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-

https://doi.org/10.1017/S0140525X03220148 Published online by Cambridge University Press

zation of the body's (specifically, the hand position's) interaction with the environment. Tapping such regularities in immediate response performance provides insight about how patterns of action mesh with those based on previous experience.

It can be argued that Glenberg's central contention "that perceptual systems have evolved to facilitate our interactions with a real, three-dimensional world" (Glenberg 1997t, sect. 1.3) holds for suppression mechanisms as well. Our evolutionary ancestors spent much of their time navigating forest canopies. In such an environment, efficient branch selection required acute spatial sensibilities and qualitative judgments about color, texture, and form, in order to choose a sound branch and avoid those that were brittle or too thin, and could lead to a precipitous tumble to the ground below. The efficient selection of appropriate branches within the canopy, necessitated rapid initial parallel processing of many branches. Because momentarily unwanted branches are likely to remain so, there would also be an adaptive advantage to implicitly encode and preserve an "unwanted" tag (Neumann & DeSchepper 1992) so that such branches are more likely to be avoided in the future. These examples may be seen "natural" analogs to selective attention tasks in the laboratory. DeSchepper and Treisman (1996; Treisman & DeSchepper 1996) have documented implicit long-term negative priming effects that are clearly indicative of this type of suppressive tagging process in humans. Such studies provide exciting possibilities for fleshing out Glenberg's embodied memory framework.

Clamping and motivation

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Abstract: Arthur M. Glenberg omits discussion of motivation and this leads him to an underestimation of the part played by pleasure and pain and desire and fear in both the clamping and the updating of percepts. This commentary aims at rectifying this omission, showing that mutual correction plays an important role.

One can readily start with Glenberg's frank admission that he has left out "hedonic valence and motivation to act" (Glenberg 1997t, sect. 7.2, p. 17). Meanings are what is embodied and meanings are centrally intentional, whatever portions of the flux, internal or external to the body, are involved in the actions they embrace. As William Epstein, from whom Glenberg has drawn his key distinction of "projectable" and "nonprojectable" properties, has insisted, "an event can only assume symbolic status when it is assigned that status by an agent or process that is endowed with intentionality" (Epstein 1993, p. 705). Both kinds of properties are therefore "endowed with intentionality." This raises an apparent problem because of two of Glenberg's claims (sect. 5.1, p. 10): (1) that the clamped environment is not changed by the embodied memories, and (2) that the promptness of embodied memories in contributing to the conceptualization of the current environment is automatic. The problem is, where does intentionality come in for these two features? I address that issue here, particularly with regard to the clamping of the percepts. The same question arises in Karl F. MacDorman's criticism that Glenberg has failed to "mesh memory with affect" (*BBS*, 20:29) and in Norman H. Anderson's commentary (*BBS*, 20:19–20), which, without pursuing the link with pleasure and pain, notes the omission of goal-directedness of cognition.

With regard to the projectable properties, Glenberg rightly notes that they are habitual – that is, having been established in an evolving manner to serve a purpose, they are maintained as long as that purpose is felt to be sustained. Their "automatic" nature is only an aspect of habit, and, should a clamping register itself with the organism to be maladaptive, then it is immediately subjected to re-jigging; so, though the environment may remain unchanged, the clampings may not. This is, of course, a re-jigging of the memory that is embedded in the perceptual clampings themselves. Glenberg drew attention to the fact that it is precisely because we, like other animals, do not wish to be subjected to "freezing, burning, drowning, falling" (sect. 2.1, p. 4) that the clamping was done in the first place. He therefore wonders what part pleasure and pain have to play (sect. 7.2, p. 17).

What is it that shows a clamping to be maladaptive? The answer, implied in the remarks about freezing, burning, and so forth, is pain. Percepts evolve to their clamping under a regime of value (Edelman 1989; Wright 1985). What clamps a percept is pleasure or pain: these are the motivations that excite the gestalt process, registering in memory whatever is so unified, which may be multiple. Pain marks the percept-memory with fear. *Mutatis mutandis* for adaptive reward: Pleasure excites the gestalt-embedding system, in this case marking the percept-memory with desire.

This marking in both cases is certainly automatic, in that one cannot prevent such a memory-embedding from taking place: One cannot stop immediately beginning to desire a repetition of pleasure, or to fear the repetition of pain – that is indeed automatic. The clamping itself, however, once established, frequently becomes so habitual by repeated confirmations that it can be said to be automatic, as Glenberg says, but only in the sense of being *prompt*. As Glenberg centrally argues, updatings are continually necessary wherever a problematic situation occurs; a new meshing (to use his own term) becomes imperative. And what is it that renders the problem imperative? In the case of aversion it is pain, whether the threat is present or to come. The clamping often emerges as a result of the discovery of a new significance in a context not previously thought to be relevant. The changing of a clamped gestalt thus comes about as in a narrative with the emergence of a contextual clue that effects a realignment of a key conceptualizaton (as in a comedy, a tragedy, a joke, a pun – any transformation, indeed, that partakes of an ironic analysis; Wright 1993). Here is a pointer to the answer to Arthur C. Graesser's question "Where in the body is the mental model for a story?" (*BBS*, 20:25). The mesh is with action precisely because of the binding of drive to percept; it is this that secures the embodiment, but the ironies, the tropes, the narrative transformations, occur because of the inescapable – and evolutionarily valuable – fact of perceptual relativity. It creates the opportunity for a mutual correction (or a lie).

A further philosophical point arises out of that very embodiment Glenberg speaks of: the clamping to particulars (sect. 3.2, pp. 6–7). If Glenberg accepts the full implications of individual embodiment he should accept that what we have is a mutual coordination of differing gestalt selections that have to be repeatedly readjusted in a cooperative act. The method we adopt is that we have to speak, out of linguistic convenience, as if there is a *numerically singular* logical particular before us, just in order to effect the needful fuzzy superimposition of our *numerically multiple* selections (Gregory 1993, p. 259; Wright 1992, pp. 42–50; 1993, pp. 192–93). To use Harnad's terms, there is a never-to-be-achieved perfect "convergence" of each agent's "approximations" to the putatively common categorization (Harnad 1987, p. 538). This being so, there is strictly no common "referent," no single Gibsonian "invariant" to provide given "affordances," only a multiplicity of individually chosen referent selections from the flux which may or may not produce a coinciding of purposeful action. The Gibsonian Richard A. Carlson asks Glenberg to mesh Piaget with his theory (*BBS*, 20:21), but Piaget regarded knowing as an assimilation of reality into "systems of transformations" (Piaget 1970, p. 15) and saw the roots of logic in the "coordination of actions" viably maintained together (ibid., p. 17). Glenberg (1997r), in his answer to those who accused him of neglecting affect, still places his analysis at the ordinary-language level in referring to given overlapping selections, about which we have to talk contin-

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