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Compound Words Reflect Cross-Culturally Shared Bodily Metaphors

Kevin J. Holmes,[a] Stephen J. Flusberg,[b] Paul H. Thibodeau[c]

[a]*Department of Psychology, Colorado College*
[b]*Department of Psychology, SUNY Purchase College*
[c]*Department of Psychology, Oberlin College*

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Abstract

Parts of the body are often embedded in the structure of compound words, such as *heartbreak* and *brainchild*. We explored the relationships between the semantics of compounds and their constituent body parts, asking whether these relationships are largely arbitrary or instead reflect deeper metaphorical mappings shared across languages and cultures. In three studies, we found that U.S. English speakers associated the English translation equivalents of Chinese compounds with their constituent body parts at rates well above chance, even for compounds with highly abstract meanings and even when accounting for the semantic relatedness of the compounds and body parts. English speakers in India and Chinese speakers in Hong Kong showed similar intuitions about these associations. Our results suggest that the structure of compound words can provide insight into cross-culturally shared ways of connecting meaning to the body.

Keywords: Metaphor; Embodiment; Concepts; Word meaning; Chinese

1. Introduction

Many common idiomatic expressions refer to parts of the body metaphorically. We may have a *knee-jerk reaction*, keep a *stiff upper lip*, or get a *foot in the door*. Body parts can also be embedded in the structure of individual words. We may admire an artist's *handiwork*, experience *heartbreak*, or invest in an entrepreneur's *brainchild*. In compound words like these, a body part morpheme forms one element of a larger semantic unit. For some compounds, the meaning of the entire word seems intuitively related to its constituent body part (e.g., *heartbreak*), but for others, the conceptual link between

Correspondence should be sent to Kevin J. Holmes, Department of Psychology, Colorado College, 14 E. Cache La Poudre St., Colorado Springs, CO 80903. E-mail: kjholmes@coloradocollege.edu

compound and body part, if any, is less obvious. For example, the meaning of *browbeat* (to intimidate or coerce) does not seem related to the body part *brow*; although a connection might be imagined (e.g., representing coercion as physically striking someone's brow), its validity could well be illusory (Keysar & Bly, 1995).

Beyond isolated examples, what is the more general relationship between compounds and their constituent body parts in a given language? On one hand, the inclusion of specific body parts in compounds may be largely arbitrary—perhaps a relic of idiosyncratic mental associations held by past speakers, but little more than "dead metaphors" in the minds of current ones (Pinker, 2007). On the other hand, the concepts denoted by compounds may be metaphorically related to their constituent body parts even in current speakers' minds, reflecting deeper patterns of thinking shared across speakers of different languages and cultures (Kövecses, 2005; Yu, 2008). To distinguish these possibilities, we examined U.S. English speakers' intuitions about associations between concepts and body parts derived from compounds in an unfamiliar language: Chinese. We also compared these intuitions to those of people from other linguistic and cultural backgrounds, including native Chinese speakers and English speakers in another culture (India).[1]

1.1. Bodily metaphors or arbitrary associations?

Across languages, the body serves as a rich source domain for metaphorically structuring many abstract concepts, including government (e.g., "the *long arm* of the law"), self-control (e.g., "get a *grip*"), thinking (e.g., "these ideas are hard to *swallow*"), and emotion (e.g., "she has *cold feet*"; Gibbs, 1994; Lakoff & Johnson, 1999). Research on historical patterns of semantic change suggests that the meanings of body part words become more abstract over time, yet remain metaphorically related to their original physical meanings. For example, the English word *heart*, which initially referred only to the bodily organ and its physical functions, later came to be used metaphorically to describe emotions such as love, excitement, and fear that can affect the heart's blood-pumping (e.g., "my *heart* leaps for you"; Sweetser, 1991). Cognitive linguists have observed both similarities and differences across languages in the body's role as a metaphorical source domain, suggesting that universal embodied experiences may be filtered through the lens of culture to generate a wide range of conceptual metaphors (Kövecses, 2005; Yu, 2008).

