To be a proper non-representational theory of perception, the sensorimotor approach must be a fully non-representational theory of behaviour

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Abstract. The sensorimotor theory of perception claims to be nonrepresentational. However, when dealing with some aspects of perception, such as epistemic properties, the theory retains conceptual aspects that are germane to representational accounts. In order to depart definitively from representationalism, it is suggested that the sensorimotor theory must treat perception as a behavioral process first and foremost. When treated thus, one of the main questions regarding perception is that of anticipation. Forwards models, which are presently very popular, constitute representational explanantia to anticipation. A different way to explain anticipatory behavior is proposed. Based on an analogy with bodily dispositions to act such as postures, it suggested that the task of the brain might be to bring itself and the body into hierarchically nested states of readiness to action towards perceived stimuli. Perceptual knowledge consists not in prediction of sensory changes but in nonrepresentational cognitive postures.

The version of the sensorimotor approach (henceforth SMT) that was introduced by O'Regan and Noë [1] is highly compatible with other approaches to perception which rely on predictions of sensory stimulation (e.g. the popular active inference approach [2, 3]. Yet sensory predictions are still representations and they can still be associated with the presence of complex world models in the cognitive apparatus [4]. Having concentrated mostly on problems of visual conscious experience, the SMT shunned one kind of representationalism that not many authors actually defend viz. pictorial representations [5]. The brain may not construe a detailed pictorial representation from current experience but may still have a previous ("prior") rich and abstract world model which it tests against the actual world.

In order to depart from these heavily representational theories, the authors of SMT must first understand that their opposition to inner models in general takes place on a behavioral ground. Efference copy, for instance, is posited as a solution to behavioral problems [6, 7, 8]. Thus, SMT should be a fully non-representational theory of behavior rather than of conscious experience. It must hypothesize or discover non-representational sensorimotor mechanisms that generate complex behavior which would normally be explained by appeal to representational knowledge (e.g. the "representation-hungry" cases [9, 10].

An example of such non-representational neural mechanism with its corresponding non-representational interpretation can be found in recent work on preparatory activity in the motor cortex ([11]; [12]; [13]). The traditional representational view of motor and premotor cortices function is that neurons therein encode final specific features of movement and/or of movement activity (e.g. speed, torque, etc.). An alternative hypothesis which seems to be vindicated by empirical findings is that individual neurons operate mechanically, setting up initial conditions for the dynamic unfolding of downstream neuromuscular activity.

If SMT opts for the non-representational path it must urgently unpack representation-loaded concepts present in its explanatory framework in a non-representational way. One such problematic concept is that of "knowledge of potentialities" ([1], p. 949). Noë [14] argued that it is a kind of conceptual knowledge, which raised worry from Keijzer [15]. Indeed it seems rather counterproductive to hold that perception requires conceptual knowledge while insisting on the fact that it is a practical knowledge ([1], p. 944). The problem could be avoided, once again, by insisting on the fact that SMT ought to explain behavior first and foremost, while Noë's position seems respond to a need to explain epistemic features of perceptual phenomena. In contrast, forward models, as non-conceptual knowledge, are put forward in an endeavor to account for anticipatory features of behavior. How, for instance, does the brain compute the right trajectory of, say, an arm when it can't count on sensory feedback for adjustment? Knowledge of potentialities in the SMT should thus serve the same purpose of explaining anticipatory features of behavior. What was expected from SMT, then, was non-representational anticipatory mechanisms for complex behavior [16, 15], instead of "knowledge" and "concepts" which are already present in more classical theories.

I suggest that a way to obtain the desired mechanisms in a sensorimotor account could consist in replacing anticipation of sensory input with some process akin to preparatory posture adjustment [17]. A baseball player, for instance, prepares the body to catch a ball before moving his arms towards the intercepting point. The preparatory posture is anticipatory yet doesn't represent the ball trajectory, nor the laws of physics governing it (as opposed to [18])--at least not in a non-trivial way. By extension, the (mature) neuromuscular system too could be conceived of as assuming postures by poising itself into an anticipatory yet non-representational state, where further incoming stimuli will be responded to in an adapted way. As an illustration, when I see a red tomato, my humanly trained brain poises itself into a behavioral state of readiness to all sorts of different actions modulated by my homeostatic state, context, etc., like my bodily posture. This state could be achieved by tuning the initial states and relevant parameters of the dynamic attractor landscape embodied in the neuromuscular system that was discovered by learning to successfully deal with red tomatoes [19, 20]. Notice, to intercept a widespread objection,

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that behavior need not be triggered by this state, not even covertly.

