ILLUSTRATING THE CREATIVE ASPECTS OF SOUND SYMBOLISM: IMPLICATIONS FOR THEORIES OF LANGUAGE EVOLUTION

Keith Jones[1] and Marcus Perlman[*1]

[*]Corresponding Author: m.perlman@bham.ac.uk
[1]English Language and Linguistics, University of Birmingham, United Kingdom

This study examines how sound symbolism might have helped people create the first spoken words. An influential hypothesis is that sound symbolism played a key role in helping listeners connect spoken forms and meanings in the absence of convention. Experiments in the dominant kiki-bouba paradigm typically focus on comprehension as discrete mappings between forms and referents, and neglect creative aspects of meaning-making. In contrast, we illustrate the creative aspects of sound symbolism with a drawn replication of Köhler's (1947) classic experiment. Participants drew *kikis*, *boubas*, *taketes*, and *malumas* in two different contexts: as a creature or as a company symbol. Findings show that size, in addition to shape, is at play: *kikis* and *taketes* are both spikier and smaller than *boubas* and *malumas*. The salience of shape varies between contexts. *Kikis* and *taketes* elicited spikier drawings as symbols than as creatures. Thus, drawings are modulated by context, not just in superficial details, but in the very feature of shape under investigation in standard experiments. Our approach highlights the construction of meaning in context, a creative process that would have been crucial to the formation of the first words.

1. Introduction

The evolution of language is, in its essence, a creative process. Consider, for example, the formation of the first spoken words. At some point in human history, our ancestors established the original symbolic vocalizations used to express the details of their thoughts and experiences. These "proto-words", in addition to being created for the first time, needed to be understood by a listener without any prior code for how to interpret their meaning. Thus, without convention to guide them, listeners needed to make sense of the vocalizations, constructing their meaning from available context (including gestures) and common ground. Indeed, philosophers have observed that understanding the meaning of a word in an entirely foreign language is, logically speaking, a remarkably difficult problem, as listeners are faced with a near-endless set of possibilities for its potential meaning (Quine, 1960).

As a solution to this challenge, some researchers have hypothesized that sound symbolism – a cross-modal resemblance between speech sounds and

meanings – played a key role in the comprehension of the first words (Cuskley & Kirby, 2013; Ramachandran & Hubbard, 2001; Imai & Kita, 2014). Köhler's (1929, 1947) classic experiment on shape-sound symbolism serves as the most influential and highly scrutinized case of how this works (Lockwood & Dingemanse, 2015). When presented with the spiky and rounded shapes in Figure 1, and asked which to call *takete* and which *maluma*, participants overwhelmingly associated *takete* with the spiky shape and *maluma* with the rounded one. Similar results, revamped by Ramachandran and Hubbard (2001) with *kiki* and *bouba*, are widely documented (Styles & Gawne, 2017), found with participants across ages (Imai et al., 2015) and cultures (Bremner et al., 2013).

The evident universality of the kiki-bouba effect has led scholars to argue that such intuitive mappings between spoken form (e.g. rounded consonants and vowels) and visual meaning (rounded shape) would place "natural constraints on the ways in which sounds are mapped on to objects" (Ramachandran & Hubbard, 2001: 19). Thus, sound symbolism could help to narrow a listener's search through semantic space, and thereby provide a critical clue to a speaker's meaning. This function of sound symbolism could have been particularly advantageous to human ancestors in the process of establishing the first vocal symbols.

In this paper, we consider how sound symbolism might have functioned to bootstrap (Imai & Kita, 2014) comprehension of the first spoken words, helping people to bridge the gap between form and meaning (Perniss & Vigliocco, 2014). Yet, while our study contributes positively to the broad enterprise of sound symbolism (Lockwood & Dingemanse, 2015), the launching point for our experiment is a critical observation about much of this research, particularly the extensively documented kiki-bouba effect. Many experiments that investigate this phenomenon operate with fixed, abstract shapes as stimuli, in which the semantic contrast of angularity is built into the design (see Westbury et al., 2018 for a thorough methodological critique). Often, as in the classic experiment of Köhler (1929, 1947), as well as Ramachandran and Hubbard's (2001) frequently cited informal replication, this contrast is accentuated in a two-alternative forced choice paradigm. Stemming from this, research on sound symbolism, and the theories that arise from it, often treat the process of comprehension as a matter of "mapping" between speech stimuli and their targeted meanings, operationalized in phrases like "cross-modal correspondence" or "association". This approach tends to background the core creative processes involved in how people construct meaning from words in context, such as sensorimotor simulation (Bergen, 2012; Hostetter & Alibali, 2008; Perlman & Gibbs, 2013) and open-ended inference (Sperber & Wilson, 1986; Sulik, 2018).

