Yap, D. F., Staum Casasanto, L., & Casasanto, D. (2014). Metaphoric iconicity in signed and spoken languages. In P. Bello, M. Guarini, M. McShane, & B. Scassellati (Eds.), *Proceedings of the 36th Annual Conference of the Cognitive Science Society* (pp.,1808-1813), Austin, TX: Cognitive Science Society.

Metaphoric Iconicity in Signed and Spoken Languages

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Abstract

Since Saussure, the idea that the forms of words are arbitrarily related to their meanings has been widely accepted. Yet, implicit metaphorical mappings may provide opportunities for iconicity throughout the lexicon. We hypothesized that vertical spatial metaphors for emotional valence are manifested in language through space in signed languages and through the spatialized dimension of pitch in spoken languages. In Experiment 1, we analyzed the directions of the hand motions constituting words in three signed languages, and related them to the valence of their English translation equivalents. The vertical direction of signs predicted their valences. On average, signs with upward movements were the most positive in valence, and signs with downward movements the most negative. Signs with non-vertical movements were intermediate in valence. Experiment 2 extended this type of analysis to a tonal language, Mandarin Chinese. The pitch contours of Chinese words predicted the valence of their English translation equivalents. These results demonstrate a previously unrecognized source of non-arbitrariness in language, revealing that implicit space-valence metaphors are encoded in the forms of words in both signed and spoken languages.

Keywords: Metaphoric iconicity; Conceptual metaphor; Valence

Introduction

Since Saussure (1959), the idea that words' forms are arbitrarily related to their meanings has been widely accepted. According to Saussure, the meaning of "tree" is unmotivated by the letters *a-r-b-r-e* in French, since in principle it can be represented by any other letters in other languages, such as *t-r-e-e* in English.

The documented exceptions to arbitrariness tend to fall into a narrow range of categories, such as ideophones (e.g., *Bang!* and *tinkle* sound like their referents; Nuckolls, 2004), phonaesthemes (e.g., words having to do with noses like *snout* and *sniffle* tend to start with the sound /sn/; Bergen, 2004), the bouba-kiki phenomenon (Maurer et al., 2006) and iconic signs in signed languages (e.g., the sign for *two* in American Sign Language is two extended fingers). These kinds of iconic relationships rely on concrete qualities of the referent being echoed in the form of the word, so only certain meanings are eligible to participate in them.

Beyond these special exceptions, are form-meaning relationships in languages truly arbitrary? If not, what are the sources of non-arbitrariness in language? Are there constraints that influence form-meaning relationships systematically *throughout* our lexicons?

Metaphoric iconicity in gestures

Iconic form-meaning relationships are common in the gestures we produce when we speak (McNeill, 1992). Iconic gestures depict some concrete aspect of the referents of the words they accompany (e.g., raising the hand to indicate that a rocket went higher). In a special class of iconics called metaphoric gestures (McNeill, 1992), concrete objects or relationships are depicted with the hands in order to represent some aspect of an abstract idea (e.g., raising the hand to indicate that a students' grades went "higher"; Cienki, 1998; Sweetser, 1998).

In metaphoric gestures, abstract ideas that we can never see or touch can nevertheless be represented with the hands via conceptual metaphor (Lakoff & Johnson, 1980). People often talk about abstract, non-spatial entities using spatial words (e.g., a *long time*, a *high price*, or *a close friendship*). Beyond talking in linguistic metaphors, there is a growing body of evidence suggesting that people also think in *mental metaphors* (Casasanto & Bottini, 2013, for review): implicit associations between non-linguistic representations in abstract *target domains* and relatively concrete *source domains* like space, force, and motion (Lakoff & Johnson, 1980). Although target domains like time are nearly impossible to depict gesturally, *per se*, their source domains can often be depicted: A long time can be indicated by a long-distance sweep of the hand; a distant time can be represented by gesturing toward a far-away point in space (see Cienki & Müller, 2008, for numerous examples of metaphorical gestures).

Metaphoric iconicity in languages

Although the evidence for metaphoric iconicity in gestures is strong, this type of iconicity is generally assumed not to extend to language. Even signed languages, which share a modality with hand gestures and therefore have the potential to express spatial iconicity, have been characterized as exhibiting largely arbitrary form-meaning mappings, in part for historical reasons having to do with establishing American Sign Language (ASL) as a full-fledged language, and not a simple system of pantomimes (Klima & Bellugi, 1979). Taub (2001) noted that signed languages' potential for iconicity is expanded by their ability to depict aspects of metaphoric source domains in sign, as in gesture. She and others have shown metaphoric iconicity in a number of ASL signs (see also Emmorey, 2001). In a multiple-choice test, non-signers were able to match the meanings of some metaphoric signs in ASL to their English glosses (O'Brien, 1999).

