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Guido Baggio

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- 1 In May 2013, Andreas K. Engel, Alexander Maye, Martin Kurthen, and Peter König published an article entitled “Where’s the Action? The Pragmatic Turn in Cognitive Science” in which they witnessed a “Pragmatic Turn” in cognitive science, *i.e.* the shift from a representation-centered perspective to a paradigm that focuses on the understanding of cognition as “enactive.” This new paradigm suggested that “cognition seems fundamentally grounded in action” (Engel *et al.* 2013: 206). The authors’ use of the term “pragmatic,” derived from the action-oriented perspectives developed by John Dewey and George H. Mead, meant to stress the conjecture that “cognition is a form of practice” (Engel *et al.* 2013: 202), namely a skillful activity that implies continuous interaction with the outside world.
- 2 The article anticipated a Forum on the “Pragmatic Turn” held in October 2013 in Frankfurt in which the debate focused on possible advances in the empirical field of this new paradigm. The result of the debate involving fifty participants is the volume edited by Andreas K. Engel, Karl J. Friston, and Danica Kragic, *The Pragmatic Turn. Toward Action-Oriented Views in Cognitive Science*. The volume collects twenty contributions that provide information on critical aspects of action-oriented

perspectives and collaborative reports on the discussion that ensued, divided into four thematic macro-areas: “Development, Acquisition, and Adaptation of Action-Oriented Processing”; “Action-Oriented Models of Cognitive Processing”; “Action-Oriented Understanding of Consciousness and the Structure of Experience”; and “Implications of Action-Oriented Paradigm Shifts in Cognitive Science.”

- 3 In the introduction to the volume, Engel, Friston and Kragic summarize the conclusions of the five-day forum by arguing that the experimental evidence from cognitive science, neuroscience, psychology, robotics, and philosophy of mind support the possibility of substantial conceptual advances toward action-oriented cognition paradigm. Such advances also refer to “new views on the functional relevance and the presumed ‘representational’ nature of neural processes” (p. 1). According to the action-oriented perspective, cognition should not be considered as a producer of veridical representations but rather as an ability to generate action structures. Neuroscience embracing this perspective should not focus on explanation of how the brain acts as a world-mirroring device, but rather as a “vehicle of world-making.” In this respect, one of the primary references of the pragmatic turn is O’Regan and Noë’s sensorimotor contingency theory (SMC) (O’Regan & Noë 2001), which draws on Gibson’s affordances theory (Gibson 1979) as well as on old concepts from neurobiology such as the “reafference principle” put forth by von Holst and Mittelstaedt (1950). Such contingencies can be identified as relations between movements and changes in the associated sensory inputs which, once learned, are similar to rules that enable us to predict the consequences of our actions. Closely related to the approach of active inference to action and perception is the idea that the learning of such predictions can be mediated by the acquisition of concepts of objects, as well as predictive coding models. Following this path, Maye and Engel’s “pragmatic” proposal (chapter 11) is to extend O’Regan and Noë’s SMC theory to what they call “‘intention-related’ eSMCs, which capture long-term regularities in action sequences and constitute our conscious experience beyond the timescale of object perception” (179).
- 4 Given that the pragmatic turn is an expression of enactivist approaches, one of the central epistemological issues is whether such a pragmatic approach to cognition should be included in a scientific research agenda or whether it should be considered as philosophy of nature. In his contribution, Gallagher (chapter 16) contends that, if enactivism, which inspires the pragmatic turn, proposed from the outset to rethink not only the nature of the mind and brain but the very concept of nature, it could not accept a mechanistic definition of nature as presupposed by science. Instead, enactivism “contends that nature cannot be understood apart from the cognitive capacity that we have to investigate it. [...]olism is a strength rather than a practical complication” (296). However, Gallagher concludes, this does not make enactivism irrelevant to scientific research; instead, it can motivate experimental science in very specific ways by offering or testing concrete hypotheses or raising new scientific questions.
- 5 Along with the question of the general nature of the pragmatic turn, there are many other open issues that the pragmatic turn paradigm has to address in order to contribute to this breakthrough in neuroscience, such as the link between neural mechanisms and memory, complex cognitive processes, the construction of inferential mental processes, and social cognition. In chapter 2, for instance, Pezzulo faces the issue of the link between neural mechanisms and higher cognitive processes from a

developmental perspective, arguing that it is difficult to determine if and how the new pragmatic view extends to the domains of higher cognition. Assuming that cognition is “a set of adaptive skills that exist *in continuity* with action-control mechanisms” (20), the author stresses that the question remains as to how pragmatic skills “support higher cognitive abilities and/or bootstrap them during development” (22). He critically analyzes three perspectives that emphasize the idea that sensorimotor development promotes higher cognition, namely the *emergentist* perspective, the *cognitive mediation* perspective, and the *abstract-and-amodal* perspective, pointing out some open questions that these perspectives pose. More specifically, Pezzulo maintains that the *emergentist* perspective, according to which the increasingly more complex (inter)action patterns self-organize during development, does not contribute to our understanding and study of circular causality between development and cognition. On the other hand, the *cognitive mediation* perspective, which stresses that certain abilities developed for the demands of situated action become mediators of higher cognitive abilities, has some difficulties in identifying the most critical cognitive mediators, while the *abstract-and-amodal* perspective, which stresses that action-based processes contribute to developing cognitive abilities that, once established, become autonomous from perceptual and motor systems, cannot prove the existence and development of amodal domains of cognition. Furthermore, Pezzulo maintains that, from an epistemological perspective, other issues arise related to the representational nature of prediction-based mechanisms, the use of symbols by the brain to mediate thought processes and the causal role of sensorimotor representations in higher cognition.

