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Research Article

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Analysing spells in the *Harry Potter* series: Sound-symbolic effects of syllable lengths, voiced obstruents and low vowels

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Abstract: The current study is the first to attempt to perform a sound-symbolic analysis of the spells featured in the *Harry Potter* series. The present research analysed 171 spells in terms of syllable lengths and the number of voiced obstruents and stressed low vowels. The results showed that the Killing Curse, *Avada Kedavra*, which is known as one of the most powerful and sinister spells, has the most voiced obstruents and stressed low vowels. The study then experimentally examined whether three factors – syllable lengths, voiced obstruents and low vowels – evoked the imagery of powerful spells using nonce words. The results suggested that voiced obstruents and stressed low vowels are sound-symbolically associated with powerful imagery, which aligns with the studies in Pokémonastics concerning strong character names (Kawahara et al. 2018; Shih et al. 2019). Moreover, names containing more syllables were favoured as powerful spells by those who are unfamiliar with the *Harry Potter* series, which is evidence of the iconicity of quantity in general English speakers.

Keywords: syllable length, voiced obstruents, low vowels

1 Introduction

1.1 Sound symbolism

There are contrastive characteristics in natural language systems. Natural language demonstrates arbitrary mapping between forms and meanings (de Saussure 1916; Hockett 1963), illustrated by the fact that an object is given a certain name in one language but a different name in another language; for example, an animal referred to as a *dog* in English is called *Hund* in German, *chien* in French, *perro* in Spanish, *cane* in Italian and *inu* in Japanese. There is no common sequence of sounds among these words across the six languages. Such an arbitrary form-meaning mapping is conventionalised based upon language users' agreement within a community to which they belong (Perniss et al. 2010).

However, natural language also displays a non-arbitrary relationship between forms and meanings, which is referred to as iconicity, a term covering a variety of phenomena, including sound symbolism, ideophones and iconicity (Perniss et al. 2010). Sound symbolism is defined here as a non-arbitrary, iconic or motivated form-meaning mapping in which certain sounds and forms at the segmental level and beyond are perceived as particular images or meanings (for a subclassification of sound symbolism, see Hinton et al. 1994/2006). One example exhibiting the sound-symbolism at the segmental level is the *mil/mal* effect

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shown by Sapir (1929), who, inspired by Jespersen (1922), experimentally demonstrated that given a minimal pair of nonce words, *mal* and *mil*, participants chose *mal* for a big object and *mil* for a small object. Subsequent studies (e.g. Berlin 2006; Newman 1933; Ohtake and Haryu 2013; Peña et al. 2011; Shinohara and Kawahara 2016; Taylor and Taylor 1965; Thompson and Estes 2011) demonstrated that for adults and infants and with a variety of methods, many but not all languages show a tendency for high/front vowels to be associated with small objects and low/back vowels with large ones. These associations can be motivated on an articulatory and acoustic basis. Articulating the low vowel [a] makes the mouth wider than articulating the high vowel [i], which is mapped onto the imagery of largeness (Sapir 1929), and high-frequency sounds in the second formant (F_2) are associated with something small, while low-frequency sounds are associated with something large (Ohala 1984, 1994/2006).

Beyond the segmental level, there is a growing body of research that demonstrates sound-symbolic phenomena observed at the suprasegmental, or syllable/mora and word, level. A famous example at the word level is the *takete-maluma* effect (Köhler 1929/1947), where *maluma* is matched with rounded shapes and *takete* with spiky shapes. This effect has also been known as the *bouba-kiki* effect since Ramachandran and Hubbard's (2001) study. For a sound-symbolic example at the syllable/mora level, Pokémonastics studies have found that the number of morae in Japanese *Pokémon* names positively correlated with their height/weight/power (Kawahara et al. 2018; Shih et al. 2019), which will be explained in detail in Section 1.2. Sound symbolism has been extensively and vigorously explored by many researchers in linguistics, psychology and cognitive science, which can be seen in overview and review articles, such as Akita (2015), Dingemanse et al. (2015), Hinton et al. (1994/2006), Kawahara (2020a), Lockwood and Dingemanse (2015), Nuckolls (1999), Perniss et al. (2010), Schmidtke et al. (2014) and Sidhu and Pexman (2018). Presently, it is widely acknowledged that the contrastive characteristics mentioned above coexist in natural languages (Dingemanse et al. 2015; Perniss et al. 2010).

1.2 Hypotheses tested

Sound symbolism has been explored in a variety of approaches, such as scrutinising basic vocabulary across languages (e.g. Blasi et al. 2016; Jespersen 1922; Johansson et al. 2020; Joo 2020; Ultan 1978; Urban 2011; Wichmann et al. 2010) or investigating real and fictional names in a particular language (see Sidhu and Pexman 2019). There is a substantial body of research showing that sound symbolism manifests itself in real and fictional human and product names in English. For example, male names tend to contain lower vowels (e.g. *Thomas*) than female names (e.g. *Emily*; Pitcher et al. 2013; for vowels, see Cutler et al. 1990). Additionally, male names are more likely to contain obstruents, while female names are more likely to contain sonorants (Slater and Feinman 1985; Wright et al. 2005), and voiced consonants are often associated with male names, while voiceless consonants are associated with female names (e.g. Slepian and Galinsky 2016). Moreover, particular types of consonants are associated with personality; sonorants (e.g. *Mona*, *Owen*) evoke high emotionality, agreeableness and conscientiousness, while voiceless stop phonemes (e.g. *Katie*, *Curtis*) evoke high extraversion (Sidhu et al. 2019). Furthermore, female names are typically longer than male names (e.g. *Elizabeth* vs *John*; Cassidy et al. 1999; Cutler et al. 1990; Slater and Feinman 1985; Wright et al. 2005), and the number of segments in baseball players' names has even been positively correlated with their weight (Shih and Rudin 2020). Moreover, for product names, certain vowels are more appropriate for particular products, such as beer and ice cream (Jurafsky 2014; Yorkston and Menon 2004; for other cases, see Coulter and Coulter 2010; Klink 2000, 2001; Lowrey and Shrum 2007; Peterson and Ross 1972; Pogacar et al. 2015; Shrum et al. 2012).

The current study focuses on three phonetic and phonological factors – syllable/mora counts, voiced obstruents and low vowels – that have been featured in recent studies on *Pokémon* character names (Kawahara et al. 2018) or dubbed Pokémonastics (Shih et al. 2019). *Pokémon*, which is the abbreviated form of *Pokeeto Monsutaa* "pocket monster," is a computer game that was originally released in 1996 by Nintendo in Japan. Game players catch creatures named *pokémon* with monster balls and make them battle with other *Pokémon* characters. Currently, *Pokémon* has spread widely across the world, and the character names have been translated into another seven foreign languages, such as English, German, French, Spanish, Italian, Chinese and Korean; for example, a lizard-like *Pokémon* character named *Hitokage* in Japanese is called *Charmander* in English. An important aspect of the Pokémon world is that some *Pokémon* characters evolve to become bigger, heavier and stronger. Kawahara et al. (2018) found that the evolved *Pokémon* names in Japanese are more likely to contain voiced obstruents and are more likely to have increased mora counts (see Kawahara and Kumagai [2019, 2021] for subsequent experimental studies). Though Kawahara et al. (2018) also reported that there were no clear differences in vowel quality between pre- and post-evolution Japanese *Pokémon* names, a subsequent experimental study (Kumagai and Kawahara 2019) demonstrated that names with low vowels were deemed more appropriate for post-evolution *Pokémon* than for pre-evolution *Pokémon*.

