

A Universal Sound Symbolic Pattern: Prosodic Length being Positively Correlated to the meaning of 'Strength'

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1 Introduction

The debate between arbitrary and non-arbitrary nature of human languages is not new and dates back to Plato's *Cratylus* where Hermogenes and Cratylus take the opposite positions. Later, Locke (1956) argues explicitly and firmly in his *Essay Concerning Human Understanding* that 'conventional connection', instead of 'natural connection', should be understood as one of the fundamental properties of human languages. The reasoning is rather simple: If 'natural connection' is dominant, then languages should be largely similar due to the similarity of human cognition. And such a deduction is obviously against the evidence from both common senses of naïve speakers and serious linguistic studies. Such an opinion is later formalized and become the received view in modern linguistics. Along this line, many scholars hold an extreme view that the connections in human languages are solely determined by conventions and are absolutely arbitrary (Garrett, 1984; Hockett, 1960; Levelt, 1989; Levelt et al., 1999). We will call this theoretical stance 'Extreme View' for the rest of this paper. To quote from Hockett (1960):

'In a semantic communicative system the ties between meaningful message elements and their meanings can be arbitrary or nonarbitrary. In language the ties are **arbitrary**...' (Hockett, 1960; p. 90)

Other scholars, despite contending that Arbitrariness is dominant, take a relatively moderate view and recognize the existence of Non-Arbitrariness in the lexicon. To quote a statement from Saussure (1916/1983):

'The fundamental principle of the arbitrariness of the sign does not prevent our singling out in each language what is radically arbitrary, i.e. unmotivated, and what is **only relatively arbitrary**...' As cited in Saussure (1916/1983).

It is worth noting that under the framework of this theoretical view, an implicit assumption that it is always one way or the other has been made. In other words, Arbitrariness and Non-Arbitrariness can never enjoy the same status and only one of them can be recognized as a fundamental property of human languages. Since Arbitrariness takes the position, Non-Arbitrariness can never get in. Therefore, the stance held by Saussure is not fundamentally different from the 'Extreme View'.

In recent decades, however, converging evidence from both studies using natural languages corpus and studies employing behavioral experiments shows that Non-Arbitrariness may be more pervasive and more important than people used to think. In other words, Non-Arbitrariness may also enjoy the status of being one of the fundamental properties of human languages, just as Arbitrariness. We will call this theoretical stance 'Hybrid View' for the rest of this paper.

It is worth noting that non-arbitrary relation with meanings has been found in different levels of linguistic system, especially phonology and syntax (for iconicity in syntax, see Haiman, 1985; Givón, 1985 for review). The focus of the current paper is on the relationship between Prosodic Length at the phonological level and Linguistic Meaning of 'Strength' at the semantic level. For the rest of this paper, following Perniss et al. (2010), we use 'Iconicity' as a cover term to refer to any non-arbitrary resemblance between form and meaning, which means 'Iconicity' can be used to describe patterns at all levels of linguistics. And we the term 'Sound Symbolism' to refer to any non-arbitrary, natural connection between phonology and semantics.

The article is organized as follows: Section 2 will review previous evidence that supports 'Sound Symbolism'; In Section 3, we will propose a universal sound symbolic pattern, namely the positive correlation between Prosodic Length and the Meaning of 'Strength', and we will present 2 corpus studies on Mainstream American English and Standard Japanese; Section 4 will be a brief conclusion.