Taub (2001) reviewed a set of signs motivated by the metaphor Good is Up / Bad is Down, which spatializes emotional valence on a vertical continuum, and is evident in many spoken languages (e.g., feeling *on top of the world* or *down in the dumps* (Lakoff & Johnson, 1980). Taub (2001) describes several signs related to the notion of *improvement* or *deterioration* that make use of vertical motions to express positive or negative valence, consistent with the mental metaphor Good is Up.

We propose that rather than being a set of isolated cases, the examples of metaphoric iconicity in signed languages that have been described to date are only the tip of the iceberg. Metaphors for ubiquitous qualities such as positive and negative emotional valence may generate iconic relationships throughout the lexicon, making true arbitrariness of the sign vanishingly rare. In the domain of valence, ASL provides some metaphor-congruent examples: the sign for "bad" moves downward and the sign for "happy" moves upwards. However, there are also some signs that show the reverse mapping. For instance, the sign for "good" moves downward, and the sign for "insult" moves upward: it is not possible to infer from hand-picked examples like these whether spatial direction is correlated with the valence of words in the ASL lexicon, in general.

Spoken languages could also encode space-valence mappings in the forms of words. Since pitch is metaphorically mapped onto a vertical spatial continuum in many languages and cultures (Dolscheid, Shayan, Majid & Casasanto, 2013), including in Mandarin Chinese, lexical tones in Mandarin could also be a source of metaphoric iconicity. Indeed, even though signed languages have more iconic form-meaning mappings than spoken languages, examples of metaphoric iconicity can be observed in the lexical tones of Mandarin. For instance, 能 (capable; néng) is a positive word and 恨 (hate; hèn) is a negative word, and they have a rising and falling tone, respectively. Like in ASL, there are also exceptions, such as 仇 (hatred; chóu), a negative word with a rising tone, and 爱 (love; ài) a positive word with a falling tone.

Because it is possible to find some examples that support our proposal and others that contradict it, we designed a quantitative study of corpora of signed languages (Experiment 1) and of Mandarin (Experiment 2) to determine whether there is any widespread systematic metaphoric iconicity in these languages. We hypothesized that vertical spatial metaphors for valence should be manifested in language through space in signed languages and through the spatialized dimension of pitch in spoken languages. We predicted that, on average, signs with upward "lexical movements" (Brentari & Padden, 2001) and Mandarin words with rising pitch contours should be the most positive in valence, consistent with the spatial metaphor Good is Up. By contrast, downward movements and pitch contours should be the most negative in valence (Bad is Down). Sign movements and pitch contours that do not move upward or downward should be intermediate in valence, on average. Valence ratings were taken from a corpus of English words (Badley & Lang, 1999) that included some expressly evaluative words like "improve," but a great majority of non-evaluative words that range in valence from the strongly positive (e.g., leader, admired, adorable) to the strongly negative (e.g., blackmail, derelict, evil). These words have no spatial meanings, and do not need to be used in metaphorical constructions to convey positive or negative valence.

Experiment 1a: Space and valence in ASL

Method

Materials We searched an online ASL dictionary (http://www.handspeak.com) for all 1034 of the words in the ANEW corpus (Affective Norms of English Words; Bradley & Lang, 1999): a set of words that were rated for valence on a 9-point scale by a large number of English speakers, and which have been used as stimuli in many experiments. We found 606 ANEW words that had clear translation equivalents in ASL. To ensure that the list of signs to be analyzed was constructed in an unbiased manner, translation equivalence was determined on the basis of the English glosses provided by the ASL dictionary; the experimenter was blind to the forms of the signs during list construction. The duration of each silent sign video was two seconds.