These tendencies are also observed in English *Pokémon* character names. In a corpus study, the number of voiced obstruents and low vowels was positively correlated with the weight of existing *Pokémon* characters (Shih et al. 2019). Furthermore, experimental studies (Kawahara and Breiss 2021; Kawahara and Moore 2021) demonstrated that names with [a] were more appropriate for post-evolution *Pokémon* names than those with [i], and names with a larger number of segments were judged appropriate for post-evolution *Pokémon* names. However, the effect of the syllable/mora counts was not confirmed (Kawahara and Moore 2021).

The sound-symbolic effects of syllable/mora counts, voiced obstruents and low vowels are motivated by phonetic and cognitive aspects. The count effect of prosodic units, such as syllable/mora counts, can be attributed to a concept called the "iconicity of quantity," discussed in the cognitive linguistics literature (see Haiman 1980, 1985), in which increments of quantity are expressed via increments of linguistic elements; for instance, greater quantities are expressed by a greater number of segments in comparatives and superlatives in Latin (e.g. *long*(*-us*) "long" <*long-ior* "long-er" <*long-issim*(*-us*) "long-est"; Haspelmath 2008; see also Jakobson's [1965, 1971] description). Additionally, it is generally known that voiced obstruents lower the frequencies of adjacent vowels (Kingston and Diehl 1994), and that sounds with low frequency, such as voiced consonants, signal large imagery (Ohala 1984, 1994/2006). Furthermore, the oral aperture of low vowels is associated with the imagery of largeness (Sapir 1929). If the imagery of largeness is linked to the imagery of strength (Kawahara and Kumagai 2021), then we can account for why the three factors evoke the imagery of largeness and powerfulness.

The sound symbolic effects of voiced obstruents and mora counts are also present in the spells and moves that appear in Japanese computer games. Kawahara (2017) showed that the number of voiced obstruents and the number of morae are positively correlated with the strengths of spells featured in a series of Japanese role-playing games called *Dragon Quest* (often called *Dorakue*), which were originally released by Square Enix in 1986. Kumagai et al. (2020) also analysed the spells in the *Final Fantasy* (FF) series, originally released in 1987 by the same company, and demonstrated that the spells' levels were more likely to increase alongside an increased number of voiced obstruents. Furthermore, Kawahara, Suzuki and Kumagai (2020) found that the strengths of the moves that *Pokémon* characters used to battle were positively correlated with the number of voiced obstruents and morae. These studies have thereby suggested that spells and moves convey strengths via the number of voiced obstruents or the mora counts in their names. However, few studies have examined the effect of low vowels on creating strong imagery in spells. Considering the abovementioned results of the Pokémonastics research, it is likely that the strong or powerful imagery in spells is conveyed via prosodic lengths (in terms of syllable/mora counts) as well as voiced obstruents and low vowels.

The current sound-symbolic analysis examines whether prosodic lengths in terms of syllables, voiced obstruents and low vowels manifest themselves in spells that appear in the famous series of novels, *Harry Potter*, written by J. K. Rowling. In the series, many wizards and witches use magic (called "spells" throughout the current study), including spells, charms, jinxes, hexes, curses, transfigurations, transportations, conjurations, dark arts, untransfigurations and vanishments (for a classification of magic in the series, see *Harry Potter Wiki*[1]). In the abovementioned studies on *Dragon Quest* and *Final Fantasy*, each

1 This is found at https://harrypotter.fandom.com/wiki/Spell (accessed 23 February 2021).

spell could be categorised into strength levels, which could be coded using numerical values. However, as far as I have investigated, there seems to be no official rating system regarding power levels in the spells in the *Harry Potter* series.[2] Therefore, Section 2 of the current study investigates the spells of the series to address the following research questions:

(1) Research questions
  a. Which spell has the most syllables in the *Harry Potter* series?
  b. Which spell contains the most voiced obstruents?
  c. Which spell contains the most low vowels with stress?

The results revealed that the spell that ranked first in questions (1b) and (1c) was the Killing Curse, *Avada Kedavra*, which is notorious as one of the three Unforgivable Curses in the series. According to *Harry Potter Wiki*,[3] this curse is one of the most powerful and sinister spells known to the wizarding world. If we assume that certain phonetic features in its name evoke certain imagery, then it is predicted that both voiced obstruents and low vowels evoke powerful and sinister imagery. In other words, they may be sound-symbolically associated with such imagery. However, as the series is a story created by a single English-speaking author, J. K. Rowling, it is unclear whether such imagery is present across the general population of native English speakers. Thus, Section 3 reports an experiment using nonce words to examine the following hypotheses focussed on powerful imagery.

(2) Hypotheses tested in the current experiment:
  a. Longer names in terms of syllable counts are associated with the imagery of powerful spells.
  b. Voiced obstruents are associated with the imagery of powerful spells.
  c. Stressed low vowels are associated with the imagery of powerful spells.

The results of the experiment showed that hypotheses (2b) and (2c) were supported. Additionally, the analysis targeting English speakers who are unfamiliar with the *Harry Potter* series showed that (2a) was also supported. These results suggest that for general native English speakers, powerful imagery in spells is evoked by not only voiced obstruents and low vowels but also long names in terms of syllable counts. This provides evidence for the iconicity of quantity in general English speakers.

2 Survey

2.1 Method

This section presents an analysis of spells in the *Harry Potter* series to address the questions presented in Section 1. There are several data sources available to investigate the spells' pronunciations: movies, audiobooks and a website called *Harry Potter Wiki*. However, there are some differences in spells' pronunciations among them. For example, the final <t> of the spell *Serpensortia* is pronounced [t] in the audiobook of the second volume, *Harry Potter and the Chamber of Secrets*, while it is pronounced as [s] or [ʃ] by Draco Malfoy in the movie. In contrast, both of them are listed in the *Harry Potter Wiki*. Since the first publication style of the *Harry Potter* series was written (non-audible) novels, it is almost impossible to determine which of the

2 It may be possible to ask *Harry Potter* fans how strong each spell is. However, not all spells are associated with powerful imagery. For example, *Wingardium Leviosa* does not attack objects but makes them fly.

