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Commentary on **Bernhard Hommel, Jochen Müsseler, Gisa Aschersleben, & Wolfgang Prinz (2001). The Theory of Event Coding (TEC): A framework for perception and action planning. BBS 24(5):849–878.**

Abstract of the original article: Traditional approaches to human information processing tend to deal with perception and action planning in isolation, so that an adequate account of the perception-action interface is still missing. On the perceptual side, the dominant cognitive view largely underestimates, and thus fails to account for, the impact of action-related processes on both the processing of perceptual information and on perceptual learning. On the action side, most approaches available conceive of action planning as a mere continuation of stimulus processing, thus failing to account for the goal-directedness of even the simplest reaction in an experimental task. We propose a new framework for a more adequate theoretical treatment of perception and action planning, a theory postulating that perceptual contents and action plans are coded in a common representational medium by feature codes with distal reference. Accordingly, perceived events (perceptions) and to-be-produced events (actions) are equally represented by integrated, task-tuned networks of feature codes – cognitive structures we call event codes. We give an overview of evidence from a wide variety of empirical domains, such as spatial stimulus-response compatibility, sensorimotor synchronization, or ideomotor action, showing that our main assumptions are well supported by the data.

Does TEC explain the emergence of distal representations?

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Abstract: Hommel et al. (2001) try to explain the emergence of distal representations by an evolutionary account which includes their theory of event coding. A closer look at the way the terms "distal representations" and "representations of events" are defined reveals, however, that their hypothesis of a common code for perceived and to-be-produced events is in fact superfluous. Moreover, it shows that they mix up empirical facts with conceptual/definitional facts in the second assumption of their explanation.

In the "Epilogue" to their target article (sect. 5), Hommel et al. (2001) ask: "How is it possible that our mental experience refers to events in the outer world [. . .], given the fact that it derives from events in our bodies and our minds?" They try to answer that question by an evolutionary account which includes their theory of event coding. First, at some point in evolution, a common representational system for both perceived and to-be-produced events evolved as a means to plan action. Second, the most efficient way of implementing such a system is by creating distal representations. Put together, "the invention of identical codes for perceived and to-be-produced events implies the construction of reality" (sect. 5).

Obviously, the emphasis here is on "identical." Hommel et al.'s main topic, the hypothesis of a common code, holds the central position in this explanation. A closer look, however, reveals that recourse to commonality is in fact superfluous. If an agent has representations for events, he already possesses distal representations, regardless of whether they are couched in a common representational medium.

My argument is quite simple. Question 1: What is a distal representation? Answer: By calling a representation "distal," we say something about its extension. A distal representation is a representation of a distal entity; it is a representation that does not refer to something inside the agent but to entities in the outer world. For example, a representation of spikes in Susan's brain does not belong to her distal representations because its extension does not consist of things in her environment.

Question 2: What is a representation of a perceived or to-be-produced event? Part 1 of the answer is as before: By calling something a "representation *of*," we say something about its extension. A representation of a perceived or to-be-produced event is a representation that refers to such an event. Part 2 of the answer: In the context of Hommel et al.'s article, "event" does not mean "event inside the agent" but, rather, "outer event"; therefore, a representation of an event is a representation whose referent is an occurrence in the person's environment. For example, a representation of electrical activity in Susan's visual cortex is not among her representations of a perceived or to-be-produced event, in the relevant sense of "event."

With these definitional facts in mind, it is clear why recourse to a common code plays no role in Hommel et al.'s explanation. A representation of a perceived or to-be-produced event is, by definition, a distal representation because it refers to a distal entity. Hence, if, at some point in evolution, a species acquires the ability to represent perceived events, or the ability to represent to-be-produced events, or both, then by definition this is sufficient for having distal representations. It does not matter at all whether those different kinds of events are coded within a common format. Even if the structure of the representations standing for perceived events differs widely from the structure of the representations standing for to-be-produced events, they are nonetheless distal representations because being such a representation means nothing else than representing entities in the outer world. It is not "the invention of identical [!] codes for perceived and to-be-produced events" that "implies the construction of reality," but just the invention of – whatever – codes for events.

Hommel et al.'s explanation therefore boils down to: We have distal codes because evolution has provided us with codes for perceived and to-be-produced events as a means to plan action. Here, their second assumption plays no role anymore. In light of my remarks, this should not come as a great surprise because the assumption sounds somewhat odd anyway. Hommel et al. claim that

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the most efficient way of producing a common system of representations referring to perceived and to-be-produced events is by creating codes with distal reference. I would rather say that this is, again by definition, the only way of implementing any system of representations referring to events, whether or not they are coded within a common medium.

