The nature of mental imagery: Beyond a basic view

[Critical Notice of Bence Nanay, *Mental Imagery: Philosophy, Psychology, Neuroscience*. Oxford University Press, 2023. Forthcoming in *Analysis*.]

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In recent work, philosophers give mental imagery a number of roles. Cavedon-Taylor (2023) argues that mental imagery is ‘grease for the mind’s gears,’ interacting broadly with and assisting perception and cognition, as well as playing key explanatory roles in our understanding of psychopathology. Myers (2023) argues that mental imagery – in particular, the analog representational format of mental imagery – undergirds the epistemic fecundity of the imagination. Nanay, in a number of papers (e.g., 2010, 2017, 2018) and in a recent book (2023), argues that mental imagery is explanatorily central or relevant (the roles are various) for amodal completion (ch. 8, see also Briscoe 2011), the ‘temporal thickness’ of perception (i.e., the specious present, ch. 12), sensory substitution (ch. 15), synesthesia (ch. 16), pain (ch. 17), object files (ch. 18), language processing (ch. 19, see also Liu 2022), various forms of memory (ch. 20), boundary extension (ch. 21), action execution (ch. 26), cognitive dissonance (ch. 28), implicit bias (ch. 29), and more.

This raises a basic philosophical question: what is mental imagery (that it could be fruitfully associated with all of these phenomena)? The literature on mental imagery is surprisingly lassez-faire about this basic question. Many philosophers treat mental imagery as a kind of perceptual representation – it is either a perceptual state, or a representation of a perceptual state.[[1]](#footnote-1) In the sciences, writers point to mental imagery by way of a standard gloss – mental imagery is said to be (often, early) perceptual processing not directly caused by sensory stimuli (Kosslyn et al. 1995).[[2]](#footnote-2)

Philosophers sometimes adopt this gloss, which I will call the *basic view*. Nanay endorses it, and appeals to it in a number of places to argue that mental imagery plays various functional or explanatory roles, as well as to argue that some mental phenomena should be seen as forms of mental imagery. In places he goes even further, relying on this view of mental imagery to explain how mental imagery is a unified kind despite heterogeneous appearances, and using this view to support his claim that mental imagery is a natural kind (ch. 5). Nanay’s book – which is a both a useful introduction to the many ways that mental imagery appears in discussions across philosophy, neuroscience, and psychology, as well as an extended argument for the multi-faceted relevance of mental imagery to a range of projects in the philosophy of mind and psychology – thus also serves as a nice test case for whether this basic view of mental imagery is good enough to aid theorizing across philosophy and the sciences. I think not. Reading Nanay’s book convinced me of this.

I will illustrate why by looking at two areas. First, I will discuss Nanay’s argument regarding mental imagery and object files. Second, I will discuss an issue Nanay raises, regarding the relationship between mental and motor imagery. A longer discussion might look to many more areas – as already mentioned, Nanay’s book covers a wide range of mental phenomena – with the same lesson emerging. The nature of mental imagery cannot be fully understood without facing an array of choice points, many of which push us to make commitments beyond the basic view.

**Object files and mental imagery**

An object file is ‘a visual representation that “sticks” to a moving object over time on the basis of how and where that object moves, and stores (and updates) information about what that object looks like’ (Scholl and Flombaum 2010, 655). Object files are posited to explain various results in vision science, and, as Green and Quilty-Dunn (2021) note, they figure crucially in discussions of ‘singular reference, object individuation, perceptual memory, and the development of cognitive capacities’ (665). Nanay claims that mental imagery ‘can do all the jobs that object files were posited to do’ (2023, 141).

That’s a striking claim – how does Nanay support it? His general strategy is to argue that, contra those who theorize that object files have a sophisticated, discursive internal structure[[3]](#footnote-3) (Green and Quilty-Dunn 2021, Quilty-Dunn et al. 2023), a simpler explanation is available. This simpler explanation involves appeal to mental imagery of objects, and involves avoidance of appeal to any abstract or amodal features in the relevant representation.

