

Iconicity in English Vocabulary and its Relation to Toddlers' Word Learning

Lynn K. Perry (lkperry@wisc.edu)

Marcus Perlman (mperlman@wisc.edu)

Gary Lupyan (lupyan@wisc.edu)

Department of Psychology, 1202 W. Johnson Street
University of Wisconsin-Madison
Madison, WI 53706 USA

Abstract

Scholars have documented substantial classes of iconic vocabulary in many non-Indo-European languages. In comparison, Indo-European languages like English are assumed to be arbitrary outside of a small number of onomatopoeic words. In three experiments, we asked English speakers to rate the iconicity of words from the MacArthur-Bates Communicative Developmental Inventory. We found English—contrary to common belief—exhibits iconicity that correlates with age of acquisition and differs across lexical classes. Words judged as most iconic are learned earlier, in accord with findings that iconic words are easier to learn. We also find that adjectives and verbs are more iconic than nouns, supporting the idea that iconicity provides an extra cue in learning more difficult abstract meanings. Our results provide new evidence for a relationship between iconicity and word learning and suggest iconicity may be a more pervasive property of spoken languages than previously thought.

Keywords: English, iconicity, sound symbolism, vocabulary, word learning

Introduction

A long-held assumption of linguistics is that languages are arbitrary by design (Saussure, 1983; C.F. Hockett, 1960), and that outside of marginal cases like onomatopoeia, the forms of words bear no resemblance to their meanings. As Pinker and Bloom observed, arbitrariness is “most obvious in the choice of individual words: there is no reason for you to call a dog *dog* rather than cat except for the fact that everyone else is doing it” (1990: p. 718).

With the modern understanding that signed languages are bona fide languages, they became recognized as an exception to the principle of arbitrariness. Many signs are clearly iconic, exhibiting correspondence between form and meaning: For example, in British Sign Language (BSL), bringing a cupped hand close to the mouth to represent “drinking.” Yet, researchers have often argued signers ignore this iconicity during normal language use, and that it is irrelevant to the acquisition of signs (e.g., Klima & Bellugi, 1979; Orlansky & Bonvillian, 1984). Meanwhile, researchers have generally maintained the theory that spoken languages are essentially arbitrary. Indeed, some have proposed that because of intrinsic limitations of the vocal modality, spoken languages could simply be no other way (e.g., Hockett, 1978; Tomasello, 2008).

However, linguists working outside of Indo-European languages have documented that many spoken languages feature a special lexical class of iconic vocabulary, often termed mimetics, ideophones, or expressives (Diffloth,

1972; Voeltz & Kilian-Hatz, 2001). These words are grammatically and phonologically distinct from other lexical classes, and they serve adverbial or adjectival functions through the depiction of sensory and motor imagery (Dingemanse, 2012). For instance, in Japanese, the word ‘koron’ refers to a light object rolling once, ‘korokoro’ to a light object rolling repeatedly, and ‘gorogoro’ to a heavy object rolling repeatedly (Imai & Kita, 2014). Across languages, these iconic words express a wide variety of meanings spanning different modalities, including qualities like luminance and color, manner of movement and speed, shape, size, duration, texture, visual appearance, taste, temperature, and emotional and psychological states.

The discovery that iconic lexical classes in non-Indo-European languages are so widespread has led some researchers to propose that iconicity, as much as arbitrariness, is a design feature of all languages, signed and spoken (Perniss, Thompson, & Vigliocco, 2010; Perniss & Vigliocco, 2014). According to this idea, Indo-European languages, and especially English, are treated as exceptional because of their obviously high degree of arbitrariness. Vigliocco et al. (2014: p. 2) note:

“Indeed, if we look at the lexicon of English (or that of other Indo-European languages), the idea that the relationship between a given word and its referent is defined by an arbitrary connection alone seems entirely reasonable. For example, there is nothing in the sequence of sounds in the English word ‘house’ that indicates its meaning of ‘a building for human habitation.’”

Iconicity in Language Learning

Along with documentation that iconicity exists in many spoken languages, mounting evidence indicates that it can facilitate word learning. The apparent speed and ease with which toddlers learn words has long seemed an incredible feat given the apparent difficulty of the task at hand—selecting the correct referent of a word from a potentially infinite number of possibilities (Quine, 1960). Some researchers have proposed that iconic words, through their resemblance to meaning, could provide the learner with cues to constrain the referent (Imai & Kita, 2014; Perniss & Vigliocco, 2014). Iconicity could be an especially useful cue when the word’s referent is not present in the environment, or when its meaning is relatively abstract (e.g. verbs compared to nouns, Gentner, 1982).

