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What COVID-19 tells us about the self: The deep intersubjective and cultural layers of our brain

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The COVID-19 crisis is affecting our sense of self and touches upon our existential fears. This extends to the self–other relationship, as there is both being infected and infecting the other. What does this pandemic crisis tell us about our self and relatedness, its cultural differences, and how these are rooted in the brain's relation to the world? First, we discuss the psychological and neuronal features of self and self–other relation and how they are rooted in a deeper layer of the brain's neural activity complementing its cognitive surface layer. Second, we demonstrate cultural differences of Eastern and Western concepts of the self (i.e., independency and interdependency) and how these reflect the manifestation of the brain's neuro-social and neuro-ecological alignment. Finally, we highlight the intersubjective and cultural nature of the self and its surface in the COVID-19 crisis. Discussing various lines of empirical data showing the brain's intimate alignment to both social and ecological environmental contexts, our results support the assumption of the brain's deep layer features by laying bare a continuum of different degrees of neuro-social and neuro-ecological alignment. This entails a two-stage model of self with neuro-social-ecological and psychological levels that extends the previously suggested basis model of self-specificity. We conclude that the current pandemic shows the importance of the deeper intersubjective and cultural layers of both the self and brain; their neglect can be life-threatening for the self and others and, paradoxically, might reduce, rather than enlarge, the self's sense of freedom and independence.

Keywords: *COVID-19, independency and interdependency, neuro-social and neuro-ecological alignment, self, spontaneous activity of the brain.*

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Then I will fumigate, purify the air, administer medicine, and take medicine. I shall avoid places and persons where my presence is not needed in order to not become contaminated, and thus perchance inflict and pollute others and so cause their death as a result of my negligence.
Martin Luther, at the time of the bubonic plague

The COVID-19 crisis touches upon our sense of self and its existential fears.[1] These existential features are not limited to the individual self, the single person, but extend beyond to the self–other relationship. The fear of being infected by or infecting another person's self touches upon a deep mostly unconscious basis of the self in the social world of the self–other relationship. The existence of myself, taken in a most literal way as opposed to death, depends no longer on my own self but also on the other person's self. Hence, the COVID-19 crisis touches upon a deeper layer of our self's existence, its intersubjective and social nature, including its anchoring in the social, cultural, and ecological world.[1–4]

The coronavirus pandemic poses a challenge for different societies, and their respective cultures, as it reveals how differently people react and regulate themselves according to this frantic situation. The deeply intersubjective, cultural, and social nature of self extends beyond its cultural differences. How do members of different societies cope with their sense of self and related existential fears[5]? In addition to the restriction imposed by different governments and their management of the COVID-19 transition,[6] how do individuals experience the fear of loneliness, the social/physical distancing,[7, 8] the fear of contagion and death that deeply affect our sense of self and relatedness with others?

Let us consider the example of masks. It seems there is no problem of wearing masks for protecting the other persons' selves in East Asian cultures, such as Chinese, Japanese, and Korean. It is a matter of politeness and respect for the other self to wear a mask, even if one suffers from a cold, so as not to infect the other. That is even more true in the times of the COVID-19 crisis. In contrast, there seems to be problems related to hiding part of one's face by a mask and about human rights and personal liberties in Western cultures, such as the Anglo-American and the European. A recent article entitled 'Coronavirus: Why Some Countries Wear Face Masks and Others Don't,' appearing in *BBC News, Singapore* and written by Tessa Wong, states: 'In [Eastern cultures], the broad assumption is that anyone could be a carrier of the virus, even healthy people. So in the spirit of solidarity, you need to protect others from yourself.'[9]

These observations point to deeper issues about the existential features of self; these existential features touch upon the deeply intersubjective nature of self that can paradigmatically be observed in

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cultural differences as when identifying one's own self in a more socially independent or interdependent way.[10] We here suggest that both features of self, intersubjective and cultural, are closely related to each other, as they are both on the same neuronal or, rather, neuro-ecological mechanisms. Complementing the explicit cognitive features of self, they reflect implicit deeper existential layers of self that are based on the brain's alignment to its environmental context, that is, the world.[3] We therefore speak of neuro-social and neuro-ecological alignment, which provides the basis for the deeply intersubjective and cultural nature of our self. This leads us to postulate a two-stage model of self with both neuro-ecological and psychological levels, which builds upon the recently proposed basis model of self-specificity.[2]

We first discuss concepts of self, including its neuronal features with a specific focus on the self's deeper intersubjective existential layers as manifest in its alignment to the social and ecological world. This will be complemented, in a second step, by discussing cultural psychological (and neuronal) differences of Eastern and Western concepts of self along the lines of independent and interdependent self. Thus, in a third part, we will highlight how the intersubjective nature and cultural differences of the self surface in the current COVID-19 crisis, which lays bare the deeply intersubjective and cultural nature of our brain and its self.

