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# Fallible Heuristics and Evaluation of Research Traditions. The Case of Embodied Cognition

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## 1. Understanding Embodied Cognition

While most surveys, defenses, and critiques of embodied cognition proceed by treating it as a neatly delineated claim,<sup>1</sup> such an approach soon becomes problematic due to the inherent plurality of this perspective on cognition. Embodied cognition is best treated as a research tradition, not as a single theory.<sup>2</sup> This tradition has evolved in opposition to a certain kind of cognitive science, usually dubbed “cognitivism”. Cognitivism is typically characterized as a view that cognition may be fully explained

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<sup>1</sup> Lawrence A. Shapiro, *Embodied Cognition* (London and New York: Routledge, 2011); Robert A. Wilson, Lucia Foglia, “Embodied Cognition”, in *The Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta, Spring 2017 (Metaphysics Research Lab, Stanford University, 2017), <https://plato.stanford.edu/archives/spr2017/entries/embodied-cognition/>; Margaret Wilson, “Six Views of Embodied Cognition”, *Psychonomic Bulletin & Review* 9, no. 4 (2002): 625–36, <https://doi.org/10.3758/BF03196322>.

<sup>2</sup> Larry Laudan, *Progress and Its Problem: Towards a Theory of Scientific Growth* (Berkeley, Calif: University of California Press, 1977); Kinga Wołoszyn, Mateusz Hohol, “Commentary: The Poverty of Embodied Cognition”, *Frontiers in Psychology* 8 (2017), <https://doi.org/10.3389/fpsyg.2017.00845>.

in terms of transformations of mental representations, most commonly amodal symbols.<sup>3</sup>

The methodological and ontological commitments of embodied cognition follow research exemplars found in embodied cognitive linguistics,<sup>4</sup> grounded cognition,<sup>5</sup> ecological psychology,<sup>6</sup> dynamical study of development,<sup>7</sup> or neurophenomenology.<sup>8</sup> Due to its inherent variety, this research tradition is not reducible to a single theory of cognitive phenomena (or to a single component subtradition). At the same time, all of these subtraditions share one feature: they reject cognitivism, in one way or another. They also feature fairly similar research heuristics for the discovery of how cognitive mechanisms work.

The job of these heuristics is to point out potential explanatory factors for further study. Importantly, heuristics are, by definition, fallible: it could turn out that these potential factors are causally irrelevant to a certain cognitive phenomenon. For example, the dynamical approach to the study of child development assumes that it is reasonable to check whether motor and sensory dynamics might explain phenomena that were traditionally explained in purely symbolic terms.

One example of such a phenomenon is A-not-B error, like that committed by a 10-month-old child pointing to the wrong location when asked where an object was hidden. The child watches a toy or another attractive object being hidden in the same location, A, over several trials, and then points to A. Afterwards, the toy is hidden in location B. However, when asked where it is, the child still points to A. After 12 months of age, children no longer point to A. Jean Piaget, who discovered this phenomenon, posited symbolic representations in babies to explain it: according to him, children at that age lack the concept of object

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<sup>3</sup> Jerry A. Fodor, *The Language of Thought*, 1st ed. (New York: Thomas Y. Crowell Company, 1975); Noam Chomsky, "Rules and Representations", *Behavioral and Brain Sciences* 3, no. 01 (February 2010): 1–1, <https://doi.org/10.1017/S0140525X00001515>.

<sup>4</sup> George Lakoff, *Women, Fire, and Dangerous Things: What Categories Reveal about the Mind* (Chicago: University of Chicago Press, 1987).

<sup>5</sup> Lawrence W. Barsalou, "Grounded Cognition", *Annual Review of Psychology* 59 (January 2008): 617–645, <https://doi.org/10.1146/annurev.psych.59.103006.093639>.

<sup>6</sup> James J. Gibson, *The Ecological Approach to Visual Perception* (Hove: Psychology Press, 1986).

