

# 1. What is action-oriented perception?

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**Abstract.** Contemporary scientific and philosophical literature on perception often focuses on the relationship between perception and action, emphasizing the ways in which perception can be understood as geared towards action or ‘action-oriented’. In this paper I provide a framework within which to classify approaches to action-oriented perception, and I highlight important differences between the distinct approaches. I show how talk of perception as action-oriented can be applied to the evolutionary history of perception, neural or psychological perceptual mechanisms, the semantic content or phenomenal character of perceptual states, or to the metaphysical nature of perception. I argue that there are no straightforward inferences from one kind of action-oriented perception to another. Using this framework and its insights, I then explore the notion of action-oriented perceptual representation which plays a key role in some approaches to embodied cognitive science. I argue that the concept of action-oriented representation proposed by Clark and Wheeler is less straightforward than it might seem, because it seems to require both that the mechanisms of perceptual representation are action-oriented and that the content of these perceptual representations are action-oriented. Given that neither of these claims can be derived from the other, proponents of action-oriented representation owe us separate justification for each claim. I will argue that such justifications are not forthcoming in the literature, and that attempts to reconstruct them run into trouble: the sorts of arguments offered for the representational mechanisms being action-oriented seem to undermine the sorts of arguments offered for the representational content being action-oriented, and vice-versa.

## 1 Introduction

Contemporary scientific and philosophical literature on perception often focuses on the relationship between perception and action, emphasizing the ways in which perception can be understood as geared towards action. Research in psychology, for example, sometimes characterizes perception as “action-specific” (Cañal-Bruland & van der Kamp, 2009; Witt, 2011), and talk of perception as being “of affordances for action” is found in both psychology and philosophy (Richardson, Shockley, Fajen, Riley, & Turvey,

2008; Chemero, 2011). Descriptions of perception as “active” are found in vision science (Whitehead & Ballard, 1990), artificial intelligence (Weyns, Steegmans, & Holvoet, 2004), psychology (Aloimonos, 2013), and philosophy (Noë, 2004); and as “enactive” in robotics (Morse & Ziemke, 2007), cognitive science (Froese & Spiers, 2007), and philosophy (Thompson, 2007). In psychology (Fajen, 2005) and also in sports science (Pijpers, Oudejans, & Bakker, 2007), perception is described as being “for action”; while the term “action-oriented” is applied to perception in philosophy (Gallagher & Zahavi, 2014), computer science (Gora & P., 2014), and neuroscience (Ridderinkhof, 2014).

In what follows, I’ll use the term ‘action-oriented’ as an umbrella-term to include approaches like these that share the idea of perception as oriented or geared towards action, in some sense. My first aim in this paper is to provide a framework within which to classify approaches to action-oriented perception, and to highlight important differences between distinct approaches.

My framework classifies action-oriented approaches to perception into one of five categories:

1. The evolution of perception as action-oriented: these approaches claim that perception evolved to guide action, or that perception was selected for its action-oriented capacities.
2. The mechanisms of perception as action-oriented: these approaches claim that the mechanisms of perception overlap with, or are closely coupled to, the mechanisms of action.
3. The contents of perception as action-oriented: these approaches claim that the contents of perception present the world to the perceiver in terms of possible actions.
4. The phenomenal character of perception as action-oriented: these approaches claim that a perceptual state is qualitatively experienced as encouraging or demanding a certain action.
5. The nature of perception as action-oriented: these approaches claim that perception has a necessary connection to action, that to be a perceiver is essentially to have certain agentive capacities or skills.

Part of my motivation for providing this framework is to clarify the discussions of action-oriented perception across philosophy and the sciences. I will show that each approach within the framework is logically independent of the others: none of the approaches can be derived from the others without further justificatory assumptions. We should thus not conclude from the fact that perception is action-oriented in one respect that it is action-oriented in any of the other respects.