Part I. Self and World: The Brain's Neuro-social and Neuro-ecological Alignment

Self as the default state of the brain's spontaneous activity

Our sense of subjectivity is often expressed and operationalized by our sense of self, which might be considered as the 'glue' that keeps together the different behavioral, affective, cognitive, and sensory motor manifestation of our self. Through empathy and mirroring,[11, 12] others can get closer to what is the experience of the self and this continuous relational process builds up the capacity to regulate our self. The self and the other are intrinsically connected to each other. Indeed, others, those considered 'like me' with similar inner experiences since infancy,[13–17] and their reflection/mirroring/empathic activity play a key role in the development of the self from infancy and predispose the basis for developing secure attachment.

In neuroscience, the self and its related processing have been shown to modulate behavioral responses related to reward,[18–21] attention,[22–25] perception,[22, 23] action,[26] emotion,[27–29] and decision-making,[30–32] and thus have been operationalized in terms of self-relatedness.[33] The activity evoked to different experimental tasks as well as the brain's spontaneous activity (or resting state) have been investigated more and more over the years.[34–37] The default mode network, in particular, comprising the cortical midline structures and showing strong low-frequency fluctuations,[38–40] together with other networks, such as sensorimotor, salience, central executive networks (see Menon[41] for a review), characterize the spatiotemporal architecture of the brain's spontaneous activity. Not surprisingly the default mode network and its cortical midline structures have been associated with self-relatedness not only in task-evoked activity but also during the resting state characterized by spontaneous thought.[42–49] These findings suggest what has been operationalized as 'rest-self overlap',[50, 51] which describes the convergence in anterior and posterior cortical midline structures[52–54] between the self and the brain's spontaneous activity that has been extended to the concept of 'rest-self containment,'[55–58] suggesting that self-specific information encoded and contained in the spontaneous activity itself may, in turn, provide the basis (i.e. the 'default mode functionality'[37]) for affective, cognitive, social, and sensorimotor functions and their respective contents.[33, 59] Recent empirical findings[60] have shown how the scale-free properties (i.e., the shape of the power spectrum with its long-range temporal correlation) of resting state activity in the anterior cingulate cortex predict the subsequent task-evoked neuronal activity related to the animate (i.e., the social) environment. These and other findings[33, 55, 60, 61] strongly suggest that the spontaneous activity's temporospatial dynamics (e.g., its scale-free properties) and the spontaneous activity's degree of self-relatedness modulate task-related activity and its self-specificity assigned to external stimuli, providing the link between our sense of self and the social environment. The self and its temporospatial dynamics[62] may be conceived as a template (i.e., 'default mode functionality') relative to which external stimuli are processed: being more proximal or distal to the temporospatial dynamics of the model itself (i.e., the self) translate to what is observed as the degree of self-relatedness assigned to the stimulus.

Self–other relation: Temporospatial alignment to the world

Such temporospatial relational alignment of the self with others, both at a neuronal and at a psychological level, is put into doubt by the COVID-19 crisis (see Fig. 1). Intersubjective relationships that are at the basis of our human existence, especially with significant others (e.g., attachment figures and romantic partners), might be no longer perceived as a 'secure base',[63] given the intrinsic fear of being infected or being the carrier of the infection. This may induce different reactions, which again may also depend upon the cultural context. In one way, the threat of fear affects our relationships such that we might no longer feel the other as closer in space and time – the self–other relation might be disrupted.

That basically means that the self has to cut some of the most fundamental conditions on the basis of which it constitutes itself – people will consequently feel lonely, depressed, and suffer from existential anxieties and fear. That, combined with the threat of death for the one's own self and for the others results in the existential fear of literally losing the self through losing the other and the world. Yet another way to react to the threat may be to move even closer together. Even if subjects have to physically isolate and distance, they can nevertheless move more closely together in social and mental terms – that secures and stabilizes the intersubjective basis of self which can be observed in Asian cultures.

