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ARTICLE

Express[p] in expressive phonology: analysis of a nicknaming pattern using 'princess' in Japanese

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Abstract

Recent studies have shown that sound-symbolic patterns can be modelled using phonological theory. The purpose of the current study is to describe a new Japanese nicknaming pattern, *pime-yobi*, wherein [h] alternates with [p] to express cuteness, and to model it using Maximum Entropy Harmonic Grammar. The current study, building on the analysis of Alderete & Kochetov (2017), proposes a sound-symbolic constraint, Express[p], which requires output forms to contain [p]. The results of two experiments show that Japanese speakers found names containing [p]s to be cuter than those without them and that *pime-yobi* nicknaming exhibits intra- and inter-speaker variation in acceptability and cuteness. Based on these results, theoretical analysis shows that the weight of Express[p] varies both across different speakers and within the same speaker.

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1 Introduction

1.1 Sound symbolism in phonology

Two contrasting relationships are exhibited between sounds and meanings in natural language. On the one hand, the association between sounds and meanings is arbitrary (de Saussure 1916; Hockett 1963), in that, for example, the sequence of sounds /tʃɛː/ (*chair*) has nothing to indicate that it refers to ‘a piece of furniture with four legs, for sitting’ in English. However, a growing body of research in linguistics, psychology and cognitive science has shown that sounds are associated with particular images and meanings; this phenomenon is generally referred to as *iconicity* or *sound symbolism* (for an overview, see Hinton *et al.* 1994; Perniss *et al.* 2010; Schmidtke *et al.* 2014; Dingemanse *et al.* 2015; Lockwood & Dingemanse 2015; Sidhu & Pexman 2018; Nielsen & Dingemanse 2021; *inter alia*). One widely observed sound-symbolic association is that [a] is associated with the image of largeness and [i] is associated with the image of smallness (Sapir 1929; Newman 1933; Taylor & Taylor 1965; Peña *et al.* 2011; Shinohara & Kawahara 2016). This ‘[a] = large, [i] = small’ association is arguably rooted in articulation, as the oral aperture of low vowels is wider than that of high vowels (Sapir 1929). This association is also motivated under the frequency code hypothesis, in which sounds with low second-formant frequencies are associated with the image of largeness, whereas sounds with higher F2 frequencies are associated with smallness (Ohala 1984, 1994).

The recent review articles cited above show that sound symbolism has been actively examined in various language science fields. However, Alderete & Kochetov (2017: 731) have noted that ‘…it is fair to say that sound symbolism has never found a natural place in generative grammar’; this means that few studies in phonology research have analysed sound-symbolic effects (see Kawahara 2020a,b for a detailed discussion). Against this background, recent works have shown that sound-symbolic effects can be analysed using phonological theory. For example, Alderete & Kochetov (2017) propose expressive/iconic constraints of the form Express(X) to account for the non-assimilatory palatalisation found in baby-talk registers or diminutives (e.g., Japanese /sakana/ ‘fish’ → /[tɕ]akana/; /dʑuːsu/ ‘juice’ → /dʑuː[tɕ]u/), which shows different features from assimilatory palatalisation. The relevant Express(X) constraint is ranked higher in cases where such non-assimilatory palatalisation occurs. In addition, numerous studies (Kawahara *et al.* 2019; Jang 2020; Shih 2020; Kawahara 2020a,c, 2021) have shown that sound-symbolic patterns can be modelled using Maximum Entropy Harmonic Grammar (MaxEnt HG) (e.g., Goldwater & Johnson 2003; Jäger 2007; Hayes & Wilson 2008), a stochastic version of Harmonic Grammar (HG, on which see Legendre *et al.* 1990, 2006; Pater 2009, 2016; Potts *et al.* 2010). These studies suggest that sound symbolism has successfully contributed to the development of phonological theory.

1.2 Purposes of the current study

The purpose of the current study is to describe a Japanese nicknaming pattern called *pime-yobi* ‘princess-calling’, in which the voiceless bilabial plosive [p] is used to express cuteness, and to model

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it using MaxEnt HG. The reason for adopting a stochastic version of HG, rather than a non-stochastic version, is that it is suitable for analysing the gradient acceptability of output variants.[1] In the early days of generative linguistics, phonology was assumed to be categorical, but a growing body of research in recent years has shown that phonological knowledge, which includes phonotactics and (some) morphophonological processes, is gradient rather than categorical (e.g., Frisch *et al.* 2000; Ernestus & Baayen 2003; Hayes & Londe 2006; Daland *et al.* 2011). The current study conducted acceptability and cuteness judgement tasks, thereby showing that variants of *pime-yobi* nicknaming exhibit gradient acceptability (rather than a categorical dichotomy between 'acceptable'/'cute' and 'unacceptable'/'not cute'). Another reason for using stochastic HG is harmonic bounding, a case where no matter how constraints are ordered, one form is never chosen as the winner (see Prince & Smolensky 2004: 168). Among the *pime-yobi* nicknaming variations is one that has never been observed in real life (see §2.3), and theoretically, this variant is harmonically bounded by another (i.e., it is never selected as a winner). However, the current experiment shows that the harmonically bounded variant is chosen by some speakers. MaxEnt HG can model this pattern because it assigns a non-zero probability to each potential output form, including harmonically bounded candidates (Jäger & Rosenbach 2006).

This study explores the '[p] = cuteness' association in Japanese. There is evidence that [p] is associated with the image of cuteness. First, studies have reported that bilabial consonants are used in cute character names for video games (e.g., Pokémon) or animation (e.g., PreCure) (Kawahara 2019; Kawahara & Kumagai 2019b) and in baby product names (Kawahara 2017; Kumagai & Kawahara 2020; Hirabara & Kumagai 2021). Therefore, bilabial consonants may be associated with an image of cuteness. This association may be derived from the cross-linguistic observation that bilabial consonants are produced at an early stage of children's development (Jakobson 1941, 1968; MacNeilage *et al.* 1997; see Ota 2015 for data from Japanese-speaking children), and may also be derived from the pouting gesture with both lips, called 'duck-face', which is said to be sexually enticing (Kumagai 2020). Additional evidence for the '[p] = cuteness' association comes from Kumagai's (2019) experimental demonstration that singleton [p] is the consonant most likely to be associated with the image of cuteness. This is consistent with the frequency code hypothesis, according to which consonants with higher acoustic frequency (such as voiceless obstruents) are predicted to be associated with the image of smallness (Ohala 1984, 1994).

The remainder of this article is organised as follows. §2 describes the new Japanese nicknaming pattern to express cuteness and proposes a new sound-symbolic Express constraint, Express[p]. Experiment 1, described in §3, examines whether the number of [p]s can affect judgements of cuteness. This section also discusses whether Express[p] shows a cumulative effect. Experiment 2, described in §4, uses two judgement tasks to examine how Japanese speakers perceive certain variants of the new nicknaming pattern. Based on the results of the two experiments, §5 models the Japanese *pime-yobi* nicknaming using MaxEnt HG, thereby showing that the weight assigned to Express[p] varies both across different speakers and within the same speaker.

2 Analysis of the *pime-yobi* nicknaming pattern

2.1 The distribution of [p] and [pp] in Japanese

The current section briefly details the distribution of singleton [p] and geminated [pp] in Japanese. This language has six plosives: [p, t, k, b, d, g]. Among these plosives, the voiceless bilabial plosive [p] exhibits different behaviours in several aspects. First, this plosive is notably less frequent than the others (see Labrune 2012: §3.15). Second, its distribution differs across Japanese lexical strata (Yamato (native) words, Sino-Japanese words, foreign words, and mimetic words; see Itô & Mester 1995, 1999;

[1] Another stochastic version of HG is Noisy HG (e.g., Boersma & Pater 2016; Hayes 2017; Zuraw & Hayes 2017; Flemming 2021). The current study uses MaxEnt HG rather than Noisy HG but makes no claim as to which approach is superior. Comparison of the two models is left for future research.

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Nasu 2015). As shown in (1a), there is no distributional restriction of [p] in foreign words (e.g., Itô & Mester 1995: 819; Labrune 2012: 61). As in (1b), mimetic words like reduplicated forms /C_1VC_2V-C_1VC_2V/ allow singleton [p] to occur in the stem-initial (C_1) position (see Nasu 2015: 261).

(1) a. *Foreign words*
paaku 'park'; *purin* 'pudding'; *sapooto* 'support'; *ai-paddo* 'i-Pad'; *shiroppu* 'syrup'
b. *Reduplicated forms in mimetic words*
puka-puka 'floating'; *pata-pata* 'flapping'; *pon-pon* 'belly' (child language)

Meanwhile, the distribution of singleton [p] is restricted in Yamato words and Sino-Japanese words. It is allowed to occur only in the stem-initial position of the second member of compounds, as exemplified in (2).[2] In Yamato words, [p] generally appears as an alternant of [h], and it almost always becomes geminated [pp], as in (2a) (Labrune 2012: 60). In Sino-Japanese compounding, illustrated in (2b), [h] alternates with [p], becoming geminated [pp], or singleton [p] after a moraic nasal (Labrune 2012: 61). Yamato words and Sino-Japanese words rarely begin with singleton [p], although a few exceptions are found in slang (e.g., *peten* 'trickery', *pakuru* 'to filch'; Labrune 2012: 72).

(2) a. *Yamato (native) words*
su 'bare' + *hadaka* 'naked' → *su***pp***adaka* cf. **padaka*
yoko 'side' + *hara* 'belly' → *yoko***pp***ara* cf. **para*

b. *Sino-Japanese words*
出 *syutsu* + 発 *hatsu* → 出発 *syu***pp***atsu* 'departure'
漢 *kan* + 方 *hou* → 漢方 *kan***p***ou* 'Chinese medicine'
cf. 発 *hatsu* + 言 *gen* → 発言 *hatsugen* 'remarks' (**patsugen*)
方 *hou* + 角 *gak* → 方角 *hougaku* 'direction' (**pougaku*)

2.2 A sound-symbolic [h]→[p] alternation

This section discusses a Japanese nicknaming pattern wherein [h] alternates with [p], as exemplified in (3) (Kumagai 2019, 2022). Example (3a), *Paruru*, is the nickname for Haruka Shimazaki, an ex-member of the Japanese girls' idol group AKB48. In this nickname, the initial consonant [h] becomes [p], and the second mora [ru] is reduplicated. This type of reduplication is often observed in Japanese girls' idol names (see Hashimoto 2016 and Kawahara *et al.* 2019 for additional examples). *Miporin*, in (3b), is the nickname for the Japanese actress and singer Miho Nakayama. Attaching a suffix-like nonce word *rin* is another nicknaming pattern found in Japanese (e.g., *Mari* + *rin* → *Maririn*; *Yosi* + *rin* → *Yosirin*), which is not exclusive to feminine nicknames. Example (3c), *Ripopo*, is the nickname for Riho Miaki, an ex-member of another Japanese idol group, Yoshimotozaka46. In this nickname, [h] turns into [p], and [po] is reduplicated. The [h]→[p] alternation in (3) is often used for (cute) feminine names; thus, it is termed a sound-symbolic [h]→[p] alternation in the current study. This kind of alternation is treated here as an output–output mapping (McCarthy & Prince 1995; Benua 1997) between the surface forms of the base and the nickname, paralleling analyses of other common nicknaming patterns such as truncation.