At first glance, compound words containing body part morphemes might seem to express bodily metaphors that are cross-culturally shared. For example, the word *brainchild* could be said to convey the ingenuity of one's idea by linking this concept to the brain, the seat of intelligence in many cultures (and in the cognitive sciences). However, this metaphorical analysis of the word's structure may not reflect the actual mental representation of the concept to which the word refers. Instead, it may simply represent a post hoc attempt to explain why *brain* (and not any other body part) appears in the compound —a kind of just-so story (Keysar & Bly, 1995; Murphy, 1996). A similar critique may be levied at any claim about conceptual representation that rests solely on observations of linguistic patterns (Casasanto, 2009).

To address this concern, cognitive scientists have gathered evidence showing that linguistic patterns are mirrored by corresponding patterns in nonlinguistic thinking. One approach is to show that people's behavior in nonlinguistic tasks converges with linguistic patterns. For example, several studies have revealed that people implicitly associate emotional valence with vertical space when processing nonlinguistic stimuli (such as pictures or locations on a map) in a manner consistent with linguistic metaphors for valence (e.g., "she's *high* on life, but he's *down* in the dumps"; Brunyé, Gardony, Mahoney, & Taylor, 2012; Crawford, Margolies, Drake, & Murphy, 2006; Flusberg, Shapiro, Collister, & Thibodeau, 2016). Such findings suggest that the linguistic expressions are not merely dead metaphors, but rather reflect active metaphorical representations in nonlinguistic thought.

Another approach is to show that people's processing of stimuli presented in one language corresponds to patterns of thinking suggested by another language. For example, in one study (Boroditsky, Schmidt, & Phillips, 2003), speakers of grammatical gender languages (Spanish and German) showed better memory for object names paired with proper names (e.g., apple-Patrick) when the gender of the proper name matched the grammatical gender of the object name in participants' native language—even though they were tested in English, which lacks grammatical gender. This cross-linguistic method goes beyond purely linguistic analyses by showing that people think in ways that align with the structure of a particular language even when not using that language.

We adapted the latter approach to investigate whether compound words express (a) deep-seated bodily metaphors shared across cultures, or (b) arbitrary or culture-specific associations between concepts and body parts. Unlike the grammatical gender work, in which the linguistic patterns of interest (object–gender associations) came from participants' native language (Boroditsky et al., 2003), we investigated whether people's intuitions about concept-body part associations align with the actual associations found in the compounds of an *unfamiliar* language spoken in a different culture. A substantial degree of alignment would suggest that the attested associations are not arbitrary or culture-specific, but rather reflect metaphorical mappings shared across languages and cultures.

In three studies, we examined which body parts native English speakers in the United States associate with words and phrases whose translation equivalents in Chinese were compounds containing body part morphemes. Chinese is a highly analytic language with morphemes that are unbound and relatively transparent in meaning (Packard, 2000). However, as in English, the meaning of a Chinese compound is not always obvious from the meanings of its constituents (e.g., *xincai* (心裁) translates to "idea," yet its individual morphemes mean "heart" and "cut").

If compounds and their constituent body parts are related arbitrarily or based on culture-specific concepts, Chinese-naïve English speakers should be no more likely to associate the meanings of Chinese compounds (translated into English) with their constituent body parts than with any other body part. However, if the relationships between compounds and their constituent body parts reflect shared bodily metaphors, Chinese-naïve English speakers should associate the meanings of Chinese compounds with their constituent body parts at above-chance rates. To preview, our first two studies support the latter prediction.

In our final study, we sought further evidence that the bodily metaphors expressed in compounds are cross-culturally shared, and not specific to U.S. English speakers. To do this, we compared U.S. English speakers' intuitions about concept-body part associations to those of native Chinese speakers in Hong Kong and of English speakers in India. If the bodily metaphors encoded in Chinese compounds are truly cross-culturally shared, all groups should associate the meanings of the compounds with their constituent body parts at above-chance rates, and comparably across groups. Our results support this prediction as well.

2. Study 1

In our first study, U.S. English speakers were asked simply to name the body part most closely associated with a given word or phrase, which (unbeknownst to them) was translated from a Chinese compound. We used this free-response method to examine the extent to which people's spontaneous concept–body part associations match those encoded in an unfamiliar language's compounds.