These observations point to the deeply intersubjective nature of self as its existential basis, the same existential fear emphasized by philosophers like Heidegger, Sartre, and Levinas. The psychological overlap and distinction between self and other has been recently pointed out at a neuronal level by Murray and colleagues.[53, 64] The authors demonstrated how a 'self–other overlap network' in resting state is characterized by a shared connectivity within the anterior cortical midline structures (i.e., the ventromedial prefrontal cortex bordering into the anterior cingulate cortex). Differentially, a 'self network' in resting state is composed by anterior midline regions, such as the perigenual anterior cingulate cortex and ventromedial prefrontal cortex, as well as

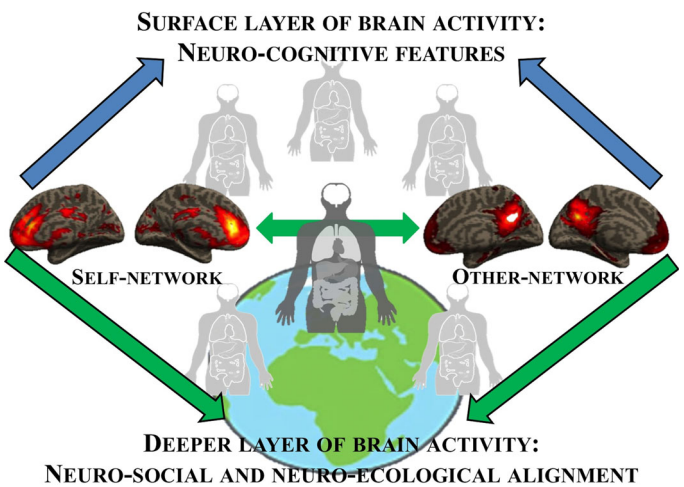

Fig.1 Deeper and surface layer of brain's neuronal activity.

the anterior insula (see also Huang *et al*.[55] and Lou *et al*.[65]), while posterior midline regions, such as the posterior cingulate cortex and the temporal parietal junction, form the so-called 'other network.' These findings imply that a phenomenological subjective and intersubjective overlap processing might be characterized by the spontaneous activity in the anterior portion of cortical midline structures.[66–72]

Self and world: Neural basis of attachment

Interaction with the animate/social environment (e.g., significant others) has been found to be crucial to the development of the sense of self and relatedness with others in numerous developmental psychology and neuroscience studies.[14, 58, 71, 73–75] This is the basis of attachment that postulates how development and maturation of brain regions involved in self and social development[76, 77] is by default environment-dependent, or to say, experience-dependent. In the context of attachment, the self–other interactions play essential roles in developing the self and its different features (e.g., continuity, constancy, and regulation of cognitive and emotional states). This suggests how both attachment and self-relatedness processing[4, 78, 79] might share similar neuronal activity. In this context, by investigating the neurobiology of attachment in animals[80] and humans using functional magnetic resonance imaging (fMRI),[81–83] recent studies have shown that the regions prevalently located in the cortical midline structures and limbic areas (e.g., the amygdala and hippocampus) are not only involved in the context of attachment but also have an impact on different functions related to the self at a very fundamental level. This amounts to what has recently been introduced as the basis model of self-specificity (BMSS).[2] This model suggests that the self is a basis function of the brain rather than a higher-order cognitive function. This is well compatible with the present view where the self as basis function is even further traced to the brain's alignment with the environment. Going beyond the purely neuronally defined self, the here-supposed neuro-ecological approach extends the basis self to the ecological or, rather, neuro-ecological realm. The self is aligned with the environment at a very basic level, the level of the brain's spontaneous activity, independent of any cognitive tasks – such alignment must be understood in spatiotemporal terms. Hence, our paper extends the BMSS to a neuro-ecological, rather than cognitive, model of the self. This also extends other models of self, such as the predictive coding model of self[84] with the prediction and predictive coding being rooted in the spatiotemporal and neuro-ecological organization of the brain's spontaneous activity.

Neuronally, a recent meta-analysis on the self[68, 85] proposed an iterative and hierarchical three-level processing model of self with the aim of illustrating how the brain integrates bodily information and external-environment information in self-processing. This is well compatible with the here-suggested neuro-ecological extension of the BMSS and the two-stage model of interdependent and independent self. The different levels of the hierarchy of self, as observed in Frewen *et al*.[85] and Qin *et al*.,[68] may then be associated with the neuro-ecological shaping of self through world–brain relation, including its cultural differentiation into independent and interdependent self on a more psychological level (see below).