(3) *Feminine nicknames showing [h]→[p] alternation*

	Base	Nickname
a.	***H**aruka*	***P**aruru*
b.	*Mi**h**o*	*Mi**p**orin*
c.	*Ri**h**o*	*Ri**p**opo*

[2]For the sake of explanation, we here assume the replacement of [h] with [p]. There is an alternative assumption that the underlying consonant /p/ alternates with [h] (see, e.g., McCawley 1968; Itô & Mester 1999: 67).

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In addition to the examples in (3), we can also find girls' nicknames affixed with a suffix-like morpheme [piː]; for example, the Japanese actress and singer Noriko Sakai is nicknamed *Noripii*, in which the first two moras of her first name are compounded with [piː]. This example shows that even if the name does not contain an [h] that can alternate with [p], it can be made to sound cute by adding another morpheme containing [p]. This process can be termed a sound-symbolic [p]-addition.

There are some interesting characteristics specific to the nicknames in (3). First, singleton [p] can occur even in word-initial position, as exemplified in (3a). In addition, although *Miho* and *Riho* are standard Japanese feminine first names, their counterparts with [p] are attested only as nicknames; to the best of my knowledge, there is no person whose original name is *Mipo* or *Ripo*.

In addition to the sound-symbolic reason for the [h]→[p] alternation, the use of [p] in the nicknaming process is also motivated by functional aspects. As mentioned in the previous section, singleton [p] is a less frequent consonant in native and Sino-Japanese words. For this reason, the name to which the [h]→[p] alternation is applied is unlikely to merge with other existing words in Japanese, and so it avoids potential functional problems for speakers. Additionally, because this consonant is less frequent in official names, singleton [p] can function as a marker of nicknaming (Kohei Nishimura, p.c.).

2.3 A nicknaming pattern using 'princess', pime-yobi and a challenging issue

This section describes a Japanese nicknaming pattern sometimes called *pime-yobi* 'princess-calling'. Recently, blogs and articles on social media written in Japanese have displayed a new kind of nicknaming pattern using the word *hime* 'princess', as exemplified in (4), wherein the initial consonant [h] becomes [p] when the word is attached after a real name (e.g., *Ayu* + *hime* 'princess' → *Ayu-**p**ime* 'Princess Ayu'). The online sources of these examples were last checked on 2 August 2022; to the best of my knowledge, some of these posts and articles were written as early as 2010.

(4) *Examples of the* pime-yobi *nicknaming pattern*

a. *Ayu-pime, Yuka-pime*[3]
b. *Kana-pime*[4]
c. *Manami-pime*[5]
d. *Nana-pime*[6]
e. *Sakura-pime*[7]
f. *Yuri-pime*[8]

This nicknaming pattern, like the examples in (3), is often found in feminine names; thus, it may be induced by the sound-symbolic [h]→[p] alternation. However, *pime-yobi* nicknaming causes a theoretical issue; the sequence of labial consonants [p…m] in the nickname would violate the constraint that penalises identical place-of-articulation features (here [labial]) occurring in a specific domain, which is a version of the Obligatory Contour Principle (OCP-PLACE; McCarthy 1986, 1988). Let us now consider this seemingly challenging issue.

A well-known morphophonological process in Japanese is *rendaku,* in which a word-initial voiceless consonant /t, k, s, h/ becomes voiced [d, g, z, b] when it is the second member of a compound, as in (5) (Vance 1987, 2015; Vance & Irwin 2016). However, the application of rendaku is blocked under several conditions. One of the best-known of these is that, as exemplified in (6), rendaku does not apply when the second member of the compound already contains a voiced obstruent. This restriction is known as Lyman's Law, and may be formalised as OCP[+voice, −sonorant] or No-D^2_m (Itô & Mester 2003). For example, the second member /tabi/ of the first compound in (6) does not undergo rendaku, because it already contains a voiced [b] before compound formation.

[3] Source: https://www.dclog.jp/en/1008438/527022319.
[4] Source: https://profile.ameba.jp/ameba/k7k7pmm.
[5] Source: https://www.jalan.net/yad316105/kuchikomi/archive/detail_04107547/.
[6] Source: https://withonline.jp/authors/FCvv7.
[7] Source: https://www.ehonnavi.net/ehon00_opinion_single.asp?no=111&rno=167185.
[8] Source: https://www.dclog.jp/yuripime8/9/.

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(5) *Application of rendaku in Japanese*

a. *kusu* 'medicine' + *tama* 'ball' → *kusu-**d**ama* 'decorative paper ball'
b. *riku* 'land' + *kame* 'turtle' → *riku-**g**ame* 'tortoise'
c. *oo* 'big' + *same* 'shark' → *oo-**z**ame* 'big shark'
d. *hako* 'box' + *hune* 'ship' → *hako-**b**une* 'ark'

(6) *Rendaku blocked by Lyman's Law*

a. *naga* 'long' + *tabi* 'travel' → *naga-tabi* 'long trip', **naga-**d**abi*
b. *hito* 'person' + *kage* 'shadow' → *hito-kage* 'silhouette', **hito-**g**age*
c. *aka* 'red' + *sabi* 'rust' → *aka-sabi* 'red rust', **aka-**z**abi*
d. *tori* 'bird' + *hada* 'skin' → *tori-hada* 'gooseflesh', **tori-**b**ada*

Another condition blocking rendaku is that /h/ does not become [b] when the second member of the compound already contains [m] (Kawahara *et al.* 2006; Kawahara 2015). As shown in (7), for example, the word *hime* 'princess' does not become **bime*. Kumagai (2017) experimentally examined whether this restriction is attributable to an OCP-labial constraint (i.e., a ban on consecutive labial consonants) observed in other languages (McCarthy 1988; Selkirk 1993; Odden 1994; Alderete & Frisch 2007; Coetzee & Pater 2008; Zuraw & Yu-An 2009). The results showed that rendaku is blocked when the second member of the compound would contain consecutive labial consonants *[b…b], *[b…m], *[b…ɸ] after compound formation (except for [b…w]).

(7) *Blocking of rendaku in contexts where it would produce *[b…m]*

a. *mai* 'dancing' + *hime* 'princess' → *mai-hime* 'dancing girl'
mai-b**ime*
b. *suna* 'sand' + *hama* 'beach' → *suna-hama* 'sand beach'
suna-b**ama*
c. *kutu* 'shoe' + *himo* 'lace' → *kutu-himo* 'shoelace'
kutu-b**imo*
d. *ma* 'genuine' + *hamo* 'pike conger' → *ma-hamo* 'genuine pike conger'
ma-b**amo*

Returning to the issue of *pime-yobi* nicknaming, if the sound-symbolic [h]→[p] alternation causes [hime] to become [pime], this output form contains two labial consonants [p…m], thereby violating OCP-labial. This violation might be regarded as trivial, because sound-symbolic processes often violate constraints enforced in native phonology (Alderete & Kochetov 2017). More importantly, however, the usual [h]→[b] alternation (*[hime]→[bime]) does not appear in *pime-yobi* nicknaming, even though both [pime] and [bime] equally violate OCP-labial. Therefore, the [hime]→[pime] alternation must be attributed to some other constraint. The current study builds on the analysis of Alderete & Kochetov (2017) and proposes that *pime-yobi* nicknaming is induced by a sound-symbolic constraint, Express[p], which is described in detail in §2.4.

2.4 The Express*[p] constraint*

Alderete & Kochetov (2017) propose Express constraints as a way to formalise sound-symbolic/iconic aspects of particular sounds in a particular register or lexical stratum. Following this study, Jang (2020) proposed another Express constraint to account for the strategies observed in a baby-talk register, Korean *Aegyo*, which people use when talking to pets and lovers. The current study proposes a sound-symbolic constraint, Express[p], which requires output forms to have the following phonological features: [labial], [−continuant] and [high-frequency]. The features [labial] and [−continuant] are motivated by the observation that, in children's phonological development, bilabial stops [p, b, m]

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are acquired earlier (Jakobson 1941, 1968; MacNeilage *et al.* 1997). The feature [high-frequency] is motivated by the frequency code hypothesis, which, as described above, associates smallness with high-frequency sound such as is found in voiceless consonants. Only [p] in Japanese has all three of these phonological features. The EXPRESS[p] constraint is defined in §5, where an HG analysis is provided.

As mentioned in §1.2, numerous studies have shown that bilabial consonants can convey the image of cuteness, thereby suggesting that the Japanese language shows sound-symbolic effects of other constraints, such as EXPRESS[b], EXPRESS[m] or a more general EXPRESS[LABIAL]. Although this is an interesting hypothesis to test, an in-depth discussion is beyond the scope of the current study. Therefore, some possibilities are briefly mentioned below. The bilabial nasal [m] (sonorant) may also be associated with the image of cuteness, because sonorants are used more frequently than obstruents in Japanese feminine first names (Shinohara & Kawahara 2013). However, nasals exhibit a low frequency in the first formant (Reetz & Jongman 2009), and are thus less likely to be associated with the image of smallness than [p]. For the same reason, voiced [b] (with low frequency) is also less likely. Moreover, voiced obstruents such as [b] have been reported to evoke an image of 'dirtiness' (Kawahara *et al.* 2008; Uno *et al.* 2020). The more general constraint EXPRESS[LABIAL] is discussed in §6.2.

2.5 Motivation for experiments

To summarise, the current study posits that the sound-symbolic [h]→[p] alternation observed in *pime-yobi* nicknaming is induced by EXPRESS[p]. Here, some questions arise regarding *pime-yobi* nicknaming and EXPRESS[p]. One question is whether more [p]s in a nickname produce a further boost to the image of cuteness. This is a key question that must be addressed in HG analysis, where the counting cumulativity effect of the constraint makes a difference in determining the optimal output form (Jäger & Rosenbach 2006). Numerous studies have addressed the question of whether sound-symbolic effects apply cumulatively (see Kawahara 2020a; Kawahara & Breiss 2021 for a background overview and analysis). For example, English speakers compared nonce words with one to five 'large' phonemes, such as back vowels and voiced consonants (*a, u, o, m, l, w, b, d, g*). The more large phonemes in a word, the more likely that word was to be associated with a larger size of 'greeble', a novel object used for testing (Thompson & Estes 2011). In Pokémonastics research (Kawahara *et al.* 2018; Shih *et al.* 2019 *et seq*.), the higher the number of moras (two to seven) in a nonce word, the more likely the name was chosen as appropriate for a post-evolved (stronger, heavier, larger) Pokémon character name (Kawahara 2020c). Other studies have shown that the cumulative sound-symbolic effect is restricted. For example, a name containing two voiced obstruents was more appropriate for post-evolved Pokémon characters than a name with only one voiced obstruent, but no difference in sound-symbolic effect was noted between names with two and three voiced obstruents (Kawahara & Kumagai 2019b; see also Kawahara & Kumagai 2019a, 2021 for the cumulative effect of voiced obstruents in Pokémonastics). The current study addresses the above question in §3 (Experiment 1) by examining whether forms containing one, two or more [p]s are perceived by Japanese speakers as cuter names, and discusses whether EXPRESS[p] shows the sound-symbolic effect in a cumulative manner.