This paper also has a second aim, which is to use this framework to explore the role of action-oriented perception in embodied cognitive science. In particular, I will focus on the claim that perceptual representations can be action-oriented. I will show that Clark (1997) and Wheeler (2005) put forward a concept of action-oriented perceptual repre-

sentations which is committed to both the representational mechanisms of perception being action-oriented, and to their contents being action oriented. But given that neither of these claims can be derived from the other, proponents of action-oriented representation owe us separate justification for each claim. I will argue that such justifications are not forthcoming in the literature, and that attempts to reconstruct them run into trouble: the sorts of arguments offered for the representational mechanisms being action-oriented seem to undermine the sorts of arguments offered for the representational content being action-oriented, and vice-versa.

In Sections 2-6, I introduce each of the distinct respects in which perception can be said to be action-oriented. Section 7 explores the use of action-oriented perceptual representations in embodied cognitive science.

## 2 The evolution of perception as action-oriented

There is an evolutionary sense in which perception can be described as action-oriented, that is often expressed with the claim that perception is “for action”. Proponents of this view emphasise that our perceptual capacities evolved to guide our bodily interactions with the world, specifically those interactions which increased our adaptive fitness. Talking about visual perception, for example, Briscoe claims that:

“[f]rom an biological or evolutionary standpoint, it is reasonable to think that vision is *for action*, that its preeminent biological function is to adapt an animal’s bodily movements to the properties of the environment that it inhabits” (Briscoe, 2014, p. 202, my italics).

On one interpretation of such claims, the idea that perception is “for action” in an evolutionary sense seems trivially true, and it’s not clear whether any believer in evolution would deny it. But the evolutionary claim is often put forward in a stronger way: the assumption is sometimes that perception evolved directly to guide action and *not* (or at least not directly) to present the perceiver with an action-neutral description of the objective world. If perception evolved for its action-guiding properties, so this line of thought goes, then it did not evolve to enable us to have beliefs about how the world is, independently of our own actions. Proponents of this view either conclude that we do not perceive the objective world in an action-neutral way, or that if we do, this is not the primary function of our perceptual systems: perception did not evolve in order to provide inputs to the human capacity to think and reason about the world. Representative versions of this view can be found in the works of philosophers like Patricia Churchland and Kathleen Akins:

“looked at from an evolutionary point of view, the principle function of nervous systems is to get the body parts where they should be in order that the organism may survive. [...] Truth, whatever that is, definitely takes the hindmost.” (Churchland, 1987, p. 548)

“evolution will favor sensory solutions that package the information in efficient and quickly accessible formats, in ways that match the particular physical form of the motor system, its motor tasks, and hence informational requirements. [...] the elegant solutions that evolution eventually selects need not involve any straightforward (to our eyes) ‘veridical’ encoding of sensory information.” (Akins, 1996, p. 353)

Notice that this involves a strong commitment to a particular evolutionary story. Proponents of this view have to rule out the possibility that the development of amodal cognition could have been more adaptive than a faster but less flexible system in which specific sensory inputs drove specific motor outputs. Some scientists claim exactly this, arguing that game theory demonstrates that selection pressures would make objective representations of the world an unlikely outcome (Hoffman, Singh, & Mark, 2013), but this is often assumed rather than argued for. Notice that even if one accepts that evolution selected for action-guiding perception, this is consistent with the claim that evolution *also* selected for the kind of perception that can yield reasoning capacities and abstract thought. It might be the case, in other words, that we have two forms of perception. This is a possibility raised by the dual-visual system theory of perception, discussed in the next section.

### **3 The mechanisms of perception as action-oriented**

According to a traditional picture of the mind, perceiving and acting are distinct mechanisms which are separate from each other and from our thinking mechanisms: perception provides input for thought, and action emerges as the output of thought. (This is what Susan Hurley (1998) terms the ‘classical sandwich’ picture of the mind.) This picture is challenged by empirical work which suggests that the mechanisms of perceiving and acting are closely intertwined, overlapping, or even co-constituting. If this is true, then there is a sense in which the mechanisms of perception can be action-oriented regardless of their evolutionary history.

One example of this comes from the literature on so-called ‘mirror neurons’: in macaque monkeys, neurons known to control hand and mouth movements fire both when the monkey is manipulating an object (e.g. reaching for a piece of food) and when the monkey is watching someone perform a similar manipulation. In creatures like humans, where single-cell recordings are not possible, there is similar data showing that areas of the brain associated with movement are active during perceptual processing: one and the same neural mechanism seems to be involved in both perception and action. Perception is action-oriented in the sense that a perceptual mechanism seems to overlap with a mechanism for action.

