



Letter to the Editor

Nature or nurture in ideas of reference? Interplay between intrinsic cognition and extrinsic environment in times of crisis



Nature or nurture? This is an old debate which re-surfaces in current neuroscience and especially in psychiatry as we gain more and more understanding of the interplay between biological-psychological and social factors. This leaves open the exact nature of their interaction, though. How do intrinsic psychological and extrinsic social factors interact? The study by Wong et al. (2021) sheds a novel light on this issue; this is especially pressing in psychiatry as we are confronted with complex scenarios of social, psychological, neuronal, and genetic factors.

Wong et al. (2021) explore the interplay of intrinsic and extrinsic psychological factors in ideas of reference (IOR). They investigate the occurrence of IOR in relation to intrinsic factors like thought as operationalized by rumination as well as in the context of extrinsic life events like COVID pandemic and social unrest. Corresponding to their aim of investigating the interplay between intrinsic cognition and extrinsic environment, they distinguish two forms of IOR: attenuated IOR are those that occur within several members of a group (IOR-A) while IOR experienced solely by a single subject are designated as IOR-E.

Obtaining subjective ratings on visual analogue scales in a large sample (> 9000 subjects) showed that rumination as related to the events,

i.e., event-based rumination, is a significant predictor of both IOR-A and IOR-E. Hence, thought dynamics like rumination with circulating thoughts contributes to IOR in general. Such shared cognitive basis of the two types of IOR is accompanied by contextual differences (Fig. 1). IOR-A are well predicted by extrinsic life events including being attacked, sexual violence and being arrested. In contrast, IOR-E was not predicted by these extrinsic life events but by the subjects' education level. Finally, applying a mediation model, they show that event-based rumination mediates between traumatic life events and severity of IOR.

What is the take home message of the paper by Wong et al. (2021)? The main message: there is an intricate interplay between intrinsic cognition and extrinsic environmental events. The authors' distinction of two types of IOR, IOR-A and IOR-R, that is, more social and more individual IOR, reflects that psychopathological symptoms like IOR operate on a continuum of intrinsic cognition and extrinsic environment. Rather than being two categorically distinct IOR, IOR-A and IOR-E reflect distinct degrees on a continuum of different possible balances of intrinsic cognitive and extrinsic environmental factors. Current research has parsed out quite well the surface, namely the intrinsic cognitive and extrinsic environmental and social factors by themselves in isolation. In contrast, we have less understanding of their deeper underlying continuum, a "biopsychosocial or neuro-ecological continuum" if one wants to say so (Northoff, 2018). The study by Wong et al. (2021) steps into the gap, the deeper realm of our self within the world.