2.1. Method

2.1.1. Participants

Fifty English-speaking U.S. adults (46% female; M_{age}: 35) were recruited from Amazon Mechanical Turk (Buhrmester, Kwang, & Gosling, 2011). None reported knowledge of Chinese. Sample sizes in all of our studies were chosen to ensure reliable point estimates of the proportion of English words and phrases for which participants generated (Study 1) or selected (Studies 2–3) the body part in the corresponding Chinese compound, for comparison against chance-level response rates (Simmons, Nelson, & Simonsohn, 2011).

2.1.2. Materials

Using the Pleco Chinese Dictionary (developed from the widely used Oxford Concise English-Chinese Chinese-English Dictionary; http://www.pleco.com), we selected six body part morphemes that appear frequently in Chinese words and phrases: *heart* (心), *head* (头), *mouth* (口), *eye* (目), *hand* (手), and *foot* (脚). For each, we reviewed a dictionary-provided list of all two-morpheme Chinese compounds containing that morpheme and selected 20 that were semantically representative of the full list (e.g., both concrete and abstract meanings, both mono- and multi-morphemic phrases when translated into English), as judged by a fluent Chinese speaker. This selection process mitigated any bias by the English-speaking experimenters to select items that were more related (metaphorically and/or semantically) to their corresponding body parts than the typical Chinese compound. The resulting 120 items are listed in Appendix S1 (all materials and data are archived at https://osf.io/hfvn6/).

To examine possible predictors of participants' responses, two additional groups of participants rated the 120 items (presented in English) on concreteness (n = 49) or imageability (n = 52) on a 7-point scale (1 = highly abstract/difficult to form an image, 7 = highly concrete/easy to form an image; Altarriba, Bauer, & Benvenuto, 1999). Because the two dimensions were highly correlated, $r = .87$, $p < .0001$, we averaged them to generate a composite *concreteness* score for each item (see Appendix S1 for scores by item).

2.1.3. Procedure

Participants were presented with the 120 English items in a randomized order and were asked to freely generate the body part most closely associated with each one. Two examples were provided ("throwing": *arm*; "to love someone": *heart*). The instructions noted that many of the items were abstract and not obviously associated with body parts, but that participants should name the body part that seemed most intuitive or came to mind most easily.

2.2. Results and discussion

For each participant, we computed the proportion of *matches*: items for which the body part generated by the participant matched the one in the corresponding Chinese compound (e.g., generating "heart" for *in a good mood*, for which the Chinese translation—*xinshun* (心顺)—contains the *heart* morpheme). For items with the *head* morpheme, "brain" and "mind" (which our American participants presumably believed to be in the head) were considered matches; for all other items, only the associated body part (or a plural variant; e.g., "feet") was considered a match.

Across participants, the mean proportion of matches was .24 ($SD = .07$) and was greater than .15 for all six body part morphemes. For 65 of the 120 items (54%), the matching body part was generated by more than 15% of participants (see Appendix S1 for results by item). For 58 items (48%), the matching body part was generated more frequently than any of the other five body parts represented by our items. For 47 items (39%), the matching body part was generated more frequently than any other body part.

Across items, the proportion of matches was not correlated with the concreteness of the concepts ($r = .01$), suggesting that the matching body part was no more likely to be generated for concrete items than abstract ones. Indeed, for the 40 most abstract items (1/3 of total), the match rate was .23, comparable to the overall mean. Thus, even some of the most abstract concepts encoded by Chinese compounds—those that do not literally involve the body (e.g., *impetus*, *soul*)—were spontaneously mapped by Chinese-naïve English speakers to their matching body parts in Chinese.

These results provide initial evidence that the structure of compound words reflects shared bodily metaphors rather than arbitrary associations. For a sizeable proportion of the concepts represented by our items, U.S. English speakers' freely generated body parts matched the concept-body part associations encoded in Chinese compounds. Although these results are suggestive of shared bodily metaphors, it is unclear from the free-response task of Study 1 whether the observed match rate was greater than expected by nonmetaphorical factors. Participants might, for example, select at random from among the relatively small number of body parts likely to be regarded as plausibly related to a given concept. Or they might rely on their implicit knowledge of the distributional properties of English, generating the body part most semantically related to a given concept based on contextual similarity alone. Our next study addressed these possibilities by using a forced-choice paradigm to test whether participants' match rates exceeded those expected by random selection and by semantic relatedness.