In visual psychology, Milner and Goodale (1995) have advanced the ‘dual visual systems’ hypothesis, which concerns the way that visual perception builds up information

about the world. They have demonstrated that sensory input to the visual system of primate brains can be processed by two independent pathways. The processes in the *ventral* pathway reflect the traditional picture of perception as the input to thought: they produce conscious perceptual states that we can categorize, memorize, and combine with thoughts to produce a broad range of actions. The processes in the *dorsal* pathway, however, do not seem to be the inputs to thought: these visual inputs instead lead only to the specific motor outputs involved in reaching and grasping objects with our hands. The dorsal processes seem to be action-oriented in the sense that visual input results in the appropriate motor output without the intermediary of conscious thought.

This sort of ‘close coupling’ between sensory input and motor output is also found in robotics and artificial intelligence. The traditional view of perception and action as distinct mechanisms separated by central thought processes creates engineering problems for designers of intelligent systems by causing bottlenecks to occur: the sorts of thinking required to update plans and amend instructions slows down the system’s ability to respond to sensory stimuli. Roboticians like Rodney Brooks produced systems that could interact with their environments in real-time, by cutting out the central ‘mind’ focusing instead on using specific input sensors to generate specific outputs. Brooks (1991) proposes that arranging these sensory-motor couplings in ‘layers’ in the appropriate way, surprisingly intelligent behavior can be produced. One layer might govern general locomotion, such that a robot will move around at random until it hits an obstacle. Another layer might then take over and turn the robot until the way is clear, before control reverts to the first layer. A third layer might sense red light and keep the robot on track to reach the light, thus overriding the first layer’s random movement. Each sensory process in these robotic architectures is thus action-oriented in the sense that each layer has its own sensors which operate exclusively for one kind of behavior. There is no amodal cognition or control: the communication between the layers is minimal, and amounts to just switching each other on and off. Such architectures can be used to create systems that display a remarkable amount of seemingly intelligent flexible behavior from purely reflex-like action-oriented sensory-motor couplings. It remains an empirical question whether such architectures can simulate higher-level behaviours, such as deciding between actions, without the addition of central thought mechanisms.

The three examples I’ve considered – mirror neurons, the dorsal visual stream, and sensory-motor architectures – are examples of ways in which the mechanisms of perception could be said to be action-oriented. Notice that claims about action-oriented perceptual mechanisms are independent from the previously considered claim that perception is action-oriented in the sense of having evolved to guide action. First, consider the robotic architectures just described. The fact that an optimal engineering solution uses action-oriented perceptual mechanisms (in the sense of reflex-like couplings between sensory inputs and motor outputs) doesn’t tell us that human perceptual systems actually evolved such couplings: evolutionary solutions are often the satisfactory but sub-optimal ones, rather than the optimal solutions. Second, while the dorsal visual stream’s use of sensory input to directly guide action seems to support the evolutionary claim, it does so only with respect to a certain subset of perceptual processing: the guiding

of fine-grained motor control, rather than action more generally. And the ventral visual stream seems to have evolved to generate the kind of perceptual states that can input into thought, which is exactly what the proponents of the stronger evolutionary claims want to deny. Third, despite many claims about the evolutionary purpose mirror neurons might have served, it's not clear that we can draw any conclusions about the action-oriented nature of perceptual evolution from the empirical data. Cecilia Heyes (2009), for example, has persuasively argued that mirror neurons are a byproduct of our general capacity for associative learning and not the result of evolutionary adaption.