1.1. Current study

In the current study, we illustrate the creative aspects of sound symbolism with a drawn replication of Köhler's classic shape-symbolism experiment. Recently,

Davis et al. (2019) found that drawings elicited by nonce words reflect sound-symbolic connections to the forms of these words. Here, we report a simple demonstration of how providing participants the freedom to draw their interpretations of *taketes* and *malumas* (and *kikis* and *boubas*) can reveal the constructive elements of meaning-making that are obscured in the standard forced-choice matching paradigm. When the contrast of angularity is not built into the experimental design, and participants are free to imagine the meanings of the words, do they still focus distinctly on shape? Or do other aspects of meaning come to mind? For instance, they might also attend to size: studies show that some of the same features of speech sounds that convey shape are also associated with magnitude, e.g., high, front vowels (Thompson & Estes, 2011) and voiceless consonants (Vigliocco & Kita, 2006) with small.

Moreover, meaning-making does not happen in a vacuum, and the sound symbolic cues of pseudowords might vary in different contexts that draw attention to different aspects of meaning. To examine the effect of context, we asked participants to produce their drawings in one of two different scenarios – as a label for a creature or as a symbol for a company. We then analyzed both the spikiness and the size of the drawings. Our findings highlight the constructive, creative process of making meaning from sound symbolism, in context, which would have been critical in the formation of the first words.

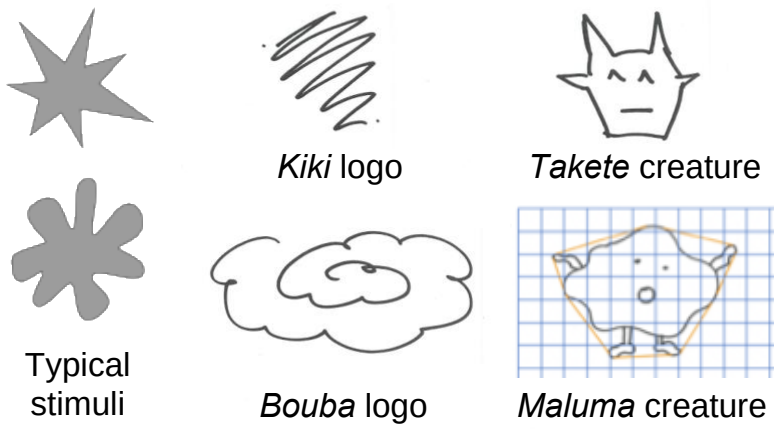

Figure 1. Left column shows typical experimental stimuli. Right columns show drawings from the current experiment. The bottom rightmost image shows how the drawing was enclosed to measure its spread.

2. Methods

2.1. Participants

52 participants were recruited on campus at the University of Birmingham in the United Kingdom. All were native English speakers. Three participants were later

excluded from analysis because they indicated previous familiarity with the kiki-bouba effect.

2.2. Materials and Design

The pseudoword stimuli used to elicit drawings included *kiki* and *bouba* from Ramachandran & Hubbard (2001) and *takete* and *maluma* from Köhler (1947). *Bouba* and *maluma* represented rounded words (consonants and vowels with lip rounding) and *kiki* and *takete* unrounded words (also characterized by voiceless plosive consonants). Each word was printed on a 4-by-6-inch white card. (Thus, notably, participants were presented with written words, a point to which we return in the Discussion.) Participants were randomly assigned to one or the other word set, and then to one of the two contextual scenarios. In the *symbol* scenario, it was explained that "An entrepreneur has founded two new brands," and in the *creature* scenario, that "A space explorer has discovered two new alien creatures." Participants were then asked to draw the two items based only on their names. The words were presented in counter-balanced order across participants. Participants drew on blank index cards fastened to a clipboard, using a black fine point marker.