<sup>7</sup> Esther Thelen, Linda B. Smith, *A Dynamic Systems Approach to the Development of Cognition and Action*, 5. print, MIT Press/Bradford Books Series in Cognitive Psychology (Cambridge, Mass.: MIT Press, 2002).

<sup>8</sup> Francisco J. Varela, "The Specious Present: A Neurophenomenology of Time Consciousness", in *Naturalizing Phenomenology: Issues in Contemporary Phenomenology and Cognitive Science*, ed. J. Petitot et al. (Stanford, CA: Stanford University Press, 1999), 266–314.

permanence.<sup>9</sup> In contrast, a dynamical explanation of this phenomenon in terms of perseverative reaching points out the intrinsic complexity of its occurrence.<sup>10</sup> Interestingly, the phenomenon depends on the posture of the baby, which suggests it is unlikely to be related to abstract conceptual representations; Thelen et al. explain it in terms of complex motor control.

However, the embodied approach would not be bankrupt if it turned out that children also tend to make purely logical mistakes. Thelen et al. do not assert that all there is to cognition could be reduced to complex motor control. And of course, for all we know, children do commit purely logical mistakes; people tend to treat, for example, *modus ponendo ponens* as more reliable a logical inference rule than *modus tollendo tollens*, which – of course – makes little logical sense.<sup>11</sup> There are a number of explanations of this phenomenon, but Thelen and Smith need not be worried that it is not reducible to perseverative reaching or other motor-related behavior. After all, drawing logical inferences or assessing logical correctness is a different cognitive phenomenon than reaching for a hidden toy.

Nonetheless, its heuristic and piecemeal approach to explanation makes embodied cognition a very difficult target for criticism, as fallible heuristics can fail without endangering the whole approach. Moreover, if this is the nature of embodied cognition, some objections to it turn out to be pointless. In the following section, I will argue that Kenneth Aizawa's attempt to reject the enactive approach to perception fails to appreciate that some of the claims he challenges are merely fallible heuristics. However, Aizawa is not really to blame. The confusion is also shared by the very defenders of the enactive view of perception.

In the next section, I will briefly introduce the case studied by Aizawa. I will highlight that the fallible heuristic under consideration is related to a functional consideration for at least a large group of cognitive processes, which is also sketched. In Section 3, I argue why the criticized claim is already widely understood by other defenders of embodied cognition as a heuristic, whose failure does not challenge this view at all, by pointing to a phenomenon that has little if anything to do with body morphology or physiology, bodily representations, and nothing at all with sensorimotor processing. In the last section, I point out that

<sup>9</sup> Jean Piaget, *The Construction of Reality in the Child*, trans. Margaret Cook (New York: Basic Books, 1954).

<sup>10</sup> Esther Thelen et al., "The Dynamics of Embodiment: A Field Theory of Infant Perseverative Reaching", *Behavioral and Brain Sciences* 24, no. 1 (February 2001): 1-34, <https://doi.org/10.1017/S0140525X01003910>.

<sup>11</sup> Keith Stenning, Michiel Van Lambalgen, *Human Reasoning and Cognitive Science* (Cambridge, Mass.: MIT Press, 2008).

the fallibility of heuristics used in interdisciplinary fashion makes embodied cognition particularly difficult to criticize. Paradoxically, one could claim that fallible heuristics seem to make the whole view infallible. To answer this challenge, I stress that research traditions need not be empirically falsifiable to remain scientific. In conclusion, I argue that it is important for philosophers to remember the institutional and organizational dimensions of scientific endeavors. Moreover, the structure of research practice can shed light on whether it is possible they could lead to a single, grand unified theory.

