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Continuing Commentary

Commentary on **Arthur M. Glenberg (1997). What memory is for. BBS 20(1):1–19.**

Abstract of the original article: Let's start from scratch in thinking about what memory is for, and consequently, how it works. Suppose that memory and conceptualization work in the service of perception and action. In this case, conceptualization is the encoding of patterns of possible physical interaction with a three-dimensional world. These patterns are constrained by the structure of the environment, the structure of our bodies, and memory. Thus, how we perceive and conceive of the environment is determined by the types of bodies we have. Such a memory would not have associations. Instead, how concepts become related (and what it means to be related) is determined by how separate patterns of actions can be combined given the constraints of our bodies. I call this combination "mesh." To avoid hallucination, conceptualization would normally be driven by the environment, and patterns of action from memory would play a supporting, but automatic, role. A significant human skill is learning to suppress the overriding contribution of the evironment to conceptualization, thereby allowing memory to guide conceptualization. The effort used in suppressing input from the environment pays off by allowing prediction, recollective memory, and language comprehension. I review theoretical work in cognitive science and empirical work in memory and language comprehension that suggest that it may be possible to investigate connections between topics as disparate as infantile amnesia and mental-model theory.

The problem of content in embodied memory

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Abstract: An action-oriented theory of embodied memory is favorable for many reasons, but it will not provide a quick yet clean solution to the grounding problem in the way Glenberg (1997t) envisages. Although structural mapping via analogical representations may be an adequate *mechanism* of cognitive representation, it will not suffice to explain representation as such.

Content and grounding. Glenberg (1997t) argues that the analogical embodied representations he postulates "do not need to be mapped to the world to be grounded because they arise from the world" (sect. 1.3). We argue that Glenberg's concept of analogical embodied representations does not eliminate the grounding problem in the way he envisages.

This is an important issue because, in the growing literature on embodied cognition, advocates of this approach often misconstrue the consequences of their theory for the grounding problem. One reason for this misconstrual is that, whereas Harnad (1990) poses the grounding problem addressing the idea of formal symbol systems as criticized by Searle (1980), memory theory addresses the general problem of cognitive content or aboutness (how can states of a memory system be about anything at all?) which can be stated *before* any commitments concerning symbol systems are made. We will therefore refer to the problem of *content* to indicate that the symbol grounding problem is just one version of that general problem.

When discussing the problem of content in memory, it is misleading to distinguish symbols from embodied representations exclusively in the context of a narrower symbol grounding problem, as Glenberg does in section 1.1, because *any* representation is symbolic in that it realizes a detonation; that is, it stands for some other entity or state of affairs (Newell 1980). Embodied representations and meaningless symbols (sect. 1.1) are both symbolic in this sense, and because of their common symbolic character they are both entangled in some version of the problem of content.

Grounding and embodiment. In Glenberg's approach, a representation is embodied if it is constrained by how one's body can move itself and manipulate objects (sect. 2.2 of the target article). This view seems to be in accordance with the prevailing concept of embodiment in current cognitive science (Feldman 1997, p. 746; see also Ballard et al. 1997), but the assumption of an analogical structure of cognitive representations does not *follow* from the fact that cognition is somehow constrained by bodily features. The thesis of analogical structures is derived from mental model theory, according to which the structure of cognitive representations corresponds to the structure of what is represented (sect. 6.1). Regardless, it is not true that analogical representations do not need to be mapped onto the world; on the contrary, *every* representation – whether analogical or amodal – requires some sort of mapping in order to represent adequately. When the representation is supposed to be analogical, then there is a structural mapping mediated by certain physiological (and other) mechanisms. But this case differs only in degree from the scenario of an arbitrary symbol theory of cognition such as Fodor's "Representational Theory of Mind" (cf. Fodor 1987) in which there is no structural mapping but rather a functional-causal one, likewise mediated by certain (perhaps insufficient) mechanisms.

Hence, analogical representations are no less symbolic than those of the Representational Theory of Mind; the latter representations are arbitrary only in the relatively weak sense that they are not *structurally* mapped to their external causes (their formal or syntactic features and their causal-functional relationships are by no means arbitrary). This is just a question of *mechanisms* of representation and their theoretical plausibility, not one of arbitrariness versus direct grounding (sect. 1.3).

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Furthermore, even if structural mapping should be the favored mechanism (as there are good reasons to assume), mapping alone will not suffice to establish representation as a cognitively relevant relation (Bickhard & Terveen 1995), for mapping merely establishes *correspondence.* But representation in a cognitive sense requires that this correspondence be (consciously or unconsciously) *recognized by* the cognitive system of which the corresponding item is a part. In less mentalistic terms, within the cognitive system a representational item will need to be processed *as* corresponding to something. What makes a correspondence a cognitive representation is that it is a correspondence *for* the cognitive system of which it is a part (this introduces a teleological component into the approach, a fact that Glenberg himself approves in section R1.1 of his response to the original commentaries; Glenberg 1997r).

Analogical representation may well be the adequate *mechanism* of embodied cognition as part of a theory that will finally solve the problem of content. But it is important to see that the analogical character of the supposed representations is not the key feature that renders any mapping superfluous and solves the problem content by a more direct grounding of these representations. Analogical representational mechanisms can only transport content, not generate it. They merely provide correspondence as such, not correspondence *for* the cognitive system.

