“Posing | solving” can be explained without representations, because it is a form of perception-action

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the socio-material practices we partake in. As John Sutton shows, a cricket batter draws on her non-local resources to eliminate reflective thinking, thus enabling her to optimize her play. In fact,

(default assumptions among cricketers thus stress the independence of acting and thinking: they see the successful doing involved in the execution of the long-practised, habitual, semi-improvisational embodied skills required for batting as independent of more explicit conscious or verbalizable forms of knowing such as those involved in autobiographical remembering.) (Sutton 2007: 767)

« 6 » The batter’s non-localized skills and habits enable her to avoid reflective thinking while, at the same time, allowing her to exploit localized resources (i.e., the bat and ball) in ways that are skillful.

« 7 » As mentioned earlier, non-local resources are not only found in competitive sports; they also condition most of our situated activities. Even teachers are relying on ‘habits’ (e.g., hand-raising) and practices (e.g., note-taking) that allow students to participate in classroom events without disrupting the dynamics of the many-to-one focus on the front of the room” (Harvey et al. 2016a: 141). In fact, had it not been for our embodied habits, we would not even be able to do basic everyday activities such as tying our shoelaces, ordering a pizza or speaking (Noë 2009). It is due to a history of interactions that individuals can be properly situated in their everyday encounters. Non-localized resources allow human experience to be “smooth” in the sense that they enable agents to enact a flow of skillful activity. Thus, non-locality gives rise to a diachronic experience that differs from the synchronic experience that, on a Varelian construal, amounts to instantaneous ecological descriptions, and is open to embodied, dynamical explanations that have no need for cognitivist models. In other words, Proulx and Maheux have shown how to get across the “cognitive gap.”

The diachrony of problem-solving strategies

« 8 » This brings us back to problem-solving. I agree with Varela (and Proulx and Maheux) that problem-solving is a kind of exploration that entails a high degree of experiential immediacy and synchronicity, since solvers are sensitive to problems that are localized in their immediate surroundings. However, by reducing the process of posing/solving to what the solver immediately experiences, one loses sight of the non-local resources that solvers inevitably bring into situations and which affect situational outcomes. Take, for instance, Amy, who engages with a simple mathematical problem. She solves 741–75 in a way that “is not ‘obvious’ for everyone and is dependent on the unique characteristics of the solver, including his or her understandings and ways of doing mathematics” (§21). Thus, Amy brings certain non-local resources into the interaction. In fact, she enacts a kind of preliminary strategy that exists prior to her final strategy.

« 9 » By focusing on the synchronic dimension of interactions, a Varelian-based epistemology seems unable to account for the fact that problem-solving involves past experiences that tacitly influence and guide the solver’s lived experience. For this reason, it overlooks the diachronic nature of human cognition and, furthermore, our capacity for engaging skillfully with the world as we bring into play non-localized resources such as our understanding, strategies and habits. The same holds for Proulx and Maheux’s contribution, which explicitly pushes the idea that problem-solving strategies are “local ways of engaging, co-emergent at the moment of posing/solving” (§35). However, the case of Amy tells a different story: strategies do not just emerge from situations; they also impact on situations. By embracing a synchronous view of cognition, however, Proulx and Maheux leave aside these diachronic aspects of human cognition.

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Upshot
The target article succeeds in conceptualizing mathematical problem-solving as a form of organism-environment coupling. So conceived, it is a suitable subject for both enactive and ecological descriptions, and is open to embodied, dynamical explanations that have no need for cognitivist models. In other words, Proulx and Maheux have shown how to get across the “cognitive gap.”

Problem solving and the “cognitive gap”

« 1 » Jérôme Proulx and Jean-François Maheux’s excellent and delightfully lucid target article bears directly on the idea that there is an explanatory “gap” between “lower-” and “higher-order” cognition. Their core claims are that

a researchers studying a prototypically abstract, rational, “higher-order” cognitive activity (“mathematical problem-solving”) need only be sensitized to its richness and context-specificity in order to understand it as a form of enaction (“posing/solving,” see §35f), and

b sensitizing them in this way gives them a more accurate, more detailed, and clearer understanding of their object of study (cf. §24f).