## 2. Sensory Processing Without Motor Activity

The reason embodied cognition is best seen in terms of fallible research heuristics rather than in terms of particular claims or theories about all cognitive agents will become clear when we consider a particular case that sought to undermine the value of the embodied approach. Kenneth Aizawa has challenged the claim that vision is constituted by sensorimotor processes by pointing out the simple fact that paralyzing eyes does not disturb vision altogether.<sup>12</sup> In particular, his target was Alva Noë's claim:

(COH) Perceptual experiences are constituted, in part, by the exercise of sensorimotor skills.<sup>13</sup>

Thus formulated, (COH) looks like a factual claim that could be easily challenged by the example cited by Aizawa. Indeed, Noë insists that "some minimal amount of eye and body movement is necessary for perceptual sensation".<sup>14</sup> This is factually wrong. As Aizawa notes, Noë seems to confuse sensory fatigue, which may be due to the unchanging sensory input (true in eye paralysis), with the need for eye movements. Instead, "it is non-constancy of retinal stimulation that is necessary for visual processing".<sup>15</sup> An experimentally induced paralysis of eye muscles does not fully obliterate visual perception.<sup>16</sup> What mostly happens

<sup>12</sup> Kenneth Aizawa, "Understanding the Embodiment of Perception", *The Journal of Philosophy* 104, no. 1 (2007): 5–25; Kenneth Aizawa, "Is Perceiving Bodily Action?", *Phenomenology and the Cognitive Sciences*, August 22, 2018, <https://doi.org/10.1007/s11097-018-9592-9>.

<sup>13</sup> Alva Noë, *Action in Perception* (Cambridge, Mass.: MIT Press, 2004).

<sup>14</sup> Noë, 13.

<sup>15</sup> Aizawa, "Is Perceiving Bodily Action?".

<sup>16</sup> John K. Stevens et al., "Paralysis of the Awake Human: Visual Perceptions", *Vision Research* 16, no. 1 (January 1, 1976): 93-IN9, [https://doi.org/10.1016/0042-6989\(76\)90082-1](https://doi.org/10.1016/0042-6989(76)90082-1).

is displacement (sudden shifts of the visual scene without moving imagery) and movement (continuous movement of a visual scene), and only sometimes, fading of the scene. The same phenomena are also observed under full paralysis, which requires the subjects to be artificially ventilated.<sup>17</sup>

Apparently, one does not have to exercise one's eye muscles to see, which seems to challenge (COH) directly. In what follows, I assume that the experimental result cited by Aizawa is actually detrimental to (COH), but not to the enactive view of perception, because (COH) is but a fallible research heuristic of the view, not its general hypothesis.

But even if (COH) is merely a fallible research heuristic, Noë did not phrase it as such in his book, and Aizawa had every right to criticize it. In other words, I must argue also against Noë's account of his meta-theoretical view of the enactive account of vision. I submit they are both wrong about the nature and role of (COH) and similar claims in scientific practice.

The point of Aizawa's argument is to say that Noë makes a claim about constitution, while having evidence merely for a causal claim – namely, that the exercise of sensorimotor skills is causally relevant to perceptual experiences (which is undeniable, according to Aizawa). In what follows, I put the causation/constitution distinction aside. The challenge can be as well put in causal terms: Aizawa could claim that visual perception occurs without causal interaction from motor processes, including eye movements. Perception, in other words, could proceed without sensorimotor skills. This is an empirical fact and can be easily studied. The problem is now whether this undermines the enactive view of visual perception: apparently, motor activity is not necessary for vision to occur, even if it can, quite clearly, causally impact it (it suffices to move one's eye to prove that eye muscles change one's visual perception).

Obviously, one crucial feature is that (COH) is hedged by the phrase "in part". For this reason, one could claim that sensorimotor skills are not strictly necessary for perceptual experience. But such a defense is fairly unsuccessful. The point of this phrase is rather to say that sensorimotor skills are not the only factors required for visual experience to occur. For example, one could claim that one must breathe as well (which, of course, would be merely causal and not constitutive for Aizawa) and must have a normal conscious experience to start with (arguably, constitutive).