## 4 The contents of perception as action-oriented

Many of the claims about action-oriented perception in philosophy concern the contents of perception: how the world is presented to us in experience. It is traditionally assumed that perception presents the world to us in a way that is entirely neutral with respect to the actions one might perform: while the contents of *beliefs* might present the world to us in terms of how we can act on it (presenting food as edible or stairs as climbable, for example), such contents are not available in perception, according to the traditional view of perceptual content as action-neutral. Proponents of action-oriented perceptual content, on the other hand, propose that action-involving properties like edibility or climbability can be presented to us in the contents of perception: “we *see* objects as edible, and do not just believe that they are” (Nanay, 2012, p. 430). Following Gibson (1979), we can use the term ‘affordance’ to describe properties like edibility and climbability, and characterize the action-oriented view of perceptual content as the claim that we perceive affordances. Action-oriented views of perceptual content come in different strengths, depending on how they characterize the idea of affordances. To perceive the world as affording a certain action might, on a weak reading, mean that we perceive the possibilities for action: the sorts of actions we are capable of performing. A stronger reading would claim that action-oriented perceptual content presents the world to us in a way that solicits or encourages us to act in a certain way; and an even stronger reading views affordance properties in perceptual content as mandating or demanding a particular action. Action-oriented perceptual content need not be consciously experienced by the perceiver, but there is a way of extending the idea of action-oriented perceptual content to include the phenomenal character of perception, which I’ll discuss in the next section.

As I am using the notion of perceptual content here in a weak way, according to which talk of perceptual content is talk of the world as presenting itself to the perceiver in experience. Such talk is not committed to the stronger claim that perceptual experience fundamentally consists in the subject perceptually representing their environment as being a certain way. The weaker notion of perceptual content is therefore not committed to representationalism about perception, but is compatible with at least some forms of relationalism (Siegel, 2014). Furthermore, proponents of action-oriented perceptual content might conceive of content as propositional or non-propositional; as structured conceptually or non-conceptually; as Russellian or Fregean, or in terms of possible worlds; and

as environment-dependent or independent.

It is important to emphasise that since action-oriented perceptual content is not committed to this content being carried by a particular neural or psychological mechanism, then *a fortiori* it is not committed to the existence of action-oriented perceptual mechanisms. This will be further discussed later in Section 7.

## 5 The phenomenal character of perception as action-oriented

Philosophers draw a distinction between the content of perception and its phenomenal character. To talk of perceptual content is to talk of how perception presents the world; whereas to talk of the phenomenal character of perception is to talk of the qualitative properties of the perceptual state, or what it feels like to undergo the perceptual experience. If we assume that perceptual states need not be consciously experienced, then it is possible for a perceptual state with the sort of action-oriented content outlined above to lack phenomenal character altogether. And where a perceptual state has phenomenal character and action-oriented content, that action-oriented content might be “non-soliciting” (Siegel, 2014): one could consciously perceive something as affording action without experiencing the motivation to perform that action. Similarly, Prosser (2011) proposes that the phenomenal character of a perceptual state correlates with its action-oriented perceptual content, but doesn’t claim that the phenomenal character itself is action-oriented.

But it looks like there could be cases where the phenomenal character of a perceptual state is itself action-oriented. Siegel (2014), for example, claims that perceiving what the environment affords can sometimes be accompanied by a felt quality of solicitation, where the perceptual experience has a qualitative feel of inviting or prompting us to act. If we think of this as action-oriented phenomenal character, then it looks like phenomenal character might be action-oriented to differing degrees: some perceptual experiences might not just feel like invitations or prompts, but more like urges that motivate us to act. Siegel (2014) proposes that this particular subset of perceptual states with action-oriented phenomenal character have a “feeling of answerability” and are experienced as mandates for action.

Notice that how one understands the relation between action-oriented content and action-oriented phenomenal character will depend on one’s attitude more generally to the relation between perceptual content and phenomenal character. A proponent of strong intentionalism about phenomenal character, for example, would presumably claim that any action-oriented aspects of phenomenal character reduce to the action-oriented properties of the perceptual content. At the other end of the spectrum, one might think that phenomenal character is entirely independent of perceptual content, and thus that it is possible to have two perceptual experiences with the same content but distinct characters.

## 6 The nature of perception as action-oriented

I have suggested that claims about perception being action-oriented can be understood as making a variety of different claims about the evolution, mechanisms, content, or character of perception. But there remains a further question about the modal strength of the claims being made. Should we understand any of these claims as proposing that perception is *necessarily* action-oriented in any of these senses? And if so, what kind of necessity is involved?

