Biological Psychiatry

Reply to: Metacognition, Adaptation, and Mental Health

To the Editor:

We thank Schnakenberg Martin and Lysaker (1) for their correspondence and are glad that they share our enthusiasm for metacognition as a foundational aspect of mental health. We disagree, however, that our approach to metacognition is too narrow ("a monolithic cognitive activity"). Our model is in fact perfectly consistent with metacognition operating across multiple domains of cognitive, emotional, and bodily experiences and being rich in both depth and breadth. We fear that this misunderstanding has arisen from a conflation of the construct of metacognition with how it is quantified within psychological science. Here, we seek to clarify this relationship between measures and models of metacognition.

First, Schnakenberg Martin and Lysaker suggest that we propose that "metacognition involves…bias…and sensitivity" parameters, but neglect a role of metacognition in adaptive behavior. In our original article, we in fact specifically highlighted how metacognition facilitates adaptive control, writing how "A lack of self-awareness may lead to a failure to adapt to changes in cognitive abilities," in line with Schnakenberg Martin and Lysaker's suggestion that "inaccurate reflection is likely to have negative consequences" (2,3). The parameters that Schnakenberg Martin and Lysaker highlight are also only one aspect of our proposed hierarchical framework for global and local metacognition. To reiterate, we propose that local metacognitive monitoring across multiple domains (as measured by parameters such as sensitivity, efficiency, and bias) continuously and dynamically informs global metacognitive estimates of self-efficacy and confidence, and even perhaps more global personal-level constructs such as self-esteem. This is a richer and more varied framework than the picture painted by Schnakenberg Martin and Lysaker's commentary, and we suspect that it is well aligned with their view of metacognition involving "various and distinct kinds of reflections."

Second, Schnakenberg Martin and Lysaker suggest that we neglect the broader role of metacognition as operating across multiple domains of mental life. Our framework is not in fact specific to a particular domain. While many of the measures and computational models of metacognition benefit from the experimental control afforded by perceptual tasks, these measures are not restricted to perception, and can (and have) been applied to various domains including emotion recognition (4,5), memory (6), subjective value (7), and learning (8,9). Considering all these levels together and how they are intertwined will be important for accounting for the generalization and transfer of various forms of metacognitive training or therapy (10–13). We think that the most relevant domains for linking metacognitive dysfunction to mental health might be interoceptive in nature, an area in which our framework can be readily applied in future work. For instance, a recent theoretical proposal highlights the maladaptive monitoring of bodily states as paving the way toward fatigue and depressive states (14). Schnakenberg Martin and Lysaker also highlight the importance of integrating multiple pieces of information, which previous models of local metacognition have rarely focused on [although see (15)]. In our framework, in contrast, bridging from local to global levels of metacognition naturally requires the integration of self-evaluations over multiple tasks and time scales. Future research should aim to characterize by which computational mechanisms this integration occurs (16).

In terms of the range of processes involved, then, we believe that our framework has much in common with the characterization of metacognition outlined by Schnakenberg Martin and Lysaker. We suspect that much of the disagreement stems from how best to measure and operationalize metacognition within psychological science. Metacognition is particularly tricky in this regard, as it eludes quantification within standard psychological questionnaires based on self-reports—i.e., we may lack the awareness of distortions needed in order to report them if metacognition is distorted. As a starting point for experimental studies, we advocate the use of behavioral tasks in which parameters governing local and global metacognition can be inferred in terms of the match between subjective evaluations of self-performance and objective accuracy. By marrying such tasks with computational models, we are able to precisely formulate predictions and hypotheses about the moment-to-moment dynamics of metacognition that are testable against behavioral and neural data: for instance, how the neural encoding of different aspects of confidence is distorted in psychiatric disorders (17). Such studies can provide information on the origin, as well as mechanistic and biological explanations, of differences in metacognitive processes originally observed in psychiatric questionnaires or clinical interviews of the sort advocated by Schnakenberg Martin and Lysaker. For instance, the Metacognition Assessment Scale–Abbreviated (18) relies on a clinician's rating of a patient's metacognitive abilities as they naturally appear (or not) in a patient's free narrative during a therapeutic session. It remains an important and open empirical question as to how these different approaches relate both to each other, and to closely related constructs such as clinical insight (19). We believe that all three approaches to quantifying metacognition (clinical interviews, questionnaires, and task-based measures) are likely to be complementary, and each is important for predicting patient treatment and recovery.

