts et al. 2016; Coulter & Coulter 2010; Jurafsky 2014; Klink 2000; Peterson & Ross 1972; Yorkston & Menon 2004). This line of research has opened up a new domain of interdisciplinary research.

4.5 Popularizing linguistics and application to pedagogy

Finally, studying sound symbolism may help us popularize linguistics, and relatedly, sound symbolism can be useful for teaching. One example that instantiates these points is a study of sound symbolic patterns in Pokémon names (Kawahara et al. 2018), which has shown, for example, that Pokémon characters' weight positively correlates with the number of voiced obstruents contained in their names. This result was featured in various popular magazines in Japan. Stephanie Shih, who followed up the original study with a much wider range of languages (Shih et al. 2019), was featured in a radio show to talk about this project. Being able to show to the general public that analytical tools that we use in phonological analyses—such as voiced obstruents—helps in the analysis of Pokémon names can be appealing. This feature of sound symbolism also often attracts undergraduate students' interests as well, as the targets of the analyses include those that they are already interested in (e.g. Pokémon). See Kawahara (2019) and MacKenzie (2018) for reports of the usefulness of using onomastics, including sound symbolism, in undergraduate education.

5 Conclusion

I hope to have shown that studying sound symbolic patterns can be interesting (at least not uninteresting) for theoretical phonologists. To recap, there are some alternation patterns that seem to be motivated by sound symbolic principles, which can interact with purely phonological considerations. Studying sound symbolism may allow us to reconsider the overall architecture of grammatical theories. There are many common interests shared by theoretical phonologists and those that work on sound symbolism, and we can mutually inform one another. There are various additional benefits that phonologists can gain from working on sound symbolism. While some of

them are admittedly not related to pursuit of truth *per se*, these are nevertheless important, as they may contribute to the further development in the field of phonology by attracting interests from students and researchers in other fields.

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