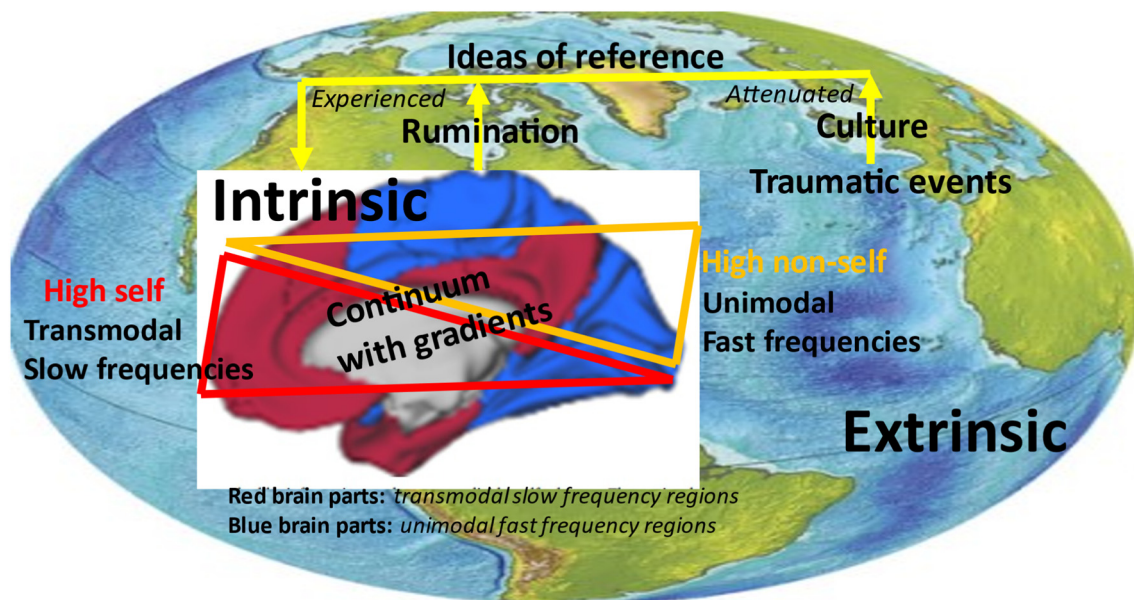


Fig. 1. Psychological continuum of self and non-self mediated by a neuronal continuum of transmodal-slow – unimodal-fast activity. Caption: The figure illustrates the interplay between extrinsic environment/world and intrinsic features of the brain in ideas of reference (IOR). The brain displays a psychological continuum with gradients of self and non-self as mediated by a neuronal continuum of transmodal-slow and unimodal-fast neural activity. Following the results by Wong et al. (2021), ideas of reference result from the interaction between intrinsic brain/cognition (rumination) and extrinsic world (traumatic events, culture).

How can we describe such biopsychosocial or neuro-ecological continuum in more detail? I give two examples, the self as basis of our cognitive life (Northoff, 2016) and the brain's most basic spatiotemporal characterization (Northoff et al., 2020a, 2020b). We usually consider the self as distinct entity that is separate and categorically different from non-self. However, that is put into doubt by the often observed continuum of self- and non-self-referential processing on both psychological and neuronal grounds (Qin et al., 2020; Kolvoort et al., 2020). Different subjects show different degrees in the balance of self- and non-self-referential processing on psychological grounds, i.e., stronger or weaker self-bias in perception and cognition (Kolvoort et al., 2020). While such self-non-self psychological balance is mediated by the neuronal continuum of slower and faster frequencies: if the brain shows stronger power in slower frequencies relative to those in faster ones, the psychological self-non-self continuum is shifted more towards the self (Kolvoort et al., 2020; Huang et al., 2016; Wolff et al., 2019). If, in contrast, the brain's power spectrum is shifted more towards the faster frequencies (relative to the slower ones), the psychological self-non-self continuum shifts more towards the end of the non-self.

The same holds, analogously on the spatial side of the brain. Shift of neural activity towards the unimodal sensory networks, i.e., the periphery of the brain's cortex, goes along with higher degrees of non-self-referential processing (Huang et al., 2016; Scalabrini et al., 2019). If shifted more towards the trans-modal default-mode network (DMN), self-referential processing dominates over non-self-referential processing (Scalabrini et al., 2019). Together, the deeper layers of our psyche and its brain can be characterized by a psychological self-non-self continuum and its basis in a neuronal continuum with the latter operating between the extremes of slow transmodal DMN at the one end and faster unimodal sensory cortical processing at the other end.

Why are these two, the psychological and neuronal continuum of self-non-self and slow DMN – fast sensory neural activity, relevant in the present context? The data on IOR described in the present study clearly illustrate that a psychopathological phenomenon like IOR stands right in-between extrinsic environmental and intrinsic psychological factors. Even the two types of IOR reflect by themselves distinct degrees of intrinsic-extrinsic balances. If the intrinsic factors on the psychological and neuronal continuum predominate over the extrinsic ones (which can still be triggering, though), one may rather experience IOR-E as restricted to the subject itself. Psychologically, one would then assume a higher degree of self-specificity of IOR and stronger slower frequencies in DMN in these IOR-E subjects (compared to non-IOR-E subjects). If, contrast, the extrinsic life events predominate and become abnormally strong as in times of crisis, one may be predisposed to experience more likely IOR-A; the self is here extended to the social context while we would expect the brain to show some abnormally slow frequencies in sensory regions.

Finally, cultural differences need to be reckoned with. The own self may be determined in either more independent of others, i.e., independent self, as in the western world. Or, alternatively, the self may be defined in more inter-dependent way, that is, in relation to others and the social context, as it is more prevalent in the far eastern world including Hong Kong where the present study was done (Scalabrini et al., 2020). Depending how one defines one's self, one may then be prone to either more IOR-E, as in the case of an independent self, or to IOR-A which I suppose to occur in a more inter-dependently defined self. That may, for instance, be especially relevant

in the times of the current pandemic crisis as another recent paper on the interplay of COVID, brain, self, and culture shows (Scalabrini et al., 2020). Accordingly, we can see an intrinsic-extrinsic continuum not only on neuronal and psychological levels but even on the cultural level. The excellent study by Wong et al. (2021) impressively demonstrates the high relevance of such intrinsic-extrinsic continuum for our self and its extreme psychopathological manifestations like IOR and, if extended further, to other forms of psychopathology like psychosis/schizophrenia (Northoff et al., 2020c).