3 This is found at https://harrypotter.fandom.com/wiki/Killing_Curse (accessed 23 February 2021).

three data sources is more reliable than the other two. The current study performed an analysis using the *Harry Potter Wiki* site, as it is easier for readers to check the spells' pronunciations on their own.[4]

The current analysis extracted 305 spells from the *Harry Potter Wiki* website,[5] which describes spell types (i.e. spells, charms, jinxes, hexes, curses, transfigurations, transportations, conjurations, dark arts, untransfigurations, vanishments), name origins and pronunciations, including syllable boundaries and stress positions, written in the Roman alphabet (not in IPA phonetic symbols); for example, *Avada Kedavra* is presented as [ah-VAH-dah keh-DAV-rah], where the hyphens represent syllable boundaries, and the capitalised letters represent the syllables assigned stress.

Not all spells had their pronunciation guides; in fact, there were 174 spells with pronunciation guides on the website. Of these, there were three spells that showed more than one pronunciation pattern: *Accio* showed various patterns such as [AK-ee-oh], [AK-see-oh] or [AK-see-oh]; *Bombarda Maxima* showed two patterns: [BOM-bar-dah MAX-ih-mah] and [bom-BAR-dah MAX-ih-mah]; and *Serpensortia* showed two patterns: [ser-pen-SOR-shah] and [SER-pehn-SOR-tee-ah]. Since these spells were excluded from the analysis, the current study targeted the remaining 171 spells.

The number of syllables was counted based on syllabification; for example, *Avada Kedavra*, [ah-VAH-dah keh-DAV-rah] consists of six syllables.[6] The graphemes <b, d, g, z, j, v> and <B, D, G, Z, J, V> were counted as voiced obstruents. As the pronunciation was written alphabetically on the website, all of the stressed vowels were translated into IPA symbols based on the current Standard Southern British (SSB) pronunciation or General British (GB; Lindsey 2019). The present study focused only on stressed vowels, as it was undiscernible to distinguish stressed low vowels from weak vowels such as the schwa in the descriptions. Table 1 presents the IPA symbols and examples, Standard Lexical sets (Wells 1982) and targeted letters. For example, the syllables that contained "I," such as "BILL, NIM, SIS and so on" were categorised into the KIT set (/ɪ/). The syllables that contained "O (+C)" (the parenthesised "C" represents "an optional consonant") were categorised into the LOT set (/ɔ/). Note that a syllable that contained "OH, OU/OW/TOE/NO" was categorised into the GOAT set instead. The word that contained "IY" was categorised as "other," as their pronunciation was unclear. Since there were nine spells that clearly showed mistakes in the descriptions, these were partly revised (see Appendix).

2.2 Results

This section presents the results of the analysis. Table 2 shows the number of spells by the number of syllables. The longest name among the 171 spells was *Amato Animo Animato Animagus* [ah-MAH-toh ah-NEE-moh ah-nee-MAH-toh an-a-MAY-jus], which consists of 14 syllables.

Table 3 displays how many voiced obstruents are contained in each spell of the *Harry Potter* series. The number of voiced obstruents is zero at the minimum and four at the maximum. The spell that contains the most voiced obstruents is *Avada Kedavra* [ah-**V**AH-**d**ah keh-**D**A**V**-rah].

Table 4 depicts the frequency of the vowels in the spells. A total of 236 vowels were analysed.

Table 5 lists 47 instances of spells that contain the TRAP (/a/) and PALM (/ɑː/) vowels with stress. Of these, there were four spells that contained as many as two low vowels with stress: no. 3, *Amato Animo Animato Animagus* [ah-**MAH**-toh ah-NEE-moh ah-nee-**MAH**-toh an-a-MAY-jus]; no. 9, *Avada Kedavra* [ah-**VAH**-dah keh-**DAV**-rah]; no. 15, *Carpe Retractum* [**CAR**-pay ruh-**TRACK**-tum]; and no. 26, *Lacarnum Inflamari* [la-**KAR**-num in-flah-**MAR**-ee].

4 Comparing pronunciation differences across the three data sources is another interesting topic for future research.

5 This is found at https://harrypotter.fandom.com/wiki/List_of_spells#A (accessed 23 February 2021).

6 Note that identical spells can give rise to different sounds. For example, the grapheme <ia>, which is not assigned stress, is included in *Colovaria*, *Protego Diabolica*, *Harmonia Nextere Passus*, *Salvio Hexia* and *Obliviate*. The first and second spells regard <ia> as one syllable: [co-loh-VA-riah] and [pro-TAY-goh dia-BOHL-i-cu]. The <ia> can thereby be analysed as the NEAR vowel. In contrast, the remaining spells regard <ia> as two syllables: [har-MOH-nee-a NECK-teh-ray PASS-us], [SAL-vee-oh HECKS-ee-ah] and [oh-BLI-vee-ate]. The <ia> in the third and fourth spells can be analysed as the FLEECE vowel, plus the schwa. The <ia> in the fifth spell can be analysed as the FLEECE and FACE vowels.