Sign Analysis The goal of the sign analysis was to determine the relationship between the vertical direction of the "lexical movement" phase of each sign and the valence of its English translation equivalent. The lexical movement phase of a sign is an invariant part of its phonology (Brentari & Padden, 2001), and part of the meaning-bearing portion of the sign. Like the stroke phase of a gesture, the movement phase can be identified on the basis of its form (McNeil, 1992; Kita, Van Gijn & Van de Hulst, 1998). A sign begins from a location and handshape that is a "hold" or starting position and entails a movement to a separate location or a change in the handshape. The directions of the preparation and retraction phases (i.e., "transitional movements") are generally not meaningful, and their directions were not analyzed.

All 606 signs were randomized and coded by one of the authors (D.Y.) who was naïve to all signed languages. He was also blind to the signs' translation equivalents in English, and therefore to their meanings. The movement phase of each sign was coded for its vertical direction: *Upward*, *Downward* or *Non-vertical*. Signs with horizontal movement phases or "holds" were coded as *Non-vertical* signs.

Some signs constitute a series of multiple movements and were coded as compound signs. Compound signs with movements in more than one direction were coded based on the direction that appeared to be dominant. For instance, the ASL sign for *curtain* consists of two movements that begin with a right closed fist moving to the right from the left closed fist, followed by a downward movement with open palms from both hands. It was coded as a *Downward* sign.

The signs were then randomized again and 25% of the signs were selected for a second blind coding to determine the intra-rater reliability. The intra-rater agreement rate was 91% (139 out of 153 signs; Kappa = .83, p = .001).

Results

On average, signs with *Upward* movements (n = 59) were the most positive in valence, followed by *Non-vertical* signs (n = 346) and then by *Downward* signs (n = 201; figure 1). There was a significant relationship between the vertical direction of the signs and the valence of their ANEW translation equivalents, $F(2,603) = 4.54$, $p = .01$. *Upward* signs were more positive than *Downward* signs, p = .007.

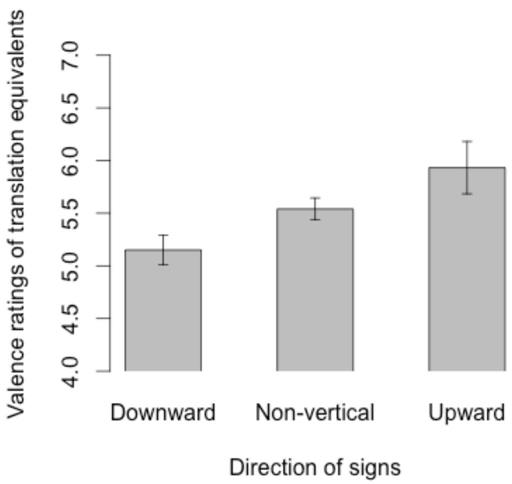

Figure 1. Valence ratings of the ANEW translation equivalents for ASL signs with downward (left), upward (right) and non-vertical (middle) strokes. The error bars show the standard error of the mean.

In summary, the vertical direction of the ASL signs predicted the valence ratings of their ANEW translation equivalents. Signs with upward movements were the most positive in valence, and signs with downward movements the most negative. Signs with non-vertical strokes were intermediate in valence.

These results support our hypothesis that the implicit mental metaphor Good is Up is manifested in the conventionalized forms of ASL words. Testing this hypothesis using English valence norms, rather than collecting new norms for these words in ASL, avoids circularity: Native ASL raters could be biased by the signs' movement directions, online, as they performed the ratings. Translation equivalence between ASL and English words is unlikely to be exact, but importantly, any noise introduced by inexact translations works *against* our hypothesis.

Experiment 1b: Space and valence in LSF

To generalize this novel result, we conducted the same analysis in French Sign Language (LSF).

Method

Materials The ANEW words were translated into French by a native speaker. We searched the LSF dictionary (http://www.lsfdico-injsmetz.fr/index.php?page=motsalphalsf) for all of the ANEW words, and found 490 that had clear translation equivalents in LSF. Thirty words were translated twice into 30 nouns and 30 verbs because the ANEW corpus did not specify the word class. The duration of each silent sign video was three seconds.

Sign Analysis The signs were analyzed in the same way as in Experiment 1a. The intra-rater agreement was 92% (Kappa = .86, p = .001; 113 out of 123 signs).

Results and discussion

The relationship between sign movement direction and valence in LSF replicated the results in ASL (see Figure 2). *Upward* signs were the most positive (n = 78), followed by *Non-vertical* signs (n = 277) and *Downward* signs (n = 135). There was a significant relationship between the vertical direction of the signs and the valence of their ANEW translation equivalents, $F(2,487) = 4.55$, $p = .01$. *Upward* signs were more positive than *Downward*, signs, p = .003.