Another question focuses on intra- and inter-speaker variation in *pime-yobi* nicknaming. The sound-symbolic [h]→[p] alternation is optional, and not all speakers perceive *pime-yobi* nicknames as cute, or even acceptable. Therefore, examining how cute or acceptable *pime-yobi* nicknaming sounds across different speakers is a crucial task. The current study addresses this question in §4, where Experiment 2 asks Japanese speakers to rate the acceptability and cuteness of three relevant variants regarding *pime-yobi* nicknaming: *hime* (the default form of the word meaning 'princess'), *pime* (the *pime-yobi* form) and *bime* (the rendaku form).

In phonology, variation in output forms has been analysed using various OT approaches: partial constraint reranking (Anttila 1997; Anttila & Cho 1998), stochastic OT (Boersma 1998; Boersma & Hayes 2001), freely ranked constraints (Reynolds 1994; Nagy & Reynolds 1997) and ranking candidates (Coetzee 2006). In HG models, variation is captured using stochastic versions of HG, such as MaxEnt HG and Noisy HG (for Noisy HG, see Boersma & Pater 2016; Hayes 2017; Zuraw & Hayes 2017;

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Flemming 2021). The current study adopts MaxEnt HG to model the variants of *pime-yobi* nicknaming, based on the results of Experiments 1 and 2, thereby establishing that the weight of Express[p] varies across particular speakers and between two distinct phonologies – expressive and non-expressive phonology (see §5).

3 Experiment 1

3.1 Task and stimuli

To examine whether Express[p] displays a cumulative sound-symbolic effect, Experiment 1 tested whether the number of singleton [p]s in names affects the image of cuteness. The experiment used a two-alternative forced-choice task, wherein participants were given two nonce words and asked to select the name they felt was cuter. As shown in Table 1, three conditions compared names with one or more [p]s (target stimuli in the right columns) and those without any [p]s; each form consisted of three CV moras. The first condition contained singleton [p] in the first mora; the second condition contained two singleton [p]s in the first and second moras and the third condition contained three singleton [p]s. The other consonants used besides [p] were [ç, ɸ, h], the allophones of /h/ before [i], [u] and [a, e, o], respectively (e.g., Vance 1987; Labrune 2012; Tsujimura 2013). Each condition comprised 10 pairs. A total of 30 pairs were presented.

3.2 Procedure

The current experiment was implemented online using the 'buy response' function provided by SurveyMonkey, in which participants are given a monetary reward after completing the experiment. Participants were first given a consent form to sign if they agreed to participate and then asked whether they were native Japanese speakers and if they had ever heard of the term 'sound symbolism'. Only those who were native Japanese speakers and had never heard of the term 'sound symbolism' were allowed to participate.

The current experiment used orthographic stimuli using katakana characters, the orthography usually used to represent loanwords in Japanese. The participants were instructed to select which of the two names sounded cuter (*kawaii* in Japanese). They were not provided with a definition of cuteness or *kawaii*. They were given one practice question, which asked which of the two names *ramire* and *remire* sounded cuter, before answering 30 questions. The orders of two names within each pair and 30 pairs of stimuli were randomised for each participant. After completing all the questions, participants were asked about their age and gender.

Table 1. *Stimuli used in Experiment 1.*

Condition 1			Condition 2			Condition 3		
haheho	*vs.*	paheho	haheho	*vs.*	papeho	haheho	*vs.*	papepo
hahohe	*vs.*	pahohe	hahohe	*vs.*	papohe	hahohe	*vs.*	papope
çiɸuho	*vs.*	piɸuho	çiɸuho	*vs.*	pipuho	çiɸuho	*vs.*	pipupo
çihoɸu	*vs.*	pihoɸu	çihoɸu	*vs.*	pipoɸu	çihoɸu	*vs.*	pipopu
ɸuhaho	*vs.*	puhaho	ɸuhaho	*vs.*	pupaho	ɸuhaho	*vs.*	pupapo
ɸuhoha	*vs.*	puhoha	ɸuhoha	*vs.*	pupoha	ɸuhoha	*vs.*	pupopa
hehoha	*vs.*	pehoha	hehoha	*vs.*	pepoha	hehoha	*vs.*	pepopa
hehaho	*vs.*	pehaho	hehaho	*vs.*	pepaho	hehaho	*vs.*	pepapo
hoçihe	*vs.*	pohihe	hoçihe	*vs.*	popihe	hoçihe	*vs.*	popipe
hoheçi	*vs.*	poheçi	hoheçi	*vs.*	popeçi	hoheçi	*vs.*	popepi

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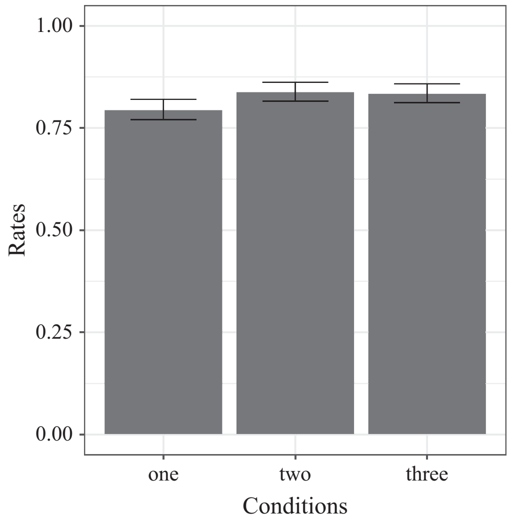

Figure 1. *Rates at which names containing one or more [p]s were chosen as cuter (n = 100).*

Table 2. *The model summary.*

	Estimate	Std. error	z-value	Pr(> |z|)
(Intercept)	2.7361	0.3636	7.525	5.27e-14***
Two [p]s	0.2351	0.3407	0.69	0.49
Three [p]s	0.5359	0.3757	1.426	0.154

3.3 Participants

The participants were 100 native Japanese speakers, of whom 64 were women and 36 were men. Most participants (n = 96) were aged between 20 and 39 years (47 speakers between 20 and 29; 49 speakers between 30 and 39). Three were over 50 years old, and one was between 18 and 19 years old.

3.4 Statistics

The two-alternative forced-choice task provided a categorical response; thus, a logistic regression model (Winter 2019) was fitted to the experimental results, using the `glmer` function in the `lme4` package (Bates *et al.* 2015) in R (R Core Team 2020). As a response variable, the response for which the target stimulus was judged to be a cute name was coded as 1, and the no-[p] response was coded as 0. The model included a fixed-effect predictor called Condition, which is the number of [p]s in the items containing at least one [p], ranging from one to three. The model also included by-stimulus random intercepts and by-participant random intercepts, as well as by-participant random slope adjustments to Condition (Baayen *et al.* 2008). The data files for analysis are available at https://osf.io/pj5qz/.

3.5 Results

Figure 1 shows the rates at which participants selected names with one or more [p]s as cuter in each condition. The error bars represent 95% confidence intervals, based on the average rate of each condition. The average rates were 0.795 in Condition 1, 0.839 in Condition 2 and 0.835 in Condition 3.

Table 2 presents a summary of the modelling, in which Condition 1 (i.e., one [p]) was set as the baseline. The estimated coefficient in the intercept was 2.7361 ($p < 0.001$), which means that names with [p]s were more likely chosen as a cute name than those without them. However, there were no significant differences between one [p] and two [p]s nor between one [p] and three [p]s.

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3.6 Discussion

The experiment results show that Japanese speakers judged names with at least one [p] as cuter than those with no [p]. This result is consistent with Kumagai's (2019) results, showing that a singleton [p] was more likely to express cuteness than other consonants in Japanese.

The experiment also showed that the number of singleton [p]s in names did not affect cuteness judgements. This result is inconsistent with the previous studies showing that sound-symbolic effects can be cumulative (e.g., Thompson & Estes 2011; see also §2.5). A reason for the discrepancy may be that abstract images in sound-symbolic associations are less likely to show cumulative effects. Cuteness is more abstract than perceptual properties, such as size in Thompson & Estes (2011); the former is more difficult to express by means of specific values than the latter. I suggested one possible reason here, but it is necessary to follow this up in further research by looking at other sound-symbolic images. Building on these results, §5 provides a definition of Express[p].

4 Experiment 2

4.1 Task and stimuli

Experiment 2 examined how Japanese speakers rated acceptability and cuteness for three variants relevant to *pime-yobi* nicknaming: nicknames with *hime* (the default form meaning 'princess'), *pime* (the *pime-yobi* form) and *bime* (the unattested form that would result from rendaku). The stimuli used are listed in Table 3.

Participants were provided non-real bimoraic names, and for each name N, they were asked to compare 'N-*pime*' with 'N-*hime*' (Condition 1) and 'N-*bime*' with 'N-*hime*' (Condition 2), using the rating scales in (8). For each criterion, a score of 3 is the baseline, indicating that the two nicknames sound equally acceptable or equally cute. For instance, if a participant believed that *yaka-pime* sounded as acceptable as *yaka-hime* in the first pair of Condition 1, they assigned a score of three points. Each condition comprised seven pairs, and a total of 14 pairs were presented.

(8) *Rating scales used in Experiment 2*

a. *Acceptability*

5: X sounds more acceptable than Y.

4: X sounds slightly more acceptable than Y.

3: X sounds as acceptable as Y.

2: X sounds slightly more unacceptable than Y.

1: X sounds more unacceptable than Y.

Table 3. *The set of stimuli in Experiment 2.*

Condition 1			Condition 2		
X		Y	X		Y
yaka-pime	*vs.*	yaka-hime	yaka-bime	*vs.*	yaka-hime
meki-pime	*vs.*	meki-hime	meki-bime	*vs.*	meki-hime
rosa-pime	*vs.*	rosa-hime	rosa-bime	*vs.*	rosa-hime
mase-pime	*vs.*	mase-hime	mase-bime	*vs.*	mase-hime
mani-pime	*vs.*	mani-hime	mani-bime	*vs.*	mani-hime
rane-pime	*vs.*	rane-hime	rane-bime	*vs.*	rane-hime
yora-pime	*vs.*	yora-hime	yora-bime	*vs.*	yora-hime

b. *Cuteness*
   5: X sounds cuter than Y.
   4: X sounds slightly more cute than Y.
   3: X sounds as cute as Y.
   2: X sounds slightly less cute than Y.
   1: X does not sound as cute as Y.