3. Study 2

In Study 2, U.S. English-speaking participants were asked to select which of several body parts was most closely associated with the concepts used in Study 1. We compared participants' rates of selecting the matching body part to those expected by (a) random selection from the options provided and (b) selection based on the semantic relatedness of the concept and body part terms, obtained from latent semantic analysis (LSA) of word co-occurrences in a corpus of English text (Landauer & Dumais, 1997).

3.1. Method

3.1.1. Participants

Eighty-seven English-speaking U.S. adults (48% female; M_{age}: 37) were recruited on Amazon Mechanical Turk. None reported knowledge of Chinese.

3.1.2. Materials and procedure

Participants were presented with the 120 items from Study 1 in a randomized order and were asked to decide which of the six body parts (presented in the top row of a matrix table) was most closely associated with each item. The left-right order of the body parts was counterbalanced across participants. Participants were instructed to select the body part that seemed most intuitive or came to mind most easily from among the six options, even if they felt that none of them was necessarily a good choice.

3.2. Results and discussion

The mean proportion of matches was .33 (SD = .08). This match rate was roughly twice the value expected by random selection from six alternatives (.167) and differed significantly from that value, $t(86) = 19.39$, $p < .0001$, $d = 2.08$. The proportion of matches was significantly higher than expected by random selection for each of the six body parts (ps < .0001; see Fig. 1) and for 96 of the 120 items (80%; χ^2s > 4.65, ps < .05; see Appendix S1 for results by item in Studies 2 and 3 combined). Across items, match rates were positively correlated with those of the free-response task of Study 1, $r(118) = .85$, $p < .0001$, suggesting that the two tasks tapped similar intuitions about concept–body part associations.

To assess whether participants' choices could be explained by semantic relatedness, we first obtained an LSA-based measure of contextual similarity for all pairwise

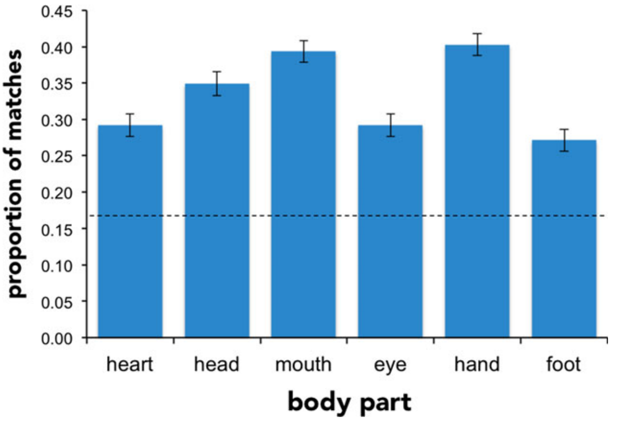

Fig. 1. Mean proportion of matches by body part in Study 2. The dashed line indicates the value expected by random selection. Error bars represent SEM.

combinations of the 120 concepts and six body part terms from the LSA website (http://lsa.colorado.edu), yielding six similarity values for each concept (one for each body part) ranging from −1 to 1. This value indicates the likelihood that the body part term appears in the same linguistic context as the word or phrase denoting the concept. Across items, the contextual similarity of the matching body part (M = .18, SD = .12) was significantly higher than the mean contextual similarity of the other five alternatives (M = .16, SD = .10), $t(119) = 2.02$, $p = .049$, $d = .19$. These results suggest that the English translations of Chinese compounds are more semantically related to their constituent body parts than to other body parts.[2]

We then tested whether this LSA-based measure of semantic relatedness could account for participants' match rates. We operationalized selection for each item based on semantic relatedness alone as the contextual similarity of the matching body part term divided by the sum of the similarity values of all six body part terms for that item (see LSA column in Appendix S1). A by-item analysis indicated that participants' match rates were significantly higher than expected by semantic relatedness (M = .18), $t(119) = 6.68$, $p < .0001$, $d = .68$, suggesting that semantic relatedness cannot fully account for participants' judgments.

Across items, the proportion of matches was not correlated with concreteness ($r = -.06$). For the 40 most abstract items, the match rate was .34, comparable to the overall mean and indicating that above-chance selection of the matching body part was not limited to concepts that literally involve the body.