2 Previous evidence

2.1 Evidence from natural languages The first type of evidence comes from natural languages, and the most discussed examples are probably onomatopoeia words. It is possible to guess the meanings of words like 'hiss' or 'boom' without any knowledge of English languages, which shows Sound Symbolism as part of universal language knowledge. However, due to the relatively small number of such cases, onomatopoeia words may not be enough to be used to make any meaningful arguments about the general and fundamental properties of human languages. In other words, this kind of evidence is not sufficient to convince the field to shift from 'Extreme View' to 'Hybrid View'. Again to take English as an example, according to Wikipedia (2025a), there are about 120 onomatopoeia words in English. Despite arguably being large in absolute numbers, these words are rare considering the whole lexicon of English containing more than 170,000 words (Oxford English Dictionary, 2024). Besides hearing system, words have been discovered to imitate experiences in other sensory modalities, including those in tactile, visual and olfactory systems. Following Perniss et al. (2010), I use the term 'Sound Symbolic Words' to refer to any words that involve a non-arbitrary cross-modal mappings between sounds and meanings, and some meanings are rooted in the sensory systems of human beings. Even when all Sound Symbolic Words are taken into consideration, This Small Inventory situation of Sound symbolic Words still extends for most Indo-European languages including English (Perniss et al. 2010). Previous studies tried to address this issue by citing languages where there are claimed even larger inventories of such words. These languages include Sub-Saharan African languages (Childs, 1994), some of the Australian Aboriginal languages (Alpher, 2001; McGregor, 2001; Schultze-Berndt, 2001), Japanese, Koren, Southeast Asian languages (Diffloth, 1972; Watson, 2001), Indigenous Languages of South America (Nuckolls 1996), and Balto-Finnic languages (Mikone, 2001). However, considering the percentage, the issue of Small Inventory still exists. To take Japanese as an example, Sound Symbolic Word list includes more than 1700 entries (Atoda & Hoshino, 1995), which is arguably huge. However, if Shinmeikai Kokugo Dictionary 8th Version (Yamada et al., 2020), which is the most popular dictionary in Japan and contains more than 79,000 words, is taken as the reference, Sound Symbolic Words only account for a small number of the whole lexicon (about $1700/79000 \approx 2.15\%$).

The concern of Small Inventory in natural languages can largely be dissolved by more recent corpus studies that take a representative subset of lexicon as the research subject. For instance, Monaghan et al (2014) investigated all the monosyllabic words in CELEX database (Baayen et al., 1995) and found systematic correlation between sound and meaning. Since monosyllabic words constitute 70.9% of all word uses in English, they argued that results from the subset is a reasonable approximation of the whole lexicon. For each pair of words, 3 measures are employed for sound similarity. The first measure operates on the phonological feature level, and is determined by the minimum number of phonological feature changes required to convert one word to another. The second measure operates on the phoneme level, and is determined by the minimum number of phoneme changes required to convert one word to another (Damerau-Levenshtein distance). The third measure also operates on the phonological feature level, and is determined by the Euclidean distance between phonological feature representations of words. For each pair of words, 2 measures are employed for meaning similarity. The first measure is based on the assumption that 'words with similar meanings tend to have similar usage', and the meaning similarity is approximated by contextual cooccurrence vectors. To be more specific, 446 contexts words are selected from British National Corpus (Burnard, 1995), and the co-occurrence vectors is calculated by simply counting the number of these words in a +/- 3-word window, The second measure is based on semantic features from WordNet (Miller et al. 1990). By using multiple measures for sound and multiple measures for meaning, potential biases caused by certain combination of sound measure and meaning measure can become obvious. Results from all 6 pairs of measure combination show above chance systematicity between sound and meaning (for all 6 pairs: $p < 0.01$), which further confirms that the correlation between sound and meaning is real in English.

One big concern with this experimental method is that the assumption of independence may be violated when conducting statistical analyses, namely words with the same origin are inherently connected and result

in the attested systematicity. To address this concern, Monaghan et al. (2014) also analyzed words with no common etymology and words with no derivational or inflectional morphology, the results still support above-chance systematicity (for these 2 conditions, 12 pairs are analyzed; for all 12 pairs: $p < 0.01$). Another concern with this methodology is that monosyllabic words may not be representative enough. It is worth noting that Monaghan et al. argued that the ability to represent the whole lexicon can be evaluated based on word uses. While such an argument makes sense, there is no guarantee that results from monosyllabic words can approximate the results from the whole lexicon in a good fashion. Independent evidence from other sources are needed to support the effectiveness of such a research method. We believe that the optimal way is always to perform this experimental method on the whole lexicon. Otherwise, concrete proof is needed to support the focused subset being a good proxy. To partially address the concern, Monaghan et al. performed the same analyses on all monomorphemic words of all lengths and showed above-chance systematicity for sound measure of phoneme feature ($p = 0.01$) and sound measure of Euclidean distance ($p = 0.02$). Overall, Monaghan et al. took a step forward but the issue that the subset of lexicon being not representative is still prominent.

With a similar research method, Tamaritz made use of a corpus of orthographically transcribed Spanish spontaneous speech (Marcos Marín, 1992), and investigated words with phonological forms of *cvcv*, *cvccv* and *cvcvcv*. These are the 3 most common *cv* phonological structures in Spanish. Different from Monaghan et al. (2014), only one measure of sound similarity (based on similarity judgment of native speakers of Spanish) and one measure of meaning similarity (based on co-occurrence vectors) are used, and results shows significance for all 3 *cv* phonological structures (*cvcv*: $p < 0.05$; *cvccv*: $p < 0.01$; *cvcvcv*: $p < 0.01$). Since only a subset of the lexicon is selected, Tamaritz's study suffers the same problem of being not representative enough.