Remember that "event" means here "event in the outer world." On that ground, the creation of event codes implies the creation of distal codes because representations that refer to events in the environment are, necessarily, distal representations. Hence, creating representations of distal entities is not a more or less efficient way of implementing representations of events. It is, rather, a trivial consequence of the way in which the terms "distal representations" and "representations of events" are defined. Claiming that it is the most efficient way is like claiming that the most efficient way for a married man to become a bachelor is by getting unmarried. If this were the most efficient way, there would be other, less efficient, ways. But there are none. Therefore, it is true that producing event codes requires creating distal codes – but note, first, that this is not an empirical but a conceptual truth; and, second, it has nothing to do with the common representational system for perception and action advocated by Hommel et al.

There is no Authors' Response to this continuing commentary.

Reference

Hommel, B., Müsseler, J., Aschersleben, G. & Prinz, W. (2001) The Theory of Event Coding (TEC): A framework for perception and action planning. *Behavioral and Brain Sciences* 24(5):849–78. [MS]

Commentary on **Zenon W. Pylyshyn (2002). Mental imagery? In search of a theory. BBS 25(2):157–182.**

Abstract of the original article: It is generally accepted that there is something special about reasoning by using mental images. The question of how it is special, however, has never been satisfactorily spelled out, despite more than thirty years of research in the post-behaviorist tradition. This article considers some of the general motivation for the assumption that entertaining mental images involves inspecting a picture-like object. It sets out a distinction between phenomena attributable to the nature of mind – what is called the cognitive architecture, and ones that are attributable to tacit knowledge used to simulate what would happen in a visual situation. With this distinction in mind the paper then considers in detail the widely held assumption that in some important sense images are *spatially displayed* or are *depictive,* and that examining images uses the same mechanisms that are deployed in visual perception. I argue that the assumption of the spatial or depictive nature of images is only explanatory if taken literally, as a claim about how images are physically instantiated in the brain, and that the literal view fails for a number of empirical reasons – for example, because of the cognitive penetrability of the phenomena cited in its favor. Similarly, while it is arguably the case that imagery and vision involve some of the same mechanisms, this tells us very little about the nature of mental imagery and does not support claims about the pictorial nature of mental images. Finally, I consider whether recent neuroscience evidence clarifies the debate over the nature of mental images. I claim that when such questions as whether images are depictive or spatial are formulated more clearly, the evidence does not provide support for the picture-theory over a symbol structure theory of mental imagery. Even if all the empirical claims were true, they do not warrant the conclusion that many people have drawn from them; that mental images are depictive or are displayed in some (possibly cortical) space. Such a conclusion is incompatible with what is known about how images function in thought. We are then left with the provisional counterintuitive conclusion that the available evidence does not support rejection of what I call the "null hypothesis"; namely, that reasoning with mental images involves the same form of representation and the same processes as that of reasoning in general, except that the content or subject matter of thoughts experienced as images includes information about how things would look.

Spatial inference: No difference between mental images and mental models

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Abstract: In contrast to Pylyshyn's view, there is no such thing as "reasoning in general." Different types of reasoning tasks are solved with different reasoning strategies. A more specific null hypothesis is that *spatial inference* with mental *images* involves the same representational formalism as that of spatial inference with mental *models.* There is no evidence that this hypothesis must be rejected.

Pylyshyn's line of argumentation starts with a "null hypothesis" and ends, after a scholarly review of empirical work, with the conclusion that the null hypothesis cannot be refuted. His hypothesis reads: "reasoning with mental images involves the same form of representation and the same processes as that of reasoning in general" (Pylyshyn 2002, p. 157). Unfortunately, the way in which the hypothesis is stated prevents it from being refuted. It has the form *X involves the same Y as Z,* with an *X* whose ontological status is disputed and a non-existing Z. There is no such thing as "reasoning in general" because different types of reasoning tasks are solved with different reasoning strategies. Consider, for instance, the following inference problem:

The hammer is to the right of the pliers
The screwdriver is to the left of the pliers
The wrench is in front of the screwdriver
The saw is in front of the hammer
Which spatial relation holds between the wrench and the saw?

In principle, such tasks could be solved by a reasoning strategy that consists of applying inference rules as suggested by Rips (1994). But this account has an important consequence: the premises must be kept separately in mind throughout the whole reasoning process. No integrated representation of the problem information is constructed. Empirical evidence suggests that a different type of strategy is adopted by most subjects: An integrated representation, or mental model, is constructed in working memory and constitutes the information on which the reasoning process operates (see, e.g., Johnson-Laird & Byrne 1991). A mental model for a spatial inference task encodes a specific spatial configuration satisfying all the premises; for example:

screwdriver pliers hammer
wrench saw

What is specific (and spatial) in this integrated representation? First, we need to clarify what is meant by properties of a

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