There is now evidence that iconicity does help learners to associate spoken words with their referents. For example, both Japanese- (Imai, Kita, Nagumo, & Okada, 2008) and

English-speaking toddlers (Kantartzis, Imai, & Kita, 2011) more accurately generalized novel sound-symbolic verbs than novel non-sound-symbolic verbs. Importantly, while the verbs in these studies were constructed based on existing Japanese sound-symbolic words both groups of toddlers benefitted from the iconicity, suggesting at least some level of universality of the sound-referent pairings. Not only are iconic words easier to learn, but when novel meanings are denoted by iconic words, the *meanings* themselves (the categories denoted by the words) have been shown to be learned more quickly (Lupyan & Casasanto, 2014).

These findings show that iconicity *can* aid learning, but left unknown is whether it plays a significant role in *actual* learning. If so, languages ought to exhibit iconicity across their lexicon in predictable ways (Imai & Kita, 2014; Monaghan, Shillcock, Christiansen, & Kirby, 2014). Iconicity should be more prevalent among the earliest-learned words and in words with referents that are most difficult to identify in the environment. Thus, the degree of iconicity in a lexicon should correlate with age of acquisition (AoA) such that words higher in iconicity are learned before words lower in iconicity. Additionally, words with abstract referents that are more difficult to identify, e.g. verbs, should be more iconic than words with concrete referents that are identified more easily, e.g., nouns.

Recent studies of BSL provide some evidence for this theory in the case of signed languages. Native BSL signers rated the iconicity of common signs. Results showed that signs learned earlier in development tend to be more iconic (Vinson, Cormier, Denmark, Schembri, & Vigliocco, 2008; Thompson, Vinson, Woll, & Vigliocco, 2012).

In spoken languages such as Japanese, with a rich iconic lexical class, caregivers may use these words more frequently with infants and toddlers to facilitate word learning. Observations of the infant directed speech of Japanese caregivers support this hypothesis (Imai & Kita, 2014). Proponents of this view have suggested that spoken languages such as English, that do not have a special iconic lexical class, may compensate for the lack of iconicity in their lexicon by the use of co-speech iconic gestures and prosody to link form and meaning (Thompson et al., 2012).

Additionally, English may actually be iconic in ways that support word learning. To our knowledge, no one has ever conducted a systematic study of iconicity across the lexicon of a spoken language¹. Here, we examine iconicity in English vocabulary by asking native speakers to rate the iconicity of 605 words from the MCDI. We assess whether rated iconicity correlates with AoA, and whether it is distributed differently across lexical classes.

¹ But see discussion below of Monaghan, et al. (2014) and their study of *systematicity* in English.

Experiment 1

Methods

Participants 442 native English speakers were recruited from Amazon Mechanical Turk and received \$0.35 for their participation.

Stimuli We used words from the MCDI Words and Sentences, a normed list of the early productive vocabulary of 16-30-month-old toddlers learning American English (Fenson et al., 1994). We removed compound and polysemous words leaving 592 of the 680 words. The words included nouns, verbs, adjectives, interjections (e.g., no), sound effects (e.g., quack), and function words. Function words comprised all closed class words including determiners, pronouns, question words, conjunctions, auxiliary verbs, prepositions and verb particles. The list did not include any open class adverbs, such as those conveying manner of motion (e.g., those productively derived from adjectives with the suffix *-ly*). For statistical analyses, we combined onomatopoeia and interjections into a single lexical category. Syntactically and phonologically, interjections behave similarly to onomatopoeia. Our measure of AoA is the proportion of toddlers producing a given word at 30 months as based on Dale & Fenson's (1996) norms.