4.2 Procedure

As in the previous experiment, Experiment 2 recruited participants using the 'buy response' function in SurveyMonkey and obtained their consent through a consent form. Participants were asked whether they were native Japanese speakers, and if they had ever heard of the terms 'sound symbolism' and 'rendaku'. All participants were native Japanese speakers, and no participant reported that they had ever heard of the terms 'sound symbolism' and 'rendaku'.

Experiment 2, like Experiment 1, used katakana characters as the orthographic stimuli. Participants were presented with feminine nicknames suffixed with *hime*, *pime* and *bime*, and were then requested to rate the acceptability and cuteness of each pair using the scales in (8). In the judgement tasks, the Japanese words *sizen* 'natural' and *kawaii* 'cute' were used to refer to the relevant properties (e.g., *X wa Y yorimo sizen-da* = 'X sounds more acceptable than Y'; *X wa Y yorimo kawaii* = 'X sounds cuter than Y'). As in Experiment 1, the current experiment did not define 'cute' or *kawaii*. After practising how to assign scores, the participants first evaluated acceptability for all 14 pairs and then evaluated the cuteness of all these pairs. All pairs and names within each pair were presented to each participant in random order. After completing the task, participants were asked about their age and gender.

4.3 Participants and grouping for analysis

Experiment 2 recruited 100 native Japanese speakers who were different from those in Experiment 1. They were categorised, based on their average scores in Condition 1 (*pime vs. hime*) in the cuteness judgement task, into three subgroups. Those whose average score was greater than three points – meaning that they judged *pime* as cuter than *hime* – were categorised as 'cuteness-sensitive speakers' ($n = 34$). In contrast, those who scored less than three points on average for the same condition – that is, those who judged *hime* to be cuter than *pime* – were categorised as 'cuteness-insensitive speakers' ($n = 50$). The remaining 16 participants, who had a mean rating of exactly 3.0, were categorised as 'other' and not analysed further. Table 4 shows the demographic composition of each group.[9]

Categorising cuteness sensitivity by age and gender may yield interesting results. This analysis is, however, left for Appendix A, because the current results do not show that these two factors were associated with any significant differences in cuteness sensitivity.

4.4 Statistics

A linear mixed-effects model was fitted to the experimental results using the `lmer` function in the `lme4` package (Bates *et al.* 2015) in R (R Core Team 2020). The response variable was the score (1 at the minimum and 5 at the maximum). Similar to the analysis in Experiment 1, the model included by-stimulus random intercepts and by-participant random intercepts, as well as by-participant random slope (Baayen *et al.* 2008). The `lmer` function does not produce *p*-values (Baayen *et al.* 2008); thus, *p*-values were calculated after installing the `lmerTest` package (Kuznetsova *et al.* 2017). The data files for analysis are available at https://osf.io/pj5qz/.

[9] There were no participants between the ages of 50 and 59.

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Table 4. *Numbers of participants in each category in Experiment 2 by age and gender.*

	Age in years					
	18–19	20–29	30–39	40–49	60+	All ages
Cuteness-sensitive	0	18 (12f, 6m)	13 (7f, 6m)	2 (1f, 1m)	1 (1f)	34 (21f, 13m)
Cuteness-insensitive	0	21 (14f, 7m)	28 (16f, 12m)	1 (1m)	0	50 (30f, 20m)
Other	1 (1f)	7 (2f, 5m)	7 (1f, 6m)	1 (1m)	0	16 (4f, 12m)
All groups	1 (1f)	46 (28f, 18m)	48 (24f, 24m)	4 (1f, 3m)	1 (1f)	100 (55f, 45m)

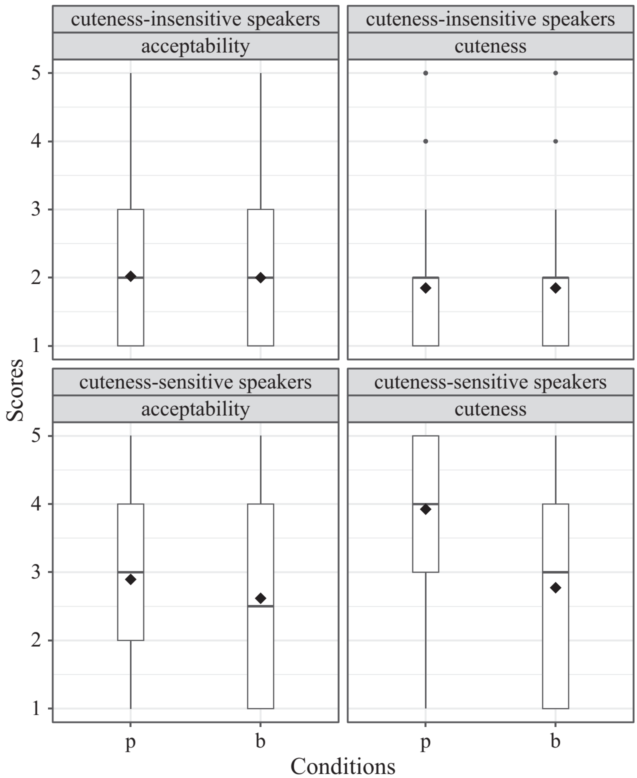

Figure 2. *Box plots for acceptability and cuteness judgement tasks (by speaker).*

4.5 Results

Figure 2 presents box plots for the results of acceptability and cuteness judgement tasks. Black diamonds represent the average score in each condition (Condition 1 is represented by 'p'; Condition 2 by 'b'). The white boxes represent the interquartile range; thin vertical lines represent the rest of the distribution; black dots represent outliers and black horizontal lines represent the median in each condition.

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Table 5. *The number of responses to higher and lower scores and observed probabilities in cuteness-sensitive and cuteness-insensitive speakers.*

		Cuteness-sensitive		Cuteness-insensitive	
Cond.	Score	Acceptability	Cuteness	Acceptability	Cuteness
1	4–5 (*pime*)	89 (0.473)	176 (0.903)	38 (0.134)	13 (0.044)
	1–2 (*hime*)	99 (0.527)	19 (0.097)	245 (0.866)	282 (0.956)
	Total	188	195	283	295
2	4–5 (*bime*)	67 (0.36)	80 (0.447)	33 (0.115)	31 (0.104)
	1–2 (*hime*)	119 (0.64)	99 (0.553)	254 (0.885)	266 (0.896)
	Total	186	179	287	297

The results of cuteness-sensitive speakers (n = 34) show that in the acceptability judgement task, the average score was 2.89 in the [p] condition and 2.62 in the [b] condition (see the lower left quadrant of Figure 2). Moreover, a significant difference was noted between the two conditions (β = 0.277, SE = 0.095, df = 34, t = 2.923, p < .01). In the cuteness judgement task, the average score was 3.92 in the [p] condition and 2.77 in the [b] condition (lower right of Figure 2). Again, a significant difference was noted between them (β = 1.151, SE = 0.207, df = 34, t = 5.561, p < .001).

The results for cuteness-insensitive speakers (n = 50) show that in the acceptability judgement task, the score in the [p] condition was 2.02 on average and 2 in the [b] condition (upper left of Figure 2), and no significant differences were detected between them (β = 0.02, SE = 0.068, df = 18.523, t = 0.292, n.s.). In the cuteness judgement task, both scores in the [p] and [b] conditions were 1.85 on average (upper right of Figure 2), and no significant differences were noted between them (β = 0, SE = 0.09, df = 36.21, t = 0.00, n.s.).

Table 5 shows the distribution of higher scores (4–5) and lower scores (1–2). Considering Condition 1 in the lower left quadrant of Figure 2 (i.e., acceptability for cuteness-sensitive speakers) as an example, there were 89 responses rated for scores 4 and 5 (i.e., *pime* sounds (slightly) more acceptable than *hime*) and 99 responses rated for scores 1 and 2 (i.e., *hime* sounds (slightly) more acceptable). The observed probabilities for each were 0.473 and 0.527, respectively. The number of responses in each category presented here are used as input values for the MaxEnt HG analysis in §5.

4.6 Discussion: The order of acceptability and cuteness

Based on the experiment results, the current section discusses the order of acceptability and cuteness of the three variants for cuteness-sensitive and cuteness-insensitive speakers. For cuteness-sensitive speakers, the average scores in the [p] and [b] conditions (2.89 for [p]; 2.62 for [b]) were less than 3.0 (the baseline) in the acceptability judgement task, although the score in the [p] condition was significantly higher than that in the [b] condition. Therefore, the order of acceptability is *hime* > *pime* > *bime*. However, in the cuteness judgement task for these speakers, the average score in the [p] condition (3.93) was above the baseline, and the average score in the [b] condition (2.77) was below it, with the difference being significant. Therefore, the order of cuteness is *pime* > *hime* > *bime*.

For cuteness-insensitive speakers, the average scores in the [p] and [b] conditions were less than 3.0 in both the acceptability and cuteness judgement tasks, and no difference was noted between the two labial stops in either acceptability or cuteness. Therefore, both the acceptability and cuteness order are *hime* > *pime* = *bime*. The order of acceptability and cuteness discussed here is summarised in Table 6, where 'A > B' means that A sounds more acceptable/cuter than B and 'A = B' means that A sounds as acceptable/cute as B. Whether each order of acceptability and cuteness can be predicted based on the H-score of each candidate is examined in §5.5.

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Table 6. *Relative acceptability and cuteness of forms as judged by cuteness-sensitive and -insensitive speakers.*

	Cuteness-sensitive speakers	Cuteness-insensitive speakers
Acceptability	*hime* > *pime* > *bime*	*hime* > *pime* = *bime*
Cuteness	*pime* > *hime* > *bime*	*hime* > *pime* = *bime*

5 Modelling the *pime-yobi* nicknaming pattern using MaxEnt HG

This section presents a MaxEnt HG analysis based on the results of the current experiments. As mentioned in §1, few studies to date have analysed sound-symbolic effects using formal phonological theory. Recently, however, a number of studies have shown that sound-symbolic effects can be modelled using formal theoretical tools such as MaxEnt HG (Kawahara *et al.* 2019; Jang 2020; Shih 2020; Kawahara, 2020a,c, 2021). Following this trend, the current study models the *pime-yobi* nicknaming pattern using MaxEnt HG.