Another issue with research on natural languages is the lack of universality, namely sound symbolic patterns found in one language usually cannot be applied to another language. To give a simple example, the sound made by a cat is often represented by 'meow' /,mi'əʊ/ in English, but by 'nyā' /nia/ in Japanese and by 'yaong' /ja.joŋ/ in Korean. In another example provided by Perniss et al. (Perniss et al. 2010), The sound of a rooster is represented by 'cock-a-doodle-doo' /kɑ:k.ə.du:.dəl'du:/ in English, but by 'kirikiri' /kikəri'ki:/ in German, and by 'cocorico' /kəkōriko/ in French. If Sound Symbolism is indeed a fundamental property of human language, we should at least expect some universal sound symbolic patterns in natural languages. One may argue that such differences are due to influence from multiple mechanisms. For example, some native speakers of Japanese report that 'nyā' /nia/ imitates both the sound and the movement of a cat, therefore it is not surprising for it to be different from its counterpart in English and Korean. Another possibility may be that pervasive cat species are different in different areas of the world and they make different sounds due to physiological structures. However, if Sound Symbolism is truly a fundamental property of human languages, again, the expectation is that we should find at least some independently invented common Sound Symbolic patterns across different language families, however, there are no such cases reported as far as we know. One reason may be that it is often very difficult to apply large-scale systematicity in one language to another language from a different language family. For example, in English, female names usually end in a vowel and have non-initial stress while male names usually end in a consonant and have primary initial stress. Also, female names tend to be longer than male names. These generalizations usually cannot be applied to other languages.

2.2 Evidence from behavioral experiments The second and more recent type of evidence for Sound Symbolism comes from behavioral experiments, which generally involve match meanings with unknown words (nonce or foreign words). The most popular example is probably so-called Bouba/Kiki effect. In a forced-choice task, the participants are presented with 2 sound stimuli, namely /bouba/ and /kiki/; and 2 meaning stimuli, which are represented by a round-shape picture and a jagged-shape picture. The majority of the participants match /bouba/ with round shape and /kiki/ with jagged shape. Such an effect has been widely found in multiple Indo-European languages including English, Russian, Finnish, Danish, Polish, Greek, Italian, Swedish. And it also extends to other language families including Japonic (Japanese), Koreanic (Korean), Tai-Kadai (Thai), Kartvelian (Georgian), Niger-Congo (Zulu and Himba), Uralic (Estonian, Finnish and Hungarian) and Herero (Bantu) (Bremner, et al., 2013; Ćwiek et al., 2021).

Besides the meanings related to shape (other studies include Ćwiek et al., 2024; Knoeferle et al., 2017; Maurer et al., 2006; Sindu & Pexman, 2015), previous behavioral experiments have also shown Sound

Symbolism effects with meanings related to other themes in visual system, which include lightness (Akita et al., 2024; Hirata et al., 2011), object size (Akita et al., 2024; Knoeferle et al., 2017; Sapir, 1929; Shinohara & Kawahara, 2010; Thompson & Estes, 2011; Thompson, 2013), object motion (Cuskley, 2013; Imai, et al., 2008; Iwasaki et al., 2007; Saji et al., 2019; Thompson, 2013), color (Moos et al., 2014) and the conceptual precision in how speakers describe what they see (Maglio et al., 2014). Similar experimental methods have also been extended to explore meanings related to other sensory modalities including Gustatory System (taste) (Maglio et al., 2014; Simner et al., 2010), Tactile system (touch) (Akita et al., 2024; Ćwiek et al., 2024; Maglio et al. 2014) as well as meanings related to human emotions (Gobl & Chasaide, 2003; Goodwin & Goodwin, 2000; Jespersen, 1922; Körner & Rummer, 2023; Majid, 2012; Wilce, 2009).

With unknown words (nonce or foreign words) being involved, same experimental paradigm can be applied to native speakers of genetically remote languages. As a result, this approach inherently has the advantage of solving the issue of lack of universality (e.g. Ćwiek et al., 2021; Körner & Rummer, 2023; Sapir, 1929; Shinohara & Kawahara, 2010).

Also, some previous studies target the phonological side at the phonological feature/phoneme level. For example, Shinohara and Kawahara (2010) tested whether the 2 vowel features of [\pm back] and [\pm high] are correlated with the meaning of size. The results confirm these connections in Chinese, English, Japanese and Korean. Since these features apply to all the vowels, and deductively all the words that contain vowels in these languages, Sound symbolism is testified in a large portion of the whole lexicon, dissolving the concern of Small Inventory.

