In response to: **A shared novelty-seeking basis for creativity and curiosity**
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Breaking down (and moving beyond) novelty as a trigger of curiosity

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Article contents

Abstract

The Novelty Seeking Model (NSM) places "novelty" at center stage in characterizing the mechanisms behind curiosity. We argue that the NSM's conception of novelty is too broad, obscuring distinct constructs. More critically, the NSM underemphasizes triggers of curiosity that better unify these constructs and that have received stronger empirical support: those that signal the potential for useful learning.

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Ivancovsky et al. propose a "Novelty Seeking Model" (NSM) of curiosity and creativity, grounded in the idea that both share common novelty-seeking mechanisms – directed toward novel stimuli, for curiosity, and novel ideas, for creativity. In the *evaluation* step of the NSM as applied to curiosity, stimuli are evaluated for their novelty (among other considerations), and this determines whether a person becomes curious. Here, we raise two challenges for this step. First, the NSM blurs the lines between several distinct constructs, labeling them all "novelty." Second, novelty is emphasized at the expense of other relevant evaluations, including those with stronger empirical support. We discuss each of these in turn.

Ivancovsky et al. refer to several constructs under the umbrella term “novelty,” arguing that this broad grouping is a key part of the evaluation step. For example, they write that curiosity is determined by a “novelty appraisal (including incongruity, complexity, unexpectedness, obscurity, and uncertainty…)” (sect. 2.5, para. 5). This grouping is puzzling, as these constructs are definitionally distinct (Barto, Mirolli, & Baldassarre, 2013; Liquin, Callaway, & Lombrozo, 2020). For example, novelty describes a lack of prior experience or exposure, unexpectedness describes a violation of one's predictions, and uncertainty describes a lack of knowledge.

Further, each construct makes different predictions about curiosity. Imagine that you notice a new flag outside your neighbor's home. The flag is novel to you (you've never seen it before), and you are uncertain about its meaning (is it some country's flag?). You're curious, but you forget to look it up. The next day, you see the flag again. It is no longer novel (you saw it yesterday), but you remain uncertain. If novelty alone drives curiosity, then curiosity should be lower on the second day than on the first. But if uncertainty alone drives curiosity, then curiosity should remain the same. Similar reasoning can be used to tease apart the concepts of novelty and *surprise* (Barto et al., 2013), which is often seen as synonymous with unexpectedness (but see Maguire, Maguire, & Keane, 2011).

By blurring the lines between these constructs, Ivancovsky et al. obscure important questions about curiosity's occurrence. For instance, is curiosity responsive to a combination of these cues (sometimes novelty, sometimes uncertainty, sometimes surprise or unexpectedness, sometimes all three)? Or is there

some other construct that unifies and explains the associations between curiosity and each cue?

We have argued elsewhere that curiosity might be sensitive to novelty, surprise, and related evaluations precisely because these cues signal *the likelihood of future learning* (Liquin et al., 2020, 2021; Liquin & Lombrozo, 2020). Supporting this claim, curiosity is highest when expected learning is highest, above and beyond variation in novelty, surprise, or uncertainty (Liquin & Lombrozo, 2020; see also Lombrozo & Liquin, 2023). Related work shows that the association between uncertainty and curiosity is modulated by future utility. People aren't curious about *all* uncertain stimuli, but specifically those likely to be useful in the future (Dubey, Griffiths, & Lombrozo, 2022; Dubey & Griffiths, 2020). Moreover, curiosity is correlated with moment-to-moment variation in learning progress: the rate at which one's predictions are improving (Poli, Serino, Mars, & Hunnius, 2020, 2022; Ten, Kaushik, Oudeyer, & Gottlieb, 2021).

This growing body of research suggests that curiosity goes beyond novelty and related cues. Curiosity is triggered by expected learning, learning progress, and utility – even controlling for variation in novelty, surprise, and uncertainty. Moreover, expected learning, learning progress, and utility tend to dominate when predicting variation in curiosity.

Ivancovsky et al. acknowledge that curiosity may depend on additional appraisals beyond novelty: (1) whether it is possible to understand the curiosity-inducing stimulus (“coping potential”) and (2) how useful it would be to

understand the curiosity-inducing stimulus. It is not clear how the former appraisal is integrated into the NSM. For the latter, Ivancovsky et al. propose that the relative weight given to novelty versus utility is determined by one's state of mind and level of inhibition. However, under the NSM, coping potential and utility are always subsidiary to novelty, as novelty is also what initially attracts attention to a stimulus (in the affinity step of the NSM). Indeed, Ivancovsky et al. define curiosity as a "state by which one seeks novelty," thus presupposing that novelty is primary.

Instead, we argue that *expected learning* and *utility* are primary, as they describe the function of curiosity for human cognition – to motivate us to learn useful information. Curiosity is sensitive to cues like novelty because these cues signal, sometimes imperfectly, that useful learning is likely. But more direct signals (e.g., expected learning, learning progress, utility) are stronger triggers of curiosity. This makes sense, as sensitivity to these triggers is likely to produce "optimal" patterns of curiosity: high curiosity when useful learning is most likely and most rapid, and low curiosity when useful learning is least likely and least rapid (Liquin et al., 2020, 2021; Poli et al., 2020).

Ivancovsky et al.'s key claim is that curiosity and creativity are unified by virtue of their novelty-seeking mechanisms. If curiosity is not geared toward novelty but rather toward useful learning, can curiosity and creativity be unified after all? One path forward is to consider the functional role that *creativity* plays in supporting human cognition, just as we have considered the functional role of curiosity. Perhaps at

this functional level, we will find new ways of approaching a unified account of curiosity and creativity.

This functional approach also invites us to consider how the mechanisms underlying creativity support its functional role. In the case of curiosity, a functional focus has led to important insights concerning the triggers of curiosity: that novelty, surprise, and uncertainty can be unified by their connection to future useful learning, and that people's curiosity is most strongly predicted by their expectations about future useful learning. Similarly, we might ask why creativity depends on assessments of novelty and usefulness – how do these assessments support creativity's function? Ultimately, answering questions inspired by a functional approach will provide a richer understanding of both curiosity and creativity – and, perhaps, a unified model.

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Conflict of interest

None.

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