But (COH) could be easily rephrased in another way. Noë could restate his view to say that the *function* of vision is to control action, which

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<sup>17</sup> Emma M. Whitham et al., "Visual Experiences during Paralysis", *Frontiers in Human Neuroscience* 5 (2011), <https://doi.org/10.3389/fnhum.2011.00160>.

would allow him to say that in paralysis, vision is partially malfunctional. Indeed, without eye movement, vision is abnormal: displacement, movement, or fading of the visual scene are not normal visual experiences. Moreover, eye movements arguably contribute to information processing in vision, instead of distorting it.<sup>18</sup> Microsaccades and saccades are not detrimental to seeing; quite the opposite.<sup>19</sup>

Hence, it would be reasonable to rephrase (COH) in functional terms:

(COHF) The biological function of perceptual experiences depends (constitutively or causally), in part, on the exercise of sensorimotor skills.

Importantly, experimental evidence for functionality should not be confused with evidence required for causation or constitution. However one construes the notion of biological function,<sup>20</sup> the evidence required to justify functional claims requires knowledge of the causal structure, evolutionary history, contribution to the overall fitness or reproduction, self-maintenance, or general genetic design of the agent. Functional contributions are usually graded: one's heart can pump blood more or less efficiently, thus functioning as a pump in a better or worse fashion. At any rate, the contribution of eye movement seems to be necessary to retain the full function of visual perception.

(COHF) implies that one should test sensorimotor factors, which are usually fairly accessible to experimental intervention in the case of perception. It is rational to test simple hypotheses before more complex ones, so (COHF) could come before some other, more complex hypothesis. Thus, it implies the following heuristic:

(COHF-HEUR) When interested in perceptual experience, first study the factors related to the exercise of sensorimotor skills.

<sup>18</sup> Michele Rucci, Jonathan D. Victor, "The Unsteady Eye: An Information-Processing Stage, Not a Bug", *Trends in Neurosciences* 38, no. 4 (April 1, 2015): 195–206, <https://doi.org/10.1016/j.tins.2015.01.005>.

<sup>19</sup> Martina Poletti, Michele Rucci, "A Compact Field Guide to the Study of Microsaccades: Challenges and Functions", *Vision Research*, Fixational eye movements and perception, 118 (January 1, 2016): 83–97, <https://doi.org/10.1016/j.visres.2015.01.018>.

<sup>20</sup> Robert Cummins, "Functional Analysis", *The Journal of Philosophy* 72, no. 20 (1975): 741–65; Colin Allen, Marc Bekoff, "Biological Function, Adaptation, and Natural Design", *Philosophy of Science* 62, no. 4 (1995): 609–22; Ruth Garrett Millikan, "Biofunctions: Two Paradigms", in *Functions: New Essays in the Philosophy of Psychology and Biology*, ed. Andrew Ariew, Robert Cummins, Mark Perlman (New York: Oxford University Press, USA, 2002); Wayne Christensen, Mark H. Bickhard, "The Process Dynamics of Normative Function", *The Monist* 85, no. 1 (2002): 3–28; Ulrich Krohs, "Functions as Based on a Concept of General Design", *Synthese* 166, no. 1 (2009): 69–89, <https://doi.org/10.1007/s11229-007-9258-6>.

This does not mean that complex relationships between cognition and embodiment are impossible according to embodied cognition. (COHF-HEUR) might fail to deliver interesting results without endangering the whole enterprise, because it represents a fallible research heuristic. But to see this, we need to focus more on the sensorimotor view of cognition. What does it actually mean that cognition is underpinned by sensorimotor processing?

### 3. Why Sensorimotor Factors Play a Merely Heuristic Role

None of the proponents of embodied cognition, at least to my knowledge, has ever denied that some activities of the brain are not *directly* related to sensorimotor processing. The connection between cognitive processes and sensorimotor processing is not as direct as its critics seem to think. It may be not only functional, as in the case of eye movements in vision, but even may not always be required for a number of other experiential and cognitive phenomena without rendering sensorimotor-embodied cognition obsolete.