Psychologically, such a neuro-ecologically extended basis model of the self entails that the self and its different regulatory strategies are dependent on the others. In this context, fostering attachment security and synchronous interactions with others[86] has been proposed as a regulatory strategy to manage the pandemic fear. This intersubjective and interdependent determination of the self (vs a mere subjective and independent configuration of the self) provides protective effects and a 'security boost' against the existential fear of losing the connectedness with the others and the world (see Fig. 1).

Part II. Cultural Differences of Brain and Self

Independent versus interdependent self I: Psychological differences

Markus and Kitayama[10] first put forward the terms 'independent self-construal' and 'interdependent self-construal' to conceptualize the views of the self in Western cultures (e.g., Western European and North American) and Eastern cultures (e.g., East Asian), respectively. They believed that Western individuals regard their selves more as bounded entities separated from their social environments. In contrast, Eastern individuals emphasize their selves more as boundless and in relation to their social environments. The cultural differences in the self and their influences have been observed by many researchers, not only in behavioral/psychological studies,[87–97] but also in neural studies.[98–105] These studies have been conducted either in different cultural groups or using cultural (self-construal) priming (or both).

In some early studies involving self-description tasks, Eastern participants (even children) mentioned social relations more frequently than Western participants.[97, 106] A number of studies employed different self-construal scales that were built on Markus and Kitayama's conceptualization to investigate the cultural differences in the self. Most (but not all) studies showed that, compared with Western participants, Eastern participants had higher scores for interdependence (and lower scores for independence).[89, 93, 95, 96, 107–110]

Similar results were also obtained by using other scales. Campbell and colleagues[88] built the Self-Concept Clarity Scale and found Canadian participants showed higher scores on self-concept clarity as well as higher correlations between self-concept clarity and self-esteem than Japanese participants, which indicated their views of self were more independent. Lay and colleagues[111] found Eastern participants scored higher on family allocentrism (namely, interdependence with family) than Western participants, through their Family Allocentrism Scale. This was replicated in Li and colleagues' research.[112] Fu and Markus[113] found that European Americans felt less overlap with their mothers than Asian Americans, by adopting the Inclusion of Other in the Self Scale.[114]

Moreover, there are some studies measuring the psychological tendencies (e.g., focused vs holistic attention) relevant to the independent versus interdependent self,[91] the implicit attitudes (positive or negative) towards them,[94] the differences in self- and other-perception between Western and Eastern participants (larger vs smaller self-advantage effect[115]), and some including priming effects (see Han and Northoff[116] for a review). Their results were consistent with the patterns of cultural differences in the self proposed by Markus and Kitayama[10] as well. For instance, Gardner and colleagues,[90] who used self-construal priming, found US participants thought highly of individual values before priming and after priming with the independent self, but they attached more importance to social values after priming with the interdependent self. Hong Kong participants were the opposite. They attached more importance to individual values after priming with the independent self, but they were more concerned about social values without priming and after being primed with interdependent self.

Independent versus interdependent self II: Neuronal differences

In addition to the above psychological studies, electroencephalogram and fMRI studies have also yielded consistent results. In an early fMRI study, the medial prefrontal cortex of Chinese participants was strongly activated in both self-judgment and mother-judgment tasks against other-judgment tasks; however, the medial prefrontal cortex of Western participants was only strongly activated in self-judgment tasks.[105]

The findings imply that mother-judgment is more included in Chinese (Eastern) self-processing but not necessarily in Western self-processing; that is, the Chinese self is more culturally interdependent on their mother (Wang *et al*.[104] replicated the same findings in fMRI). Furthermore, bicultural Chinese participants showed neural differentiation between self and others (mother and a non-identified person) after Western-culture priming, but showed neural overlaps between self and others in the ventral medial prefrontal cortex after Chinese-culture priming.[101] Taken together, this suggests that there are cultural differences in the self and its independence versus interdependence at the neuronal level.