Table 1: IPA symbols and targeted letters

IPA symbols	Lexical sets	Targeted letters
/ɪ/	KIT	Contains "I," such as "BILL, NIM, SIS, FRING, FIN, PIS, FLINT, MIH, GLISS, BIV, WIB, JIL, LIB, MIM, BLI, KID, ICK, PIX, TRI, BIHL, DILL, MILL, MICK" e.g. *Obliviate* [oh-BLI-vee-ate]
/ɛ/	DRESS	Contains "E," such as "MEN, PE, SEN, EKS, REST, MEN, SEH, SIS, RECK, ES, PECK, PELL, NESS, PEN, NECK, VEH, LEDJ, NEH, PES, RENN, PEL, PEH, VEL, SEM, HECKS, SEMP, LEN, STEH, LEG, VEN, NES, NEN" e.g. *Expelliarmus* [ex-PELL-ee-ARE-muss]
/ɔ/	LOT	Contains "O (+C)," such as "BOM, POX, HOM, CON, NOCKSS, RON," except for "OR, OU, OW, TOE, NO, SO" (see THOUGHT and GOAT) e.g. *Epoximise* [ee-POX-i-mise]
/a/	TRAP	Contains "A (+C)," such as "AK, NAP, A, DAV, MAX, CAN, TRACK, VA, AN, LANG, LAP, DAK, LASH, SAL, AL, LAN," except for "AH, AR, ARE, PASS" (see PALM) e.g. *Avada Kedavra* [ah-VAH-dah keh-DAV-rah]
/ɵ/	FOOT	—
/ʌ/	STRUT	Contains "U," such as "RUCK, FUN, PUL, DUCK, BUB, SKUH, PUHL, NUN, SKULL, PUG, DUK, MUH, KUL, SPUN, VUL" e.g. *Reducto* [re-DUK-toh]
/ɪː/	NEAR	Contains "EER," such as "PEER" e.g. *Imperio* [im-PEER-ee-oh]
/ɛː/	SQUARE	Contains "AIR," such as "VAIR, PAIR" e.g. *Vera Verto* [vair-uh-VAIR-toh]
/oː/	THOUGHT	Contains "OR, AW, OAR," such as "MOR, VOR, POR, GOR, GORE, FOR, COR, SAWL, SAW, NAW, OAR" e.g. *Orbis* [OR-biss]
/ɑː/	PALM	Contains "AH, AR, ARE, BRA, PASS," such as "AH, LAR, MAH, AH, PAR, RAHN, VAH, BAR, CAR, CAH, STAH, ARE, TAH, GRAH, PASS, MAH, KAR, MAR, AR, PAR, PAH, WAH, GAR" e.g. *Wingardium Leviosa* [win-GAR-dee-um lev-ee-OH-sa]
/ɵː/	CURE	Contains "UR," such as "SKYUR" e.g. *Obscuro* [ob-SKYUR-oh]
/əː/	NURSE	Contains "IR, ER, SIR, VUHR," such as "SIR, VER, PUR, VUHR, SKUR, SOR, SKURJ, SUR, TUR, VERD" e.g. *Everte Statum* [ee-VER-tay STAH-tum]
/ɪj/	FLEECE	Contains "EE," such as "NEE, EE, TEE, TREEM, LEE, PREEM, NEE, TREE, MEE" e.g. *Amato Animo Animato Animagus* [ah-MAH-toh ah-NEE-moh ah-nee-MAH-toh an-a-MAY-jus]
/ɛj/	FACE	Contains "AY," such as "MAY, LAY, PAY, GLAY, FLAY, TAY" e.g. *Glacius* [GLAY-see-us]
/oj/	CHOICE	—
/ɑj/	PRICE	—
/aw/	MOUTH	—
/ʉw/	GOOSE	Contains "OO, EW," such as "KROO, DYOO, ROOL, DOO, FYOO, LOO, MYOO, STOO" and "YEW" e.g. *Crucio* [KROO-see-oh]
/əw/	GOAT	Contains "OH, OU, OW, TOE, NO, SO" such as "LOH, FOH, KOH, TROH, MOH, DOUGH, TOE, SO, SCOW, NO, TOH, BOHL" e.g. *Protego Diabolica* [pro-TAY-goh dia-BOHL-i-cu]
Others	—	IY *Quietus* [KWIY-uh-tus]

2.3 Discussion

The current study explored spells that appear in the *Harry Potter* series in terms of (1) syllabic lengths, (2) the number of voiced obstruents and (3) the number of stressed low vowels. As a result, the current analysis found that the spell that ranked first in the second and third factors was the Killing Curse, *Avada Kedavra*, which was named after the ancient spell *abracadabra* in Aramaic, meaning "let the thing be destroyed"

Table 2: Number of syllables in spells (*N* = 171)

No. of syllables	*N*	Example
1	2	Nox [NOCKSS]
2	9	Lumos [LOO-mos]
3	42	Bombarda [bom-BAR-dah]
4	55	Obliviate [oh-BLI-vee-ate]
5	23	Mobiliarbus [mo-bil-lee-AR-bus]
6	19	Avada Kedavra [ah-VAH-dah keh-DAV-rah]
7	14	Protego Diabolica [pro-TAY-goh dia-BOHL-i-cu]
8	5	Wingardium Leviosa [win-GAR-dee-um lev-ee-OH-sa]
9	1	Harmonia Nextere Passus [har-MOH-nee-a NECK-teh-ray PASS-us]
10	0	—
11	0	—
12	0	—
13	0	—
14	1	Amato Animo Animato Animagus
ALL	171	[ah-MAH-toh ah-NEE-moh ah-nee-MAH-toh an-a-MAY-jus]

Table 3: Number of voiced obstruents in spells (*N* = 171)

No. of voiced obstruents	*N*	Example
0	63	Nox [NOCKSS]
1	76	Amato Animo Animato Animagus [ah-MAH-toh ah-NEE-moh ah-nee-MAH-toh an-a-MAY-jus]
2	27	Obliviate [oh-BLI-vee-ate]
3	4	Bombarda [bom-BAR-dah]
4	1	Avada Kedavra
ALL	171	[ah-VAH-dah keh-DAV-rah]

(*Harry Potter Wiki*[2]; see also the fourth volume of the series [Rowling 2000], where the curse appears for the first time). Since this curse is one of the most powerful and sinister spells (*Harry Potter Wiki*[2]), it is likely that voiced obstruents and stressed low vowels convey powerful and sinister imagery in English. However, such a conclusion cannot be supported with this observation because the *Harry Potter* series was created by a single author, J. K. Rowling. Unless experimental exploration is attempted, it cannot be ascertained that voiced obstruents and stressed low vowels are sound-symbolically mapped onto the imagery of powerful and sinister spells across native speakers of English.

Additionally, it should be examined through experiments whether the sound-symbolic effect of prosodic units via syllable length is present in English. As aforementioned in Section 1.2, the effect of mora counts was not observed in the Pokémonastics experiment for English speakers (Kawahara and Moore 2021). However, the iconicity of quantity is quite possibly shared by language speakers, as some aspects of

Table 4: Frequency of vowels

IPA symbols	Lexical sets	N	Rates
/ɪ/	KIT	26	0.1102
/ɛ/	DRESS	45	0.1907
/ɔ/	LOT	5	0.0212
/a/	TRAP	16	0.0678
/ɵ/	FOOT	—	0
/ʌ/	STRUT	16	0.0678
/ɪː/	NEAR	1	0.0042
/ɛː/	SQUARE	2	0.0085
/oː/	THOUGHT	17	0.072
/ɑː/	PALM	35	0.1483
/ɵː/	CURE	1	0.0042
/əː/	NURSE	9	0.0381
/ɪj/	FLEECE	11	0.0466
/ɛj/	FACE	13	0.0551
/oj/	CHOICE	—	0
/ɑj/	PRICE	—	0
/aw/	MOUTH	—	0
/ʉw/	GOOSE	18	0.0763
/əw/	GOAT	20	0.0847
Others	—	1	0.0042
ALL		236	—

sound symbolism are ubiquitous across languages (for a related discussion, see Akita 2015; Godoy et al. 2021; Imai et al. 2008; Kawahara 2020a; Nuckolls 1999; Shih et al. 2019). The next section presents an experiment with nonce words that tested whether each of the three factors – syllable lengths, voiced obstruents and low vowels – is associated with the imagery of powerful spells in English.

3 Experiment

3.1 Task and stimuli

The experiment presented herein tested the following hypotheses.

(3) Hypotheses tested in the current experiment:
 a. Longer names in terms of syllables evoke the imagery of powerful spells.
 b. Names that contain voiced obstruents evoke the imagery of powerful spells.
 c. Names that contain stressed low vowels evoke the imagery of powerful spells.

The current study adopted a two-alternative forced choice (2AFC) task in which the participants were presented with pairs of written nonce words and were required to choose which was appropriate for a more powerful spell. There were three conditions in total, each of which consisted of four to six pairs of nonce words.[7]

7 The current study prepared six pairs of nonce words in each condition at first, but an anonymous reviewer pointed out that some of the nonce words were (phonetically) similar to existing words. Thus, the current study performed a re-analysis excluding those pairs.