This strategy needs the appeal to mental imagery to be an appeal to something simpler than object files that have a sophisticated structure. But nothing in the basic view of mental imagery supports this assumption – off-line perceptual processing may be as non-simple as perception, producing representations with sophisticated structure. Indeed, Green and Quilty-Dunn (2021) argue that object files are a proper part of perception. If they are right, we might expect to find that mental imagery traffics in object files as well: and there is some evidence for this (Cochrane and Milliken 2019, see also Pylyshyn 2003).

For the appeal to mental imagery to work, one needs to supplement the basic view in various ways. One might, for example, characterize the representational format(s) in which mental imagery traffics. In this connection, in chapter 6 Nanay claims that mental imagery shares with perception an analog representational format (i.e., mental imagery involves the representation of magnitudes, by magnitudes). This analog format is what Nanay has in mind when claiming that no abstract or amodal features are required to explain certain results. But in this dialectical context one cannot simply rely on claims about the representational format of perception. One needs evidence and argumentation, for the representational format of perception is in part what is at issue in debates over the structure of object files: the structure of object files is a key part of an argument that perception utilizes a pluralism of representational formats (Quilty-Dunn 2020).

Suppose one thinks that evidence and argumentation support the view that perception has analog or iconic format. Even so, issues about mental imagery may be unresolved. For it is possible to maintain that [a] object files have sophisticated structure, and that [b] mental imagery traffics in hybrid formats (see, e.g., Kosslyn 1980). Ned Block (2023), a leading defender of the view that perception is formatted iconically, argues that representations in visual working memory – which Nanay argues is also mental imagery (ch. 20) – are embedded in a ‘cognitive envelope,’ and thus presumably possess a sort of hybrid format.[[4]](#footnote-4)

If one wants to appeal to mental imagery to do theoretical work regarding object files, then, what is called for is [a] a more thorough assessment of the wide range of evidence that bears on the structure of object files,[[5]](#footnote-5) [b] a more robust account of mental imagery – e.g., one that considers issues of representational format, and issues concerning the deployment of mental imagery in cognition – than that given by the basic view.

**Mental imagery and motor imagery**

Motor imagery is typically characterized in terms of the kinds of conscious experiences one has when one imagines oneself acting (Jeannerod 1994, 2006).[[6]](#footnote-6) Motor imagery is said to stem from ‘the mental rehearsal of a motor act’ (Crammond 1997, 54), and to be composed of ‘imagery of one’s own action without any overt behavior, and with the imager being the agent of the action’ (Frank et al. 2023). But, as others have noted (Berendzen 2014, Nanay 2020), this is not quite right. Motor imagery may be unconscious as well as conscious (McAvinue and Robertson 2008).

This characterization suggests unrefined ideas about similarities and dissimilarities between motor and mental imagery, but that is all. Interestingly, in spite of the fact that the standard gloss on mental imagery obviously fails to apply to motor imagery, many assume that motor imagery is a form of mental imagery – that motor imagery falls under a more general umbrella that mental imagery covers. Ganis and Schenden (2011, 239) describe one version of this idea in passing, when they write, ‘Although there are different types of mental imagery (e.g., visual, auditory, motor) . . .’ Or consider Patel’s (2022) proposal that mental imagery should be understood as a set of conative states – states that represent ‘things as *to be made* a certain way’ (16). Patel moves from motor control models of inner speech, and the motor imagery involved therein, to mental imagery more broadly. Now, Patel is not concerned directly with the classification of motor imagery, or with answering our guiding question. But one can draw on his assumptions to suggest an answer: motor imagery is just a form of mental imagery, because mental imagery in general should be understood as a set of (presumably, analog or imagistic) conative states, and this applies to motor as well as sensory imagery.

But is this right? Patel considers how this proposal generalizes from inner speech to visual imagery. And he argues as follows.