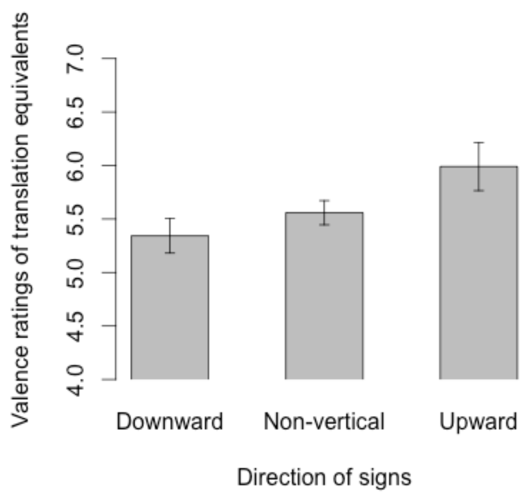

Figure 2. Valence ratings of the ANEW translation equivalents for LSF signs with downward (left), upward (right) and non-vertical (middle) strokes. The error bars show the standard error of the mean.

Half of the 30 ANEW English words that were translated twice were coded with the same direction. After excluding 15 pairs of French signs with different directions and the duplicate signs with the same direction, there was a significant relationship between the vertical direction of the signs and the valence of their ANEW translation equivalents, $F(2,487) = 4.55$, $p = .03$. *Upward* signs were more positive than *Downward* signs $p = .007$.

The vertical direction of the LSF signs predicted valence ratings of their ANEW translation equivalents, replicating our findings in ASL.

Experiment 1c: Space and valence in BSL

Although ASL and LSF are not mutually intelligible, they are genetically related. We sought to generalize these findings further by testing our hypothesis in a third, genetically unrelated language, British Sign Language (BSL).

Method

Materials We searched the BSL dictionary (http://www.signstation.org/index.php/bsl-dictionary/desktop-dictionary) for all of the ANEW words (Bradley & Lang, 1999), and found 458 that had clear translation equivalents in BSL. The duration of each silent sign video was two seconds.

Sign Analysis The signs were analyzed in the same way as in Experiments 1a-b. The intra-rater agreement was 96% (Kappa = .92, $p < .001$; 110 out of 115 signs).

Results and discussion

The BSL results replicated the results of ASL and LSF. *Upward* signs were consistently the most positive in valence ($n = 65$), followed by *Non- vertical* signs ($n = 281$) and *Downward* signs ($n = 112$). Overall, there was a marginally significant relationship between the vertical direction of the signs and the valence of their ANEW translation equivalents, $F(2,455) = 2.33$, $p = .099$. *Upward* signs were significantly more positive than *Downward* signs, $p = .03$.

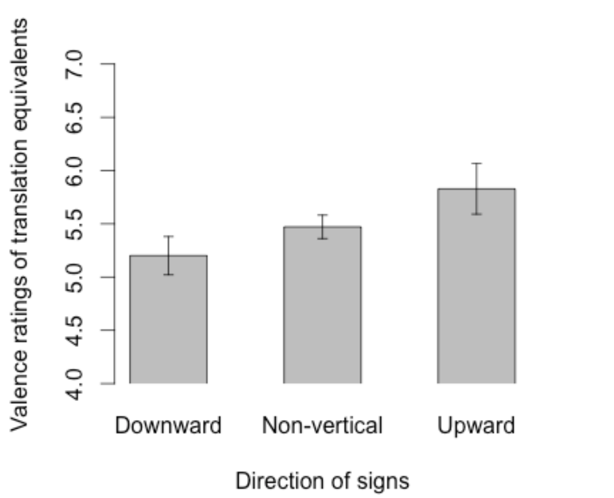

Figure 3. Valence ratings of the ANEW translation equivalents for BSL signs with downward (left), upward (right) and non-vertical (middle) strokes. The error bars show the standard error of the mean.

Analysis of the BSL corpus showed a similar relationship between space and valence as shown for ASL and LSF, in a genetically unrelated sign language.

Experiment 2: Pitch and valence in Mandarin

Although iconicity in signed languages has been discussed in the linguistic literature, iconicity in spoken languages is considered to be rare (cf., Perniss, Thompson & Vigliocco, 2010). Mandarin Chinese is a tonal language with four basic lexical tones: (1) a high, level tone, (2) a rising tone, (3) a low falling tone (but with a rising tail in single characters) and (4) a high falling tone. Figure 4 (based on Speer, Shih & Slowiaczek, 1989) shows the four tones with the corresponding tone contours.