Besides, in an fMRI study with gambling tasks, relative to winning money for a friend, the bilateral ventral striatum of Chinese university students was activated more during wining money for the self, after independent-self priming. However, after interdependent-self priming, no significant difference in the activation of the bilateral ventral striatum was found.[117]

Lin *et al*.[118] investigated the influences of self-construals on event-related brain potentials (ERP) in global and local perception tasks, using priming. When Chinese participants were primed with the independent self, their P1 amplitudes were higher in the local perception tasks than in the global ones. When they were primed with the interdependent self, the P1 amplitudes were greater in the global. The study indicates that, on the one hand, self-construals affect perception (local-focused vs global-focused); and on the other hand, the influences of self-construals were reflected in the ERP.

Another ERP study showed that, compared with no priming and independent-self priming, the activation of anterior N2 in British participants was decreased in self-face recognition after interdependent-self priming. In contrast, independent-self priming led to the reduction of the activation of the anterior N2 in Chinese participants during friend-face recognition.[102]

The patterns of functional connectivity and electroencephalogram connectivity in resting-state activity between self network and other network (e.g., default mode network and temporal parietal junction) were also found to be related to the scores or primes of independence (individualism) versus interdependence (collectivism).[98, 119]

Altogether these findings show us how our self, both at psychological and neuronal levels, is deeply influenced, not only by the quality of intersubjective relationships but also by the cultural priming and the respective cultural context.

Culture and self: Two-stage model of self

We suppose that such cultural dependence of both psychological and neuronal features of self can ultimately be traced to the same mechanisms, the neuro-social and neuro-ecological alignment of the brain to its respective environmental context (see Fig. 2). Neuro-social and neuro-ecological alignment, in turn, make possible that the brain's spontaneous activity and its temporospatial dynamics are shaped by their respective social and cultural contexts – this accounts for 'enculturation' of the brain[120] or constitutive context-dependence of the brain.[116] At the same time, the enculturation of the brain's spontaneous activity and its temporospatial dynamics lead to different perception, action, and cognition of the environment and the own self – this can be clearly seen in the psychological differences of self and self–other relation: the environment and the self–other relationships are shaped in terms of the brain reflecting 'embrainment.'[116, 120] Together, we can see mutual dependence of brain and environment, that is, embrainment and enculturation, with both being different facets or sides of one and the same mechanism: neuro-social and neuro-ecological alignment.

Cultural differences in the self and brain are usually seen as differences in degree. Some studies (in cultural neuroscience) regard independent and interdependent selves as two extremes of one continuum. While some studies (in cultural psychology) regard them as two different continuums. The latter can explain why a sample is both more independent and more interdependent than another sample – Chinese participants scored higher on both independence and interdependence than British participants in an early study.[110]

However, it was found that interdependence and independence are malleable, as cultural priming changed participants' pattern from independence to interdependence or *vice versa*[98, 101] – this is more compatible with one continuum where independence and interdependence represent its extreme ends.

The here-proposed two-stage model (or that called the 'neuro-ecological model') of self is closer to this view considering independence and interdependence being two extremes of one and the same underlying continuum. Independence and interdependence result as the second stage from a more basic first stage, the self–environment relation with a continuum of distinct degrees. The self–environment continuum, in turn, is constructed by the brain's spontaneous activity and its alignment to its environmental context in a spatiotemporal way (i.e., world–brain continuum).[3] Differentiating the self from such an underlying spatiotemporal neuro-ecological world–brain continuum as the first stage leads to the distinction of self-construals as the second stage in psychology, and a variety of different patterns of self in philosophy.[121]