[V]isual imagery is identical to a sensory representation of seeing an object from a perspective. In the case of normal eye movement, the sensory representation generates motor commands for eye movements, which, when executed, result in moving one’s eyes in a direction that brings about seeing an object from a perspective. In the case of visual imagery, however, the sensory representation of seeing an object from a perspective is activated but downstream processes are suppressed. The central idea is that the same conative processes that are used to drive motor commands relevant to perception and action are re-used in generating mental images. (18)

My chief worry about this proposal is that Patel’s view does not seem to fully generalize. Mental imagery of a wide range of passive phenomena – including falling through space, being pushed, hearing an alarm, and feeling a pinch – do not clearly involve motor preparation, or goals. This is because having a perceptual perspective does not require any specific sort of goal, or motor command.

Certainly motor imagery and perceptual imagery are closely intertwined. For example, mental rotation tasks – a classic way to tap into mental imagery – often involve motor processing (Cohen et al. 1996, Kosslyn et al. 2001). A plausible explanation for this, however, is that participants often perform mental rotation tasks by utilizing a cognitive strategy that deploys motor imagery of the rotation. Participants are also able to utilize strategies that do not involve motor imagery, or invoke motor processing in the same way (Wraga et al. 2003). This line of work suggests that, while motor and perceptual imagery can be utilized by the same cognitive operations, they are distinct in ways that a good account of motor imagery should be able to explain.

I turn to Nanay’s discussion (see also Nanay 2020), which is laudably unique in directly addressing the relationship between mental and motor imagery. He argues that motor and mental imagery are distinct, but structurally analogous: ‘Whereas mental imagery is the first stop of perceptual processing that is not directly caused by any input, motor imagery is the last stop of motor processing that does not directly cause any output’ (2023, 201). By speaking of the ‘last stop,’ Nanay is not relegating motor imagery to primary motor cortex, or the spinal tract. He writes, ‘I’m not claiming that activity in M1 that does not directly trigger bodily movements, is necessary for motor imagery. Even if M1 is silent but the premotor cortex or the SMA is not, and there is no overt movement, we can still talk about motor imagery’ (201).

Looking at areas of the brain where processing occurs during motor imagery and mental imagery can provide important clues. But the clues in this case are difficult to interpret. The processing involved in motor planning is widely distributed, involving not only primary motor cortex, but premotor cortex, posterior parietal cortex (Torres et al. 2013), hippocampus (Miller et al. 2017), and even prefrontal cortex (Mushiake et al. 2006). Depending on the action-type in question, processing may be difficult to parse into ‘sensory’ or ‘motor.’ For example, processing areas like the frontal eye fields (FEF) seem to be important for the motor planning of eye movements (Wong et al. 2015), and seem to be properly associated with both mental as well as motor imagery (Jonikaitis et al. 2023).

Nanay’s proposal takes motivation from Jeannerod’s remarks on motor imagery and motor physiology – remarks consistent with a ‘functional equivalence’ view of motor imagery. On this view, motor imagery involves a rehearsal of action without acting, and the processing involved is more or less the same as that when acting, minus the motor output. More recently, however, a number of studies indicate that the processing involved in off-line motor imagery is different in important ways from the processing involved in action execution (Guillot et al. 2009, Hetu et al. 2013, Van der Lubbe et al. 2021). In particular, frontal cortex and executive control are involved in unique ways. If given tasks that tax executive control, the time course of motor imagery is impaired compared to that of action execution (for the same action-type) (Glover and Baran 2017, Glover et al. 2020). But the functional equivalence model of motor imagery predicts the opposite.

Understanding the relationship between motor and mental imagery, in my view, requires us to go beyond the basic view of mental imagery, and a structurally analogous view of motor imagery.

Regarding motor imagery, the key phenomenon is picked out initially by tasks that require people to mentally rehearse bodily action. Mental rehearsal involves executive control resources, of course, and mental actions of imagination. We can think of motor imagery as an integral part of these actions – as representational resources agents access as a part of these processes. This allows us to zero in on two things that are unique about motor imagery.