Take for example the operation of the default-mode network, which occurs when individuals are not focused on the external environment.<sup>21</sup> The operation of the network is independent from sensory and motor areas of the brain. Nonetheless, proponents of embodied cognition do not find this fact disturbing. Quite the opposite; for example, Michael A. Anderson stresses that the operation of the network should be understood in terms of the intrinsic activity of the brain and synchronized collections of its oscillators.<sup>22</sup> Note that Anderson is a well-known defender of the claim that even abstract cognition recycles evolutionarily older areas of the brain.<sup>23</sup> But is the idea of intrinsic activity consistent with embodied cognition?

Obviously, it does not challenge even the original formulation of (COF), as the default-mode network is not solely responsible for perceptual experience, even if it can be sometimes engaged during percep-

<sup>21</sup> Randy L. Buckner, Jessica R. Andrews-Hanna, Daniel L. Schacter, "The Brain's Default Network: Anatomy, Function, and Relevance to Disease", *Annals of the New York Academy of Sciences* 1124 (March 2008): 1–38, <https://doi.org/10.1196/annals.1440.011>.

<sup>22</sup> Michael L. Anderson, *After Phrenology. Neural Reuse and the Interactive Brain* (Cambridge, Mass.: MIT Press, 2014), 110.

<sup>23</sup> Michael L. Anderson, "Neural Reuse: A Fundamental Organizational Principle of the Brain.", *The Behavioral and Brain Sciences* 33, no. 4 (August 2010): 245–66; discussion 266–313, <https://doi.org/10.1017/S0140525X10000853>.

tual tasks. However, a stronger understanding of the role of sensorimotor processing could be expressed in terms of the following claim:  
(EH) Sensorimotor processing is relevant to any cognitive activity.

The default mode network operation, quite clearly, is opposed to (EH): it can be active in individuals with locked-in syndrome who are completely paralyzed.<sup>24</sup> Still, it is doubtful whether (EH) is a working hypothesis underlying the research practices of embodied cognition,<sup>25</sup> even if one assumes that the idea of the extended mind, as defended by Clark and Chalmers<sup>26</sup> is cogent: Clark and Chalmers think consciousness has a special status and does not extend to the environment. In other words, the assumption that cognition can spread beyond one's head does not imply that one must be engaged in sensorimotor processing in all cognitive tasks.

At the same time, it could be argued that cognitive processing evolved to help biological agents cope with their problems, and that cognition cannot normally occur if only the default mode network is active, and no other part of the neural system. In other words, cognitive activities require much more than mere consciousness, and in particular, cognition without possible action seems evolutionarily quite doubtful. Knowing what to do without any possibility of doing anything would not be selected for by natural selection. Thus, a defender of embodied cognition might press the point that proper functioning of biological agents normally requires sensorimotor processing to occur. But such a claim is actually quite weak. It simply boils down to saying that sensorimotor processing has a biological function in contributing to the *overall* fitness of agents. It does so, quite clearly, by underlying *some* cognitive processes. But none of this is even remotely controversial.

Therefore, it turns out that embodied cognition relies on fairly bland metaphysical claims and embraces weak, fallible heuristics in cognitive research. Far from being controversial, it may even lack controversial content to start with. At least it could seem so: what could then undermine this approach? Is it even testable?

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<sup>24</sup> Audrey Vanhaudenhuyse et al., "Default Network Connectivity Reflects the Level of Consciousness in Non-Communicative Brain-Damaged Patients", *Brain* 133, no. 1 (January 1, 2010): 161–71, <https://doi.org/10.1093/brain/awp313>.

<sup>25</sup> Cf. Miriam Kyselo, "Locked-in Syndrome and BCI – Towards an Enactive Approach to the Self", *Neuroethics* 6, no. 3 (December 1, 2013): 579–91, <https://doi.org/10.1007/s12152-011-9104-x>.