2.3. Procedure

Participants were approached outdoors on the university campus, where they were asked to complete a brief experiment. After agreeing to participate, they signed a consent form and the experiment began. Participants first read their scenario, and then were handed the marker and clipboard on which to produce their drawings. They were then presented with the words, one at a time. Participants had 20 seconds to complete each drawing. At the end, participants provided written responses to three questions: (1) Can you describe both of your [symbols / creatures]?; (2) Can you explain how you decided on the size and shape of your [symbols / creatures]?; and, (3) Have you heard of the 'kiki-bouba effect'?

2.4. Analysis

We conducted quantitative analyses of the shape and size of the drawings. For shape, we measured their degree of angularity by soliciting judgments from three naïve raters. The raters viewed the drawings one at a time in randomized order. For each, they rated its shape on a scale from 1 to 7, with 1 being most spiky and 7 most round. Analyses used the average of the three ratings for each drawing.

To gauge the size of the drawings, we measured the spread of the surface area they covered. Using a photocopier, each drawing was transferred onto gridded paper (1 cm_2) and enlarged by 200%. The spread was measured by enclosing the drawing with a (hand-drawn) convex polygon that contacted its outward points (Figure 1). We then counted the number of grid-squares inside the

enclosed area, with bisected squares counted when half or more was enclosed. The total spread of the drawing was the sum of the counted grid-squares.

Statistical analyses were conducted in R version 3.4.3 (R Core Team, 2015), and mixed effects models analyses were performed with the lme4 package version 1.1-21 (Bates, Maechler, Bolker, & Walker, 2015). Statistical significance was determined using model comparisons with and without the factor of interest.

3. Results

Examples of drawings for each word and scenario are shown in Figure 1.

3.1. Quantitative Analysis of Shape and Size

Figure 2 displays means and standard errors of the shape ratings and spread. These include results of each word separately and combined together, in both contextual scenarios. The complete statistical analysis and results can be found at https://osf.io/z7ty4/. Here, we report the overall results for the four words combined. To test whether word type affected the shape and size of the drawings, and whether this varied between contexts, we constructed two linear mixed effects models, one with shape ratings and one with spread as the dependent measure. In each, fixed effects included word type (rounded / unrounded), context (creature / symbol), and a factor for their interaction. Random intercepts were added for participant and word set (kiki-bouba / takete-maluma), as well as a random slope for word type by word set. Independent variables were centered.

The results show that drawings of unrounded words were rated as spikier than drawings of rounded words, b_0 = -1.99, *s.e.* = 0.32, t = -6.31, p = 0.007. This effect was modulated by context: unrounded words were rated as spikier in the symbol condition, b_0 = -1.23, *s.e.* = 0.58, t = -2.14, p = 0.033. There was a marginal main effect of context on the shape ratings, b_0 = -0.55, *s.e.* = 0.30, t = -2.14, p = 0.068.

For size, we found a main effect of word type on the spread of drawings: drawings for unrounded words were smaller than rounded words, b_0 = -25.6, *s.e.* = 7.4, t = -3.46, p = 0.019. There was no interaction between word type and context, and no main effect of context.

3.2. Participants' Descriptions

To gain further insight into the motivation for the drawings, we coded participants' responses to the post-experiment question asking them to describe their drawings. The adjectives they used were categorized as relating to spiky or curved shape and to small or large size. For example, spiky words like "angular", "sharp", "jagged", "pointy" and "spiky" were among those adjectives used for *takete* symbols. *Bouba* creatures were described as "long", "large", "blob-like", and "bulbous". Table 1 presents a summary of these results.

Table 1. Frequency of shape and size words used in participants' descriptions.

Word	*Creature Shape (Spiky / Curved)*	*Symbol Shape (Spiky / Curved)*	*Creature Size (Small / Large)*	*Symbol Size (Small / Large)*
Kiki	0 / 1	11 / 0	5 / 1	0 / 0
Bouba	0 / 3	0 / 8	1 / 6	0 / 2
Takete	4 / 0	8 / 0	3 / 5	0 / 0
Maluma	0 / 7	0 / 9	0 / 2	0 / 0