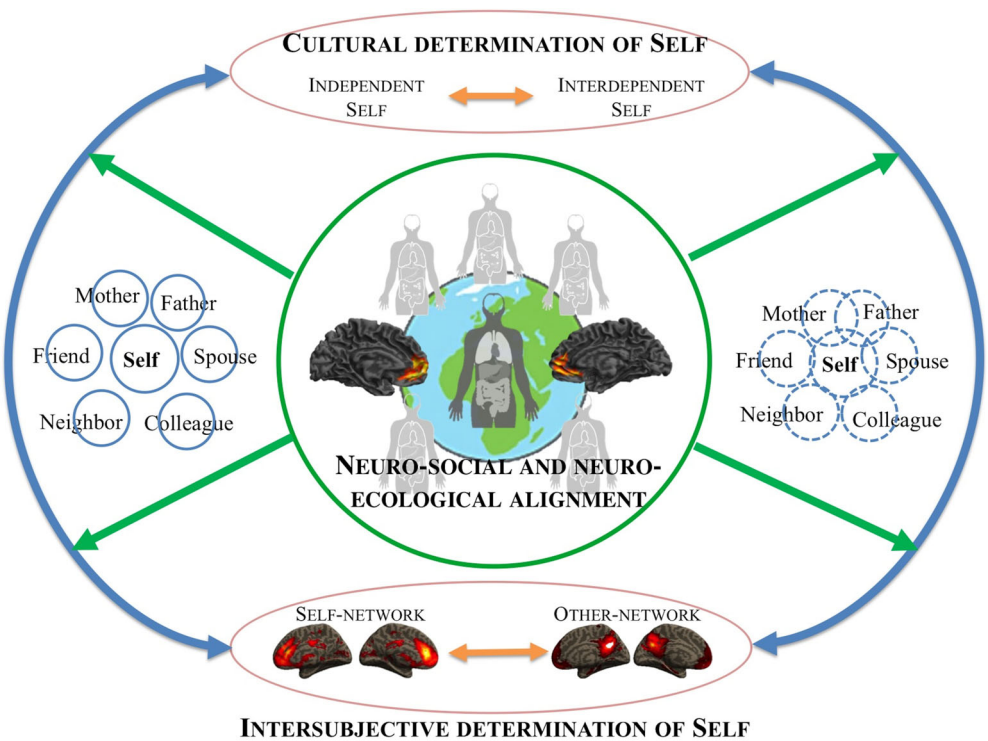

Fig.2 From the brain's neuro-social and neuro-ecological alignment to cultural differences of self.

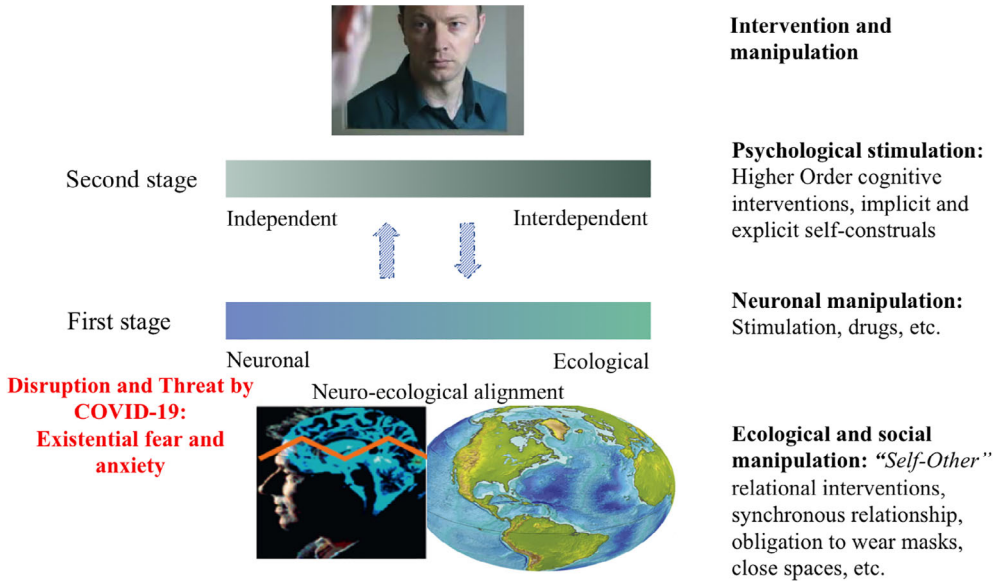

Fig.3 The two-stage neuro-ecological/ neuro-social model of self.

If Eastern selves have a higher degree of neuro-ecological/neuro-social alignment than Western selves, as we predict, the COVID-19 pandemic may influence Eastern and Western individuals in different ways. Neuro-ecological alignment provides stability and stability makes one more resilient against external perturbations threatening the self, such as COVID-19. Hence, we assume that subjects with high interdependence are better able to cope with the stress and anxiety induced by COVID-19 as they can better stabilize themselves through their high degree of inter-connectedness. How can we test that? Our two-stage model yields a testable hypothesis. One hypothesis concerns an implicit bottom-up modulation of the self from variation of the neuro-ecological world–brain relation. This may mainly work through implicit levels of self-construals modulating the degree of anchoring of the self on the underlying neuro-ecological continuum, while one may also modulate the explicit self-construal itself and then, via top-down modulation, change the degree of the self's anchoring on the neuro-ecological continuum (Fig. 3 right part).