I take it that most of those making action-oriented claims concerning the evolution of perception or the mechanisms of perception are making largely empirical claims about features of perception in the actual world. But at least some proponents of action-oriented perception seem to be making modal claims, which can be interpreted in at least two ways. On one hand, the necessity at play might be nomological necessity. To say that perception is necessarily action-oriented in the nomological sense is not to say that perception is action-oriented in all possible worlds, but rather to say that the laws of nature in the actual world make it physically impossible for perception not to be action-oriented in the actual world. Alternatively, the necessity in question might be metaphysical necessity, concerning the nature of perception across possible worlds. To posit a metaphysically necessary connection between perception and action is to claim that there is no possible world in which perception is not action-oriented in some appropriate sense.

The claims made by some proponents of sensorimotor theories of perception, such as Alva Noë (2004) and Susan Hurley (1998), seem to suggest that there is a constitutive dependence of perception on our capacity for action: that to be a perceiver is necessarily to be an agent. It is not clear what kind of necessity is involved, but their reliance on empirical evidence suggests that they are primarily concerned with making a case for nomological necessity. The case for action being metaphysically necessary for perception is perhaps found in Schellenberg (2010) exploration of the relationship between perception, self-location, and spatial know-how. Her key claim, that perception requires the capacity to know what it would be to act in relation to objects, seems to rely on our intuitions about how perception could be in possible worlds rather than how it is in the actual world.

Notice that even where claims of nomological necessity are made and supported by empirical evidence about the mechanisms of perception, there is not direct entailment from action-oriented perceptual mechanisms to the claim that perception is necessarily action-oriented. We cannot simply read off claims of nomological necessity from empirical facts (Callender, 2011). And claiming that perception is necessarily action-oriented in the sense that Schellenberg intends does not entail that either perceptual content or phenomenal character is action-oriented. In fact, Schellenberg proposes that perception's dependence on action capacities is what allows us to perceive more than just the relational or perspectival properties associated with affordances: she claims that the action-oriented nature of perception can account for our access to the intrinsic, observer-independent properties of the objects perceived.



## 7 What about action-oriented representation?

I've differentiated several different approaches to perception that fall under the umbrella-term 'action-oriented', and demonstrated that each approach makes claims that are independent from the others. There is no entailment from one variety of action-oriented perception to another without the addition of further premises.

While I've talked about the mechanisms of perception and the content of perception, I have said little about the matter of perceptual *representations*: content-bearing internal states of the perceiver. In fact, many people working in action-oriented perception want to play down the role of representations. This is because in cognitive science, representational mechanisms are traditionally posited to account for the flexibility of intelligent human behaviour: our capacity to respond differently to similar stimuli, and similarly to different stimuli, in a way that can't be easily accounted for in terms of reflex-like responses. Positing internal representations allows cognitive science to say that the same stimulus can be represented in different ways: the same extensional content can be carried by different representational 'vehicles' which play distinct causal roles within the cognitive mechanism.<sup>1</sup> These vehicles are just internal representations individuated by the non-semantic properties in virtue of which they are causally efficacious: the formal, functional, or physical properties to which the cognitive mechanisms are sensitive. Thus two representations are tokens of the same vehicle type when they are treated similarly by the cognitive processes at play (Shea, 2007).

Traditionally, cognitive science suggests that these representational mechanisms are genuinely cognitive in the sense of being non-perceptual: they are distinct from the mechanisms of perception, and they are what allow the same perceptual input to result in different action outputs. Proponents of embodied cognitive science, however, deny that explanations of flexible and context-specific behaviour require this sort of mediating representational mechanism. They argue instead that if perceptual mechanisms are action-oriented in the sense discussed in Section 3, then these sorts of coupled mechanisms can account for the behaviour.

But not everyone agrees that the insights from action-oriented approaches to perception should lead to the rejection of internal representational states. There are many within embodied cognitive science who allow that there are internal representations, but deny that these are the sort of amodal cognitive representations in a central cognitive architecture. Andy Clark (1997), for example, argues that behaviour is not mediated by "action-independent inner states; ones which require additional cognitive operations to drive appropriate behavior", but rather by action-oriented representations which are "poised between pure control structures and passive representations of external reality" (Clark, 1997, p. 49). A similar approach is put forward by Michael Wheeler, who understands

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<sup>1</sup>For naturalistic reasons, cognitive science is generally committed to extensional content.

the idea of action-oriented perceptual representations as “special-purpose adaptive couplings” that are “tailored to a particular behavior” (Wheeler, 2005, p. 196). Both Clark and Wheeler propose that the sorts of action-oriented mechanisms of perception discussed in Section 3 are best understood as representational mechanisms: as containing perceptual states which are both causally efficacious and semantically evaluable. They argue that these perceptual representations themselves, and not just the mechanisms in which they occur, should be understood as action-oriented because in virtue of the way that they are causally coupled to certain motor processes.

