# Exorcizing the homunculus from ideomotor/simulation theory: A commentary on Bach et al. (2022), Frank et al. (2023), and Rieger et al. (2023)

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The contributions to this special issue are trying to understand why imagining oneself acting can have very similar effects as actually performing the imagined action. While this may sound almost like magical thinking, these kinds of phenomena are widespread and often systematically used in sports and other areas that rely on human actions. Bach et al. (2022), Frank et al. (2023), and Rieger et al. (2023) (BFR in short) argue that they are much less surprising if one considers the intimate relationship between perception and action. Human action is much more than merely responding to particular stimuli in particular ways, and many of the stimuli we perceive are actually generated by our own actions (Dewey, 1896). Hence, perception and action may not just represent two different faculties that are related or that interact, but may rather be two sides of the same coin. In fact, Hommel, Müsseler, Aschersleben, and Prinz (2001) have suggested that the terms perception and action refer to the exact same sensorimotor activity, only that the perception term highlights the receptive, and the action term the productive aspect of this activity. The suggestions of BFR are very much along these lines, which leaves me nothing to complain about the very useful approaches that these authors are suggesting. I'm convinced that taking their insights on board will move our understanding of imagery forward. Instead, I would like to characterize a theoretical challenge that is likely to be the next obstacle in our scientific journey.

This challenge derives from the fact that imagery implies an agent who more or less consciously has to have the experiences that active imagination is believed to come with. Indeed, both ideomotor and simulation theory imply what Dennett (1991) has coined a "Cartesian theatre", in which plays or movies are presented. But to whom? Imagery is not something that we suspect a robot or computer to engage in, but something that is reserved for beings capable of conscious experience. And it is this experience that we believe plays a crucial role in the chains of processes involved in imagery-based action acquisition, for example. It is this theoretical aspect that makes the research area and the proposed theoretical approaches so

intuitive. Psychology is the only science in which the human mind is scientific subject (researcher) and scientific object (carrier of the researched mind) at the same time. This often invites confusion between the *personal* level of description, at which agents perceive, think, and act in meaningful ways, and the *systems* level of description, at which chains of processes translate available information into particular action outcomes. Our scientific task is to reconstruct the personal level, that we experience and can talk about, at a sub-personal systems level (Hommel, 2020), so that our ability to perceive and act can be mechanistically explained by the chain of processes that this reconstruction has revealed. However, systems-level reconstructions do not really match our personal experiences, so that non-scientists may find systems-level reconstructions overly reductionist and insufficiently rich. Ideomotor and simulation theory along the lines of BFR represent a good compromise, because they seem to relate our subjective experience—the content we imagine during imagery—to less intuitive sub-personal processes that eventually generate our actions. In other words, these theoretical approaches seem to causally connect the personal and the systems level.

But do they? The empirical phenomenon that the ideomotor and simulation approaches of BFR aim to explain refers to the observation that people can "think of" or "relive" the perceptual consequences of their actions and thereby activate and improve their representations of these actions. Ideomotor and simulation approaches account for this phenomenon by referring to the sensorimotor nature of action representations and by assuming that engaging in imagery activates the sensory part of these representations. This indeed can explain why activating the sensory part of these representations (in the process of "thinking of" the action effects) can interact and prime the motor part of these representations. But this comes with an unfortunate theoretical consequence: it leaves a Homunculus in the causal chain—the audience of the Cartesian theatre. It is "the person" who does the imagery (the "thinking of" action consequences in ideomotor theory and the "simulation" in simulation accounts), and it is her

experience that is taken to explain what follows. This would be a reasonable theoretical move if we would understand how imagery works mechanistically, but we don't. We do have reasons to believe that performing and improving action can benefit from imagining its consequences—as this is the very phenomenon we aim to explain—but we have no clue how that works. How does one imagine, anticipate, and think of a representation of action consequences in the first place? And how does this conscious experience get the machinery going to eventually perform the action?

While this seems to be merely an academic question, it is key in tackling a crucial theoretical problem: even though we have evidence suggesting that we engage in imagining, anticipating, and thinking of action consequences in the process of performing voluntary actions, we do not yet know whether any of these experiences actually has any causal impact. Along the lines of Wegner (2002), all the conscious experiences we have in the process of acting might be causally unimportant by-products of the systems-level processing that actually takes care of action control. Accessing the representations of our actions (in the process of "mental" training or during actual performance) may tend to activate their sensory parts, which in turn may provide us with the internal movies that people engaging in imagery report. But whether this movie is actually "played" and whether anyone is "watching" may not make any difference. The reported conscious experiences may indicate some aspects of the underlying processes (e.g., which representations were activated), but this does not show that the having of this experience was of any mechanistic relevance.

To demonstrate such mechanistic relevance, we either need to demonstrate that preventing the experience through experimental means (e.g., by "functionally lesioning" the activation of, or the conscious access to the neural action-effect representation through transcranial magnetic stimulation) strongly impairs action control, and that it does so in non-trivial ways (e.g., not by simply creating a dual-task situation). Or we need to better understand

the process of imagery, action-effect anticipation or simulation in a more mechanistic fashion. In other words, we need to fully exorcise the Homunculus from our theoretical stories by not allowing the having of conscious experiences carrying any explanatory burden. A first step towards this aim is likely to come to grips with the concept of goals that are driving our actions. As elaborated elsewhere (Hommel, 2022), stripping the representations of goals from any conscious or personal theoretical overhead allows us to better understand how goals are emerging and how they translate into activating action representations without any conscious intervention. This approach is likely to eventually render action-related conscious experiences entirely epiphenomenal, but more systematic exorcizing endeavors might generate alternative theoretical avenues. Let us tackle this next step!

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