Procedure To quantify the iconicity of English vocabulary, we relied on a measure comparable to that used in the study of signed languages: ratings by native speakers (Thompson et al., 2012; Vinson et al., 2008) (see General Discussion for a possible reservation with this procedure). Iconicity was defined through the following instructions:

“Some English words sound like what they mean. For example, SLURP sounds like the noise made when you perform this kind of drinking action. An example that does not relate to the sound of an action is TEENY, which sounds like something very small (compared to HUGE which sounds big). These words are iconic. You might be able to guess these words' meanings even if you did not know English. Words can also sound like the opposite of what they mean. For example, MICROORGANISM is a large word that means something very small. And WHALE is a small word that means something very large. And finally, many words are not iconic or opposite at all. For example there is nothing canine or feline sounding about the words DOG or CAT. These words are arbitrary. If you did not know English, you would not be able to guess the meanings of these words.”²

Participants then rated each word, one at a time, on a scale from -5 to 5 such that -5 indicated words that sound like the opposite of what they mean, 5 indicated words that sound like what they mean, and 0 indicated words that are arbitrary—do not sound like what they mean or the opposite. Each word was presented to the left of a slider scale that participants used to indicate their rating.

² This example of anti-iconicity comes from Hockett (1960: 90): “‘Whale’ is a small word for a large object; ‘microorganism’ is the reverse.” ‘Dog’ and ‘cat’ are commonly used as examples of arbitrariness, as in Pinker and Bloom (1990) above.

Participants were asked to say each word aloud before making their judgment. We collected at least 10 judgments for each word, with each participant rating 20 words.

Analysis We examined the effect of iconicity on predicting Age of Acquisition using linear mixed effects regression models. Significance levels were calculated using chi-square tests that compared fit of mixed-effect models with and without the factor of interest (Baayen, Davidson, & Bates, 2008). To eliminate alternative explanations for a relationship between our ratings and AoA, we regressed out the effects of other factors known to relate to AoA from our iconicity ratings. We then predicted the residual iconicity ratings from AoA. These factors included log frequency, concreteness, word length (as measured by number of phonemes and number of morphemes), and systematicity. Additionally, we collected ratings of the association of each word with babies (independent of AoA) from a separate group of participants, and we regressed these ratings out of iconicity ratings as well.

Monaghan, et al. (2014) measured the systematicity of English words, or statistical regularity of sound-meaning pairings. They found that even after factoring out derivational and inflectional morphology and historical relatedness, there was a small but significant tendency for words with similar meanings to have similar forms. Moreover, they found earlier learned words were more systematic than later learned words. As Monaghan et al. note, this measure, sometimes called “relative iconicity,” is in theory orthogonal to resemblance between form and meaning—what we refer to here as iconicity. Systematicity measures were only available for half of our words. Thus, we first conducted analyses on the full set of words regressing out concreteness, log frequency, word length, and association to babies from iconicity ratings. We then conducted a second analysis on the subset to examine whether iconicity predicts AoA even after accounting for systematicity.

Results and Discussion

The average rating across all words was .75, (SD=.99, range = -2.10 - 4.36). Examples of words along the continuum are listed in Table 1. We next examined whether iconicity corresponds to AoA and lexical class.

Age of Acquisition As shown in Figure 1a, iconicity correlated with AoA such that words rated as more iconic were more likely to be produced by toddlers. A regression analysis revealed that iconicity rating was a reliable predictor of AoA, $b=.006$, 95% CI [.003, .008], $X^2(1)=20.19$, $p<<.0001$. This held for the reduced set of words for which we had the systematicity measure, $b=.004$, 95% CI [.0005, .008], $X^2(1)=4.87$, $p=.03$. AoA was still a reliable predictor of iconicity after removing onomatopoeia and interjections, $b=.003$, 95% CI [.001, .006], $X^2(1)=7.50$, $p=.006$.

Lexical Class As shown in Figure 2a, iconicity varied by lexical class. Participants rated onomatopoeia, $M=3.15$, and interjections, $M=2.70$, as more iconic than all other lexical classes, $p<<.0001$. Adjectives, $M=1.31$, and verbs, $M=1.15$, were rated as more iconic than nouns, $M=.51$, and function words, $M=.36$, $p<<.0001$. Finally, iconicity was overall very negatively related to concreteness, $X^2(1)=663.93$, $p<<.0001$, suggesting that iconicity is most needed for learning abstract words.