5.1 A brief explanation of MaxEnt HG

MaxEnt HG (Goldwater & Johnson 2003; Jäger 2007; Hayes & Wilson 2008) is a probabilistic model based on HG (Legendre *et al.* 1990, 2006; Pater 2009, 2016; Potts *et al.* 2010). In standard HG, the harmonic score (H-score) is calculated for each candidate based on the sum of $C_i \times w_i$, where for each constraint i, the number of violations of i incurred by the candidate (C_i) is multiplied by the weight of the constraint (w_i). The candidate with the lowest H-score is selected as the winner. Rather than merely selecting an individual winner, MaxEnt HG uses the H-scores to calculate predicted probabilities for all output forms, including harmonically bounded candidates (Jäger & Rosenbach 2006). The procedure is as follows. First, each candidate's eHarmony is calculated as $e^{-\text{H-score}}$, where e is the base of natural logarithms. Second, Z is calculated by summing eHarmony for all candidates. Finally, the predicted probability of each candidate is eHarmony divided by Z.

The MaxEnt calculation is illustrated in (9), which shows two candidates being evaluated by three constraints weighted as follows: $w_{\text{Con1}} = 1$, $w_{\text{Con2}} = 2$ and $w_{\text{Con3}} = 3$. Candidate 1 incurs two violations of Con1 and one violation of Con2, and Candidate 2 incurs one violation of Con3. In this case, the H-score of Candidate 1 is 4 ($= w_{\text{Con1}} \times 2 + w_{\text{Con2}} \times 1$), giving it an eHarmony of 0.0183 ($= e^{-4}$), and the H-score of Candidate 2 is 3 ($= w_{\text{Con3}} \times 1$), for an eHarmony of 0.0498 ($= e^{-3}$). Z is the sum of the two eHarmony values (0.0183+0.0498 = 0.0681). Consequently, the predicted probability of Candidate 1 is 0.2689 (= 0.0183/0.0681), and the predicted probability of Candidate 2 is 0.7311 (= 0.0498/0.0681).

(9) *Illustration of how probabilities are predicted in MaxEnt HG*

weight (w):	Con1 1	Con2 2	Con3 3	H-score	eHarmony	Predicted probability
Candidate 1	2	1		4	$e^{-4} = 0.0183$	$\frac{0.0183}{0.0183+0.0498} = 0.2689$
Candidate 2			1	3	$e^{-3} = 0.0498$	$\frac{0.0498}{0.0183+0.0498} = 0.7311$

The current MaxEnt HG analysis is based on the results of Experiments 1 and 2. Experiment 1 showed that Japanese speakers found names with [p]s to be cuter than those without them, which suggests a categorical [p]-favouring constraint that prefers candidates with at least one [p], but does not motivate multiple [p]s. Experiment 2 showed that acceptability and cuteness judgements of the variants in *pime-yobi* nicknaming are gradient across different speakers, and that the variant *bime,* though unattested in observed usage, is selected by some speakers.

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5.2 Constraints

The four constraints needed for the current analysis are defined in (10).

(10) a. Express[p] (abbreviated Exp[p])
Assign a violation mark to candidates that do not contain any singleton [p]s.

b. Realise Morpheme (RealMorph)
Assign a violation mark for every morpheme in the input that has no phonological exponent in the output.

c. Ident[F] (Ident)
Assign a violation mark for every pair of corresponding segments that do not agree in their value of feature [F]. (Here, the relevant [F] is the feature [±voice].)

d. OCP(Labial) (OCP(Lab))
Assign a violation mark for a pair of labial consonants within a single morpheme.

The current analysis posits that the Express[p] constraint in (10a) distinguishes candidates with [p]s from those without any [p]s, based on the results of Experiment 1. For example, the output form *pime* contains one singleton [p], and thus incurs no violation marks; the forms *hime* and *bime* contain no [p], incurring one violation mark each.

The Realise Morpheme (Kurisu 2001) and Ident[F] (McCarthy & Prince 1995, 1999: 226) constraints in (10b) and (10c) are used in Itô & Mester's (2003) analysis of rendaku, in which Realise Morpheme takes precedence over Ident[F] (i.e., $w_{\text{RealMorph}} > w_{\text{Ident}}$).[10] Itô & Mester (2003) posit a featural linking morpheme $\mathfrak{R}$ specified with [+voice]; in their analysis of rendaku, RealMorph is satisfied if this feature is realised on some segment in the output (e.g., *hako* 'box' + $\mathfrak{R}$ + *hune* 'ship' → *hako-**b**une* 'ark'). However, the current study assumes that it treats both [p] and [b] as phonological exponents of compoundhood, since we are concerned here not only with the rendaku form and its voicing alternation (*hime→bime*) but also with the nickname and its [h]→[p] alternation (*hime→pime*). In other words, not only nicknames with *bime* (the rendaku form), but also those with *pime* (the *pime-yobi* form) satisfy RealMorph.[11]

One might suspect that Exp[p] and RealMorph functionally overlap with each other, as both motivate the [h]→[p] alternation in *pime-yobi* nicknaming. However, the two constraints are distinguished from each other. As mentioned in §2.3, we observe the [h]→[p] alternation in ambient language data, but not [h]→[b]. Thus, there should be a constraint (Express[p]) that specifically favours [p] and is distinct from Realise Morpheme, which is equally well satisfied by either *pime* or *bime*.

The current analysis also posits the OCP(Lab) constraint in (10d), confirmed in a nonce-word experiment (Kumagai 2017, 2019). There are monomorphemic native words with two labial consonants in Japanese, such as *mame* 'bean', *mimi* 'ear' and *momo* 'peach'. Thus, Ident must be assigned a substantially higher weight than OCP(Lab) ($w_{\text{Ident}} > w_{\text{OCP(Lab)}}$).

We see the constraint violation profile of rendaku blocking in (11). As explained above, the relative weighting of the constraints is $w_{\text{RealMorph}} > w_{\text{Ident}} > w_{\text{OCP(Lab)}}$. As seen in §2.3, *hime* 'princess' does not undergo rendaku to become **bime* (e.g., *mai-hime* 'dancing girl'; **mai-bime*), and Experiment 2 confirmed that *hime* is more acceptable than *bime* (see Table 6). The form *hime* is chosen as a winner, even though it violates the highest-weighted of these three constraints, RealMorph. This is an instance of ganging-up cumulativity: violations of multiple lower-weighted constraints collectively outweigh a

[10] The definition of RealMorph here is different from the original proposal of Kurisu (2001). Kurisu's version of RealMorph can be satisfied not only by affixation but also by deletion or metathesis; all it requires is that a derived form be distinguishable from its base. I adopt the definition in (10b) for expository simplicity.

[11] This assumption can be motivated by the orthography-based perspective that rendaku is a process adding 'dakuten' (Vance 2007, 2015, 2016; Kawahara 2015, 2018). In the Japanese kana syllabaries, voiced obstruents are marked with a diacritic called *dakuten* (゛), and a singleton [p] has a diacritic called *han-dakuten* (°) (e.g., ば=[ba]; ぱ=[pa]), whereas other voiceless obstruents have no such diacritics (e.g., は=[ha]). Thus, the RealMorph constraint can be defined as a constraint that requires an initial consonant in the second member of the compound to have a [+diacritic] feature.

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violation of a higher-weighted constraint (Jäger & Rosenbach 2006). In the *hime*→**bime* case, the lower-weighted constraints Ident and OCP(Lab) together overcome RealMorph.

(11) *Rendaku blocking:* hime → hime (*bime)

Input		Output	RealMorph	Ident	OCP(Lab)
hime	☞	*hime*	1		
		bime		1	1

We then see the constraint violation profile of *pime-yobi* nicknaming in (12). Experiment 2 showed that *pime* was judged as a cuter name than *hime* by cuteness-sensitive speakers (see Table 6). This effect is due to Express[p]; as shown in (12), *hime* (without [p]) incurs one violation mark and is thereby evaluated as less cute than *pime* (by some speakers). In addition, *bime* is harmonically bounded by *pime,* which can explain the fact that the *hime*→**bime* case is not observed in real nicknames.

(12) Pime-yobi *nicknaming:* hime → pime

Input		Output	Exp[p]	RealMorph	Ident	OCP(Lab)
hime		*hime*	1	1		
	☞	*pime*			1	1
		bime	1		1	1

5.3 Cuteness-expressive phonology

The current HG analysis captures the gradient acceptability of the *pime-yobi* variants by building on the concept of co-phonology, namely, multiple strata or subgrammars within a language (Itô & Mester 1995; Orgun 1996; Inkelas 1998; Itô & Mester 1999; Anttila 2002; etc.). Two types of co-phonology in Japanese speakers are assumed here: non-expressive phonology, defined as the grammar used for acceptability judgement, and *I*-expressive phonology, defined as the grammar used for judgement of an image *I*. The current study assumes that the cuteness-expressive phonology used for cuteness judgement is an *I*-expressive phonology.[12]

5.4 Input data

The current analysis calculates constraint weights using the Maxent Grammar Tool software (Hayes 2009). This calculation requires input data for learning. (The input data files are available at https://osf.io/pj5qz/.) The input values for the calculation are shown in (13) and (14). (13a) and (13b) correspond to Conditions 1 and 2 of Experiment 2, respectively. The input–output pairs in (13a) compare two output forms *hime* and *pime* for the input form *hime,* and the input–output pairs in (13b) compare two output forms *hime* and *bime* for the same input form. The shaded region indicates the constraint violation profiles for the candidates. The last four columns show the frequencies reported in Table 5, which were used to calculate the constraint weights for each co-phonology: ns = **n**on-expressive phonology in cuteness-**s**ensitive speakers; es = **e**xpressive phonology in cuteness-**s**ensitive speakers; ni = **n**on-expressive phonology in cuteness-**i**nsensitive speakers; and ei = **e**xpressive phonology in cuteness-**i**nsensitive speakers. In terms of the constraint violation profile, the candidate *bime* is harmonically bounded by *pime* (i.e., no possible weighting of constraints will prefer *bime* over *pime,* because *bime*'s constraint violations are a proper superset of *pime*'s), but MaxEnt HG allows us to calculate a (non-zero) probability for every candidate, including harmonically bounded ones (Jäger & Rosenbach 2006).

[12]The cuteness-expressive phonology is distinguished from a baby-talk register or children-directed speech, wherein an adult speaker talks as if they were a baby or child (Ferguson 1977; Bombar & Littig Jr. 1996). One of the reasons for this is that, although the sound-symbolic [h]→[p] alternation expresses cuteness, it is never observed in Japanese baby-talk words.