To claim that a mechanism is representational is to be committed to vehicles of content. But this does not commit one to any particular views about the nature of that content: what it is or how it is determined, evaluated, or structured. (We might agree that a list of items is a representation, while disagreeing over whether it is a description or an instruction, for example; we might believe a drawing to be a map without knowing what it is of; we might know that someone’s utterances are linguistic without knowing what they mean.) To understand an internal state as a representational vehicle does not, therefore, entail a particular view of its content. *A fortiori*, it does not entail that its content is action-oriented in the sense of presenting the world in action-relevant ways. The reverse is also true, as already discussed in Section 4: action-oriented perceptual content is neutral with regard to the mechanisms of perception, and therefore compatible with a range of cognitive architectures. Action-oriented perceptual content does not entail action-oriented perceptual mechanisms, and *a fortiori* does not entail that there are action-oriented vehicles of representation bearing the action-oriented perceptual content.

Interestingly, however, both Clark and Wheeler seem to assume that their action-oriented vehicles of perceptual representation have action-oriented perceptual content. Clark claims that action-oriented perceptual representations “simultaneously describe aspects of the world and prescribe possible actions”, with the result that “to thus know the world is at once to know what possibilities it affords for action and intervention” (Clark, 1997, p. 49), while Wheeler claims that action-oriented perceptual states “represent the world in terms of specifications for possible actions” with “bearer-relative content” (Wheeler, 2005, p. 196). Their action-oriented representations, in other words, seem to be examples of action-oriented perceptual mechanisms with action-oriented perceptual contents.

Neither Clark nor Wheeler explain why they think that action-oriented vehicles will have action-oriented contents. Any attempt to reconstruct their arguments will, I suggest, encounter the following problem: reasons to think of perceptual vehicles as action-oriented seem to undermine our reasons to think of perceptual contents as action oriented, and vice-versa.

To see this, consider the role played by representational vehicles. Recall that vehicles are just internal representations individuated by the non-semantic properties in virtue of which they are causally efficacious within the representational mechanisms. Vehicles provide a naturalistic way of understanding how the same extensional content can play distinct cognitive roles, such as when the same heavenly body is thought about in

different ways according to the time of day it is observed. The extensional content is the same, but the representational vehicles have distinct causal properties in each case and thus interact differently with other states of the mechanism. If we claim, as Clark and Wheeler do, that representational vehicles should be individuated according to their action-guiding properties, then this enables us to show how the same extensional content (e.g. a mountain) can be represented as climbable in one context and unclimbable in another context: distinct vehicles, with different causal relations to action, can carry the same extensional content. But if this is the role of representational vehicles, to provide a naturalistic means of accounting for modes of presentation, then it removes the need to think of the content itself as action-oriented. The perceptual content can be action-neutral because the relevant action-guiding information is supplied by the perceptual mechanisms.

One might, however, have independent motivation for thinking that affordance properties are part of the perceptual content itself: we perceive the climbability of the mountain, for example, rather than perceptually representing the mountain as climbable. But if we don't need to perceptually represent the mountain as being a certain way, then it's not clear what motivation we'd have for positing vehicles of representation, rather than non-representational mechanisms. This, I take it, is the essence of Gibson's (1979) view of perception. And even if we had reason to posit representational mechanisms, we'd then need a further argument for individuating the representational vehicles according to their action-guiding properties.

In summary, the arguments for taking perceptual vehicles to be action-oriented seem to undermine the arguments for taking perceptual contents to be action-oriented, and the arguments for taking perceptual contents to be action-oriented seem to undermine the arguments for taking perceptual vehicles to be action-oriented. None of this rules out that there may be arguments from the action-oriented status of either vehicles or contents to the other, but it suggests that the onus is on proponents of such views to provide them.

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