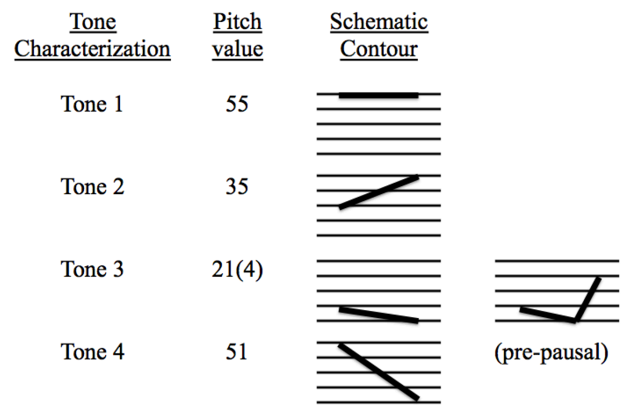

Figure 4. Pitch Contours of the four lexical tones in Mandarin Chinese. Each lexical tone is schematized along a vertical axis of five units (Speer, Shih & Slowiaczek, 1989).

In some multisyllabic words, a group of characters (e.g., 子) assume the neutral tone. The pitch value of a neutral tone is influenced by its preceding tone. For instance, the neutral tone following the four lexical tones are [55-2], [35-3], [21-4] and [51-1] respectively (Duanmu, 2007).

Method

Materials The entire ANEW corpus of 1034 words was translated into Chinese characters and their respective pinyin using the Goggle Translator (http://translate.google.com/#en/zh-CN/). A native Mandarin speaker then reviewed the list and edited 176 words.

Tone analysis The four lexical tones were classified into three vertical pitch movement categories according to their respective pitch contours as shown in Figure 4. Tone 1 is defined as a *Level* pitch contour because its pitch value remains at 5. Tone 2 (rising tone) is defined as an *Upward* pitch contour that moves up two pitch values (from 3 to 5). Tones 3 and 4 fall one pitch value (from 2 to 1) and 4 pitch values (from 5 to 1) respectively and thus are defined as *Downward* pitch contours.

The pitch analysis of multisyllabic words considers the entire word as a continuous pitch contour because we want the level of analysis to be as similar to the natural speech stream as possible. Therefore, the overall pitch movement is defined as the sum of all the individual tone's vertical pitch movements. The pitch transition of two tones is also included in the calculation of the overall pitch movement. A resulting positive sum constitutes an *Upward* pitch contour, and a negative sum a *Downward* pitch contour. A sum of 0 constitutes a *Level* pitch contour. For example, a 2-character word, 食品 (tone 2 and tone 3) as shown in Figure 4, would result in the value of $(5 - 3) - 3 + (1 - 2) = -2$ which classifies it as a continuous *Downward* pitch contour.

Results and discussion

The vertical pitch contours of the Mandarin pinyin were analyzed at three levels: (1) the entire corpus, (2) monosyllabic words, and (3) multisyllabic words.

Entire corpus Valence ratings for the Mandarin Chinese words' ANEW translation equivalents were highest for words with *Upward* pitch contours (n = 226), followed by *Level* (n = 227) and *Downward* (n = 581) pitch contours respectively. The vertical pitch contours predicted the valence of the words' ANEW translation equivalents, $F(2, 1031) = 5.52$, $p = .004$. Words with *Upward* pitch contours were more positive in valence than words with *Downward* pitch contours, $p = .001$.

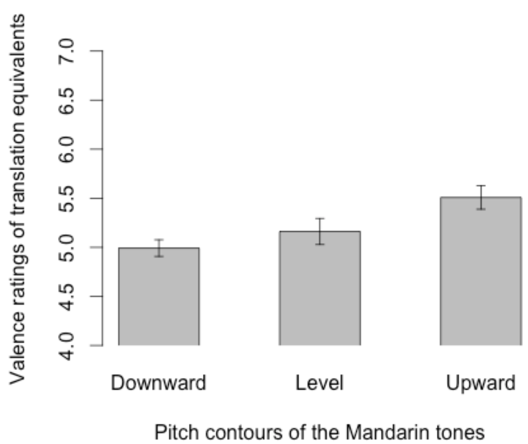

Figure 5. Valence ratings of the ANEW translation equivalents for Mandarin tones with downward (left), upward (right) and level (middle) pitch contours. The error bars show the standard error of the mean.