Meshing Glenberg's embodied memories with negative priming research on suppression

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Abstract: This commentary examines Glenberg's characterization of "suppression" in light of negative priming and related phenomena. After offering a radically different slant on suppression, an attempt is made to weave this alternative version into Glenberg's provocative discussion of embodied memories.

Citing Lakoff and Johnson (Johnson 1987; Lakoff 1987; Lakoff & Johnson 1980), Glenberg argues in his 1997 *BBS* target article, "What memory is for," that memories are not meaningless propositionally related symbols found in many cognitive theories, but instead "arise from bodily interactions with the world" and thus represent embodied, analogically related representations. In Glenberg's view, suppression is the key to free the mind to engage in the internal processing required for memory operations, and such reflective thought processes as prediction, recollection, and language comprehension. Suppression thus functions as a kind of filter that blocks external input from the environment so that internal processing can occur. From this perspective, suppression is quite similar to strict, early selection, filtering models of attention (Broadbent 1958). The problem with this notion of suppression is that it fails to take into account research findings indicative of more sophisticated suppression mechanisms that function both on internal and external stimuli (e.g., Neumann & DeSchepper 1992; Tipper & Driver 1988).

Glenberg contends that suppression is an "effortful," "dangerous," and "risky operation" because "it loosens the tie between reality (the current environment) and conceptualization" (Glenberg 1997t, sect. 3.4). This pronouncement reflects a longstanding bias against suppression (or inhibition) as an explanatory construct in psychology (Anderson & Spellman 1995). It can be argued, however, that suppression is an elementary processing mechanism integral to the functioning of human memory and is not more dangerous or effortful than activation. In this account, suppression and activation operate synchronously on both internal and external stimuli and play an equal and central role in self-regulatory processes – with each capable of operating on a continuum from more automatic to effortful, depending on the current goals of the perceiver (Neumann & DeSchepper 1991; 1992). Because Glenberg proposes that memory's primary role is to serve perception and the guidance of action, his framework would benefit by not characterizing suppression as something dangerous, instead elevating it to a central position in the core operations of memory. This more benign characterization of suppression emerges from phenomena studied under the rubric of negative priming.

Negative priming occurs when ignoring an object hampers a subsequent response to it, presumably on account of its prior suppression. The mechanism of suppression posited to account for negative priming is typically conceived as a form of active inhibition. In this situation, multiple stimuli compete for processing priority, with some being selected, while others are suppressed. The philosopher Herbart (1834/1891) originally proposed this conception of inter-representational competition as a mechanism to explain the unity and coherence of conscious experience. For Herbart, an inhibitory mechanism existed for the purpose of forcing momentarily irrelevant representations "out of consciousness," thereby preventing the contents of consciousness from becoming disorderly or muddled. Accordingly, suppression is integral to the orchestration of high-level thought processes.

Although investigations of negative priming are currently deemed the best available index for observing the operations of suppression (see e.g., Fox 1995, for a review), observations about the role of suppression have been postulated in other cognitive domains as well. These domains include, but are not limited to, retrieval processes in arithmetic (Campbell & Tarling 1996), memory retrieval (Anderson & Spellman 1995), and language processing (Gernsbacher 1990). In language processing, for example, it appears that a suppression mechanism serves a central regulatory function in processing anaphors, cataphors, and metaphors (Gernsbacher & Jeschenik 1995; Gernsbacher & Keysar 1995); in resolving lexically ambiguous words (Simpson & Kang 1994); and in shifting from one language to another by multilinguals (Neumann et al. 1999). Taken together with studies of negative priming, these findings suggest that suppression is utilized when one mental entity is in a position to conflict with another one, in order to resolve the competition. Through the simultaneous use of activation and suppression processes, perceivers can apparently amplify a target signal while momentarily suppressing unwanted distracting material, thereby enhancing their ability to pull the competing representations (i.e., signal and noise) apart (Houghton & Tipper 1994). Activation and suppression may thus be seen as two basic, ubiquitous, information-processing mechanisms.

If these conjectures regarding suppression have psychological reality, they should be able to generalize to Glenberg's embodied memory framework if it also has psychological reality. If it is shown that suppression can play a functional role in his framework, then these hypothetical constructs may be deemed mutually reinforcing. What is intriguing is that negative priming studies emphasizing body position and spatial sensibilities demonstrate the "embodiment" of the processes of suppression. An example of this is provided by Tipper et al. (1992).

Tipper et al. (1992) asked subjects to reach for and depress target keys adjacent to red lights while ignoring distractors adjacent to yellow light. Negative priming was produced when the red light landed on a position previously occupied by a yellow light; indicating that in this task suppression was associated with an action-based representation of a three-dimensional environment. Moreover, the magnitude of negative priming depended on the spatial relationship between the distractor and the responding hand; distractors nearest and ipsilateral to the responding hand on the priming trial produced more negative priming on the subsequent trial than distractors in other locations. This supports Glenberg's notion of action-based embodied memories. In this case, it appears that the guided action that makes it possible to avoid obstacles is carried out, at least in part, through suppression of a distracting location. The embodied memory of this action is revealed by subsequent responding, which was clearly constrained by characteri-

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