First, motor imagery utilizes and expresses a first-personal knowledge of action. As others have noted, motor imagery involves imaging action from the agent’s perspective, which intimately involves the agent’s body, as well as the agent’s unique motor skills. Motor imagery is built up by practice – this is why experts display different neuroimaging patterns than novices (Krauetner et al. 2018), and why motor imagery is more effective for experts than novices (Toth et al. 2020). An expert’s action-relevant representations are more efficiently organized, and this shows up in both the quality of their motor imagery, and in how they put it to use (Frank et al. 2023).

Second, motor imagery presents the action as occurring in imagery in much the way the agent experiences the action occurring when executed. Motor imagery thus taps a special representational resource (likely involving analog format(s)), distinct from general declarative knowledge regarding action or bodily physics. This resource is plausibly constituted, at least in part, by specialized models of action, built by practice and stored in memory, that the agent accesses in motor imagery (Grush 2004).

This picture of motor imagery fits into a general perspective, on which the simulations that utilize imagery constitute a multi-use cognitive tool (see Aronowitz and Lombrozo 2020). As Nick Shea has argued, ‘Running a simulation gives conceptual thinking access to information that could not simply be retrieved from memory or inferred by reasoning’ (2023, 2). Shea is primarily concerned with how conceptual cognition taps simulation as a way to solve general problems, but he sees the application to action as well: ‘A thinker may have little explicit knowledge about the statistics and physics of their environment, but if they simulate actions, their conclusions about what will happen are effectively informed by the information encoded implicitly in the processing dispositions of their sensorimotor systems’ (2023, 2). One claim that this picture supports concerns a primary function of motor imagery. Motor imagery is prominent in an agent’s mental life *because* it taps specialized representational resources that constitute action knowledge.

Now, as Nanay also notes, these specialized representational resources intimately involve some of the same representational resources mental imagery utilizes, including visual and kinaesthetic imagery of the body, and aspects of the world that bodily action involves and impacts (see, e.g., Stinear et al. 2006).[[7]](#footnote-7) One interesting upshot of this is that, while motor imagery practice is widely reported to lead to improvements in overt action performance, a key mechanism for these improvements seems to be perceptual learning (Ingram et al. 2016, Frank et al. 2023). Frank et al. (2023) argue that this form of learning is sensorimotor, in the sense that motor imagery leads to the construction of novel perceptual-cognitive scaffolds that package information about ‘anticipated (quasi-)sensory consequences for which motor commands can then be readily produced’ (4). Motor imagery, then, involves ‘the gathering, structuring and fostering of cognitively represented perceptual effects of the action which results in a refined representation that guides one’s actions’ (2023, 4).

The specialized resources that constitute motor imagery involve sensory representations, but not exclusively. Motor representations add structure to the behavior of the sensory representations, and add information regarding the execution of action on which purely sensory representations are silent.

In addition, motor imagery arguably involves specialized metacognition that gives the agent access to information about the quality of an imaged action and the action’s associated costs (see MacIntyre et al. 2014). This information may be present in the form of metacognitive feelings of effort (Bermúdez 2023), fluency (Pacherie 2007, Sidarus et al. 2017), or confidence (Metcalfe et al. 2013).

Motor imagery thus not only constitutes a specialized source of action knowledge, it affords the agent specialized access to a kind of structured information about action outcomes. Motor imagery thus functions as a cognitive tool for both future-oriented and present-oriented action planning and control; it is available to enhance the agent’s control-related abilities: action learning, action planning, action execution, and action observation.