Despite the advantages, this type of evidence from behavioral experiments shares the same issues with research using similar experimental methods in other subfields of psychology. The most notable one may be the issue of 'Low Ecological Validity' (Chaytor et al., 2003; Orne, 1962; Schmuckler, 2001; among others). Since these experiments involve artificial settings that are different from the real world, the responses from the participants may be affected in unexpected directions. In this particular case, the employment of unknown words is particularly concerning due to the possibility that they may fail to mimic real word stimuli (Bentley & Varon, 1933; Ćwiek et al., 2021; Nielsen & Rendall, 2012; Winter, 2019).

Also, it is hard to rule out the influence from 'Demand Characteristics' (Nicols & Maner, 2008; Orne, 2009; among others) where participants might guess the purpose of the experiment and behave accordingly (consciously or unconsciously). Such a concern becomes especially disturbing in Sound Symbolism research since the behavioral experimental design is usually rather simple and also off-line. As commented by Perniss et al. (2010), judgements from these off-line studies is indirect and may be affected by metacognitive strategies.

These concerns may be partially addressed by on-line studies where more complex experimental designs are involved. The speakers are expected to be distracted and the real purpose of the experiment may be hidden. For example, Bergen (2004) used lexical priming method to testify the existence of Sound Symbolic effect in Phonaesthemes (Firth, 1930), which is defined as sound-meaning pairings that are usually not analyzed as morphemes. The focus is /gl/ onset sequence, which has long been noticed to be associated with the meanings of 'light' and 'vision', examples include 'glimmer', 'glisten', 'glitter', 'gleam' and 'glow' (Wallis, 1699; Bloomfield, 1933). Bergen shows that if both prime and target start with /gl/ sequence, speakers are quicker in judging whether the target is a real word or not when the prime word is presented. However, the result becomes suspicious when the same effect are shown in the baseline condition, i.e. when the prime and target are unrelated in both form and meaning. Moreover, when target and prime share an onset or a semantic feature, speakers are even slower in wordhood judgement, which is contrary to the predicted direction.

Overall, although behavioral experiments provide some evidence, the evidence is still far from being conclusive due to the problems we have raised in the previous few paragraphs. Therefore, this kind of evidence alone is not enough to convince the believers of 'Extreme View' to shift to 'Hybrid View'.

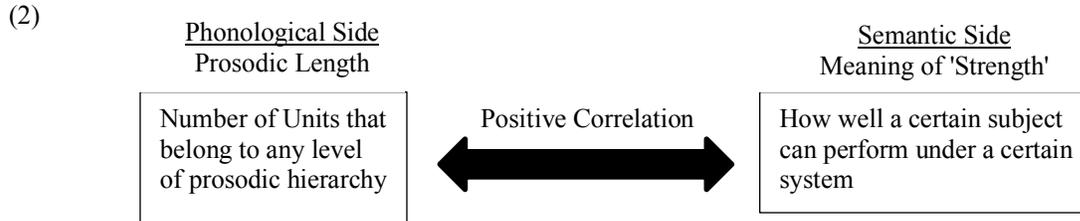
2.3 *Desiderata* To avoid the issues in previous studies and to fully support the idea that both Arbitrariness and Non-Arbitrariness are fundamental properties of human languages (i.e. 'Hybrid View'), the proposed theory should meet the following two requirements.

- (1) a. The main evidence should come from natural languages. And the corpus should be large and also be representative enough to serve as a proxy for the whole lexicon.

- b. The proposed Sound Symbolic pattern should be universal.

3 The Current Proposal and Previous Evidence from Large-Scale Corpus Studies

For this paper, we propose a universal Sound Symbolic effect: Prosodic Length is positively correlated with the Meaning of 'Strength'. Kawahara et al. (2018) used the term 'Longer-is-Stronger' principle to refer to this effect, which will be inherited in this paper. Prosodic Length is defined as the number of units that belong to any level of prosodic hierarchy (Hayes, 1989; Nespor & Vogel, 1986; Selkirk, 1996). Meaning of 'Strength' is defined as how well a certain subject can perform under a certain system. The proposal is also illustrated in (2).



Based on previous and current evidence from large-scale corpus studies on both Mainstream American English and Standard Japanese, we assert that, without interfering factors, a stronger object tends to be endowed with a longer names in any languages. We will review the previous evidence from both Mainstream American English and also present a new piece of evidence on Standard Japan in this section.