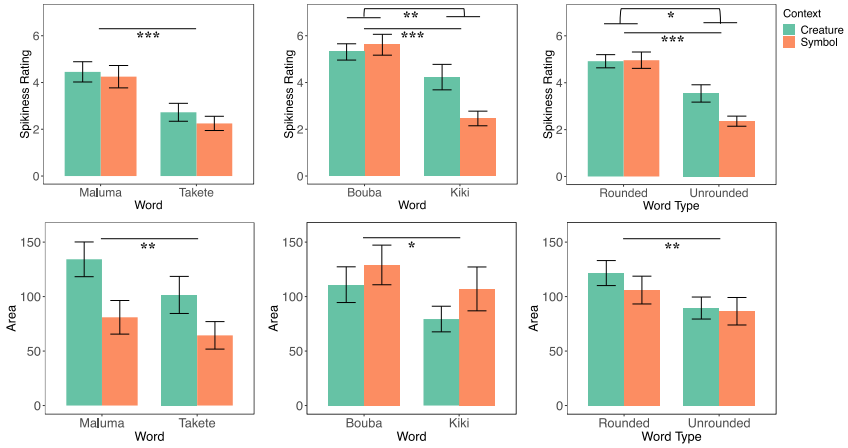

Figure 2. Means and standard errors of the shape ratings (top) and spread (bottom). Creatures are shown in green, symbols in orange. Lines show significant differences between the word types, and brackets show interactions between word and context. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

4. Discussion and Conclusion

Our study launches from the critical observation that the seminal paradigm of experiments on sound symbolism, the kiki-bouba effect, is based on a design that builds in discrete representations of meaning. This reduces the creative aspects of comprehension – for example, processes of meaning-making such as sensorimotor simulation or open-ended inference – to the discrimination of specific semantic contrasts. Thus, by its design, the paradigm reinforces the notion that the primary function of sound symbolism is to facilitate mapping between forms and referents, rather than focusing on sound symbolism as a guiding cue in the construction of meaning. To contrast these two perspectives, we examined whether, by giving participants more freedom to construct meaning from pseudowords, we could uncover aspects of sound symbolism that are lost in many standard experiments. Such an approach might provide fresh perspective

into the formation of the first vocal symbols by shifting focus to more creative aspects of sound symbolism.

In our replication of Köhler's classic experiment, participants drew pictures of *kikis*, *boubas*, *taketes*, and *malumas* – either as an alien creature or as a symbol for a company. Analysis of their drawings replicates the typical shape-sound symbolism effect, but also reveals patterns that extend beyond this standard finding. Quantitative results indicate that multiple semantic dimensions – size in addition to shape – are at play in the representation of the words. *Kikis* and *taketes* are both spikier and smaller than *boubas* and *malumas*. Critically, the salience of the shape dimension varies between the two contexts: unrounded words are depicted as spikier as a symbol than as a creature. Thus, the representations that people draw are modulated by context, not just with respect to superficial details, but to the very feature of shape that is under test in standard shape-sound symbolism experiments.

The effect of context on the salience of the shape and size dimensions was also evident in participants' descriptions of their drawings, which referred to key differences between representations of the words in the different scenarios. References to size were far more common in participants' explanations for creatures, whereas this dimension was scarcely mentioned with respect to symbols. Thus, size appears to be a more salient semantic feature of creatures than company logos. In contrast, descriptions of symbols focused much more on shape. Thus, we see how context can modulate sound symbolism, drawing attention to different semantic dimensions depending on their relevance.

Critical readers will note that while our study aims to examine sound symbolism, participants based their drawings on written prompts. Therefore, there is the potential that their drawings were influenced by the orthographic shapes of the words, a possibility that is amplified by research showing that, even with auditory stimuli, orthography can play a major role in the kiki-bouba effect (Cuskley et al., 2017). To investigate this possibility in our results, we coded participants' explanations of their drawings for whether they directly mentioned the orthography and the sound of words as motivation. Of the 49 participants (who had not heard of the kiki-bouba effect), 32 suggested that word-sound alone influenced the appearance of their drawings, while only three suggested that orthography alone had an influence and four referred to word-sound in combination with orthography. These data suggest that participants generally had the intuition that they were attending mainly to the sound of the words. Whether this is true is to be determined in future work, in which we plan to compare our results to the vocal presentation of the words.