Part III. How the COVID-19 Crisis Reveals the Deeper Layers of Self

How do these cultural differences in the self affect its standing in the COVID-crisis? For the moment, this can only be speculated about as no empirical data have yet been reported.

Determination of self: Being infected versus infecting others

One cultural difference concerns the attitude towards others. The self is afraid of being infected and getting sick from COVID-19 (fear for the self and fear of others). In contrast to the fear of being infected, the fear of infecting others does not often prevail in the perception of more independent selves (there is no fear for others). This is for instance well reflected in the often-uttered statement: 'I am young, so even if I am infected, I will not fall sick.'

Being infected does not induce any fear; life goes on as normal – the COVID-19 crisis is dealt with in a purely intra-subjective way. In contrast, the intersubjective dimension, the risk of infecting others, is completely lost and overlooked – it remains absent. That, as we postulate, is possible only by defining the self merely from the inside of one's own person independent of other selves – this amounts to an independent concept of self where the other is not included in determining the own self.

In contrast, the fear of infecting others seems to be more prevalent in more interdependent selves, as in Eastern cultures. Part of that may be the previous experience of an epidemic, for example, SARS in 2003.[122] But, according to our hypothesis, it might also be related to the different concepts of self, which are defined in a more interdependent than independent sense. The interdependence shifts the focus from the intra-subjective self to its intersubjective relationship with the other: 'If I am infected, the risk of infecting another person is high, which disrupts my relationship with the other person's self and, in turn, harms my own self, including its intra-subjective sense, which then may be plagued by guilt and fear'.

We speculate that both attitudes towards infecting the other reflect different degrees on a continuum between the extreme poles of total and zero degrees of neuro-social and neuro-ecological alignment. On that continuum, subjects with strong Eastern cultural attitudes may be positioned more towards stronger neuro-social and neuro-ecological alignment, while subjects with stronger Western cultural views may head in the opposite direction on that continuum.

Even stronger shifts towards either total or zero neuro-social and neuro-ecological alignment lead to mental disorders, such as schizophrenia (lack of neuro-social and neuro-ecological alignment[123, 124]) or mania (too much neuro-social and neuro-ecological alignment[125]). Accordingly, degrees of alignment around more or less medium or average values are good and extremes are bad[126] – this is paradigmatically laid bare by the COVID-19 crisis.

Given our two-stage model, we assume that people from interdependent cultures may be more resilient to and after the COVID-19 pandemic. Individuals with interdependent self-construal regard others as part of themselves and adapt to the changes of environment. Thus, they can more easily accept public health policies, such as wearing masks and lockdown quickly, to prevent the loss of parts of themselves (including others' lives), and to maintain the self–other/self–environment connection. Therefore, we suppose that the psychological and existential impact of the COVID-19 pandemic will be less severe in interdependent cultures.

How about therapeutic intervention? Our two-stage model shows that we can use higher-order cognitive (top-down) and neuronal (bottom-up) and ecological and/or social manipulation (including interventions focusing on self–other relational-affective-attachment security) to modulate world–brain relation, self–environment relation, and ultimately the degree of interdependence or independence of the self. Since the pandemic affects our self's anchoring in the neuro-ecological continuum, it threatens our most basic existential foundation of self; this requires strong manipulation through ecological–social manipulation and, in the individual case, possibly neuronal manipulation, while higher-order cognitive manipulation may partially remedy the acuteness of the existential fear but not the existential fear itself.

Freedom of self: Relative versus absolute

Yet another example of cultural differences with respect to COVID-19 is the persistent expression of freedom in more Western parts of the world. Lockdown measures are often criticized in demonstrations and social media for taking away the freedom and even the human rights of individual persons: 'It is my freedom to go shopping, to travel, to go to bars and participate in events; these are essentials for me.' However, this kind of statement often neglects that taking such freedom may occur at the expense of the other person's self as it increases their risk of being infected – this limits the other person's freedom.

Accordingly, the absolute freedom of the self as an independent entity is, in COVID-19 times, possible only at the expense of the freedom of others. And, ironically, restricting the other persons' freedom by expanding the own self's freedom may ultimately harm the independent selves themselves, as it increases their risk of being infected by exposing them to others with the same attitude and sense of freedom.