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Georg Northoff

I am the sole and only contributor

Georg Northoff

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Georg Northoff

References

- Huang, Z., Obara, N., Davis, H.H., I.V., Pokorny, J., Northoff, G., 2016. The temporal structure of resting-state brain activity in the medial prefrontal cortex predicts self-consciousness. *Neuropsychologia* 82, 161–170. <https://doi.org/10.1016/j.neuropsychologia.2016.01.025>.
- Kolvoort, I. R., Wainio-Theberge, S., Wolff, A., & Northoff, G. (2020). Temporal integration as "common currency" of brain and self-scale-free activity in resting-state EEG correlates with temporal delay effects on self-relatedness. *Hum. Brain Mapp.* Advance online publication. <https://doi.org/10.1002/hbm.25129>
- Northoff, G., 2016. Is the self a higher-order or fundamental function of the brain? The "basis model of self-specificity" and its encoding by the brain's spontaneous activity. *Cogn. Neurosci.* 7 (1–4), 203–222. <https://doi.org/10.1080/17588928.2015.1111868>.
- Northoff, G., 2018. *The Spontaneous Brain: From the Mind-body to the World-brain Problem*. MIT Press.
- Northoff G, Wainio-Theberge S, Evers K. (2020a) Is temporo-spatial dynamics the "common currency" of brain and mind? In quest of "spatiotemporal neuroscience". *Phys Life Rev* 2020 Jul;33:34–54. doi: <https://doi.org/10.1016/j.plrev.2019.05.002>. (Epub 2019 May 23).
- Northoff G, Wainio-Theberge S, Evers K. (2020b) Spatiotemporal neuroscience - what is it and why we need it. *Phys Life Rev*. 2020 Jul;33:78–87. doi: <https://doi.org/10.1016/j.plrev.2020.06.005>. Epub 2020 Jul 10. PMID: 32684435
- Northoff, G., Sandsten, K. E., Nordgaard, J., Kjaer, T. W., & Parnas, J. (2020c). The self and its prolonged intrinsic neural timescale in schizophrenia. *Schizophr. Bull.*, sbaa083. Advance online publication. <https://doi.org/10.1093/schbul/sbaa083>
- Qin, P., Wang, M., & Northoff, G. (2020). Linking bodily, environmental and mental states in the self-a three-level model based on a meta-analysis. *Neurosci. Biobehav. Rev.* 115, 77–95. Advance online publication. <https://doi.org/10.1016/j.neubiorev.2020.05.004>
- Scalabrini, A., Ebisch, S.J.H., Huang, Z., Di Plinio, S., Perrucci, M.G., Romani, G.L., Mucci, C., Northoff, G., 2019. Spontaneous brain activity predicts task-evoked activity during animate versus inanimate touch. *Cereb. Cortex* 29 (11), 4628–4645. <https://doi.org/10.1093/cercor/bhy340>.
- Scalabrini, A., Xu, J., Northoff, G., 2020. What COVID-19 tells us about the self: the deep intersubjective and cultural layers of our brain. *Psychiatry Clin. Neurosci.* (2020 Dec 10) <https://doi.org/10.1111/pcn.13185>. Online ahead of print.
- Wolff, A., Di Giovanni, D.A., Gómez-Pilar, J., Nakao, T., Huang, Z., Longtin, A., Northoff, G., 2019. The temporal signature of self: temporal measures of resting-state EEG predict self-consciousness. *Hum. Brain Mapp.* 40 (3), 789–803. <https://doi.org/10.1002/hbm.24412>.
- Wong, S., Huim, C., Wong, C., Suen, Y., Chan, S., Lee, E., Chang, W., Wong, G., Chen, E., 2021. Induced ideas of reference during social unrest and pandemic in Hong Kong. *Schizophr. Res.* (in press).

Georg Northoff

University of Ottawa Institute of Mental Health Research, Ottawa, Canada

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