Monosyllabic words The analysis of 133 monosyllabic (single character) words replicated results in the whole corpus. Valence ratings in ANEW are highest in *Upward* pitch contours (n = 70; 5.50 +/- .21), followed by level pitch contours (n = 31; 4.59 +/- .29) and downward pitch contours (n = 32; 4.24 +/- .33). The vertical pitch contours predicted the valence of the words' ANEW translation equivalents, $F(2, 130) = 6.82$, $p = .002$. Words with *Upward* pitch contours were more positive in valence than words with *Downward* pitch contours, $p = .001$.

Multisyllabic words The analysis of 861 multisyllabic (more than one character) words based on the overall pitch contours also provided converging results. Valence ratings in ANEW are highest in *Upward* pitch contours (n = 156; 5.51 +/- .15), followed by *Level* pitch contours (n = 196; 5.25 +/- .15) and *Downward* pitch contours (n = 549; 5.04 +/- .09). The vertical pitch contours predicted the valence of the words' ANEW translation equivalents, $F(2, 898) = 3.62$, $p = .03$. Words with *Upward* pitch contours were more positive in valence than words with *Downward* pitch contours, $p = .009$.

Pitch contour was a significant predictor of the words' ANEW translation equivalents. Words with rising tones were the most positive, words with falling tones the most negative, and words with level tones intermediate in valence. The Mandarin Chinese corpus replicated the findings of the three signed languages and demonstrated the same vertical spatial metaphors for valence.

General Discussion

Here we demonstrate a previously undiscovered relationship between form and meaning, in three signed languages and a spoken language. The vertical direction of signs predicted the valence ratings of their ANEW translation equivalents for all three signed languages. On average, signs with upward lexical movements were the most positive in valence, and signs with downward movements the most negative. Signs with non-vertical movements were intermediate in valence. Likewise, in Mandarin Chinese, a tonal spoken language, words with upward pitch contours were more positive in valence than words with downward pitch contours, and words with level pitch contours were intermediate.

Why is this particular non-arbitrariness preserved in the lexicon, across signed and spoken languages? One possible reason is that metaphoric iconicity makes words easier to learn. Activating mental metaphors via simple motor actions can improve word learning. In one study (Casasanto & de Bruin, submitted), students learned the definitions of positive and negative words better after moving vocabulary flash cards in a vertical direction consistent with the Good is Up metaphor. The same principle could facilitate the learning of metaphor-congruent words in signed languages and tone languages. (See also Imai et al., 2008; Kantartzis et al., 2011, for evidence that literal sound-meaning correspondences can benefit word learning).

If metaphoric iconicity improves word learning, why isn't non-arbitrariness more pervasive in languages? That is, why don't all positive words have upward movements or tones, and all negative words downward movements / tones? One possible explanation is that there may be many weak iconic (and other) constraints on word forms. Thus, the spatial metaphors described in this study (Good is Up and Bad is Down) could be the source of one such constraint, but they operate in the context of many others.

Another reason that iconicity in language might be limited: perhaps both arbitrary and non-arbitrary mappings have roles to play in language. Computational analyses and findings from an artificial language learning study demonstrated that both arbitrariness and non-arbitrariness facilitate word learning via complementary functions (Monaghan, Christiansen & Fitneva, 2011). Specifically, non-arbitrariness facilitates the generalization of words to semantic categories while arbitrariness facilitates the mapping of words to specific meanings.

Form-meaning relationships are not as arbitrary as was once assumed. Beyond special cases like onomatopoeia, implicit metaphorical mappings may provide opportunities for multiple kinds of non-arbitrariness, throughout the lexicons of signed and spoken languages. We tested for exactly one form-meaning relationship, motivated by one of the hundreds of mental metaphors that scaffold our thoughts, and found evidence for it in every language we tested. Perhaps there are (many) other such relationships. Perhaps languages are shaped by a lattice of weak iconic constraints, which can potentially be identified through blind, quantitative testing methods like we introduce here. A better understanding of the extent of iconic (or other non-arbitrary) constraints on form-meaning relationships is the first step toward discovering how and why these relationships are preserved in language -- and how they have shaped the evolution of languages, and perhaps of the language faculty itself.

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