These results provide further evidence that compound words reflect shared bodily metaphors. Even for highly abstract concepts, participants selected the matching body part significantly more often than expected by random selection or semantic relatedness. These results extend the findings of Study 1 by showing that nonmetaphorical factors cannot account for participants' selections. However, both studies included only U.S. English speakers. If compound words truly reflect shared bodily metaphors, speakers of other languages and cultures should perform similarly. Testing other populations raises an additional possibility: that the concept-body part associations encoded in a language's compounds, while intuitive to people unfamiliar with the language, are even more intuitive to native speakers, for whom the associations are habitually reinforced (Dolscheid, Shayan, Majid, & Casasanto, 2013; Holmes, Moty, & Regier, 2017). Accordingly, our final study investigated both the cross-cultural robustness of our findings and the possibility of heightened sensitivity to concept-body part associations in speakers of a language in which those associations are codified in compounds (i.e., native Chinese speakers).

4. Study 3

In Study 3, we compared intuitions about concept-body part associations in English speakers in the United States, English speakers in India, and native Chinese speakers in Hong Kong, using the forced-choice task from Study 2. All groups were tested in English, precluding any differences in stimuli or instructions that might account for the results (Boroditsky et al., 2003).

4.1. Method

The U.S. English speakers (n = 74; 66% female; M_{age}: 20) and Hong Kong Chinese speakers (n = 76; 38% female; M_{age}: 20) were undergraduates at SUNY Purchase College and Lingnan University, respectively. The Indian English speakers (n = 89; 74% female; M_{age}: 32) were recruited on Amazon Mechanical Turk. Most of the U.S. participants (97%) were native English speakers, and most of the other participants (Indian: 61%; Chinese: 92%) were nonnative English speakers. No U.S. or Indian participants reported knowledge of Chinese. All participants completed the forced-choice task from Study 2.

4.2. Results and discussion

Across groups, the mean proportion of matches (.29; SD = .08) was significantly higher than expected by random selection overall, $t(238) = 24.15$, $p < .0001$, $d = 1.56$, for each of the six body parts (ps < .0001; see Fig. 2), and for 73 of the 120 items (61%; χ^2s > 4.45, ps < .05; see Appendix S1). Match rates were also significantly higher than expected by semantic relatedness (assessed using LSA as in Study 2), $t(119) = 6.65$, $p < .0001$, $d = .65$.

In addition to these overall effects, a one-way ANOVA on match rates by group revealed significant group differences, $F(2, 236) = 8.45$, $p < .001$, $\eta_p^2 = .07$. Contrary to the possibility that Chinese speakers are especially sensitive to the associations encoded in Chinese compounds, the U.S. English speakers had significantly higher match rates than either of the other groups (ps < .001), which did not differ significantly ($p > .6$). As shown in Fig. 2, group differences were observed for all but the *heart* items, perhaps due to greater knowledge of semantic relatedness in the U.S. native English speakers (see

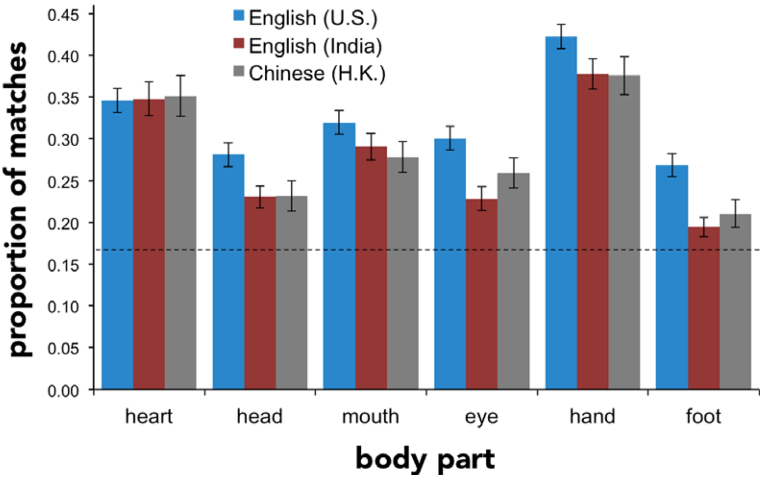

Fig. 2. Mean proportion of matches by group and body part in Study 3. The dashed line indicates the value expected by random selection. Error bars represent SEM.