3.1 Previous Evidence from Mainstream American English To explore Sound Symbolic patterns in Mainstream American English, Shih and Rudin (2020) conducted a unique study on names of players in Major League Baseball (MLB, one of the professional baseball leagues in the United States and Canada). They found that 'Number of Segments of Registered First Names' (Indicator of Prosodic Length) are positively correlated with 'Player Weight' (Indicator of Strength of Players). In total, 324 baseball nicknames and 2557 registered names are taken into consideration, which accounts for a large corpus. Since baseball players are indisputably the core of the sports of baseball, the corpus are a good proxy of the whole lexicon in the world of American professional baseball. Overall, the 2 desiderata stated in Section 2.3 are met.

Considering that players who do not have enough appearances may not be an integrated part of the league, only names of all hitters with more than 450 plate appearances from 1920 to 2017 are considered to prevent potential interfering nonlinguistic factors. Three types of names are investigated, namely the First Names Given at Birth, Registered First Names that the players chose, and Baseball Nicknames. For the purpose of probing linguistic knowledge, only Registered First Names and Baseball Nicknames are of interest since they have the potential to be chosen based on meaning (in this case, attributes of the players) and therefore may reflect the effect of Sound Symbolism.

Among the players attributes examined in Shih and Rudin (2020), we believe 'Player Weight' is a good approximation for the Meaning of 'Strength'. It is an intuitive feeling that heavier people tend to be more powerful, which is also generally true in many professional sports. For example, combat sports like wrestling and boxing divide weight classes to prevent advantages gained from weight.

The prosodic length is represented by Number of Segments in this study. However, Number of Feet, instead of Number of Segments, may be the best choice. Based on differences in basic units in rhythm, spoken languages are generally considered to belong to 3 categories, namely stress-timed, syllable-timed, and mora-timed languages (Abercrombie, 1967; Port et al., 1987). Since Mainstream American English is usually considered as a stress-timed language (Abercrombie, 1967; Lloyd James, 1940; Pike, 1945), foot is the basic rhythmic unit that determines segmentation. Therefore Number of Feet may be optimal to be tested with the indicator of strength (Weight of Player). Despite this issue, Evidence involving the Number of Segments can still provide support for the 'Longer-is-Stronger' principle due to the fact that segment is at least still part of prosodic hierarchy (Hayes, 1989; Nespor & Vogel, 1986; Selkirk, 1996).

As predicted by 'Longer-is-Stronger' principle, the result shows that Number of Segments in Registered Names (Prosodic Length) does have a positive correlation with Weight of the Player ($\rho = 0.094$; $p < 0.01$). The

data with linear regression line are summarized in Figure 1.

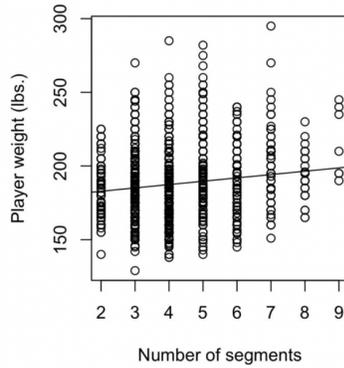


Figure 1: ‘Player Weight (in pounds)’ by ‘Number of Segments in Registered Names’

It is worth noting that Longer-is-Stronger Principle also predicts Number of Segments of Baseball Nicknames to be positively correlated with Player Weight. However, no statistical significance is found in this pair. One possible reason may be the small sample size. There are only 324 baseball nicknames analyzed. In contrast, 2557 registered names are taken into consideration.

Since the research targets are names of professional baseball players, it is reasonable to contemplate that baseball-specific statistics may be a better approximation of the meaning of ‘strength’. There are 4 such measures considered in Shih and Rudin (2020). The first one is ‘Slugging Percentage’, which is calculated by total bases divided by at-bats. Since the ultimate goal is to score by running around the bases, ‘Slugging Percentage’ serves as a good measure of how productive and how effective a hitter is at the plate. The second one is ‘Batting Average’, which is simply calculated by dividing the number of hits by the number of at-bats and therefore is a straightforward measure of how well a player can hit. The third one is ‘Batting Average on Balls in Play (BABIP)’. Compared with ‘Batting Average’, ‘Batting Average on Balls in Play (BABIP)’ excludes home runs and strikeouts and can tell if a hitter is lucky or not. The last one is ‘On-Base Percentage Plus Slugging (OPS)’, which is a combination of ‘Slugging Percentage’ and ‘On-Base Percentage’. It indicates how well a player can reach base and hit for power. Among these 4 criteria, ‘Slugging Percentage’ and ‘On-Base Percentage Plus Slugging (OPS)’ are considered as better stats to evaluate the hitters. If our proposal is valid, it would predict that both ‘Number of Segments in Registered Names’ and ‘Number of Segments in Baseball Nicknames’ should have positive correlations with the 4 criteria. However, significance is only found between ‘Number of Segments in Registered Names’ and ‘Batting Average on Balls in Play (BABIP)’ ($\rho=0.089$; $p<0.01$). The data with the linear regression line is summarized in Figure 2.