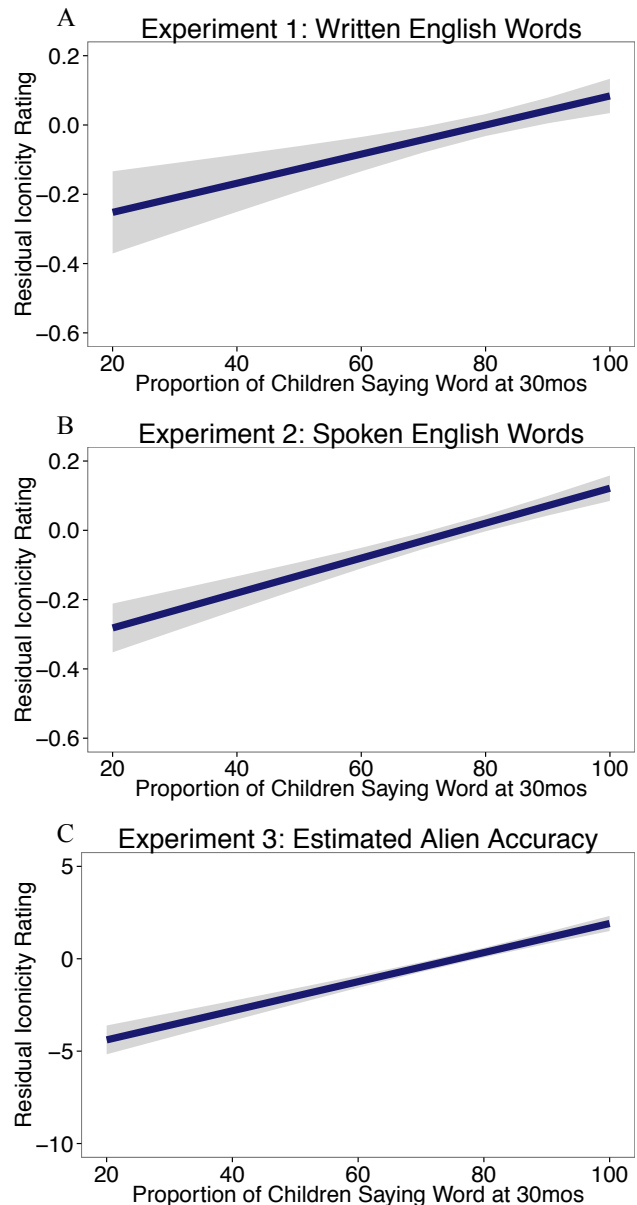


Figure 1. Relationship between age of acquisition (as measured by proportion of children saying each word at 30 months of age) and A) iconicity ratings of written stimuli, B) iconicity ratings of spoken stimuli, and C) judgments of an alien’s accuracy in guessing a word’s meaning from its sound. Error bands represent standard error of linear model estimates.

Conclusions The results of the first experiment demonstrate that more iconic words are learned earlier than less iconic words. Critically, iconicity predicts AoA above and beyond other known predictors of AoA. Additionally, the differences between words of different lexical classes fits with the prediction that word classes like verbs and adjectives, with referents that are more difficult for toddlers to identify, may be especially iconic to facilitate learning. Together, these results suggest that not only is there iconicity in early English vocabulary, but also that this iconicity has consequences for language learning.

Table 1. Examples of words with ratings from Experiment 1 from iconic (5) to opposite (-5) meanings.

Word	Lexical Class	Average Rating
Uh oh	Onomatopoeia	4.36
Hard	Adjective	3.69
No	Interjection	2.81
Stop	Verb	2.50
Jeans	Noun	0.00
Purse	Noun	-1.64
Would	Function Word	-2.1

Experiment 2

In Experiment 2, we sought to replicate the results of Experiment 1 with spoken stimuli. Participants listened to the words rather than read them. We wondered whether hearing the words would enhance or otherwise alter participants' sense of an iconic relationship between the word forms and their meanings.

Methods

Participants 343 native English speakers were recruited from Mechanical Turk and received \$0.35 for participation.

Stimuli Auditory recordings of each word from Experiment 1 were made by a female native English speaker.

Procedure The procedure was identical to that of Experiment 1 except that participants listened to an audio recording of each word on each trial before making their judgment. The written word was still presented to ensure that participants heard and interpreted the word accurately.

Results and Discussion

The average iconicity rating across all words was .78 (SD=.98, range = -2.18 - 4.64). This mean was not reliably different from that in Experiment 1, $\chi^2(1)=.31, p=.58$. A correlation between the ratings obtained in Experiment 1 and 2, $r=.61, p<.0001$, suggests a moderate degree of consistency in ratings regardless of modality.