<sup>26</sup> "The Extended Mind", *Analysis* 58, no. 1 (1998): 7–19.

## 4. Pseudoscience and Fallibility

Embodied cognition as a research tradition remains quite resilient to contrary evidence in individual experimental cases. This is because many principles defended by its proponents are merely fallible research heuristics. While this resilience may be helpful for the research tradition as a whole, it does not seem advantageous from another point of view, that of testability. It becomes utterly difficult to overthrow this tradition, if all it offers are just bland heuristics.

But if it can never be overthrown because of its inability to be disconfirmed by empirical evidence, is it even scientific? One could think that embodied cognition resembles pseudoscience in this regard. After all, no imaginable fact could undermine it. Hence, it is instructive to focus on the role of heuristics to elucidate whether their fallibility implies that the whole embodied approach is pseudoscientific.

Embodied cognition offers heuristics for designing new experiments, such as (COHF-HEUR), and this makes it fruitful in cognitive research. These heuristics are used in an interdisciplinary fashion: researchers from different subtraditions and subfields of cognitive science use them in conjunction with their theoretical background and experimental techniques. This interdisciplinary mode of research makes embodied phenomena suggested by heuristics more difficult to study because of differing evidential standards and possibly divergent experimental protocols.<sup>27</sup>

The role of heuristics is to provide hints for designing experiments. But these experiments are not performed to overthrow one simple philosophical claim; rather, they test quite specific hypotheses, for example, whether sensorimotor processing is present when people process abstract linguistic material. In other words, these heuristics play a role in designing specific experiments. But embodied cognition cannot be reduced to a set of specific experiments because it is a research tradition.

Research traditions are more abstract than scientific theories and should not be confused with them. The notion of research tradition was introduced by Larry Laudan,<sup>28</sup> who, following in the steps of Imre Lakatos and his account of research programs as distinguished from theories,<sup>29</sup> stresses the historically evolving nature of traditions. Instead

<sup>27</sup> Jacqueline A. Sullivan, "The Multiplicity of Experimental Protocols: A Challenge to Reductionist and Non-Reductionist Models of the Unity of Neuroscience", *Synthese* 167, no. 3 (2009): 511–39, <https://doi.org/10.1007/s11229-008-9389-4>.

<sup>28</sup> *Progress and Its Problem*.

<sup>29</sup> Imre Lakatos, "Falsification and the Methodology of Scientific Research Programmes", in *Criticism and the Growth of Knowledge: Proceedings of the International Colloquium in the Philosophy of Science, London, 1965*. Vol. 4, ed. Imre Lakatos, Alan

of accentuating, like Lakatos, that there is an immutable hard core of research programs, Laudan argues that in reality, the methodological and metaphysical commitments of research traditions evolve. Both Lakatos and Laudan insist that research traditions (or programs) are sometimes extremely difficult to disconfirm empirically. But they measure their progress differently: for Lakatos, it is the ability to predict more empirical results, and for Laudan, it is the capacity to solve the problems of a given tradition, be they empirical or theoretical.

This is especially important for embodied cognition. A research tradition may remain scientific if it is able to solve more and more problems over time, while its hypotheses are so abstract that they cannot be disconfirmed experimentally. In the case of embodied cognition, one particular fact is clearly visible: all of its proponents are specifically critical of cognitivism that views cognition in terms of processing of amodal symbols.<sup>30</sup> Moreover, by following the research heuristics that are supposed to contribute to overthrowing cognitivism, they are able to design and perform new experiments.