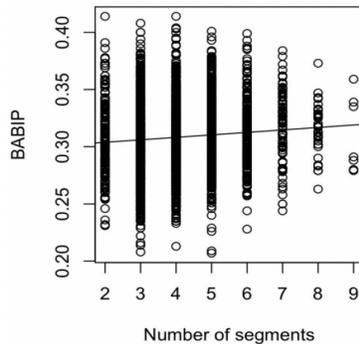


Figure 2: ‘Player Batting Average on Balls in Play (BABIP)’ by ‘Number of Segments in Registered Names’

We believe the reason is as follows: Major League Baseball players usually register their names before they play in the league, and it is not common for players to change their registered names. It is of course difficult to predict players' performances before they enter the league, therefore it turns out that many

registered names and nicknames do not match the performances of corresponding players. In contrast, the weight data are available when players finalize their registered names and sign the contracts. The fact that no Sound Symbolic patterns being found in baseball nicknames can be blamed on the small sample size.

Overall, despite predictions not being attested in many situations, the large corpus study based on baseball player names at least provided some evidence for our proposed Universal Sound Symbolic patterns.

3.2 Current Evidence from Yu-Gi-Oh 5D's Yu-Gi-Oh is a Japanese media franchise. Its products include manga (Japanese comics), animated series, trading cards and video games. The original manga named Yu-Gi-Oh! was written and illustrated by Kazuki Takahashi. Fictional monster characters in Yu-Gi-Oh can be used to battle by human beings based on a duel system (Konami Yu-Gi-Oh Website, 2025). Since the whole creating process of Yu-Gi-Oh products is traceable, the direction and degree of interference from non-linguistic performance factors may be identified. Through direct interviews with the creators, identified performance factors may be attested and previously unidentified performance factors may be found. As one of the highest-grossing media franchise of all time, the popularity of Yu-Gi-Oh can provide some support for monster names conforming to people's linguistic knowledge (Wikipedia, 2025b). As of 2025, Yu-Gi-Oh has developed to include more than 10 anime works, each work is relatively independent with an unique story and monster characters. We chose Yu-Gi-Oh 5D's as the research topic since it is the most popular anime among the whole anime series.

Each Yu-Gi-Oh character is assigned with several parameters, which include 'Type', 'Race', 'Attack', 'Defense' and 'Special Effect'. An overall judgement is given to each monster character in terms of level based on how strong the monster is in the duel. The level then serves as a reliable indicator of the Meaning of 'Strength'. Conveniently, levels are represented in numeric values (integers) that can be easily employed in quantitative analysis.

It is worth noting that not all monster characters in Yu-Gi-Oh 5D's has the same status. Those main monster characters owned by the protagonists enjoy more spotlight and get many more chances of appearance than other normal monster characters. It is reasonable to believe that the creators put more efforts in designing these main monster characters than normal monster characters. As a result, the names of main monster characters have a high possibility of conforming to linguistic knowledge. To accommodate to this situation. We count each appearance of a monster character as one token, and the total number of tokens that are included in the analysis is 1813, which forms as a relatively large corpus. Again, due to the fact that Yu-Gi-Oh 5D's monster characters are undoubtedly at the central position of the Yu-Gi-Oh 5D's world, the corpus are a good proxy of the whole lexicon in this small universe. As a result, the 2 desiderata stated in Section 2.3 are met.