Table 5: Spells that contain stressed low vowels

No.	Names	Pronunciation	Stressed TRAP	Stressed PALM
1	Aguamenti	AH-gwah-MEN-tee		1
2	Alarte Ascendare	a-LAR-tay a-SEN-der-ay		1
3	Amato Animo Animato Animagus	ah-MAH-toh ah-NEE-moh ah-nee-MAH-toh an-a-MAY-jus		2
4	Anapneo	ah-NAP-nee-oh	1	
5	Aparecium	AH-par-EE-see-um		1
6	Appare Vestigium	ah-PAR-ay ves-TEE-jee-um		1
7	Aqua Eructo	A-kwa ee-RUCK-toh	1	
8	Arania Exumai	ah-RAHN-ee-a EKS-su-may		1
9	Avada Kedavra	ah-VAH-dah keh-DAV-rah	1	1
10	Avifors	AH-vi-fors		1
11	Avis	AH-viss		1
12	Bombarda	bom-BAR-dah		1
13	Brackium Emendo	BRA-key-um ee-MEN-doh		1
14	Cantis	CAN-tiss	1	
15	Carpe Retractum	CAR-pay ruh-TRACK-tum	1	1
16	Cave inimicum	CAH-vay uh-NIM-i-kuhm		1
17	Colovaria	co-loh-VA-riah	1	
18	Everte Statum	ee-VER-tay STAH-tum		1
19	Expelliarmus	ex-PELL-ee-ARE-muss		1
20	Fianto Duri	fee-AN-toh DOO-ree	1	
21	Finite Incantatem	fi-NEE-tay in-can-TAH-tem		1
22	Flagrate	flah-GRAH-tay		1
23	Harmonia Nextere Passus	har-MOH-nee-a NECK-teh-ray PASS-us		1
24	Inanimatus Conjurus	in-an-ih-MAH-tus CON-jur-us		1
25	Incarcerous	in-KAR-ser-us		1
26	Lacarnum Inflamari	la-KAR-num in-flah-MAR-ee		2
27	Langlock	LANG-lock	1	
28	Lapifors	LAP-ih-fors	1	
29	Meteolojinx Recanto	mee-tee-OH-loh-jinks reh-CAN-toh	1	
30	Mobiliarbus	mo-bil-lee-AR-bus		1
31	Molliare	mull-ee-AR-ay		1
32	Muffliato	muf-lee-AH-to		1
33	Partis Temporus	PAR-tis temp-OAR-us		1
34	Petrificus Totalus	pe-TRI-fi-cus to-TAH-lus		1
35	Prior Incantato	pri-OR in-can-TAH-toh		1
36	Protego Maxima	pro-TAY-goh MAX-ee-ma	1	
37	Protego totalum	pro-TAY-goh toh-TAH-lum		1
38	Redactum Skullus	reh-DAK-tum SKULL-us	1	
39	Reparifors	re-PAR-i-fors		1
40	Relashio	ruh-LASH-ee-oh	1	
41	Reparifarge	reh-PAR-i-farj		1
42	Reparo	reh-PAH-roh		1
43	Salvio Hexia	SAL-vee-oh HECKS-ee-ah	1	
44	Specialis Revelio	spe-see-AL-is reh-VEL-ee-oh	1	
45	Titillando	ti-tee-LAN-do	1	
46	Waddiwasi	wah-deh-WAH-see		1
47	Wingardium Leviosa	win-GAR-dee-um lev-ee-OH-sa		1
		ALL	16	35

The first condition ("Long Wds") tested whether longer names in terms of syllables evoke powerful imagery. As shown in Table 6, the experimental group consisted of nonce words with five or six syllables, while the control group consisted of words with three or four syllables. The stimuli ended with the letter *o*, as do some spells in the *Harry Potter* series, which is said to stem from the first person singular in Latin (e.g.

Table 6: Stimuli in the "Long Wds" condition

Pair no.	Experimental groups	Control groups
1	Aboroborio	Aboro
2	Eramoramio	Eramo
3	Ospitopitio	Ospito
4	Aferdiferdo	Aferdio
5	Elviolivo	Elvio
6	Odriodiro	Odrio

Table 7: Stimuli in the "Vcd Obs" condition

Pair no.	Experimental groups	Control groups
1	Derdirio	Tertirio
2	Vervento	Ferfento
3	Dondimus	Tontimus
4	Vinvaltus	Finfaltus

Accio "to summon"; *Protego* "to protect"; Nakamura 2016: p. 63). Each group consisted of three nonce words ending with *-o* and three nonce words ending with *-io*. Additionally, the stimuli began with the vowels *A*, *E* or *O*, which possibly eschewed the effects of initial consonants (see Kawahara et al. [2008] for initially positional effects in sound symbolism). The current experiment did not use nonce words beginning with the vowel *U* as there is no such spell in the *Harry Potter* series. Furthermore, the study did not use nonce words that begin with the vowel *I*, as many I-initial spells in the series begin with *Im-* or *In-*, which native speakers of English could associate with the negative prefix /in/. The untargeted consonant types of the stimuli within each pair remained the same.

The second condition ("Vcd Obs") examined whether names that contain voiced obstruents are more appropriate for powerful spells than those that contain no voiced obstruent. As shown in Table 7, each stimulus consisted of three or four syllables, and the number of syllables within each pair remained the same. The experimental group contained two voiced obstruents per stimulus, while the control group did not. The voiced obstruents comprised any of the plosives used in English, /d, v/, and they were replaced with their voiceless counterparts, /t, f/, in the control group. The current experiment avoided the contrasts /k/ vs /g/ and /s/ vs /z/ in the stimuli because orthographic stimuli allow participants to read letters in more than one way; for instance, the letter *c* reads as /k/ or /s/ in English (e.g. *chaos* vs *circle*), and the letter *s* in a word-medial position can be pronounced as [z], as in *scissors* (Kawahara, Godoy and Kumagai 2020). The current experiment also avoided using the contrasts /p/ vs /b/ because /b/ can show contrasting imagery (Uno et al. 2020): it may be used as a voiced obstruent to potentially evoke powerful imagery, and it may also be used as a bilabial consonant to potentially evoke cute imagery (Kumagai 2020).

The third condition ("Low Vowels") tested whether names that contained stressed low vowels were appropriate for powerful spells. Each stimulus consisted of three syllables. The targeted vowel was contained in the first syllable in each stimulus. The experimental group used the letters *ar* (assuming /ɑː/ in PALM) in that syllable, while the control group used the letters *ee* or *oo* (assuming /ɪj/ in FLLECE or /ʉw/ in GOOSE). The letters *dio*, which were never stressed in the real *Harry Potter* spells, were used in the second syllable, which allowed the participants to read words in which the first syllable is assigned stress. The stress positions of the nonce words used here were also checked by a native speaker of English before the experiment was conducted.