Many of these new experiments seem quite surprising and novel. For example, children no longer make A-not-B errors, which were considered purely logical by Jean Piaget,<sup>31</sup> when they simply change their bodily posture.<sup>32</sup> But some surprising and novel experiments, sometimes suggestive of strong support for (EH), have turned out to be much more problematic. For example, the action–sentence compatibility effect<sup>33</sup> or the impact of the smile on the perception of hilarity of jokes<sup>34</sup> fail to replicate.<sup>35</sup> These experiments could have suggested that cognitive processes are always strongly embodied, i.e., that bodily posture

Musgrave (Cambridge: Cambridge University Press, 1970), 91–195, [http://www.springerlink.com/index/10.1007/978-94-010-1863-0\\_14](http://www.springerlink.com/index/10.1007/978-94-010-1863-0_14).

<sup>30</sup> Fodor, *The Language of Thought*; Chomsky, “Rules and Representations”.

<sup>31</sup> *The Construction of Reality in the Child*.

<sup>32</sup> Thelen et al., “The Dynamics of Embodiment: A Field Theory of Infant Perseverative Reaching”.

<sup>33</sup> Arthur M. Glenberg, Michael P. Kaschak, “Grounding Language in Action”, *Psychonomic Bulletin & Review* 9, no. 3 (2002): 558–565, <https://doi.org/10.3758/BF03196313>.

<sup>34</sup> F. Strack, L.L. Martin, S. Stepper, “Inhibiting and Facilitating Conditions of the Human Smile: A Nonobtrusive Test of the Facial Feedback Hypothesis”, *Journal of Personality and Social Psychology* 54, no. 5 (1988): 768–77, <https://doi.org/10.1037/0022-3514.54.5.768>.

<sup>35</sup> E.-J. Wagenmakers et al., “Registered Replication Report: Strack, Martin, & Stepper (1988)”, *Perspectives on Psychological Science* 11, no. 6 (November 2016): 917–928, <https://doi.org/10.1177/1745691616674458>; Megan H. Papesh, “Just Out of Reach: On the Reliability of the Action-Sentence Compatibility Effect”, *Journal of Experimental Psychology. General* 144, no. 6 (December 2015): e116–41, <https://doi.org/10.1037/xge0000125>.

or movement could influence how people perform cognitive tasks. As it turns out, these effects are mostly negligible in cases of verbal processing or joke understanding.

But note two things. First, these experiments can be reproduced to show that their results diverge from what was reported in the original publications. In other words, nothing about embodied cognition makes its particular research hypotheses or experiments resilient to testing. They can fail, which is all the better for scientific credentials of research exemplars in this tradition. Second, the failure to replicate seems to have as little effect as Aizawa's conceptual argument on the whole tradition. Simply, researchers never considered (EH) as a universally true principle of cognition. However, they thought that (EH) or something close enough to it could be used to design new experiments – and the flurry of results that seem to undermine the amodal approach is clear evidence of this fact.<sup>36</sup>

From Laudan's point of view, embodied cognition is a progressive research tradition as long as it solves its problems. Just because one of its problems is to show that Chomsky and Fodor are wrong about cognition, and proponents of the embodied cognition deliver results that suggest that the amodal symbol view of cognition is flawed, it remains progressive in this respect. It does not mean that embodied cognition must solve all possible problems. As I argue elsewhere (Miłkowski and Nowakowski, under review), embodied cognition, in spite of its intrinsic variety and the number of subtraditions it encompasses, could be considered unificatory to a degree, as it contributes to simplifying models of cognition by extrapolating a number of mechanisms related to body morphology, bodily simulations and such.

So, could embodied cognition as a research tradition fail in general? Critics of embodied cognition could point out, for example, that its proponents no longer propose new, unforeseen connections between bodily morphology and cognition. In general, it seems inevitable that fallible research heuristics will, at some point, stop providing theoretically or empirically new results. Unless a more systematic theory of cognition is proposed, which could fuel research for years, the tradition could run out of steam. But the jury is still out on this.

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<sup>36</sup> Marcin Miłkowski, "Autopoiesis Nie Wywołała Rewolucji", in *Filozof w Krainie Umysłów. Profesorowi Andrzejowi Klawiterowi w Darze*, ed. Grzegorz Króliczak et al. (Poznań: Wydawnictwo Naukowe Wydziału Nauk Społecznych UAM, 2018), 217–227.