« 2 » This is strong new evidence that the “cognitive gap” is a chasm we academicians have manufactured rather than one we have encountered or observed (Stewart 2010; Thompson 2007: 6–8), and that rather than reflecting the explanatory shortfall of enactive theories, it reflects our collective failure of investigative creativity.

« 3 » The “cognitive gap” names a distinction between those cognitive and behavioral phenomena for which enactivism’s
explanatory tools are adequate, and those which demand representational explanations. Andy Clark (2001) captures the difference with his usual perspicacity:

"What, in general, is the relation between the strategies used to solve basic problems of perception and action and those used to solve more abstract or higher level problems? Can the capacity to solve more intuitively ‘cognitive’ problems (such as planning next year’s vacation, thinking about absent friends, and designing a particle accelerator) be understood in essentially the same terms as the capacity to follow walls, to coordinate finger motions, to generate rhythmic stepping, and so on?" (Clark 2001: 135)

"The core idea in this passage is that solving "intuitively cognitive" problems like long-term planning probably needs to be explained differently from solving "perception and action" problems like bi-manual coordination. That makes Clark’s questions emblematic of a trend in discussions of the cognitive gap, namely, that whether a given phenomenon or behavior is taken to be enactivist-amenable or representation-requiring (with respect to accounting for it or explaining it) seems to depend on whether it has been clearly described in enactive terminology. Consider another example:

"When I find myself mentally trying to solve the tower of Hanoi problem, thinking about which discs to move on top of which, my thoughts are standing in for the actual discs. They are thoughts with the content small disc, or medium disc, or large disc. I do not need to manipulate the actual discs, because I have representations that, at least momentarily, serve as well (or almost as well)." (Shapiro 2014: 214f)

"Shapiro describes mental math in explicitly representational terms, and concludes that it demands a representational explanation. He experiences "mentally" solving the Tower of Hanoi as manipulating a set of disks, and concludes that because he is not manipulating the physical disks with his hands, he must be manipulating mental ones with his brain.

"Shapiro thus shares with Clark an implicit and unwarranted assumption that Evan Thompson (2007: 270–275; Pessoa, Thompson & Noë 1998) calls “analytical isomorphism”: the idea that...

"successful explanation requires [...] one-to-one correspondence between the phenomenal content of subjective experience and the structure or format of the underlying neural representations." (Thompson 2007: 272).

"Analytical isomorphism helps to account for a general pattern in which explanations are usually applied only to phenomena that have been described in neatly commensurate terms. For instance, the most common way to invoke the cognitive gap is to claim that representational explanations are required for activity in which agents “de-couple” from their immediate surroundings and “manipulate information that is absent from the environment and so has to be internally represented” (Spaulding 2014: 204; cf. Carruthers 2013; Chemero 2009: 47–66). Spaulding offers “the capacity to engage in counterfactual reasoning” as an example; Leon de Bruin and Lena Kästner (2012: 546) invoke “explicit forms of first- and second-order false belief understanding”; Robert Clowes and Dina Mendonça (2016: 40) list hallucinating, dreaming, and other cases in which they take it that humans “experience perceptual richness, continuity and integration even when sensory contact is depleted or confused.” These examples are conceived as mental and/or neural processes that are “about” certain worldly entities (mental states, dreamed scenarios), where “aboutness” is implicitly assumed to be possible only by means of constant causal connection between the processes and the entities they are “about.” Because that connection cannot be “cashed out” as millisecond-to-second-scale sensorimotor coupling (e.g., between a sleeping person’s body and the things they experience their daydreams as being about), the writers conclude that the processes must instead be causally connected to a neutrally generated representation of the relevant worldly entity.

"But this is not the only way to conceptualize and describe “higher-order” cognitive activities. Thinking about them differently makes it far less clear that we need representations to explain them. Proulx and Maheux’s description of mathematical activity demonstrates this perfectly.

Mathematical activity as “posing|solving”

"The phenomenon Proulx and Maheux address is “mathematical problemsolving,” i.e., whatever it is that happens when humans “work on” a verbally, numerically, or graphically posed math problem. For example, in §16 we read about a student who “thought about his graphical representation, picturing a line at y = 5 on which he imagined superimposing the curve y = x²–4,...” Clark, Shapiro, or Spaulding would presumably conceive of this according to the “selection-then-execution hypothesis” (see §1, §12, and §17), which holds that mathematical activity involves identifying the computational form of a problem, selecting an already-learned strategy like cross-multiplication or long-division, and executing that strategy step by step.