3.2 Procedure

The experiment was conducted online via SurveyMonkey.com. The URL was distributed in the UK between 14 and 15 January 2021. In the experiment, the participants were first shown a consent form and were then asked to verify that they were native speakers of English and that they had never studied sound symbolism before. The participants who met both of the conditions were presented with the following instructions: “There are loads of spells, including charms, curses, hexes and jinxes, in the *Harry Potter* series. In Experiment 1, you are presented with two new names per question. Your task is to choose which you feel is more powerful. There are 18 questions in total. Please answer all the questions.”[8] The current study did not provide participants with definitions of powerful imagery, which implies that each participant independently interpreted distinct images as powerful spells. As shown in Section 3.5, however, a significant tendency was (partly) found in each of the three sound-symbolic effects. Thus, the current experiment assumed that the participants conceptualised a particular image of a powerful spell.

The participants were presented with orthographic stimuli in alphabet form, as in Tables 6–8. Most sound-symbolic experiments using nonce words present auditory or written stimuli. With written forms, participants’ judgments can be more or less affected by letter shape features, such as curvature (e.g. Cuskley et al. 2015; Monaghan and Fletcher 2019; Westbury et al. 2018). However, the current experiment assumed that participants’ judgments were hardly affected by visual stimuli, as each condition of the stimuli comprised a different set of pairs.

After the participants completed the task, they were asked to share their gender, age and birthplace as well as how much of the *Harry Potter* series they had read/watched, about how many spells of the *Harry Potter* series they knew, and how many Unforgivable Curses of the *Harry Potter* series they could recall. The last three questions were asked to assess participants’ familiarity with the series, which will be explained in Section 3.3.

3.3 Participants

A total of 115 native speakers of English participated: 98 speakers were born in Britain, 2 in America, 3 in Australia, 2 in Canada and 10 in other countries. Of the participants, 73 speakers were female, and 42 were male. Concerning age, 61 speakers were between 18 and 29 years old, 32 speakers were between 30 and 39 years old, 15 speakers were between 40 and 49 years old, 3 speakers were between 50 and 59 years old and 4 speakers were over 60 years old. Participants who completed their given task received a monetary reward from SurveyMonkey.

The experimental studies on Pokémonastics (e.g. Kawahara et al. 2020; Kawahara and Moore 2021; Kumagai and Kawahara 2019) addressed whether the sound-symbolic effects observed in the study could be skewed by participants’ existing knowledge of *Pokémon* characters. The results showed that the participants’ familiarity with *Pokémon* made no difference in their judgments, which suggested that the sound-symbolic associations tested therein were present not only for *Pokémon* designers but also for general native speakers of Japanese. Following these studies, the current study offers not only an analysis of the overall participants but also an analysis that takes the participants’ knowledge of the *Harry Potter* series into consideration.

The current analysis extracted 36 participants who met two conditions: they had read/watched all seven volumes of the series, and that they knew two or three of the Unforgivable Curses. Another 36 participants were also extracted who reported that they had read/watched four or less books/movies of the *Harry Potter* series and who also stated that they never knew or knew at most one of the Unforgivable

8 The current experiment consisted of two blocks (Experiments 1 and 2), and only the first one targeted powerful imagery in spells. Thus, the second experiment is not reported here.

Table 8: Stimuli in the "Low Vowels" condition

Pair no.	Experimental groups	Control groups
1	Bardio	Beedio
2	Dardio	Deedio
3	Kardio	Koodio
4	Gardio	Goodio

Curses. The former group is dubbed "HP-familiar speakers" and the latter "HP-unfamiliar speakers" below. The current analysis did not use the answers to the question concerning how many spells of the series participants knew because most of the participants answered at most "10" or less. This does not mean that they knew little regarding the spells in the series but that they may have counted the spells they were able to "say."

3.4 Statistical analysis

The results of the experiment are presented herein. The current experiment used a 2AFC task to obtain a categorical response, but the slopes and intercepts of the model differed between the participants. Thus, the current analysis fitted generalised linear mixed-effects models, with the `glmer` function in the `lme4` package (Bates et al. 2015) for `R`, in which the response variable was whether targeted stimuli were chosen as an appropriate name for a powerful spell, and the participants and stimuli were random effects (Baayen et al. 2008). The current model included by-stimuli random intercepts, by-participant random intercepts and by-participant random slopes for the effect in each condition. The subsections below showed, for each condition, an estimate value of the slope as a logit coefficient (represented as b), standard error (SE), z-value and p-value. If the slope in a particular condition is positive and so is the z value, then it is likely that the stimuli in the condition will be judged appropriate for a powerful spell.

3.5 Results

The figures below indicate the rates at which the participants chose the nonce words of the experimental group as more appropriate names for powerful spells. The error bars represent the 95% confidence intervals based on the mean value of each condition. Figure 1 shows the results for all of the participants ($N = 115$). The rates of each condition were 0.5 in "Long Wds," 0.593 in "Vcd Obs" and 0.646 in "Low Vowels." Significant effects were confirmed in the second condition ($b = 1.958$; SE = 0.302; $z = 3.501$; $p < 0.001$) and in the third condition ($b = 1.206$; SE = 0.173; $z = 6.967$; $p < 0.001$) but not in the first condition ($b = -0.023$; SE = 0.356; $z = -0.083$; n.s.).

Figure 2 presents the rates in HP-familiar speakers. The rates for powerful imagery were 0.447 in the "Long Wds," 0.584 in the "Vcd Obs" and 0.644 in the "Low Vowels" conditions. There were significant responses in the second ($b = 0.673$; SE = 0.195; $z = 3.448$; $p < 0.001$) and third conditions ($b = 1.477$; SE = 0.444; $z = 3.328$; $p < 0.001$) but not in the first condition ($b = -0.62$; SE = 0.543; $z = -1.14$; n.s.). The results aligned with the overall results for the participants.

Figure 3, in turn, depicts the results from the HP-unfamiliar speakers. The rates were 0.606 in "Long Wds," 0.632 in "Vcd Obs" and 0.66 in "Low Vowels." A significant effect for powerful spells was detected not only in the second ($b = 1.422$; SE = 0.498; $z = 2.858$; $p < 0.01$) and third conditions ($b = 1.97$; SE = 0.744; $z = 2.647$; $p < 0.01$) but also in the first condition ($b = 1.379$; SE = 0.63; $z = 2.19$; $p < 0.05$). It is noteworthy that the significant effect in the first condition was detected in the HP-unfamiliar speakers, which differed from the HP-familiar speakers.

