Human motivation is organized hierarchically, from proximal (means) to ultimate (ends)

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ABSTRACT

Murayama and Jach raise a key problem in behavioural sciences, to which we suggest evolutionary science can provide a solution. We emphasize the role of adaptive mechanisms in shaping behaviour and argue for the integration of hierarchical theories of goal-directed cognition and behavioural flexibility, in order to unravel the motivations behind actions that, in themselves, seem disconnected from adaptive goals.

MAIN TEXT

We fully agree with Murayama and Jach's advocacy for a better characterization of the *mental computational processes* underlying motivated behavior. Their article rightly highlights the limitations of high-level motivational constructs and the necessity of opening the black boxes within which these constructs operate.

Evolutionary psychology has long endeavored to decode the functional aspects of what might initially appear to be mental black boxes. This approach conceptualizes motivations not as abstract high-level constructs, but as adaptive mechanisms shaped by evolutionary pressures to regulate behavior (Tooby et al., 2014). This approach offers a clear solution to the black-box problem: the study of *input-output specifications* (proximate level) in a way that is consistent with *design-function fit* (ultimate level).

This approach has, in our view, already clarified the concept of motivation by dissecting the evolutionary functions behind specific motivations (Al-Shawaf, 2024; Del Giudice, 2023), and by introducing the concept of regulatory variables (i.e., cognitive parameters that allow value computation; Sznycer, 2022). To take the example given by Tooby and colleagues (2014), to explain hunger, it is not enough to say that humans approach food. This black box can be unpacked by studying the variables which, in the case of hunger, are calculated and valued by the human mind (e.g., calorie density, package size, search time).

What evolutionary psychologists have done is precisely to unveil the input, regulatory variables and output of many other motivations (Al-Shawaf & Shackelford, 2024), such as the motivations not to be socially devalued (shame; Sznycer et al., 2018), to bargain (anger; Sell & Sznycer, 2021), to pair-bond (love; Fletcher et al., 2015), to respect one's duties (morality; André et al., 2022), or to avoid predators (fear; Öhman & Mineka, 2001). This framework brings such high-level motivations closer to basic motivational constructs such as hunger or thirst.

How do these innate high-level motivational systems and associated regulatory variables initiate the concrete, context-dependent actions of organisms? An answer is to be found in cognitive theories of goal-oriented cognition, whose developments in philosophy of action (Pacherie, 2008), evolutionary biology (Del Guidice 2023), developmental psychology (Goddu & Gopnik, 2024), and comparative psychology (Tomasello, 2022) have all emphasized its hierarchical nature. Our view is that adaptive motivations are superordinate goals that shape and prioritize lower-level instrumental goals, with a cascading effect on the selection of immediate tasks and the execution of motor actions. This suggestion is consistent with an observation often made in the field of goal hierarchies, namely that higher-order goals determine the motivational value of lower-order goals (Carver & Scheier, 1982; Diefendorff & Seaton, 2015; Höchli et al., 2018).

Now, what about actions that could not have possibly been the original target of such evolved motivations? What about, for example, filling a form to apply for a job? This action does not seem to have been initiated by an evolved motivation, as administrative forms are very recent inventions. Here we want to raise a case for behavioral flexibility (Tomasello, 2022). As flexible causal agents (Kelso, 2016; Goddu & Gopnik, 2024), humans can invent new associations between their own actions and goals at multiple levels of the hierarchy (Chu & Schulz, 2024; see "instrumental learning" in Tomasello, 2022). As a matter of fact, humans have specific motivational systems to reward such adaptive rearrangements of the goal hierarchy, through the practice of novel action-outcome associations without consequence (i.e., play; Pellis et al., 2019) or even simulated (Tooby & Cosmides, 2001).

We hypothesize that these new associations between actions and goals, whether experienced, observed, played or simulated, are rewarded not by a general reward function, but by the evolved motivational systems themselves. This constraint is fully compatible with the idea that this type of learning is open-ended (i.e., it is possible to learn an almost infinite number of new action-outcome associations; Sigaud et al., 2024). The proximate means are open-ended, but the ultimate ends are highly constrained and limited in number. As Tomasello (2022) puts it, the means for achieving adaptive goals are left to the individual's discretion, since these means always depend on the context. In other words, we propose that *open-ended instrumental goals are means to a limited number of adaptive goals* (Baumard et al., 2024). Without these higher-order, adaptive goals, there would be no sense of fulfillment or effectiveness for lower-level, instrumental goals (Tomasello, 2022; Singh, 2022).

As an illustration, writing this commentary could be said to be the direct outcome of one or more evolved motivations (even if the activity itself is clearly evolutionarily novel), such as (1) the motivation to appear competent (i.e., pride; Sznycer et al., 2017), (2) the motivation to learn new knowledge that makes a difference (curiosity; Murayama, 2022; Goddu & Gopnik, 2024), or (3) the motivation to reciprocate (i.e., for the payment we receive as public workers; Trivers, 1971; André et al., 2022). Specifically, these motivations have evolved to reinforce the value of new actions the result of which leads to (1) an increase in perceived competence, (2) the generation of new difference-making information, and (3) reciprocal cooperation, each of which is associated with specific regulatory variables. Behavioral flexibility is the key solution to this problem: our minds can connect the action of writing this commentary to low-level goals (e.g.,

re-reading some papers, writing a draft) and up to the higher-level adaptive goals that make these instrumental goals ultimately motivating.

In closing, we want to emphasize two key points. First, behavioral flexibility is by no means specific to humans: it can be found in mammals and even reptiles (Wilkinson & Huber, 2012). As always, the difference between humans and non-human animals is a matter of degree. Second, adaptive motivations need not be conscious: there is no evolutionary reason why the ultimate functions of motivational systems should be explicit or accessible to introspection, as long as they can regulate the learning and implementation of concrete chains of actions that fulfill adaptive goals. As a matter of fact, one of the recurring problems of evolutionary psychology as a field is that these adaptive motivations are often profoundly counter-intuitive.

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