## 5. Conclusion: From Research Heuristics to Theory

In this paper, it was claimed that principles of embodied cognition, such as (COH) are best understood in terms of fallible research heuristics, such as (COHF-HEUR). As I argued, their failure does not undermine the whole tradition. However, the tradition can still be considered scientific and progressive if it continues to provide new solutions to its problems (and, possibly, offer new problems to solve). Conversely, it could be considered degenerate if it fails to provide novelty and originality.

Even though embodied cognition is an extremely varied research tradition, the point of my argument is not that it is reducible to a set of fallible research heuristics. If it were reducible, the job of a philosopher of science would be to produce a catalog of these heuristics as implied by various subtraditions of embodied cognition. Although the role of fallible heuristics in the process of scientific discovery should not be underappreciated, research traditions are more than mere collections of unstructured fallible heuristics. They also come with some commitments to metaphysics and methodology, and their identity over time is mostly based on historical continuity. Embodied cognition is best viewed as a dynamic population of various subtraditions that retain a certain similarity to its best exemplars, which have shaped this tradition in cognitive science.

Only by studying how this tradition evolves and grows over time, not just its metaphysical and methodological commitments, can we gain a deeper understanding of its dynamics. The dynamics are suggestive of a fairly loose theoretical background common to all proponents of embodied cognition, which may also underpin the ongoing integration of embodied cognition with mainstream cognitive science. Instead of offering a grand new unification of cognitive theorizing, embodied cognition complements the information processing view of cognition, which remains the main theoretical framework in cognitive science. Alas, this main framework is still very abstract and remains insufficiently systematic to become a grand unified theory of cognition. But that is a theme for another occasion.

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## Summary

In this paper, I argue that embodied cognition, like many other research traditions in cognitive science, offers mostly fallible research heuristics rather than grand principles true of all cognitive processing. To illustrate this claim, I discuss Aizawa's rebuttal of embodied and enactive accounts of vision. While Aizawa's

argument is sound against a strong reading of the enactive account, it does not undermine the way embodied cognition proceeds, because the claim he attacks is one of fallible heuristics. These heuristics may be helpful in developing models of cognition in an interdisciplinary fashion. I briefly discuss the issue of whether this fallibility actually makes embodied cognition vulnerable to charges of being untestable or non-scientific. I also stress that the historical approach to this research tradition suggests that embodied cognition is not poised to become a grand unified theory of cognition.

**Keywords:** embodied cognition, heuristics, research tradition, representational unification

## Streszczenie

### Zawodne heurystyki a ocena tradycji badawczych. Przypadek poznania ucieśnionego

Celem artykułu jest uzasadnienie tezy, że ucieśnione poznanie, jak wiele innych tradycji badawczych w kognitywistyce, dostarcza zbioru zawodnych heurystyk badawczych, a nie ogólnych zasad obowiązujących we wszelkiego rodzaju procesach poznawczych. Teza ta jest zilustrowana przykładem polemiki Kennetha Aizawy z enaktywnymi i ucieśnionymi koncepcjami widzenia. Podczas gdy argumentacja Aizawy jest poprawna materialnie w odniesieniu do mocnej interpretacji koncepcji enaktywnej, nie podważa ona ucieśnionego poznania, gdyż wymierzona jest jedynie w zawodną heurystykę. Heurystyki takie mogą być pomocne w rozwijaniu modeli poznania w sposób interdyscyplinarny. Krótko opisuję problem, czy ta zawodność wystawia ucieśnione poznanie na zarzut niesprawdzalności i pseudonaukowości. Podkreślam też, że historyczne podejście do tej tradycji badawczej sugeruje, iż nie może ona stać się wielką unifikacyjną teorią poznania.

**Słowa kluczowe:** ucieśnione poznanie, tradycje badawcze, unifikacja reprezentacyjna