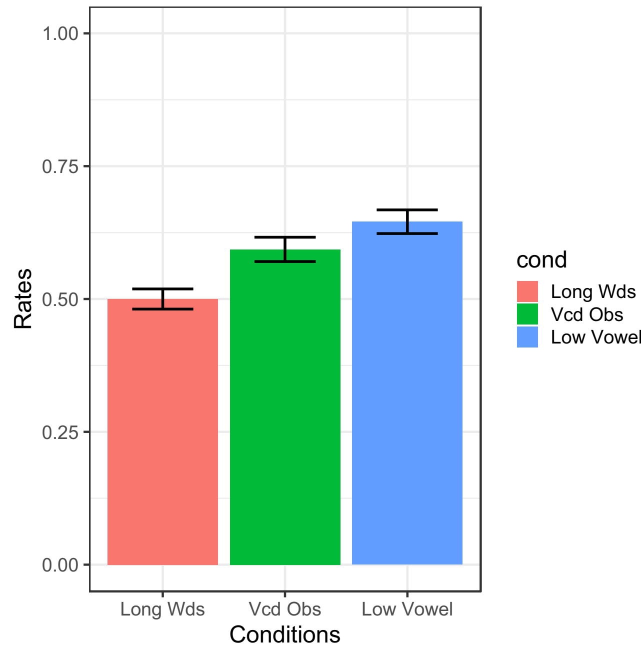

Figure 1: Rates at which the nonce words in the experimental groups were judged as powerful spells (all participants; $N = 115$).

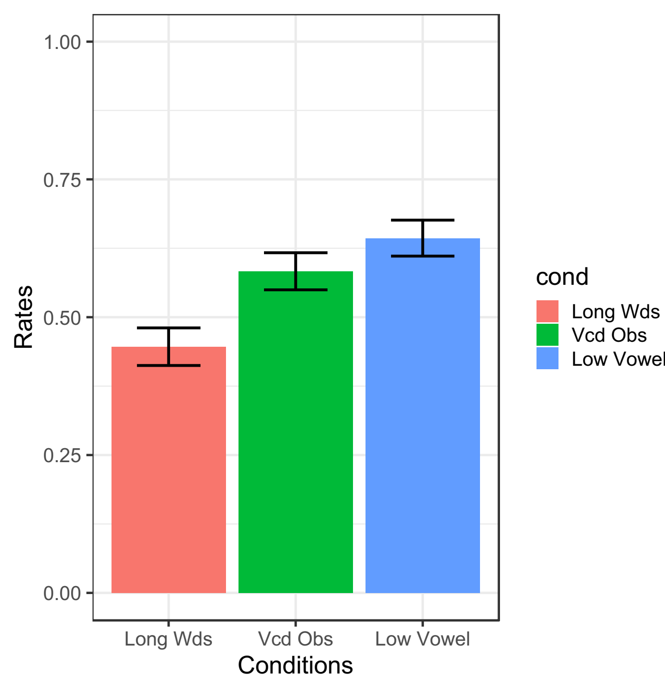

Figure 2: Rates at which the nonce words in the experimental groups were chosen as powerful spells by those familiar with the *Harry Potter* series ($n = 36$).

3.6 Discussion

The current experiment tested whether powerful imagery was conveyed by longer names (in syllable counts), voiced obstruents and stressed low vowels. The overall results showed that voiced obstruents evoked powerful imagery in spells. The effect of voiced obstruents on powerful spells aligns with the

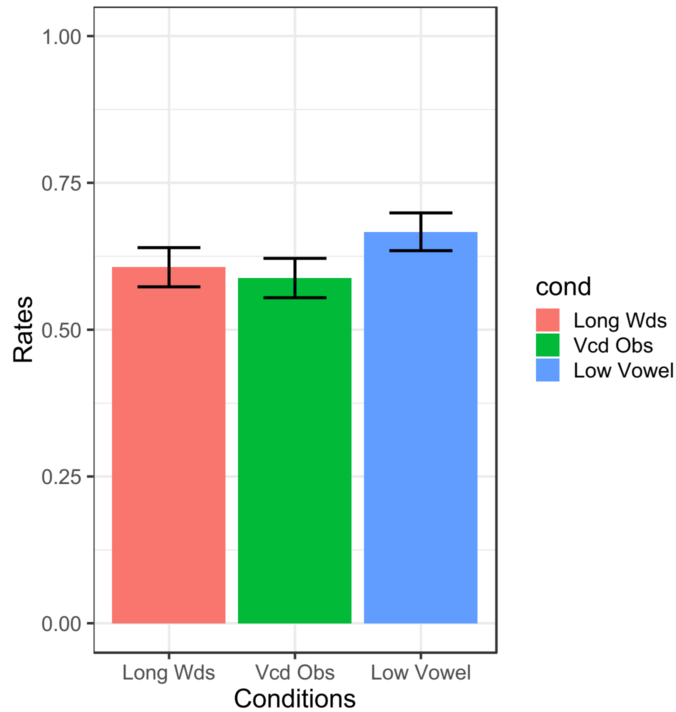

Figure 3: Rates at which the nonce words in the experimental groups were chosen as powerful spells by those unfamiliar with the *Harry Potter* series (n = 36).

previous studies on *Dragon Quest* (Kawahara 2017) and *Final Fantasy* (Kumagai et al. 2020) reviewed in Section 1.2, in which voiced obstruents were more likely to appear in strong spells. Additionally, the current results are consistent with the studies of English and Japanese *Pokémon* characters, which found that names containing voiced obstruents were deemed more appropriate for post-evolution, or stronger, *Pokémon* characters (Kawahara et al. 2018; Kawahara and Kumagai 2019; Kawahara and Moore 2021; Kumagai and Kawahara 2019; Shih et al. 2019).

The overall results also showed that stressed low vowels evoked powerful imagery. The current experiment examined not only the [a] vs [i] distinction but also the [a] vs [u] distinction in the third condition. Overall, the names containing a low vowel were more likely to be deemed powerful spells than those containing high vowels. This can be accounted for by the articulatory motivation, as the oral aperture of low vowels reflects the imagery of largeness (Sapir 1929), and by the interrelated semantic association between the imagery of largeness and the imagery of powerfulness (Kawahara and Kumagai 2021). However, Kawahara and Moore (2021) demonstrated in an experiment with English speakers that names containing [u] were deemed more appropriate for post-evolution *Pokémon* names than those containing [i], which can be explained not by the largeness of the oral aperture but by the frequency code hypothesis, in which sounds with low second formants (i.e. back vowels) are associated with the imagery of largeness (Ohala 1984, 1994/2006). Hence, it is necessary to conduct a follow-up experiment that examines whether the [i] vs [u] distinction is observed in powerful spells.

The current analyses showed similar and different results between HP-familiar and HP-unfamiliar speakers. Voiced obstruents and stressed low vowels evoked the imagery of powerful spells for both sets of speakers. However, differing results between the HP-familiar and HP-unfamiliar speakers arose because of the effect of syllable counts, which were positively correlated with the imagery of powerfulness for the HP-unfamiliar speakers. This suggests that there is a potential sound-symbolic association between prosodic length and the imagery of powerfulness, at least for general native English speakers, which may be evidence of the iconicity of quantity. The current results regarding the syllable count effect do not correspond with Kawahara and Moore (2021), who, as mentioned in Section 1.2, reported that English speakers did not show a syllable count effect in post-evolution *Pokémon* names. Since there is no way to know why such a different result arose, it may be necessary to conduct follow-up experiments.