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(13) *Input data based on Conditions 1 and 2 of Experiment 2*

Input	Output	EXP [p]	REAL MORPH	IDENT	OCP (LAB)	Frequency NS	ES	NI	EI
a. *hime*	*hime*	1	1			99	19	245	282
	pime			1	1	89	176	38	13
b. *hime*	*hime*	1	1			119	99	254	266
	bime	1		1	1	67	80	33	31

The input values in (14) were used to ensure that $w_{\text{RealMorph}} > w_{\text{Ident}} > w_{\text{OCP(Lab)}}$ in Japanese phonology. In (14a) candidate *mame* 'bean' is faithfully selected as a winner, even though it violates OCP(LABIAL). In (14b), rendaku produces *hune→bune* 'ship', since REALMORPH is substantially more heavily weighted than IDENT. The preference for the winning candidate in each pair was assumed to be categorical – that is, 1 *vs.* 0 for both *mame* over *name* and *bune* over *hune.*

(14) *Input data to ensure the weight ordering $w_{\text{RealMorph}} > w_{\text{Ident}} > w_{\text{OCP(Labial)}}$*

Input	Output	EXP [p]	REAL MORPH	IDENT	OCP (LAB)	Frequency
a. *mame*	*mame*				1	1
	name			1		0
b. *hune*	*hune*		1			0
	bune			1		1

5.5 Results

The calculation results for cuteness-sensitive speakers' co-phonologies are presented in (15): the non-expressive phonology in (15a) and the cuteness-expressive phonology in (15b). The weight of EXPRESS[p] was higher in cuteness-expressive phonology (15b) than in non-expressive phonology (15a), whereas the weights of the other three constraints remained almost the same between the two co-phonologies. In other words, EXPRESS[p] plays a crucial role in cuteness judgement. Moreover, the expected probabilities (EP) of each candidate were confirmed to be consistent with the observed probabilities (OP) obtained in Experiment 2 (see Table 5).

(15) *HG tableaux for cuteness-sensitive speakers*

a. *Non-expressive phonology*

		EXP [p]	REAL MORPH	IDENT	OCP (LAB)			
Input	Output	0.4672	45.46	30.754	15.28	H-score	EP	OP
hime	*hime*	1	1			45.927	0.527	0.527
	pime			1	1	46.034	0.473	0.473
hime	*hime*	1	1			45.927	0.64	0.64
	bime	1		1	1	46.501	0.36	0.36

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b. *Cuteness-expressive phonology*

		Exp [p]	Real Morph	Ident	OCP (Lab)			
Input	Output	2.4393	46.101	31	15.314	H-score	EP	OP
hime	*hime*	1	1			48.54	0.097	0.097
	pime			1	1	46.314	0.903	0.903
hime	*hime*	1	1			48.54	0.553	0.553
	bime	1		1	1	48.753	0.447	0.447

In turn, the non-expressive phonology for cuteness-insensitive speakers is presented in (16a), and their cuteness-expressive phonology in (16b). The weight of Express[p] was near zero in both co-phonologies. In other words, Express[p] is almost inert for cuteness-insensitive speakers. We can confirm that the EP and OP of each candidate are similar or identical.

(16) *HG tableaux for cuteness-insensitive speakers*

a. *Non-expressive phonology*

		Exp [p]	Real Morph	Ident	OCP (Lab)			
Input	Output	0.1746	47.883	32.792	17.131	H-score	EP	OP
hime	*hime*	1	1			48.058	0.866	0.866
	pime			1	1	49.923	0.134	0.134
hime	*hime*	1	1			48.058	0.885	0.885
	bime	1		1	1	50.098	0.115	0.115

b. *Cuteness-expressive phonology*

		Exp [p]	Real Morph	Ident	OCP (Lab)			
Input	Output	0	48.234	33.195	17.565	H-score	EP	OP
hime	*hime*	1	1			48.234	0.956	0.926
	pime			1	1	50.76	0.044	0.074
hime	*hime*	1	1			48.234	0.896	0.926
	bime	1		1	1	50.76	0.104	0.074

There is an approach to acceptability judgements in which a candidate with an H-score closer to zero is more harmonic (i.e., grammatical/acceptable) compared to a candidate with an H-score further from zero (Keller 2000, 2006). This comparison can be made across candidate sets for a particular input (e.g., output candidates *hime, pime, bime* for input *hime*, though see Coetzee & Pater 2008 for a problem with this approach). If we take this approach, the order of acceptability and cuteness discussed in §4.6 can be predicted by the H-scores of the three variants: *hime* (45.927) > *pime* (46.034) > *bime* (46.501) in (15a); *pime* (46.314) > *hime* (48.54) > *bime* (48.753) in (15b) and *hime* (48.234) > *pime* (50.76) = *bime* (50.76) in (16b). However, in (16a), the H-score for *pime* (49.923) is not equal to that of *bime* (50.098); thus, the order of acceptability (*hime* > *pime* = *bime*) is not completely predictable. A reason for this unsuccessful result is that the weight of Express[p] is not zero (= 0.1746), leading to a difference in

H-score between *pime* and *bime.* One solution for this problem is to assume that the weight of EXPRESS[p] in (16a) is infinitesimally small (i.e., $w_{\text{EXP}[p]} \approx 0$), which would then minimise the difference in H-score between *pime* and *bime.*

6 Concluding remarks

6.1 Summary

The current study is briefly summarised in this section. *Pime-yobi* is a new Japanese nicknaming pattern that uses an [h]→[p] alternation to express cuteness. The current study proposes that this pattern is induced by a constraint EXPRESS[p], which requires output forms to contain a singleton [p]. The two experiments conducted have shown that names with [p]s are found to be cuter than those without them, and the degrees of acceptability and cuteness for the variants of the *pime-yobi* nicknaming are different across speakers. Based on the experimental results, the current study modelled *pime-yobi* nicknaming patterns using MaxEnt HG, in which we saw that the sound-symbolic effect of EXPRESS[p] is gradient across different speakers (cuteness-sensitive *vs.* cuteness-insensitive) and within two types of co-phonology (non-expressive *vs.* cuteness-expressive), and in addition, a variant *bime,* though harmonically bounded by *pime,* is assigned non-zero probability.

6.2 Questions for future research

Is EXPRESS[p] active in languages other than Japanese? The current study has noted (§1.2) that EXPRESS[p] is rooted in cross-linguitic patterns in phonological development and the frequency-code hypothesis, which associate cuteness with labiality and high frequency. Therefore, the sound-symbolic effect in question should be found in other languages that have [p] or some other sound that has these properties. Recent experimental studies have shown that labial consonants (including [p]) are more likely to be associated with an image of cuteness than non-bilabial consonants across several languages (Kumagai 2020; Kawahara *et al.* 2021; Kumagai & Moon 2021). Further research is needed to examine whether the sound-symbolic association of labials with cuteness, or a more generalised constraint, EXPRESS[LABIAL], is cross-linguistically ubiquitous.

As noted by Alderete & Kochetov (2017) (see §1.1), sound-symbolic effects have yet to be actively discussed in the literature on theoretical phonology. However, recent studies have shown that sound-symbolic phenomena can be modelled using theoretical tools such as MaxEnt HG (Kawahara *et al.* 2019; Jang 2020; Kawahara 2020c,a, Kawahara 2021; Shih 2020). The current study contributes to this discussion by proposing a sound-symbolic EXPRESS constraint and modelling a Japanese nicknaming pattern, *pime-yobi*, in MaxEnt HG.

A Analysis by age and gender

A growing body of sociolinguistic studies shows that factors such as age and gender can lead to different speech styles. There are several studies focusing on speakers' sensitivity to cuteness. Jang (2021) explored how Korean speakers perceive Korean *aegyo* variants in terms of cuteness, experimentally showing that female and older speakers rated cuteness with higher scores, compared with male and younger speakers. In other words, older female speakers were most sensitive to cuteness. In addition, the older female speakers showed the largest difference between high and low scores. Beyond linguistics, a psychological study by Nittono (2016, 2019) investigated Japanese speakers' attitudes toward *kawaii* 'cuteness', thereby revealing that Japanese women showed a more positive response to *kawaii* than males, whereas age-related differences were relatively low. Nittono also showed that older female speakers were less sensitive to *kawaii* than younger female speakers. Below, we examine whether these

Table 7. *Average scores for acceptability and cuteness by gender.*

		Acceptability		Cuteness	
	n	[p]	[b]	[p]	[b]
Male	43	2.48	2.36	2.74	2.47
Female	57	2.42	2.30	2.74	2.19

Table 8. *Average scores for acceptability and cuteness by age.*

		Acceptability		Cuteness	
	n	[p]	[b]	[p]	[b]
Younger (≤ 29)	47	2.6	2.47	2.89	2.39
Older (≥ 30)	53	2.31	2.2	2.61	2.23

Table 9. *Average scores for acceptability and cuteness by age and gender.*

		Acceptability		Cuteness	
	n	[p]	[b]	[p]	[b]
YF	30	2.72	2.56	2.95	2.49
OF	27	2.09	1.99	2.51	1.85
YM	17	2.39	2.29	2.78	2.21
OM	26	2.53	2.4	2.71	2.63

two factors, age and gender, play a role in detecting cuteness-sensitivity speakers in Japanese *pime-yobi* nicknaming. The data files for analysis are available at https://osf.io/pj5qz/.

Table 7 presents the average scores for acceptability and cuteness by gender (43 male speakers *vs.* 57 female speakers). With regard to cuteness in the [p] condition, no significant difference was found between male (2.74) and female speakers (2.74) (β = −0.002; *SE* = 0.217; *df* = 96.998; *t* = −0.008; n.s.). For the results of cuteness in the [b] condition, the male speakers' average score (2.47) was higher than that of female speakers (2.19), but no significant difference was found between the two values (β = 0.2797; *SE* = 0.2142; *df* = 97.079; *t* = 1.306; n.s.). These results show no effect of gender on cuteness judgements of *pime-yobi* variants.

Table 8 shows the average scores for acceptability and cuteness by age. The current analysis categorised 47 speakers whose ages were between 18 and 29 years as 'younger' speakers, and 53 speakers whose age was 30 years or more as 'older' speakers. The results showed no significant difference between younger and older speakers in the [p] condition (2.89 *vs.* 2.61; β = −0.2811; *SE* = 0.2167; *df* = 98.551; *t* = −1.297; n.s.), nor in the [b] condition (2.39 *vs.* 2.23; β = −0.1573; *SE* = 0.2173; *df* = 97.797; *t* = −0.724; n.s.). These results suggest that age had little if any effect on cuteness judgements of the *pime-yobi* variants.

A further analysis divided all speakers by age and gender into four groups: 30 younger female (YF) speakers, 27 older female (OF) speakers, 17 younger male (YM) speakers and 26 older male (OM) speakers. The results are presented in Table 9.

One noticeable result is that the younger female speakers showed the highest score for cuteness in both the [p] and [b] conditions ([p] = 2.95; [b] = 2.49), whereas the older female speakers showed the

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lowest score ([p] = 2.51; [b] = 1.85). That is, younger female Japanese speakers were the most sensitive to cuteness and older female speakers were the least sensitive. These results align with those of Nittono (2016, 2019): female speakers were more sensitive to cuteness than male speakers, and female speakers were less sensitive as they grew older.

Another noticeable result is that the older male speakers showed the smallest difference between the [p] and [b] conditions ([p] = 2.71; [b] = 2.63), whereas they showed the highest score for cuteness in the [b] condition. This result suggests that the older male speakers found the *bime* form to be as cute as the *pime* form.