In this study, we have presented a critique of the theoretical bias that is introduced by an experimental design that operationalizes comprehension as mapping words to discrete meanings along narrow semantic dimensions. For the purpose of demonstration, we have focused on the classic kiki-bouba effect because of its widely cited influence in sound symbolism research (Lockwood &

Dingemanse, 2015). There is, of course, a great deal of varied work on sound symbolism, in methodology, as well as in the phenomena of study (Motamedi et al., 2019). Sound symbolism goes far beyond visual shapes, with experiments finding that people associate different phonemes with properties related to dimensions like brightness, taste, speed, and precision, to name a few (Lockwood & Dingemanse, 2015). In some experiments, participants are able to modulate the meaning space in their response, for example, adjusting the speed of a moving ball (Cuskley, 2013), and recent work has also elicited sound-symbolic drawings (Davis et al., 2019). Other experiments test large sets of word stimuli varying in phonetic properties (Ahlner & Zlatev, 2011), and present participants with large batteries of semantic dimensions (Monaghan & Fletcher, 2019; Klink, 2000; Westbury et al., 2018). Experiments also test the comprehensibility of real words in foreign languages, typically using translations of the words as alternative responses (Brown et al., 1956; Dingemanse et al., 2016). And still others investigate sound symbolism in the process of learning novel words (Nielsen & Rendall, 2012), including whether sound-symbolic labels help to categorize different stimuli (Lupyan & Casasanto, 2015). There is also considerable work examining sound symbolism across development (Kantarzis et al., 2011) and across cultures (Bremner et al., 2013). Yet, while this various research is highly informative, it still tends to operationalize comprehension of sound symbolism as a discrete mapping between the form of a word and its meaning or referent.

Our study builds on the premise that the evolution of language is, at its core, a creative process. Therefore, in order to understand the function of sound symbolism in language origins (e.g. the formation of words), we reason that it is important to examine its creative aspects. Indeed, the creative nature of sound symbolism is well documented outside of experiments on the kiki-bouba effect and the comprehension of sound symbolism. Studies of natural language use, particularly those in a multimodal framework, highlight the rich ways that sound symbolism manifests in human communication – although it is often discussed in somewhat different terms, e.g. demonstration, depiction, ideophones, mimicry, and iconicity (e.g. Clark, 2016; Dingemanse, 2013; Kendon, 2017; Laing, 2019; Lewis, 2009).

In this light, we hope that this simple demonstration – a drawn replication of Köhler's classic experiment – has illustrated some of the creative aspects of sound symbolism that are obscured in the standard kiki-bouba paradigm. Critically, this approach, rather than formulating comprehension as a discrete mapping between forms and meanings, emphasizes the construction of meaning in context. We suggest that this kind of creativity might have been crucial to the formation of the first words, during a period when early humans could not rely on a well-established system of vocal symbols.

References

Ahlner, F., & Zlatev, J. (2010). Cross-modal iconicity: A cognitive semiotic approach to sound symbolism. *Sign Systems Studies, 38*(1/4), 298–348.

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. Journal of Statistical Software, (67), 1–48.

Bergen, B. K. (2012). *Louder Than Words: The New Science of how the Mind Makes Meaning.* Basic Books.

Bremner, A.J., Caparos, S., Davidoff, J., de Fockert, J., Linnell, K. J., & Spence, C. (2013). "Bouba" and "Kiki" in Namibia? A remote culture make similar shape–sound matches, but different shape–taste matches to Westerners. *Cognition, 126*(2), 165–172.

Brown, R.W., Black, A.H., & Horowitz, A.E. (1955). Phonetic symbolism in natural languages. *Journal of Abnormal Psychology, 50*(3), 388–393.

Clark, H. H. (2016). Depicting as a method of communication. *Psychological Review, 123*(3), 324–347.

Cuskley, C., & Kirby, S. (2013). Synesthesia, Cross-Modality, and Language Evolution.

Cuskley, C., Simner, J., & Kirby, S. (2015). Phonological and orthographic influences in the bouba–kiki effect. *Psychological Research*, 1–12.

Davis, C.P., Morrow, H.M., & Lupyan, G. (2019). What does a horgous look like? Nonsense words elicit meaningful drawings. *Cognitive Science, 43*.

Dingemanse, M. (2013). Ideophones and gesture in everyday speech. Gesture, 13(2), 143–165.