The prosodic length in Japanese is represented by the number of morae. The subsyllabic mora has been widely argued to be the basic rhythmic unit in Japanese (Itô, 1989; Kawahara, 2016; Kawahara et al., 2020; Kubozono, 1990; Labrone, 2012; Vance, 1987). A typical mora in Japanese can be a short vowel or a consonant plus a short vowel (CV). As shown in the first example in Table 1, the city or prefecture name of Fukuoka is composed of 4 morae. Following the tradition in Kubozono (2017), we use hyphen /-/ for mora boundary and dot ./ for syllable boundary. Other types of mora include (a) a moraic nasal that appears in the coda position of a syllable, so the second and third examples in Table 1 contain 4 morae; (b) The second part of a diphthong or a long vowel. As a result, a long vowel or a vowel sequence (diphthong) are considered as two morae as shown in the third and forth example in Table 1. (c) The first part of a geminate, so the last example in Table 1 consists of 4 morae.

Ordinal	IPA	Meaning in Japanese	Number of Morae
1	/hu-ku-o-ka/	The Prefecture of Fukuoka/ The City of Fukuoka	4 morae
2	/si-n-ba-si/	Place name in Tokyo	4 morae
3	/se-n-da-i/	The City of Sendai	4 morae
4	/o-o-i-ta/	The Prefecture of Ōita/ The City of Ōita	4 morae
5	/to-t-to-ri/	The Prefecture of Tottori/ The City of Tottori	4 morae

Table 1: Mora Count Examples in Japanese

For statistical analysis, we employed Non-Parametric Spearman Correlation Analyses. The 'Longer-is-Stronger' principle is attested ($\rho = 0.39$, $p < 0.01$). Figure 3 illustrates the effect of Prosodic Length (Number of Morae) on 'Strength' ('Level') with the linear regression line.

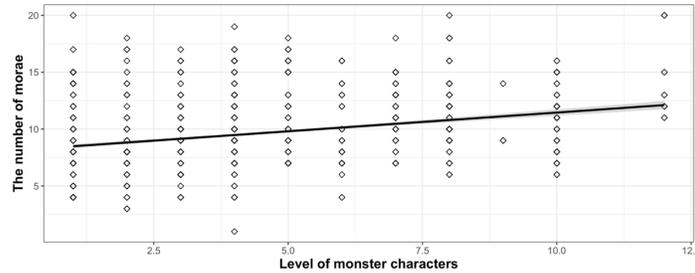


Figure 3: The distribution of 'The number of morae' over 'Level' with linear regression line

Despite a few exceptions, there is almost no evolution systems in Yu-Gi-Oh 5D's. Therefore, monster characters at different levels almost do not share the same origin. As a result, the assumption of independence can be argued to be fulfilled for statistical analysis. It is worth noting that many monster characters are still related to each other in other ways. For example, some monster characters share the same owners, some monster characters share the same race, etc. However, anyone who use these connections to question the assumption of independence has the responsibility to clarify the mechanism of how these connections can affect the naming of monster characters. As far as we can see, the inference from these relations on naming is rather vague.

The monster character names of Yu-Gi-Oh 5D's are not created once by the same group of people. The first episode of Yu-Gi-Oh 5D's was first on air on April 2, 2008 and the last episode was first on air on March 30, 2011. The 3-year time span and the change of main artists (including Screenwriter, Storyboard Artist, Episode Director, Animation Director) may cause inconsistency inside this anime. At the worst situation, the attested overall effect of 'Longer-is-Stronger' may come from certain part of the anime. This anime work is divided into 5 chapters. Chapter 1 is from Episode 1 to Episode 26; Chapter 2 is from Episode 27 to Episode 64; Chapter 3 is from Episode 65 to Episode 136; Chapter 4 is from Episode 137 to Episode 151; Chapter 5 is from Episode 152 to Episode 154. We make the assumption that the assignment of level is relatively consistent inside one single chapter. To address the inconsistency concern and to further support the 'Longer-is-Stronger' principle by showing that this effect is widespread in corpora, we conducted Non-Parametric Spearman Correlation Analyses for all 5 chapters. The results show that the correlations are all positive and significant. The results are summarized in Table 2. Figure 4 illustrates the effects of Prosodic Length (Number of Morae) on 'Strength' ('Level') with the linear regression lines for all chapters.