The current results also showed that there was no effect of syllable counts amongst the HP-familiar speakers. The tendency may have potentially arisen from the influence of prior knowledge of the *Harry Potter* series on the judgment of the HP-familiar speakers. In the series, there are powerful but a relatively short spells in terms of syllable counts; for example, *Bombarda* [bom-BAR-dah], which is seen in the third volume of the series (Rowling 1999), is a charm that causes explosion (*Harry Potter Wiki*[9]). It contains as many as three voiced obstruents though it has only three syllables. Thus, longer spells may not always be associated with the imagery of powerfulness for HP-familiar speakers.

3.7 Remaining issues

The current experiment leaves a number of issues that should be addressed in future research. One of the tested hypotheses was that longer names in terms of syllable length evoked powerful imagery. As shown in Table 6, the current experiment compared longer names with shorter ones (e.g. *Aboroborio* vs *Aboro*). Since the sound-symbolic effects of other vowels and consonants were ruled out, identical vowels and consonants were used. As a result, some longer names contained parts of the shorter names; for example, *Aboroborio* contains *Aboro* in the first three syllables. However, such a pair may have made the participants think that they were reduplicated forms of the shorter names. Reduplication is known to appear in English baby-talk words (Ota et al. 2018). Some languages, like Chinese, use reduplication as diminutives as well (Shih et al. 2019). Thus, if reduplicated forms express smallness or diminutiveness in English, it is unlikely that they are associated with powerful imagery, which could have dampened the sound symbolic effect of syllable lengths. A follow-up experiment should use stimuli that do not include reduplicated forms.

The second hypothesis tested whether names with voiced obstruents evoke powerful imagery. As shown in Table 7, the stimuli in the experimental group contained two voiced obstruents, while those in the control group did not contain any voiced obstruents. A question that remains to be seen is whether powerful imagery is conveyed by only one voiced obstruent, or if it is strengthened by two and more voiced obstruents. This is reminiscent of recent Pokémonastic experiments that addressed whether voiced obstruents exhibit cumulative effects on sound symbolism. For example, a number of recent experiments demonstrated that Japanese speakers were more likely to assess names with two voiced obstruents as post-evolution *Pokémon* names than those with one voiced obstruent (Kawahara and Kumagai 2021; Kumagai and Kawahara 2019). On the other hand, there was no difference found between one voiced obstruent and two voiced obstruents in English speakers (Kawahara and Kumagai 2019). Since cumulativity is one of the featured topics in sound symbolic research (Kawahara 2020b, 2020c, forthcoming; Kawahara and Breiss 2021; Thompson and Estes 2011), it would be valuable to test whether the number of voiced obstruents can contribute to strengthening powerful imagery in spells.

The third hypothesis was that stressed low vowels evoke powerful imagery. As shown in Table 8, the current experiment used only the grapheme <ar> in the first syllable, like *Pardio*, in the experimental group, which led English speakers to assume that the vowel was pronounced like the PALM vowel. A follow-up experiment should test the hypothesis by including not only the PALM vowel but also the TRAP vowel in the low vowels. Furthermore, since these two vowels are different in mora counts (i.e. /a/ is counted as one mora and /ɑː/ as two morae), it is possible to examine the sound symbolic effects of mora counts, for example, by testing *Pamdio* /a/ vs *Parmdio*/ɑː/. Another issue in testing the effect of low vowels was that only high vowels were used as contrasting vowels in the control group. If low vowels potentially evoke powerful imagery, then it is predicted that names with low vowels are more likely to evoke powerful

9 This is found at https://harrypotter.fandom.com/wiki/Exploding_Charm (accessed 23 February 2021).

imagery than those with mid vowels, like the DRESS (/ɛ/) or THOUGHT (/oː/) vowels. Thus, a follow-up experiment that examines the low vs mid vowel distinction needs to be conducted.

In addition to the aforementioned stimuli issues, there was also a methodological issue regarding 2AFC tasks. Westbury et al. (2018) argued that such a task may distort the interpretation of experimental results (see also Lockwood and Dingemanse [2015] for a discussion). For example, in the case of Sapir's experiment (1929), in which participants were asked whether *mal* or *mil* was more appropriate for a big or small table, respectively, if many participants chose *mal* for the big table, then it could be concluded that the vowel [a] evokes a "big" image, but it cannot be concluded that the vowel [i] evokes a "small" image, and *vice versa*. In the current experiment, the English speakers might have chosen the stimuli of the experimental groups as powerful spells only because they judged the stimuli of the control groups to be weak spells. This issue can be resolved using a follow-up experiment in which participants are presented with a stimulus per question and are asked to judge whether it is a strong or weak spell or are asked to rate how strong each stimulus is.

4 Concluding remarks

The current study presents a sound-symbolic analysis of the spells in the *Harry Potter* series. The corpus study showed that the spell containing the most voiced obstruents and stressed low vowels is the Killing Curse, *Avada Kedavra*, which is famously known as one of the most powerful and sinister spells in the wizarding world. A subsequent experiment made it clear that voiced obstruents and stressed low vowels were sound-symbolically associated with the imagery of powerful spells. A further analysis revealed that the positive significant effect of syllable counts is present only in HP-unfamiliar speakers, which may indicate that the HP-unfamiliar speakers made a pure judgment via potential sound-symbolic associations (i.e. iconicity of quantity), as they possess little knowledge of the series. There is a famous line in *Romeo and Juliet* by William Shakespeare (1984): "What's in a name? That which we call a rose by any other name would smell as sweet," which implies that names do not impact the features they label. Contrary to this implication, the current study suggests that *Avada Kedavra* contains phonetic features that are perceived as appropriate for a powerful spell, in that the spell contains voiced obstruents and low vowels, which are associated with powerful imagery.

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Appendix

There are nine spells whose pronunciation patterns were revised:

Spells	Harry Potter Wiki	The current analysis
Informous	in-FOR-m-es	in-FOR-mes
Lapifors	LAP-ih-forz	LAP-ih-fors
Legilimens	Le-JIL-ih-mens	le-JIL-ih-mens
Lumos Maxima	LOO-mos Ma-cks-ima	LOO-mos MAX-ee-ma
Protego Diabolica	pro-TAY-goh dia-BOHL-i-cub	pro-TAY-goh dia-BOHL-i-cu
Protego Maxima	pro-TAY-goh MAX-ee-Ma	pro-TAY-goh MAX-ee-ma
Steleus	STEH-lee-us, or perhaps STEH-nee-us	STEH-lee-us
Tarantallegra	ta-RON-ta-LEG-gra	ta-RON-ta-LEG-ra
Verdimillious Duo	VERD-dee-MILL-lee-us	VERD-ee-MILL-lee-us DOO-oh