"Proulx & Maheux’s target article transforms that model of problem-solving into the “posing|solving” of mathematical problems (§§8–22). In this re-conceptualization, the student encounters a “prompt” rather than a math problem with a pre-determined structure. The idea is that math problems are not encountered in the first instance as computational challenges, but as concrete bits of vocalizing, drawing, sketching, or printing by means of which one human presents another human with a word problem, equation, graph, or diagram. The problem-solver then “poses” a problem to themselves based on the prompt. They do not internalize or “comprehend” the problem, rather they encounter or engage the prompt, finding an idiosyncratic way to connect with it so that it can function as a constraint on what action they take next (§66, 8–10, 15). That action is therefore not a step in executing a pre-determined and repeatable problem-solving strategy, it is simply skillful coping (cf. Dreyfus 2002) with the situation they find themselves in, as that situation is modified by the way they posed the problem to themselves. Actions change their relationship to the prompt, leading to a new posing of the problem, leading to new actions, and so on: “[P]osing and solving are not only mutually influential, but inseparable, being mutually constitutive of each other [...]” This is how they live in a dialectical relationship, how they become one in a posing|solving” (§17)."
“Posing | Solving” Can Be Explained Without Representations

Matthew Isaac Harvey

Explanations for “posing | solving”

Note that the target article has done more than simply put a new terminological gloss on existing theories. It argues convincingly that *what children do in mathematics classrooms conforms closely to the logic of “enaction” and of “perception-action.” In support of their model, the authors offer both clear examples of the wide variation in idiosyncratic posing|solving “strategies” (see, in particular, Box 1, Box 2, §§15f, and Footnote 4 in §17), and references to other education scholars who agree with their substantive, empirical claims but don’t themselves adopt enactivist perspectives (e.g., §§2, 6, 10f, 17f). If this evidence holds up, then “posing|solving” uses enactive terminology to give an adequate description of one type of “higher-order cognition.”


- Both are forms of asymmetrical organism-environment coupling, in which the organism’s contribution is logically and ontologically prior;
- The constraints the environment imposes on the activity of the organism are determined by the organism’s organization, which is itself a product of that organism’s past interactions with the environment;
- The coupling is “recursive” in the sense that it continually changes its own enabling conditions – any action an organism takes changes the opportunities for its future actions.

« 12 » There is an equally clear analogy to be drawn between “posing|solving” and the logic of “perception-action” as that term is used in ecological psychology (e.g., Heft 2001; Turvey 2007) and the sensorimotor theory of perception (e.g., Hurley 2001; Noé 2004; O’Regan 2011; O’Regan & Noé 2001). The core insight of both schools of thought is that perception – whether it is understood functionally or phenomenologically – is everywhere and always part of action. There is no such thing as “passive” perception, there is only “perception-action”: active, perceptually-guided engagement with the environment. Organisms never perceive objects, only “opportunities for action.” Thus Kevin O’Regan and Alva Noé (2001: 970) write, “[T]he basic thing people do when they see is that they exercise mastery of the sensorimotor contingencies governing visual exploration,” and Michael Turvey (1992: 174) says, “[C]onducting an act requires that one perceives [rather than “knows’] whether the act as a whole is possible, what subacts are possible with respect to the surface layout, and the possible consequences of current subacts if current (kinetic, kinematic) conditions persist.”

« 13 » Both ecological psychology and sensorimotor theory are rooted in the work of James Gibson (1979), who argued that how we move through our physical environments determines what information about those environments is available to us via our visual sensitivity to patterns in the structure of ambient light. In turn, the information we “pick up” constrains our ongoing movements, which further modify the information available to us, and so on. The same logic applies when Proulx and Maheux tell us that posing a problem to ourselves constrains what next steps are possible, where “possible” means “evident to us now as possibilities for action,” and that taking one of those steps presents us with a new posing of the problem. Just as “looking” is engaging with the environment such that certain opportunities for locomotion show up for us, so “posing” is engaging with the environment such that certain opportunities for “solving” show up for us.

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http://constructivist.info/13/v/160.proulx