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References

Alderete, John & Stefan Frisch (2007). Dissimilation in grammar and the lexicon. In Paul de Lacy (ed.) *The Cambridge handbook of phonology*. Cambridge: Cambridge University Press, 379–398.

Alderete, John & Alexei Kochetov (2017). Integrating sound symbolism with core grammar: the case of expressive palatalization. *Lg* **93**, 731–766.

Anttila, Arto (1997). Deriving variation from grammar. In Frans Hinskens, Roeland van Hout & Leo Wetzels (eds.) *Variation, change and phonological theory*. Amsterdam: John Benjamins, 35–68.

Anttila, Arto (2002). Morphologically conditioned phonological alternations. *NLLT* **20**, 1–42.

Anttila, Arto & Young-Mee Yu Cho (1998). Variation and change in Optimality Theory. *Lingua* **104**, 31–56.

Baayen, R. Harald, Douglas J. Davidson & Douglas M. Bates (2008). Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language* **59**, 390–412.

Bates, Douglas, Martin Maechler, Ben Bolker, Steven Walker, Rune Haubo Bojesen Christensen, Henrik Singmann, Bin Dai & Gabor Grothendieck (2015). Package 'lme4'. Available at https://github.com/lme4/lme4/.

Benua, Laura (1997). *Transderivational identity: phonological relations between words*. PhD dissertation, University of Massachusetts Amherst.

Boersma, Paul (1998). *Functional phonology: formalizing the interactions between articulatory and perceptual drives*. The Hague: Holland Academic Graphics.

Boersma, Paul & Bruce Hayes (2001). Empirical tests of the gradual learning algorithm. *LI* **32**, 45–86.

Boersma, Paul & Joe Pater (2016). Convergence properties of a gradual learning algorithm for harmonic grammar. In John J. McCarthy & Joe Pater (eds.) *Harmonic grammar and harmonic serialism, Advances in Optimality Theory*. Sheffield: Equinox, 389–434.

Bombar, Meredith L. & Lawrence W. Littig Jr. (1996). Babytalk as a communication of intimate attachment: an initial study in adult romances and friendships. *Personal Relationships* **3**, 137–158.

Coetzee, Andries W. (2006). Variation as accessing 'non-optimal' candidates. *Phonology* **23**, 337–385.

Coetzee, Andries W. & Joe Pater (2008). Weighted constraints and gradient restrictions on place co-occurrence in Muna and Arabic. *NLLT* **26**, 289–337.

Daland, Robert, Bruce Hayes, James White, Marc Garellek, Andrea Davis & Ingrid Norrmann (2011). Explaining sonority projection effects. *Phonology* **28**, 197–234.

de Saussure, Ferdinand (1916). *Cours de linguistique générale*. Paris: Payot.

Dingemanse, Mark, Damián E. Blasi, Gary Lupyan, Morten H. Christianson & Padraic Monaghan (2015). Arbitrariness, iconicity and systematicity in language. *Trends in Cognitive Sciences* **19**, 603–615.

Ernestus, Mirjam & R. Harald Baayen (2003). Predicting the unpredictable: interpreting neutralized segments in Dutch. *Lg* **79**, 5–38.

Ferguson, Charles A. (1977). Baby talk as a simplified register. In Catherine E. Snow & Charles A. Ferguson (eds.) *Talking to children: language input and acquisition*. Cambridge: Cambridge University Press, 219–235.

Flemming, Edward (2021). Comparing MaxEnt and Noisy Harmonic Grammar. *Glossa: A Journal of General Linguistics* **6**, 1–42.

Frisch, Stefan A., Nathan R. Large & David B. Pisoni (2000). Perception of wordlikeness: effects of segment probability and length on the processing of nonwords. *Journal of Memory and Language* **42**, 481–496.

Goldwater, Sharon & Mark Johnson (2003). Learning OT constraint rankings using a maximum entropy model. In Jennifer Spenader, Anders Eriksson & Östen Dahl (eds.) *Proceedings of the Stockholm workshop on variation within Optimality Theory*. Stockholm: Stockholm University, 111–120.

Hashimoto, Daiki (2016). Recursive feet in Japanese: avoidance of LH structure. *Phonological Studies* **19**, 1–10.

Hayes, Bruce (2009). Manual for Maxent Grammar Tool. Ms., University of California, Los Angeles. Available online at https://linguistics.ucla.edu/people/hayes/MaxentGrammarTool/ManualForMaxentGrammarTool.pdf.

Hayes, Bruce (2017). Varieties of noisy harmonic grammar. In Karen Jesney, Charlie O'Hara, Caitlin Smith & Rachel Walker (eds.) *Proceedings of the 2016 annual meetings on phonology*. Washington, DC: Linguistic Society of America, 17 pp.

Hayes, Bruce & Zsuzsa Cziráky Londe (2006). Stochastic phonological knowledge: the case of Hungarian vowel harmony. *Phonology* **23**, 59–104.

Hayes, Bruce & Colin Wilson (2008). A maximum entropy model of phonotactics and phonotactic learning. *LI* **39**, 379–440.

Hinton, Leane, Johanna Nichols & John J. Ohala (eds.) (1994). *Sound symbolism*. Cambridge: Cambridge University Press.

Hirabara, Go & Gakuji Kumagai (2021). Sound symbolism of bilabials: a case study of baby formula names in Japanese [in Japanese]. *Papers from the National Conference of the Japanese Cognitive Linguistics Association* **21**, 481–485.

Hockett, Charles (1963). The problem of universals in language. In Joseph Greenberg (ed.) *Universals of language*. Cambridge, MA: MIT Press, 1–22.

Inkelas, Sharon (1998). The theoretical status of morphologically conditioned phonology: a case study from dominance. In Geert Booij & Jaap Van Marle (eds.) *Yearbook of morphology 1997*. Dordrecht: Springer, 121–155.

Itô, Junko & Armin Mester (1995). Japanese phonology. In John Goldsmith (ed.) *The handbook of phonological theory*. Oxford: Blackwell, 817–838.

Itô, Junko & Armin Mester (1999). The structure of the phonological lexicon. In Natsuko Tsujimura (ed.) *The handbook of Japanese linguistics*. Oxford: Blackwell, 62–100.

Itô, Junko & Armin Mester (2003). *Japanese morphophonemics: markedness and word structure*. Cambridge, MA: MIT Press.

Jäger, Gerhard (2007). Maximum entropy models and stochastic Optimality Theory. In Annie Zaenen, Jane Simpson, Tracy Holloway King, Jane Grimshaw, Joan Maling & Chris Manning (eds.) *Architectures, rules, and preferences: variations on themes by Joan W. Bresnan*. Stanford, CA: CSLI, 467–479.

Jäger, Gerhard & Anette Rosenbach (2006). The winner takes it all – almost: cumulativity in grammatical variation. *Linguistics* **44**, 937–971.

Jakobson, Roman (1941). *Kindersprache, Aphasie und allgemeine Lautgesetze*. Uppsala: Uppsala Universitetet.

Jakobson, Roman (1968). *Child language aphasia and phonological universals*. The Hague: Mouton. Translated by Allan R. Keiler from Jakobson (1941).

Jang, Hayeun (2020). Register-specific phonology in core grammar: expressive strategies in Korean Aegyo. *Japanese/Korean linguistics* **26**, 43–54.

Jang, Hayeun (2021). How cute do I sound to you? Gender and age effects in the use and evaluation of Korean baby-talk register, Aegyo. *Language Sciences* **83**, 19 pp.

Kawahara, Shigeto (2015). Can we use rendaku for phonological argumentation? *Linguistics Vanguard* **1**, 3–14.

Kawahara, Shigeto (2017). *'A' ha 'i' yorimo ookii? Onsyotyo de manabu onseigaku nyuumon [Introductory phonetics through sound symbolism]*. Tokyo: Hituzi Shobo.

Kawahara, Shigeto (2018). Phonology and orthography: the orthographic characterization of rendaku and Lyman's Law. *Glossa* **3**, 1–24.

Kawahara, Shigeto (2019). What's in a PreCure name? *ICU Working Papers in Linguistics* **7**, 15–22.

Kawahara, Shigeto (2020a). Cumulative effects in sound symbolism. Ms., Keio University. Available at https://ling.auf.net/lingbuzz/004980.

Kawahara, Shigeto (2020b). Sound symbolism and theoretical phonology. *Language and Linguistics Compass* **14**, e12372.

Kawahara, Shigeto (2020c). A wug-shaped curve in sound symbolism: the case of Japanese Pokémon names. *Phonology* **37**, 383–418.

Kawahara, Shigeto (2021). Testing MaxEnt with sound symbolism: a stripy wug-shaped curve in Japanese Pokémon names. *Lg* **97**, e341–e359.

Kawahara, Shigeto & Canaan Breiss (2021). Exploring the nature of cumulativity in sound symbolism: experimental studies of Pokémonastics with English speakers. *Laboratory Phonology* **12**, 1–29.

Kawahara, Shigeto, Mahayana C. Godoy & Gakuji Kumagai (2021). English speakers can infer Pokémon types based on sound symbolism. *Frontiers in Psychology* **12**, 13 pp.

Kawahara, Shigeto, Hironori Katsuda & Gakuji Kumagai (2019). Accounting for the stochastic nature of sound symbolism using Maximum Entropy model. *Open Linguistics* **5**, 109–120.

Kawahara, Shigeto & Gakuji Kumagai (2019a). Expressing evolution in Pokémon names: experimental explorations. *Journal of Japanese Linguistics* **35**, 3–38.

Kawahara, Shigeto & Gakuji Kumagai (2019b). Inferring Pokémon types using sound symbolism: the effects of voicing and labiality. *Onsei Kenkyu [Journal of the Phonetic Society of Japan]* **23**, 111–116.

Kawahara, Shigeto & Gakuji Kumagai (2021). What voiced obstruents symbolically represent in Japanese: evidence from the Pokémon universe. *Journal of Japanese Linguistics* **37**, 3–24.