Age of Acquisition As shown in Figure 1b, iconicity correlated with AoA, such that words learned earlier tended to be more iconic, $b=.005, 95\% \text{ CI } [.003, .007], \chi^2(1)=17.93, p<.0001$. This effect held for the reduced

set of words for which we had systematicity measures, $b=.004, 95\% \text{ CI } [.00007, .008], \chi^2(1)=3.98, p=.05$. AoA was still a reliable predictor of iconicity after removing onomatopoeia and interjections, $b=.003, 95\% \text{ CI } [.0007, .005], \chi^2(1)=6.68, p=.01$.

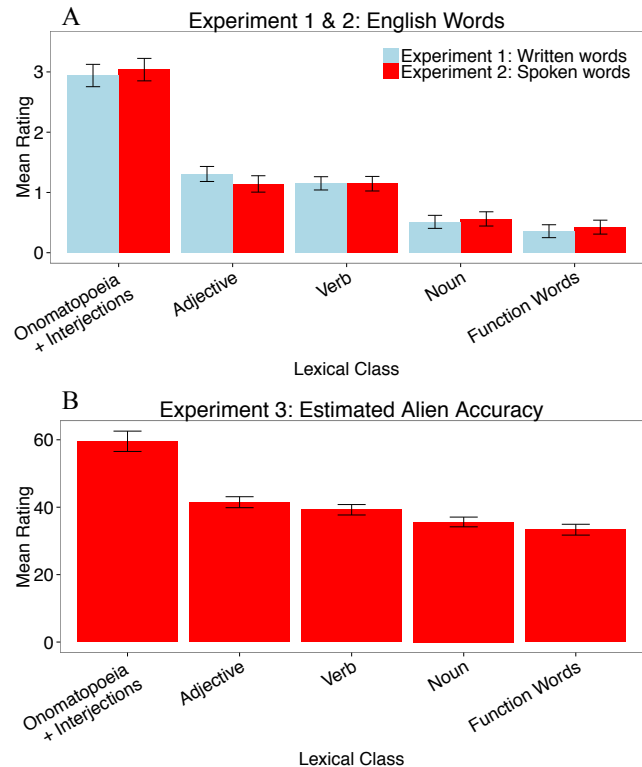


Figure 2: Relationship between words' lexical class and A) iconicity ratings based on written and spoken stimuli, B) participants' judgments of an alien's accuracy in guessing a word's meaning from its sound. Error bars depict the standard error of the mean.

Lexical Class As shown in Figure 2a, iconicity varied with lexical class similarly to Experiment 1. Onomatopoeia, $M=3.39$, and interjections, $M=2.46$ (combined), were again rated as most iconic, $p<.0001$. Adjectives, $M=1.14$, and verbs, $M=1.15$ were rated as more iconic than nouns, $M=.56$, and function words, $M=.42, p<.0001$.

Conclusions Experiment 2 replicated Experiment 1, indicating more iconic words are learned earlier than less iconic words and iconicity relates to lexical class. These relationships remain after factoring out effects of other factors related to AoA. We found no evidence that listening to the word compared to saying it aloud oneself altered participants' sense of iconicity.

Experiment 3

One potential concern about the results of Experiments 1-2 is that, despite our instructions, participants might not have understood the concept of iconicity. In Experiment 3, we sought to measure iconicity in a more implicit task.

Methods

Participants 415 native English speakers were recruited from Mechanical Turk and received \$0.35 for participation.

Stimuli The same words from Experiment 1 were used.

Procedure Participants were told that a space alien who did not know any English was trying to translate English words into his own language. They were asked to judge how accurately the alien could guess each word's meaning based only on its sound. They responded on a scale from 0 to 100 with 0 indicating that the alien would likely guess the wrong meaning and 100 indicating that the alien would likely guess the correct meaning. Participants were asked to pronounce each word aloud before making their judgment.

Results and Discussion

The average judgment of accuracy across all words was 37.06 (SD= 11.97, range = 8.64 - 74.67). There was a significant correlation between judgment of iconicity from Experiment 1 and judgments of alien accuracy from Experiment 3, $r=.46$, $p<.0001$, suggesting a moderate correspondence between ratings in a task explicitly measuring iconicity and one implicitly measuring iconicity.

Age of Acquisition As shown in Figure 1c, participants' judgments of the alien's perceived guessing accuracy corresponded to human AoA of those words, $b=.10$, 95% CI [.08, .13], $X^2(1)=58.81$, $p<.0001$. The effect held for the reduced set of words for which we had systematicity measures, $b=.12$, 95% CI [.08, .16], $X^2(1)=37.17$, $p<.0001$. AoA was still a reliable predictor of alien accuracy after removing onomatopoeia and interjections, $b=.08$, 95% CI [.05, .10], $X^2(1)=35.35$, $p<.0001$.