The COVID-19 crisis undermines the traditional association of the independent self with freedom. Freedom is often taken in an absolute way in the Western world, that is, independent of any other person and the respective context: the more independent one is of the other, the more free one supposedly is. Accordingly, presupposing an independent self, 'freedom' is defined as freedom of the own self, which is supposed to be possible through freedom from the other self. That no longer holds in times of the COVID-19 crisis, though. Coupling the independent self with an independent sense of absolute freedom can only occur at the expense of the other person's freedom – freedom of self impinges upon the freedom of the others' selves.

The COVID-19 crisis shows us that freedom is relative (i.e., dependent upon the respective context), rather than absolute (i.e., independent of others and context). Even more important, it tells us that freedom is relative and intersubjective rather than absolute and intra-subjective. That, we conceive it, is paradigmatically reflected in the discussion about masks, as their wearing is often supposed to impinge upon the individual's freedom. [9, 127, 128]

Freedom is interdependent rather than independent; it is relative to the other rather than being absolute as exclusively associated with the self alone. COVID-19 reveals that difference, namely that freedom is relative rather than absolute. Wearing a mask or not is a relative freedom as my freedom not to wear it may strongly impact the freedom of others. Obviously, far Eastern cultures have had the previous experience that masks can prevent infection. However, even in non-epidemic times, masks are worn if one suffers from a cold. Why? In order to avoid infecting the other and transferring the cold and its germs from one's own self to the other. There is a deeper meaning to that. It keeps the relationship with the other (which may be impeded if the own self infects the other) stable and harmonious. Such a harmonious relationship with the other stabilizes the own self – intersubjectivity constitutes intra-subjectivity.

We tentatively speculate that the harmonious relation of self and other can ultimately be traced to our brain's need to be in an energetic equilibrium with its respective environmental context, that is, the free energy principle, according to Friston.[129, 130] Neuro-social and neuro-ecological alignment and ultimately harmonious self–other relationship may then ultimately be nothing but the manifestation of the degree of the brain's energetic equilibrium with its environment. The brain's neuronal activity, through its neuro-social and neuro-ecological alignment manifesting the free energy principle, stands relative to its environment rather than being absolute by itself, independent of the latter. Albeit highly speculative, we assume that the relative (rather than absolute) nature of the brain (i.e., relative to the environment) may ultimately provide the biological basis for the relative rather than absolute nature of human freedom.

Conclusion

The self is a multilayered construct. The COVID-19 crisis exposes deeper neurobiological layers of our self, which we usually do not perceive, or which do not surface in our daily life. Here we have identified two such strongly neuronally or, rather, neuro-ecologically grounded dimensions: the intersubjective dimension of self as grounded in its relationship to other selves, and its transcultural differences in terms of interdependent and independent concepts of the self. The COVID-19 crisis has exposed the double positioning of the self as it runs the risk of being infected and, at the same time, infecting others. This lays bare the deeply intersubjective and interdependent nature of the self, as well as its relative rather than absolute freedom. Following empirical evidence, we assume that the deeply intersubjective and interdependent nature of the self can ultimately be traced to the brain's deeper layer featured by neuro-social and neuro-ecological alignment to its respective environmental context. This extends the recently proposed basis model of self-specificity[2] in neuro-ecological regard and entails a two-stage model of cultural differentiation on neuro-ecological and psychological grounds.

Neglecting these deeper neuro-ecological and neuro-social layers of the brain's spontaneous activity might result in several forms of self- psychopathology (e.g., depression[131]) and prevent us from recognizing the deep rooting and anchoring of our self in its social, cultural, and ecological contexts. These deeper layers complement and ground the cognitive surface layers of self as they are often identified and discussed in current psychology and neuroscience[68, 85, 132] – this entails a neuro-ecological extension of the basis model of self-specificity, including two-stage cultural differentiation. The neglect of these deeper intersubjective and interdependent layers of the self leads to abnormal aggravation of the cognitive surface layers of the self with the extreme insistence on independence, freedom, and human rights. That, as the COVID-19 crisis tells us, can be life-threatening for both the self and the other by which, contrary to its intentions, the proclaimed independence and freedom of the self is restricted rather than enlarged.

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Disclosure statement

The authors declare no potential conflicts of interest.

Author contributions

A.S. and G.N. conceptualized and designed the study. A.S., J.X., and G.N. wrote the article together and equally contributed to the final version of the manuscript.

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