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Models need mechanisms, but not labels

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Abstract:	The target article proposes a model involving important but not well investigated topics of curiosity and creativity. The model, however, falls short of providing convincing explanations of the basic mechanisms underlying these phenomena. We outline the importance of mechanistic thinking in dealing with the concepts outlined in this article specifically and within psychology and cognitive neuroscience in general.

Target article by Tal Ivancovsky, Shira Baror and Moshe Bar

Models need mechanisms, but not labels

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Abstract: The target article proposes a model involving important but not well investigated topics of curiosity and creativity. The model, however, falls short of providing convincing explanations of the basic mechanisms underlying these phenomena. We outline the importance of mechanistic thinking in dealing with the concepts outlined in this article specifically and within psychology and cognitive neuroscience in general.

Ivancovsky et al. attempt to offer an integrative account of curiosity, creativity, attention and other aspects of cognitive functioning. We fully appreciate the underlying motive to offer a unified model, but we believe the paper falls short of mechanistically explaining the phenomenon of curiosity and creativity – a problem that is pervasive within psychology and cognitive neurosciences (Hommel, 2020). A good mechanistic theory in cognitive neuroscience would require specifying the basic components underlying a phenomenon and a specification of how these components interact (Bechtel, 2008; Craver, 2006). Instead, what we commonly see is an ever-increasing categorization of new phenomena with circular definitions. An example of this is defining curiosity as a tendency to attend to novel or surprising information and then attributing the tendency to attend to novel or surprising information to curiosity, thereby not shedding any light on what gives rise to this phenomenon.

Such problems are already evident in the description of the role of "attention" in the four-stage novelty-seeking model (NSM) proposed by the authors. The NSM proposes that attention is involved only in the first stage of *Affinity* where "the scope of attention directs the search towards the novel". However, many of the subsequent stages seem to involve mechanisms that sound a lot like attention. For instance, in the *Activation* phase, the authors say that "new combinations potentially cross a relevance threshold, depending on their saliency". Similarly, in the *Evaluation* stage, "involvement of cognitive control is essential for preventing overbursts of stimulation and to efficiently direct the available resources". What specific mechanism warrants invoking the concept of attention in the first stage but not in the others? Viewing attention as a basic selection mechanism would implicate it in all the stages of the NSM model. These issues are further compounded by the fact that "attention" is not at all a unitary concept and a diverse range of behavior is often attributed to attention (Di Lollo, 2018; Hommel & Colzato, 2015). So, it is not clear which flavor of attention is being discussed in relation to this model. Finally, no one really knows what attention is, how the different forms of attention are similar to or different from each other and how precisely they differ from other concepts like cognitive control (Anderson, 2011; Hommel et al., 2019).

The lack of mechanistic thinking is also evident in the discussion of the interaction between disinhibition/hyper-inhibition and exploration/exploitation. The concepts of exploration and exploitation are just labelled, rather than explained. What gives rise to exploratory or exploitatory behaviour in the first place? How does an agent know when to switch from one to the other, and how do exploration and exploitation work? We don't know. The proposed schema further assumes that exploration and exploitation do not involve cognitive control, which stands in direct contradiction to recent theorizing. In fact, exploration and exploitation are often considered strategies of cognitive control (Cohen et al., 2007). They are assumed to address a basic control dilemma that agents are facing (how much, how long to exploit, and when to explore?), alongside similar dilemmas like the persistence/flexibility dilemma or the speed/accuracy trade-off. Adaptive behavior requires agents to find the right balance between the respective two extremes and to integrate individual goals with situational demands (Eppinger, Goschke, & Musslick, 2021; Goschke, 2003).

From this perspective, disinhibition and hyper-inhibition represent just another version of these basic dilemmas. And yet, the authors fail to recognize the connection between this dilemma, the other similar control dilemmas that are discussed in the literature and the mechanisms that have been proposed to underlie them. For instance, the metacontrol state model (Hommel, 2015; Hommel & Wiers, 2017) addresses how agents balance between two opposing control strategies: persistence and flexibility. Persistence is characterized by top-down bias from current goals and a strong mutual inhibition between competing alternatives, while flexibility is characterized by weak support from current goals and weak mutual inhibition. The mechanisms responsible for persistence and flexibility may or may not entirely overlap with mechanisms underlying exploitation and exploration, but there is evidence to suggest significant commonalities (van Dooren et al., 2021), and the mechanistic underpinnings of metacontrol can easily account for how disinhibition and hyper-inhibition may work (see Hommel & Colzato, 2017; Mekern, Hommel & Sjoerds, 2019).

Hence, while we certainly believe in the importance of viewing different forms of human behaviour, including pathological manifestations, as a result of an interaction between different control dilemmas along a continuum, we feel that the approach put forth in the target article begs many important theoretical questions in its current form. Most importantly, we recommend replacing mere labeling with true mechanistic considerations, which can be found in the literature on cognitive control.

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Competing Interest statement
The authors declare no competing interests.

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