Lexical Class As shown in Figure 2b, judgments of alien accuracy varied with lexical class similar to the patterns found in Experiments 1 and 2. Onomatopoeia, $M=56.55$, and interjections, $M=63.15$ (combined), were rated as most likely to be guessed accurately, $p<.0001$. Adjectives, $M=41.48$, and verbs, $M=39.24$, were rated as more likely to be guessed accurately than nouns, $M= 35.62$, and function words, $M=33.33$, all $p<.05$.

Conclusions This more implicit measure of iconicity—assessing people's intuitions of sound/meaning correspondence without directly asking them to rate iconicity—replicates the findings of the first two experiments with respect to AoA and lexical class.

General Discussion

We conducted a systematic study of iconicity across the early-learned vocabulary of a spoken language. In three experiments we replicate the same pattern of results: English words that are rated as more iconic tend to be learned earlier than less iconic words. Although we cannot establish with certainty that iconicity plays a causal role in

learnability, the strong relationship between iconicity and AoA after accounting for several other factors known to relate to word learning, including frequency, concreteness, word length, and Monaghan, et al.'s (2014) measure of systematicity (relative iconicity), is consistent with the possibility of a causal relationship. Moreover, by factoring out the degree to which the words were associated with babies, we can rule out the possibility that the relationship between iconicity and AoA is driven by participants strategically rating baby-like words as iconic. We additionally found that word classes like verbs and adjectives (with referents that are more difficult for toddlers to identify), exhibit more iconicity than nouns (which are typically more concrete).

Both patterns are consistent with the proposal that iconicity in spoken languages serves to bootstrap word learning (Imai & Kita, 2014; Perniss & Vigliocco, 2014). Iconicity supports early language learning by helping young, inexperienced learners to identify a referent from the environment; iconicity is therefore expected to be more prevalent in the earliest-learned words. Similarly, as the referents of words like verbs and adjectives are typically more difficult to identify from the environment than nouns (cf. Gentner, 1982), these words are expected to be more iconic to provide the learner with extra help.

Our findings also fit with recent accounts suggesting that languages exist in a dynamic balance between iconicity and arbitrariness (Gasser, 2004; Monaghan et al., 2014). Iconicity grounds language in our sensorimotor system, and helps learners connect word forms with meanings. However, it also constrains the phonological space of a word, and leads words with similar meanings to be less discriminable from each other. Consequently, iconicity tends to erode as lexicons become more densely populated in semantic space and discriminability becomes a more critical factor. As English has fewer verbs and adjectives than nouns, these classes may end up being more iconic than nouns.

Altogether these results provide compelling new evidence that iconicity is alive and well within the English lexicon. It is strongest in onomatopoeia, but spreads across the vocabulary, concentrating in the earliest learned words, and especially in the abstract classes of adjectives and verbs. Compared to the distinct iconic lexical classes documented across many non-Indo-European languages, the iconicity found in early English vocabulary is subtle. It nevertheless may play an important role in word learning, raising the interesting question of whether languages with large iconic lexical classes also exhibit more distributed iconicity in early-learned vocabulary in the manner of English.

One potential limitation of our findings is that they rely on the subjective ratings of English speakers. Unlike frequency or AoA, it is not possible to compute objective iconicity values of word forms. So, although there may be something about the word "sour" that makes it a better match to a sour taste than a bitter one, this can only be ascertained by studying people's responses to the word-form. In this way, our iconicity measure is similar to other subjective ratings

commonly used in psycholinguistics such as concreteness. If subjective ratings provided by English speakers correlate with AoA because iconic words are related to meanings in a non-arbitrary way, then we expect those words rated by English speakers as most iconic (and whose meanings will be most accurately guessed by an alien), to correspond to words that are easier to guess/learn by people unfamiliar with English and related languages. Showing this correspondence is a natural next step.

Ultimately, our findings suggest that iconicity may be a fundamental design feature of language (Imai & Kita, 2014; Perlman & Cain, in press; Perniss & Vigliocco, 2014), both signed and spoken. English, the linguistic poster child for arbitrary languages, may not be so arbitrary after all.

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