Dingemanse, M., Schuerman, W., Reinisch, E., Tufvesson, S., & Mitterer, H. (2016). What sound symbolism can and cannot do: Testing the iconicity of ideophones from five languages. *Language, 92*(2), e117–e133.

Hostetter, A.B., & Alibali, M.W. (2008). Visible embodiment: Gestures as simulated action. Psychonomic Bulletin & Review, 15(3), 495–514.

Imai, M., & Kita, S. (2014). The sound symbolism bootstrapping hypothesis for language acquisition and language evolution. *Philosophical Transactions of the Royal. Society B, 369*(1651), 20130298.

Imai, M., Miyazaki, M., Yeung, H.H., Hidaka, S., Kantartzis, K., Okada, H., & Kita, S. (2015). Sound Symbolism Facilitates Word Learning in 14-Month-Olds. *PLOS ONE, 10*(2), e0116494.

Kendon, A. (2017). Reflections on the "gesture-first" hypothesis of language origins. *Psychonomic Bulletin & Review, 24*(1), 163–170.

Klink, R.R. (2000). Creating Brand Names With Meaning: The Use of Sound Symbolism. *Marketing Letters, 11*(1), 5–20.

Kohler, W. (1970). *Gestalt Psychology: The Definitive Statement of the Gestalt Theory (2nd Revised edition edition)*. New York: Liveright.

Lewis, J. (2009). As well as words: Congo Pygmy hunting, mimicry, and play. In R. P. Botha & C. Knight (Eds.), *The Cradle of Language*. Oxford University Press USA - OSO.

Lockwood, G., & Dingemanse, M. (2015). Iconicity in the lab: A review of behavioral, developmental, and neuroimaging research into sound-symbolism. *Frontiers in Psychology*, *6*.

Lupyan, G., & Casasanto, D. (2015). Meaningless words promote meaningful categorization. *Language and Cognition*, *7*(2), 167–193.

Monaghan, P., & Fletcher, M. (2019). Do sound symbolism effects for written words relate to individual phonemes or to phoneme features? *Language and Cognition*, 1–21.

Motamedi, Y., Little, H., Nielsen, A., & Sulik, J. (2019). The iconicity toolbox: Empirical approaches to measuring iconicity. *Language and Cognition*, 1–20.

Perlman, M., & Gibbs Jr, R.W. (2013). Sensorimotor simulation in speaking, gesturing, and understanding. In C. Müller, A. Cienki, E. Fricke, S. Ladewig, D. McNeill, & S. Tessendorf (Eds.), *Body—Language—Communication: An International Handbook on Multimodality in Human Interaction* (Vol. 1, pp. 512–533). De Gruyter, Inc.

Perniss, P., & Vigliocco, G. (2014). The bridge of iconicity: From a world of experience to the experience of language. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *369*(1651).

Quine, W.V.O. (1960). *Word and object*. Cambridge, MA: MIT Press.

R Core Team. (2014). R: A Language and Environment for Statistical Computing. Retrieved from http://www.R-project.org/

Ramachandran, V.S., & Hubbard, E.M. (2001). Synaesthesia–a window into perception, thought and language. *Journal of Consciousness Studies*, *8*(12), 3–34.

Sperber, D., & Wilson, D. (1986). Relevance: Communication and cognition (Vol. 142). Harvard University Press Cambridge, MA.

Styles, S.J., & Gawne, L. (2017). When Does Maluma/Takete Fail? Two Key Failures and a Meta-Analysis Suggest That Phonology and Phonotactics Matter. *I-Perception*, *8*(4), 2041669517724807.

Sulik, J. (2018). Cognitive mechanisms for inferring the meaning of novel signals during symbolisation. *PLOS ONE*, *13*(1), e0189540.

Thompson, P.D. & Estes, Z. (2011). Sound symbolic naming of novel objects is a graded function. *Quarterly Journal of Experimental Psychology*, *64*, 2392-2404.

Vigliocco, G. & Kita, S. Language-specific properties of the lexicon: Implications for learning and processing. *Language and Cognitive Processes*, *21*, 790-816.

Westbury, C., Hollis, G., Sidhu, D.M., & Pexman, P.M. (2018). Weighing up the evidence for sound symbolism: Distributional properties predict cue strength. *Journal of Memory and Language, 99*, 122-150.