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Comment

Abstract meanings may be more dynamic, due to their sociality Comment on "Words as social tools: Language, sociality and inner grounding in abstract concepts" by Anna M. Borghi et al.

J. Ben Falandays, Michael J. Spivey *

Cognitive and Information Sciences, University of California, Merced, United States of America

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Borghi et al. [1] present a convincing and comprehensive review of diverse evidence that urges the field to reconsider a perspective that is often overlooked: That concepts and language are as much a social phenomenon as a mental one. Their treatment draws on important insights that have survived decades [2], as well as on new insights availed by cognitive neuroscience [3]. As Borghi et al. uncover the exceptional reliance of abstract concepts on *social* aspects of language use, we suggest that representations for abstract meanings may be more flexible and dynamic than for concrete meanings.

While the authors trace their thesis back to Wittgenstein [2], parallels can also be found in the tradition of Lev Vygotsky, dating back to the 1930's. Vygotsky [4] argued that language begins as a means for influencing others, and is only later internalized as a means of influencing the self in the form of "inner speech." Consider, for example, an account of the development of referential pointing in children, offered by A.N. Leontiev (Vygotsky's student). He saw the gesture starting out as a grasping motion towards an out-of-reach object, but when the parent comes to the rescue, the movement begins to transform into a social indicator; an object-directed action becomes an other-directed action [5]. Hence, the concept eventually internalized by the child is grounded only by virtue of the response it elicits in the social realm.

It is a shame that this perspective did not catch on earlier in cognitive science, since the field has now traced a long and circuitous path back to quite similar insights. The more mainstream work in linguistics and psycholinguistics for decades began with virtual disregard for social or contextual factors, in both abstract and concrete language use. After Vygotsky and Wittgenstein, philosophers of language and experimental psycholinguists began to grapple with abstract and figurative language in the laboratory. For example, in response to Searle's [6] suggestion that when you hear an idiom (such as "kick the bucket") it must first be understood literally and concretely before it can then be re-understood as figurative and abstract, Gibbs [7] reported evidence for more or less direct access to the abstract figurative meaning in the right context. Careful analysis of the real-time dynamics of these abstract figurative meanings eventually revealed that the incremental word-by-word comprehension of a sentence allowed for direct access of the figurative meaning for some idioms (e.g., "in seventh heaven") and a more parallel access of both meanings for

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* Corresponding author.
E-mail address: spivey@ucmerced.edu (M.J. Spivey).

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other idioms (e.g., "landed on his feet"). Thus, rather than context-free word meanings getting "accessed" and then secondarily modified by context, perhaps context and word meaning are processed together at the same time [8–12].

Having accepted that figurative language processing has a more articulated time course than Searle [6] first imagined, the field moved to testing for embodied effects of those figurative/abstract meanings of phrases, with mixed results. For example, some reports found evidence that both concrete and abstract verbs activate visuospatial representations [13,14], whereas others observed no such embodied effects in the case of abstract language [15]. The neuroimaging results are equally mixed. For example, some have found somatotopic activation from non-literal uses of action verbs [16], whereas others have found no recruitment of sensorimotor cortex in figurative language processing [17,18]. Borghi et al. offer part of an explanation for these mixed findings: Abstract figurative language may be grounded *differently* than concrete literal language, and perhaps we have been looking in the wrong places. But if we accept Borghi et al.'s proposal that abstract concepts have a different developmental trajectory than concrete concepts, we must also admit the possibility that the respective representations may diverge or converge over intermediate and short timescales as well.

Indeed, work on the neural career of literal and metaphorical phrases supports the view that sensorimotor grounding is dependent upon both context and familiarity. Desai and colleagues [19,20] found that activation of primary motor cortex in response to the *same* action verbs decreased as the sentential context went from concrete to abstract, and that activation in response to abstract contexts was negatively correlated with participants' familiarity with the phrase. The authors suggest that conventionalization of abstract language results in a gradual detachment from sensorimotor representations. Zwaan [21] offers a framework for understanding dynamics in the grounding of concepts, whereby the degree to which referents are embedded in the immediate environmental context determines the degree of sensorimotor grounding required to process them. Results suggest that the representations of abstract concepts (and possibly their recruitment of sensorimotor brain regions) may be quite dynamic, and that we cannot ask where or how words and concepts are grounded without considering the current social, environmental, and linguistic context [22].

Borghi et al.'s [1] argument that abstract language may rely more on the sociality of language use (since it has less embodiment to rely on, compared to concrete language use) suggests that language processing may be better studied with dyads and groups (especially in the case of abstract language use), rather than with an individual processing language by herself in a computerized presentation format, as so many psycholinguistic and neurolinguistic experiments do. By studying dyads in unscripted conversation, researchers have found that groups often reshape their language use on-the-fly to generate synchronies and synergies in their behavior. Dyads experience coordination in their utterance formation [23], their postural sway [24], their eye movements [25], their hand and facial movements [26], their joint-perceptual judgments [27], and even in their brain activity [28].

The environmental support for embodied understandings of concrete concepts tends not to change very much over the lifespan of a human and across different cultures and languages. However, the environmental support for socialized understandings of abstract concepts does change a fair bit, as people move from one context to another, from one lifestyle to another, from one culture to another. Those social contexts tend to change in more ways than the embodiment contexts do. Hence, while the embodied concrete concepts are allowed to remain somewhat stable over time and across cultures, the socialized abstract concepts must be more flexible and able to change frequently.

Indeed, this kind of flexibility shows up in recent approaches to conceptual "representation" in general. A traditional way of describing what a mind does when it thinks of a concept is that it "accesses" a fixed symbolic representation from long-term memory and places it into some working memory buffer where it can be combined with context. However, that computer metaphor for the mind has been losing ground in the cognitive and neural sciences for decades [29]. Instead, new proposals involve on-the-fly construction of a conceptual meaning each time it is encountered. Thus, it may be that context and "core meaning" are processed together at the same time – flexibly making each momentary instantiation of a concept into a unique "representation" every time [30,31]. Borghi et al.'s proposal implies that this may be especially true for abstract concepts and abstract language.

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