General Discussion). Nevertheless, the match rates of the Indian (M = .27) and Chinese (M = .28) groups were significantly higher than expected by random selection or semantic relatedness (all ps < .0001), and the match rates of all three groups were highly correlated across items (all rs > .8), indicating substantial cross-group agreement.

Once again, the proportion of matches was not correlated with concreteness (r = −.07). For the 40 most abstract items, the match rate was .30, comparable to the overall mean. These results show that our findings apply not only to U.S. English speakers, but also to speakers of other languages and cultures. All groups selected the matching body part significantly more often than expected by nonmetaphorical factors, providing further evidence that compounds reflect shared bodily metaphors.

5. General discussion

The body offers a rich source domain for talking about everything from *mouths* of rivers and *legs* of tables to more complex notions like getting something *off your chest* or having a *nose for mystery*. Indeed, many useful words have been generated by combining a body part with another morpheme to create a new semantic unit, like *armchair, foothill*, and *heartstring*. In three studies, we used a cross-linguistic method to investigate whether compound words like these reflect bodily metaphors shared across speakers of different languages and cultures.

We found that U.S. English speakers associated the English translations of 120 Chinese compounds with their constituent body parts more frequently than other body parts in a free-response task, and at rates well above chance in a forced-choice task, even for compounds with highly abstract meanings (e.g., *moral purity*, *pretext*). English speakers in

India and Chinese speakers in Hong Kong also had above-chance match rates, albeit lower than those of the U.S. participants. This group difference may simply reflect greater knowledge of the distributional properties of English in our majority native-English U.S. group, offsetting any heightened sensitivity to the Chinese-based associations in Chinese speakers—a limitation of testing all participants in English. Importantly, all groups selected the matching body part at rates above and beyond that expected by the semantic relatedness of the concept and body part terms in our English stimuli, as measured by LSA. These results indicate that participants' selections, though perhaps driven in part by knowledge of language statistics, were based on more than such knowledge—namely, we suggest, on cross-culturally shared metaphorical mappings between concepts and the body that are manifested in the compound words of Chinese.[3]

How are these shared mappings mentally represented? One possibility is that the mappings constitute implicit associations stored in long-term memory, perhaps instantiated as sensorimotor simulations involving specific body parts (Glenberg & Kaschak, 2002). Indeed, even abstract mentalistic words (e.g., *thought*, *logic*) have been found to activate face motor areas of the brain (Dreyer & Pulvermüller, 2018), possibly because they recruit the embodied mechanism of inner speech (Borghi & Zarcone, 2016). However, our results do not necessarily imply the existence of stored representations. Another possibility is that participants constructed mappings on the fly by relying on prior embodied experience to infer the similarity between concepts and body parts (Bowdle & Gentner, 2005). From this perspective, our tasks may be seen as mirroring the process by which body-based compounds are formed in a language; that is, an individual faced with generating or selecting a body part for a target concept may rely on the same sensorimotor-based knowledge considered by entire language communities when settling on a conventionalized word for the concept (Boster, 1986). In this way, our findings suggest that metaphorical mappings embedded in the structure of a language's compounds are also reflected in the cognitive strategies by which speakers of different languages connect meaning to the body. These results offer new insights into the universality of (and variation in) bodily metaphors across cultures that go beyond evidence based on linguistic analyses alone (e.g., Kövecses, 2005; Yu, 2008).

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Notes

1. Following Lakoff and Johnson (1980), we consider any mapping (in current speakers' minds) between body parts and concepts that do not literally involve body

parts to be metaphoric in nature. Our studies explore the cross-cultural consistency of such mappings, but not how the mappings originally came to be encoded in any particular language's compounds (e.g., arising from metaphor and/or nonmetaphoric forces such as metonymy).

2. The contextual similarity of concepts and their Chinese-associated body parts in English might itself be driven by shared bodily metaphors. However, without non-linguistic corroboration, this claim is subject to the same critique of linguistic evidence discussed in the Introduction.
3. Although we suggest that many concept-body part mappings are shared across cultures (and may be expressed in compounds or other linguistic devices), others are clearly culture-specific (e.g., the association between thinking and the mid-torso in Japanese Sign Language; Wilcox, 2005).

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Appendix S1. Proportion of matches, LSA values, and mean concreteness scores by item, listed in order of increasing concreteness for each body part.