The concept of neuromuscular anticipatory posture can be nicely linked to Gibson's affordances, since the state of readiness to act corresponds to the concept of "opportunity for action" [21] Thanks to its being behavior-oriented, the concept can also provide a more natural meaning to the non-representational practical "knowledge" the authors of SMT are striving to explicate. Moreover, three critical properties typically ascribed to representational processes can be obtained with postures, viz. instantiation in absentia of stimuli, continuous sequences of internal state changes, and complex internal structure [22]. Indeed the neuromuscular system can (1) enter a poised state of readiness for action in the absence of its normal triggering stimulus, (2) follow sequences of changes from one poised state to the next in the absence of changing stimulation or, crucially, anticipating it temporally [23], and (3) support complex structure such as hierarchical organization where some region of the brain enters a state of readiness vis-à-vis another region of the brain. Finally, preparatory posture could, although as an incidental effect, explain what a perceptual state is: the system poised in the behavioral readiness towards the input, not by predicting how the input could change but by being ready to change itself towards the particular behaviors the input can trigger.

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The sensorimotor theory of perception claims to be nonrepresentational. However, when dealing with some aspects of perception, such as epistemic properties, the theory retains conceptual aspects that are germane to representational accounts. In order to depart definitively from representationalism, it is suggested that the sensorimotor theory must treat perception as a behavioral process first and foremost. When treated thus, one of the main questions regarding perception is that of anticipation. Forwards models, which are presently very popular, constitute representational explanantia to anticipation. A different way to explain anticipatory behavior is proposed. Keywords AISB Sensorimotor Theory Workshop; Book Review; Cognitive Science; Enactive approach; Phenomenological consciousness; Sensorimotor contingency; Visual perception ! 1 The background The volume under consideration stems from the first AISB1 member's workshop on "Sensorimotor Theories of Perception", which was held at Goldsmiths, University of London on September 2012. In the preface it is pointed out that the contributors to the workshop were asked not only to comment on the contemporary state of sensorimotor theories of perception but also to "reflect on their place within modern Cognitive Science". In certain respects much... Sensorimotor Theory and the Problems of Consciousness. Abstract: The sensorimotor theory is an influential account of per-ception and phenomenal qualities that builds, in an empirically supported way, on the basic claim that conscious experience is best construed as an attribute of the whole embodied agentâ€™s skill-driven interactions with the environment.Â The prevailing scientific understanding of the mind takes it that con-scious phenomena such as perception and thought, though incom-pletely understood, are things that happen in the brain. The problem is that no intelligible connection has been made between mere brain activity and the conscious experience, seemingly quite different in character, it is believed to constitute. Children with desire perception theory should be able to predict the perceptions of others, including those in which the perceptions are different from their own. By age of two and half a child can reliably predict when an agent will or will not see an object. They also can predict how seeing an object will lead to later action (Level-Iundersatnding).Â This stage appears to be an intermediate one between a fully non-representational and a fully representational theory of mental states. Transforming from two and half to five years have all features being a theory change. "While initially the theory protects itself from counter-evidence, the force of such a counter-evidence eventually begins to push the theory in the direction of change. Sense-perception has long been a preoccupation of philosophers. One pervasive and traditional problem, sometimes called â€œthe Problem of Perceptionâ€, is created by the phenomena of perceptual illusion and hallucination: if these kinds of error are possible, how can perception be what we ordinarily understand it to be, an openness to and awareness of the world? The present entry is about how these possibilities of error challenge the intelligibility of the phenomenon of perception, and how the major theories of experience in the last century are best understood as responses to this challenge. 1. The Ordinary Conception of Perceptual Experience. 1.1 Openness.