In sum, we agree with Schnakenberg Martin and Lysaker on the need for a broad view of metacognition in psychiatry, both in terms of its hierarchical levels and how it operates across a range of cognitive, emotional, and interoceptive experiences. Our computational framework seeks to pin down the basic neural mechanisms that are at play in many forms of metacognitive function. By capitalizing on the emerging picture of "low-level" metacognitive building blocks such as decision confidence, we hope to similarly furnish an understanding of metacognitive functioning at higher levels, including those most relevant to naturalistic self-reflection. We expect that

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future work that combines the approaches used across multiple subfields will provide a holistic view of the role of metacognition in mental health.

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Article Information

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References

1. Schnakenberg Martin AM, Lysaker PH (2022): Metacognition, adaptation, and mental health. Biol Psychiatry 91:e31–e32.
2. Gilbert SJ (2015): Strategic use of reminders: Influence of both domain-general and task-specific metacognitive confidence, independent of objective memory ability. Conscious Cogn 33:245–260.
3. Hu X, Luo L, Fleming SM (2019): A role for metamemory in cognitive offloading. Cognition 193:104012.
4. Bègue I, Vaessen M, Hofmeister J, Pereira M, Schwartz S, Vuilleumier P (2019): Confidence of emotion expression recognition recruits brain regions outside the face perception network. Soc Cogn Affect Neurosci 14:81–95.
5. Kelly KJ, Metcalfe J (2011): Metacognition of emotional face recognition. Emotion 11:896–906.
6. Pannu JK, Kaszniak AW (2005): Metamemory experiments in neurological populations: A review. Neuropsychol Rev 15:105–130.
7. De Martino B, Fleming SM, Garrett N, Dolan RJ (2013): Confidence in value-based choice. Nat Neurosci 16:105–110.
8. Meyniel F, Schlunegger D, Dehaene S (2015): The sense of confidence during probabilistic learning: A normative account. PLoS Comput Biol 11:e1004305.
9. Cortese A (2021): Metacognitive resources for adaptive learning [published online ahead of print Sep 15]. Neurosci Res.
10. Wells A (2013): Advances in metacognitive therapy. Int J Cogn Ther 6:186–201.
11. Moritz S, Veckenstedt R, Bohn F, Köther U, Woodward TS (2013): Metacognitive training in schizophrenia: Theoretical rationale and administration. In: Roberts DL, Penn DL, editors. Social Cognition in Schizophrenia: From Evidence to Treatment. London: Oxford University Press, 358–383.
12. Lysaker PH, Gagen E, Klion R, Zalzala A, Vohs J, Faith LA, *et al.* (2020): Metacognitive reflection and insight therapy: A recovery-oriented treatment approach for psychosis. Psychol Res Behav Manag 13:331–341.
13. Carpenter J, Sherman MT, Seth AK, Fleming SM, Lau H, Kievit RA, *et al.* (2019): Domain-general enhancements of metacognitive ability through adaptive training. J Exp Psychol Gen 148:51–64.
14. Stephan KE, Manjaly ZM, Mathys CD, Weber LAE, Paliwal S, Gard T, *et al.* (2016): Allostatic self-efficacy: A metacognitive theory of dyshomeostasis-induced fatigue and depression. Front Hum Neurosci 10:550.
15. Deroy O, Spence C, Noppeney U (2016): Metacognition in multisensory perception. Trends Cogn Sci 20:736–747.
16. Rouault M, Dayan P, Fleming SM (2019): Forming global estimates of self-performance from local confidence. Nat Commun 10:1141.
17. Hoven M, Lebreton MMM, Engelmann JB, Denys D, Luigjes J, van Holst RJ (2019): Abnormalities of confidence in psychiatry: An overview and future perspectives. Transl Psychiatry 9:268.
18. Lysaker PH, Carcione A, Dimaggio G, Johannesen JK, Nicolò G, Procacci M, *et al.* (2005): Metacognition amidst narratives of self and illness in schizophrenia: Associations with neurocognition, symptoms, insight and quality of life. Acta Psychiatr Scand 112:64–71.
19. David AS, Bedford N, Wiffen B, Gilleen J (2012): Failures of metacognition and lack of insight in neuropsychiatric disorders. Philos Trans R Soc B Biol Sci 367:1379–1390.