Kawahara, Shigeto, Atsushi Noto & Gakuji Kumagai (2018). Sound symbolic patterns in Pokémon names. *Phonetica* **75**, 219–244.
Kawahara, Shigeto, Hajime Ono & Kiyoshi Sudo (2006). Consonant co-occurrence restrictions in Yamato Japanese. *Japanese/Korean linguistics* **14**, 27–38.
Kawahara, Shigeto, Kazuko Shinohara & Yumi Uchimoto (2008). A positional effect in sound symbolism: an experimental study. *Papers from the National Conference of the Japanese Cognitive Linguistics Association* **8**, 417–427.
Keller, Frank (2000). *Gradience in grammar: experimental and computational aspects of degrees of grammaticality*. PhD dissertation, University of Edinburgh.
Keller, Frank (2006). Linear Optimality Theory as a model of gradience in grammar. In Gisbert Fanselow, Caroline Féry, Ralph Vogel & Matthias Schlesewsky (eds.) *Gradience in grammar: generative perspectives*. Oxford: Oxford University Press, 270–287.
Kumagai, Gakuji (2017). Testing the OCP-labial effect on Japanese rendaku. Ms., NINJAL. Available at https://ling.auf.net/lingbuzz/003290.
Kumagai, Gakuji (2019). A sound-symbolic alternation to express cuteness and the orthographic Lyman's Law in Japanese. *Journal of Japanese Linguistics* **35**, 39–74.
Kumagai, Gakuji (2020). The pluripotentiality of bilabial consonants: the images of softness and cuteness in Japanese and English. *Open Linguistics* **6**, 693–707.
Kumagai, Gakuji (2022). What's in a Japanese kawaii 'cute' name? A linguistic perspective. *Frontiers in Psychology* **13**, 9 pp.
Kumagai, Gakuji & Shigeto Kawahara (2020). Feature-based sound symbolism: labiality and diaper names in Japanese [in Japanese]. *GENGO KENKYU (Journal of the Linguistic Society of Japan)* **157**, 149–161.
Kumagai, Gakuji & Changyun Moon (2021). Do labial consonants evoke the images of softness and cuteness cross-linguistically? An experiment with Chinese and Korean speakers. *Onsei Kenkyu [Journal of the Phonetic Society of Japan]* **25**, 87–96.
Kurisu, Kazutaka (2001). *The phonology of morpheme realization*. PhD dissertation, University of California, Santa Cruz.
Kuznetsova, Alexandra, Per B. Brockhoff & Rune H. B. Christensen (2017). lmerTest package: tests in linear mixed effects models. *Journal of Statistical Software* **82**, 26 pp.
Labrune, Laurence (2012). *The phonology of Japanese*. Oxford: Oxford University Press.
Legendre, Géraldine, Yoshiro Miyata & Paul Smolensky (1990). Harmonic Grammar – a formal multi-level connectionist theory of linguistic wellformedness: an application. In Martin Ringle (ed.) *Proceedings of the twelfth annual conference of the Cognitive Science Society*. Hillsdale, NJ: Lawrence Erlbaum, 884–891.
Legendre, Géraldine, Antonella Sorace & Paul Smolensky (2006). The Optimality Theory–Harmonic Grammar connection. In Paul Smolensky & Géraldine Legendre (eds.) *The harmonic mind: from neural computation to Optimality-Theoretic grammar: linguistic and philosophical implications*, volume 2. Cambridge, MA: MIT Press, 339–402.
Lockwood, Gwilym & Mark Dingemanse (2015). Iconicity in the lab: a review of behavioral, developmental, and neuroimaging research into sound-symbolism. *Frontiers in Psychology* **6**, 14 pp.
MacNeilage, Peter F., Barbara L. Davis & Christine L. Matyear (1997). Babbling and first words: phonetic similarities and differences. *Speech Communication* **22**, 269–277.
McCarthy, John J. (1986). OCP effects: gemination and antigemination. *LI* **17**, 207–263.
McCarthy, John J. (1988). Feature geometry and dependency: a review. *Phonetica* **45**, 84–108.
McCarthy, John J. & Alan Prince (1995). Faithfulness and reduplicative identity. *University of Massachusetts Occasional Papers in Linguistics* **18**, 249–384.
McCarthy, John J. & Alan Prince (1999). Faithfulness and identity in prosodic morphology. In René Kager, Harry van der Hulst & Wim Zonneveld (eds.) *The prosody–morphology interface*. Cambridge: Cambridge University Press, 218–309.
McCawley, James D. (1968). *The phonological component of grammar of Japanese*. The Hague: Mouton.
Nagy, Naomi & Bill Reynolds (1997). Optimality Theory and variable word-final deletion in Faetar. *Language Variation and Change* **9**, 37–55.
Nasu, Akio (2015). The phonological lexicon and mimetic phonology. In Haruo Kubozono (ed.) *Handbook of Japanese phonetics and phonology*. Berlin: De Gruyter Mouton, 253–288.
Newman, Stanley S. (1933). Further experiments on phonetic symbolism. *American Journal of Psychology* **45**, 53–75.
Nielsen, Alan K. S. & Mark Dingemanse (2021). Iconicity in word learning and beyond: a critical review. *Language and Speech* **64**, 52–72.
Nittono, Hiroshi (2016). The two-layer model of 'kawaii': a behavioural science framework for understanding kawaii and cuteness. *East Asian Journal of Popular Culture* **2**, 79–95.
Nittono, Hiroshi (2019). *Kawaii no tikara [Power of kawaii]*. Kyoto: Dojin Sensho.
Odden, David (1994). Adjacency parameters in phonollogy. *Lg* **70**, 289–330.
Ohala, John J. (1984). An ethological perspective on common cross-language utilization of F0 of voice. *Phonetica* **41**, 1–16.
Ohala, John J. (1994). The frequency code underlies the sound symbolic use of voice pitch. In Leane Hinton, Johanna Nichols & John J. Ohala (eds.) *Sound symbolism*. Cambridge: Cambridge University Press, 325–347.
Orgun, Cemil Orhan (1996). *Sign-based morphology and phonology with special attention to Optimality Theory*. PhD dissertation, University of California, Berkeley.
Ota, Mitsuhiko (2015). L1 phonology: phonological development. In Haruo Kubozono (ed.) *Handbook of Japanese phonetics and phonology*. Berlin: De Gruyter Mouton, 681–717.

https://doi.org/10.1017/S0952675724000101 Published online by Cambridge University Press

Pater, Joe (2009). Weighted constraints in generative linguistics. *Cognitive Science* **33**, 999–1035.
Pater, Joe (2016). Universal grammar with weighted constraints. In John J. McCarthy & Joe Pater (eds.) *Harmonic Grammar and Harmonic Serialism*. Sheffield: Equinox, 1–46.
Peña, Marcela, Jacques Mehler & Marina Nespor (2011). The role of audiovisual processing in early conceptual development. *Psychological Science* **22**, 1419–1421.
Perniss, Pamela, Robin L. Thompson & Gabriella Vigliocco (2010). Iconicity as a general property of language: evidence from spoken and signed languages. *Frontiers in Psychology* **1**, 15 pp.
Potts, Christopher, Joe Pater, Karen Jesney, Rajesh Bhatt & Michael Becker (2010). Harmonic Grammar with linear programming: from linear systems to linguistic typology. *Phonology* **27**, 77–117.
Prince, Alan & Paul Smolensky (2004). *Optimality Theory: constraint interaction in generative grammar*. Oxford: Blackwell.
R Core Team (2020). *R: a language and environment for statistical computing* [Computer program]. Vienna: R Foundation for Statistical Computing. Available at https://www.R-project.org.
Reetz, Henning & Allard Jongman (2009). *Phonetics: transcription, production, acoustics, and perception*. Oxford: Wiley-Blackwell.
Reynolds, William Thomas (1994). *Variation and phonological theory*. PhD dissertation, University of Pennsylvania.
Sapir, Edward (1929). A study in phonetic symbolism. *Journal of Experimental Psychology* **12**, 225–239.
Schmidtke, David S., Markus Conrad & Arthur M. Jacobs (2014). Phonological iconicity. *Frontiers in Psychology* **5**, 6 pp.
Selkirk, Elisabeth (1993). [Labial] relations. Ms., University of Massachusetts, Amherst.
Shih, Stephanie S. (2020). Gradient categories in lexically-conditioned phonology: an example from sound symbolism. In Hyunah Baek, Chikako Takahashi & Alex Hong-Lun Yeung (eds.) *Proceedings of the 2019 Annual Meeting on Phonology*. Washington, DC: Linguistic Society of America, 8 pp.
Shih, Stephanie S., Jordan Ackerman, Noah Hermalin, Sharon Inkelas, Hayeun Jang, Jessica Johnson, Darya Kavitskaya, Shigeto Kawahara, Miran Oh, Rebecca L. Starr & Alan Yu (2019). Crosslinguistic and language-specific sound symbolism: Pokémonastics. Ms., University of Southern California, University of California, Merced, University of California, Berkeley, Keio University, National University of Singapore and University of Chicago. Available at https://ling.auf.net/lingbuzz/004725.
Shinohara, Kazuko & Shigeto Kawahara (2013). The sound symbolic nature of Japanese maid names. *Papers from the National Conference of the Japanese Cognitive Linguistics Association* **13**, 183–193.
Shinohara, Kazuko & Shigeto Kawahara (2016). A cross-linguistic study of sound symbolism: the images of size. *BLS* **36**, 396–410.
Sidhu, David M. & Penny M. Pexman (2018). Five mechanisms of sound symbolic association. *Psychonomic Bulletin & Review* **25**, 1619–1643.
Taylor, Insup K. & Maurice M. Taylor (1965). Another look at phonetic symbolism. *Psychological Bulletin* **64**, 413–427.
Thompson, Patrick D. & Zachary Estes (2011). Sound symbolic naming of novel objects is a graded function. *Quarterly Journal of Experimental Psychology* **64**, 2392–2404.
Tsujimura, Natsuko (2013). *An introduction to Japanese linguistics*. Oxford: Wiley-Blackwell.
Uno, Ryoko, Kazuko Shinohara, Yuta Hosokawa, Naho Atsumi, Gakuji Kumagai & Shigeto Kawahara (2020). What's in a villain's name? Sound symbolic values of voiced obstruents and bilabial consonants. *Review of Cognitive Linguistics* **18**, 428–457.
Vance, Timothy J. (1987). *An introduction to Japanese phonology*. New York: SUNY Press.
Vance, Timothy J. (2007). Have we learned anything about rendaku that Lyman didn't already know? In Bjarke Frellesvig, Masayoshi Shibatani & John Charles Smith (eds.) *Current issues in the history and structure of Japanese*. Tokyo: Kurosio Publishers, 153–170.
Vance, Timothy J. (2015). Rendaku. In Haruo Kubozono (ed.) *Handbook of Japanese phonetics and phonology, volume 2 of Handbooks of Japanese Language and Linguistics*. Berlin: De Gruyter Mouton, 397–441.
Vance, Timothy J. (2016). Introduction. In Timothy J. Vance & Mark Irwin (eds.) *Sequential voicing in Japanese compounds: papers from the NINJAL rendaku project*. Amsterdam: John Benjamins, 1–12.
Vance, Timothy J. & Mark Irwin (eds.) (2016). *Sequential voicing in Japanese compounds: papers from the NINJAL rendaku project*. Amsterdam: John Benjamins.
Winter, Bodo (2019). *Statistics for linguists: an introduction using R*. New York: Routledge.
Zuraw, Kie & Bruce Hayes (2017). Intersecting constraint families: an argument for Harmonic Grammar. *Lg* **93**, 497–548.
Zuraw, Kie & Yu-An Lu (2009). Diverse repairs for multiple labial consonants. *NLLT* **27**, 197–224.