- 6 Another question dealt with in the volume is that of predictive coding and active inference based on the Bayesian paradigm. In his contribution (chapter 6) Friston frames questions about embodied cognition and action in terms of *active inference*, moving toward a view of the brain as a statistical organ that generates unconscious inferences tested against sensory evidence. Hohwy (chapter 7) takes into account the idea that the brain is fundamentally engaged in prediction error minimization (PEM) (see Friston 2010, Clark 2013, Hohwy 2013) and highlights some issues in uniting PEM’s proclivity for internal processing and the embodied, enactive, extended approach to cognition, whereas Kilner *et al.* (chapter 10) take into account possible models of the interrelationships between action and cognition, focusing in particular on ideomotor theory and drawing a formalization under the enactivist version of the Bayesian paradigm.
- 7 A genuine pragmatist alternative to such formalization is Menary’s “Pragmatism and the Pragmatic Turn in Cognitive Science” (chapter 13), in which the author interprets active inference in a more pragmatist vein as an abductive process. In particular, Menary relates the principle of active inference to concepts of exploratory inference in classical pragmatism, arguing that pragmatists did not rely solely on a behavioural account of sensorimotor interactions with the environment. Instead, they framed the nature of such interactions in terms of “exploratory inferences” and “transactions.” According to Menary, a pragmatist approach to cognition relies on three principles: 1) thinking “is structured by the interaction of an organism with its environment”; 2) cognition “develops via exploratory inference, which remains a core cognitive ability throughout the life cycle”; and 3) inquiry “begins with genuinely irritating doubts that arise in a situation and is carried out by exploratory inference” (216). Moreover, a genuinely pragmatic turn in cognitive science would assume a *pluralistic* approach to styles of interaction. Thus, although SMCs and predictive inferences are core methods

for understanding cognition as interactive, different styles in interactions imply “differences in how we model or explain those different styles” (217). And though in keeping with enactivism and embodied cognition pragmatists reduced the importance of representational explanation of cognition, they denied a complete break with the role of representation. In line with Peirce’s view, Menary looks at signs as representational mediators that develop in the process of continuous dynamical interpretation. He then refers to the Peircean Principle (Menary 2007), which establishes a sign/intentional/representational relation based on a principle of continuity, allowing “us to explain how sign action works in both natural and social environments, by giving the same structural conditions for teleonomic and teleological signs” (220). Following the pragmatist idea of fallibilism and exploratory inference, Menary maintains an externalist interpretation of the role of active inferences and thereby avoids an internalist view of the Bayesian brain. He refers to the niche construction account of developmental biases, which are both endogenous and exogenous, and focuses on the selective role of Peirce’s abductive inference as instinctual. He thus points out that cognition is “shot through with active exploratory inference that is abductive – a pattern of action that is a search strategy for a conjecture that can be further tested” (226). What is particularly interesting about Menary’s proposal is that he interprets abductive inference in early developmental and at least sensorimotor cases as based on motor activity rather than on beliefs or representations. It would therefore be possible “to give a nonrepresentational account of active inference, and this would be entirely consistent with the likely evolutionary origin of those inferences in sensorimotor interactions with the environment” (226). As he puts it, this interpretation is also consistent with Dewey’s theory of sensory circuit and his externalist explanation of the symmetrical transaction in organism-environment transactions.

- 8 The perspective that Engel, Friston and Kragic’s *The Pragmatic Turn* promotes is praiseworthy. However, what can be noticed in reading the contributions is that, although all the essays are presented under the broad umbrella of the “pragmatic turn,” which should be inspired by pragmatist authors, there are very few references to pragmatist authors. The only essay in the volume that contributes to the pragmatic turn debate by referring to pragmatists is Menary’s. Of course, we appreciate that the pragmatic turn in cognitive science somehow reassumes the scientific attitude and experimental approach of the early pragmatists. Nevertheless, however auspicious it may be, such an approach seems to be strongly undermined by an epistemological premise that precludes the profitable use of pragmatist theories in contemporary action-oriented explanations, that is a strong physicalism that reduces any action-oriented perspective to its description in terms of brain activation, networks and neural structures. Although many contributions in the volume take into consideration other aspects besides neural activation, such as behaviour and social interaction, almost all take for granted a focus on the internal states of the cognitive system, identifying them with brain activation, thus distancing itself from pragmatists, and failing to grasp the richness of their non-reductionist naturalism.
- 9 It is possible, therefore, to trace two possible sides of the pragmatic turn in cognitive science: on the one hand, a physicalist side based on neuroscientific and artificial intelligence studies, which make use of hypotheses useful to implementing empirical insights, and, on the other hand, a theoretical side, which promotes a holistic approach to cognition, aiming to contribute to both a new cognitive ontology and a new

philosophy of nature (see for instance Gallagher and Menary). Almost all contributions to *The Pragmatic Turn* fall on the first side. However, what makes the perspective promoted by Engel and his colleagues particularly interesting and the path traced rich with potential development is that the pragmatic turn is young and strongly influenced by a discussion of the various aspects of cognition. Therefore, more significantly taking into account the differences and potential of pragmatist authors would certainly contribute to consolidating the empirical and philosophical sides, highlighting their natural complementarity.

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AUTHORS

GUIDO BAGGIO

Roma Tre University
guido.baggio[at]uniroma3.it