Strength Parameters	Number of Tokens	ρ	p value
Chapter 1	204	0.30	<0.01
Chapter 2	368	0.38	<0.01
Chapter 3	961	0.39	<0.01
Chapter 4	228	0.40	<0.01
Chapter 5	52	0.38	<0.01

Table 2: Results of Non-Parametric Spearman Correlation Analyses for Each Chapter

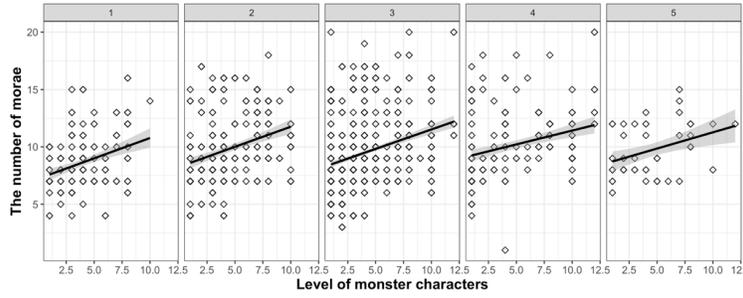


Figure 4: The distribution of 'The number of morae' over 'Level' with linear regression line in all 5 chapters

Although we believe that the different statuses of monster characters in Yu-Gi-Oh 5D's should be taken into consideration and more weight should be given to monster characters with more appearances in the anime, we also conducted analysis based on the assumption that all monster characters enjoy the same status to provide some further support for the main argument. The total number of monster characters analyzed is 578, and the 'Longer-is-Stronger' principle is attested by Non-Parametric Spearman Correlation Analysis ($\rho = 0.28, p < 0.01$). Figure 5 illustrates the effect of Prosodic Length (Number of Morae) on 'Strength' ('Level') with the linear regression line.

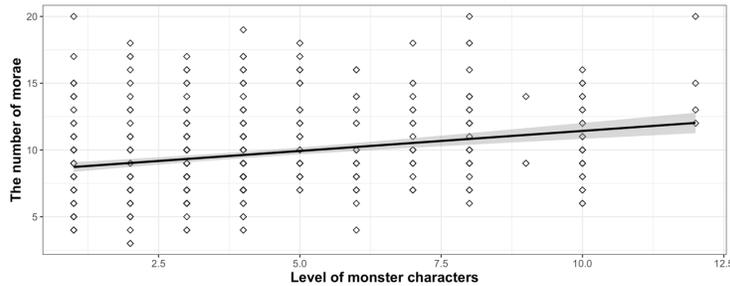


Figure 5: The distribution of 'The number of morae' over 'Level' with linear regression line

Again, to address the concern that the 'Longer-is-Stronger' effect is only coming from certain parts of the corpus, we conducted Non-Parametric Spearman Correlation Analyses for all 5 chapters. The results are summarized in Table 3. Figure 6 illustrates the effects of Prosodic Length (Number of Morae) on 'Strength' ('Level') with the linear regression lines for all chapters.

The results show that the correlations are positive and significant for the first 3 chapters. However, no significance is shown for Chapter 4 and Chapter 5. The reason may be lack of data. For the first 3 chapters, there are more than 100 data points. In contrast, there are only 53 data points for Chapter 4 and 13 data points for Chapter 5.

Strength Parameters	Number of Monster Characters	ρ	p value
Chapter 1	103	0.28	<0.01
Chapter 2	126	0.29	<0.01
Chapter 3	283	0.30	<0.01
Chapter 4	53	0.11	0.43
Chapter 5	13	0.20	0.52

Table 3: Results of Non-Parametric Spearman Correlation Analyses for Each Chapter

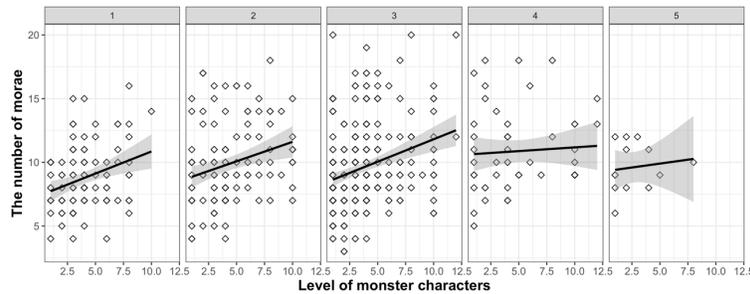


Figure 6: The distribution of 'The number of morae' over 'Level' with linear regression line in all 5 chapters

Overall, the current study on Yu-Gi-Oh 5D's provides strong support for the existence of 'Longer-is-Stronger' effect in Standard Japanese. The names of Yu-Gi-Oh monster characters at different levels almost do not share the same origin and are not directly related with each other, so the assumption of independence can be assured. Moreover, for each subset of the Yu-Gi-Oh corpus, the 'Longer-is-Stronger' effect is attested, which provides strong evidence for the main argument.

4 Conclusion

In this paper, we propose a universal Sound Symbolic effect: Prosodic Length is positively correlated with the Meaning of 'Strength'. And the evidence from both Mainstream American English and Standard Japanese supports this principle.

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