What are the implications for mental imagery? The basic view entails a sharp distinction between mental and motor imagery. But the basic view is not sufficiently informative. The functional sketch of motor imagery just offered suggests an important distinction. Mental imagery concerns a wide range of worldly objects, events, and properties that perception depicts; its functions may be best understood by closely considering how mental imagery impacts perception.[[8]](#footnote-8) By contrast, motor imagery repurposes sensory imagery and organizes it in line with the needs of action. Motor imagery is a kind of specialized action knowledge, useful for future-oriented and present-oriented action planning and control, as well as action observation and understanding. Its functions are best understood by closely considering how motor imagery impacts action learning, planning, execution, and observation.

With this functional distinction drawn, however, it is not clear to me whether it should be seen as carving mental and motor imagery, or rather, perceptual and motor imagery. It is not clear, that is, where lay the joints of this aspect of the mind. This issue cannot be settled without making commitments that move us beyond the basic view of mental imagery. Towards the development of such an account, we have to do more work to understand what representational resources are available to various perceptual, cognitive, and motoric capacities. And we have to chart what these resources have in common, and how they differ, across differences in uptake by various capacities.

**Conclusion**

Nanay has been at the vanguard of work that places mental imagery at the center of a number of important issues in the philosophy of mind and psychology. Indeed, I think Nanay’s book is successful in illustrating the wide relevance of mental imagery to understanding a range of mental phenomena. But if mental imagery is to be as important as Nanay claims, then we face a number of difficult issues (regarding, e.g., the unity of different forms of mental imagery, the functional roles of mental imagery, the relation of mental imagery to perception, and to cognition, and the representational format(s) of mental imagery) that push us in the direction of a more robust account of mental imagery than that provided by the basic view. To be clear, Nanay confronts many of these issues in his book, offering arguments and views with which philosophers should engage. I have discussed only two. The aim of my discussion has been to illustrate that without going through the details of such arguments and views, we will not understand the nature of mental imagery.

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1. Cavedon-Taylor’s (2021) discussion of ‘perceptualist’ accounts and their problems nicely illustrates my claim that the literature doesn’t delve very deep into the nature of mental imagery. [↑](#footnote-ref-1)
2. While perceptual representations are driven by sensory stimuli, mental images draw on working memory and long-term memory in various ways (see, e.g., Baddeley and Andrade 2000). Like perception, mental imagery comes in many varieties, involving the many sensory modalities and multi-modal combinations of them (Nanay 2023). Like perception, mental imagery may be conscious or unconscious. Unlike perception, however, mental imagery can (but is not always) voluntarily generated or manipulated. [↑](#footnote-ref-2)
3. For those curious for more, Green and Quilty-Dunn’s view is that ‘(i) object files are propositional representations consisting of discrete symbols standing for individuals and features, (ii) that feature representations are organized into separate, category-specific slots within an object file, and (iii) that representations of individuals (that is, indexes) function computationally as pointers that enable access to these category-specific slots’ (2021, 693). [↑](#footnote-ref-3)
4. The claim that visual working memory alters perceptual representations has been challenged (Quilty-Dunn forthcoming). [↑](#footnote-ref-4)
5. For argumentation marshalling a wide range of evidence against views like Nanay’s, see the discussion of object files in Quilty-Dunn et al. (2023). [↑](#footnote-ref-5)
6. It is worth noting that this characterization says little about the types of experiences being posited. Kosslyn et al. (2010, 9) write that ‘in our view the term ‘motor imagery’ may be slightly misleading. It is likely that participants do not activate the motor commands alone, but also activate representations of kinaesthetic feedback.’ But how motor commands are integrated with, or rely upon, content drawn from sensory imagery, is a substantive issue. A similar issue, concerning the place of motoric contents in experiences of acting, is discussed in Shepherd (2016, 2017). [↑](#footnote-ref-6)
7. Interestingly, although the issue has been little studied, aphantasics may have impaired motor imagery (Dupont et al. 2022). [↑](#footnote-ref-7)
8. This is a very substantive task, taken up by Nanay in a number of chapters of his book (see also, e.g., Nanay 2010, Pearson et al. 2015). [↑](#footnote-ref-8)