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Neural correlates of nondual awareness in meditation

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Dualities such as self versus other, good versus bad, and in-group versus out-group are pervasive features of human experience, structuring the majority of cognitive and affective processes. Yet, an entirely different way of experiencing, one in which such dualities are relaxed rather than fortified, is also available. It depends on recognizing, within the stream of our consciousness, the nondual awareness (NDA)—a background awareness that precedes conceptualization and intention and that can contextualize various perceptual, affective, or cognitive contents without fragmenting the field of experience into habitual dualities. This paper introduces NDA as experienced in Tibetan Buddhist meditation and reviews the results of our study on the influence of NDA on anticorrelated intrinsic and extrinsic networks in the brain. Also discussed are preliminary data from a current study of NDA with minimized phenomenal content that points to involvement of a precuneus network in NDA.

Keywords: nondual awareness; anticorrelated intrinsic/extrinsic networks; neural correlates; meditation

Introduction

Asian contemplative philosophies, going back to at least the 4th century C.E.,[1] and perhaps as far back as the 8th century B.C.E.,[2] have described the structuring of human experience along the subject–object dichotomy, accompanied by a competition between internally and externally driven mentation. Such structuring has been labeled as *duality* and seen as fragmenting the field of experience into unnecessarily antagonistic poles, such as inside versus outside, self versus other, good versus bad, and consciousness versus matter. Roots of this duality are variously understood as being due to a basic identification of one's self with one's body and mind, or due to a notion of an independently existing self in persons and objects, or due to a grammatical structure of language that inevitably organizes cognition along a subject–object dichotomy.[3] Different aspects of duality have been observed in contemporary science as well. Biological roots of self and nonself have been associated with the functioning of the immune system,[4] with interoceptive and exteroceptive neural maps representing body boundaries,[5,6] and with maps of the effects of interactions with the environment on the homeostasis of internal bodily systems.[7] Dualistic structuring of cognitive processes has been explored in relation to self-referential versus other-referential cognitions,[8,9] and to socially constructed construals such as in-group versus out-group memberships.[10] Although most of such dualities occur naturally, psychological hardening around them can lead to excessive fragmentation of experience.

In terms of large-scale cortical organization, an interesting but speculative idea is that this fragmentation of human consciousness reflects the broad segregation of the cortex into intrinsic and extrinsic networks.[11,12] The time courses of these two broad brain networks are usually anticorrelated, even when subjects are at rest.[13–15] Each of the two global networks is composed of a number of subnetworks, such as those for vision, audition, sensory–motor function, episodic memory, voluntary attention, salience, and executive control.[16–19] The extrinsic network responds positively to tasks involving external stimuli and includes a dorsal attention network, prefrontal cognitive control network, and sensory and motor networks. The intrinsic or default mode network responds more strongly when

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we are not engaged in a task (but see Ref. 20), and includes the midline core network and the medial temporal lobe network that includes areas of precuneus, the posterior cingulate cortex, the inferior parietal lobule, and the medial prefrontal cortex, as well as hippocampal areas in the medial temporal lobe. The intrinsic network has been implicated in a wide range of self-referential processes, including self-awareness or self-reflection, future planning and decision making about one's current personal state, constructing a scene from memory or imagining the future, creativity, as well as mind wandering.[21–24] Interarea correlations indicating functional connectivity between nodes of the intrinsic network exhibit various changes during different stages of sleep, sedation, and hypnosis, suggesting that an individual's state of awareness can have significant effects on the synchronization between these areas.[25–28] Of particular interest in this respect are the studies exploring changes in functional connectivity of the nodes of the intrinsic/default network in minimally conscious patients.[29–31] Studies that include such patients, as well as studies of a return to consciousness from anesthesia, point to the central role of the areas that compose the intrinsic network, and of the precuneus in particular, in consciousness.[32–34]

One of the central, although scientifically challenging, ideas of nondual contemplative traditions, specifically of Dzogchen and Mahamudra within Tibetan Buddhism and of Advaita Vedanta and Kashmiri Shaivism within Hinduism, is that at some fundamental level, human experience is not fragmented into opposing dualities, but that such fragmentation, though a universal condition of human life, is adventitious to a more unified reality underlying our daily experiences.[35,36] Such unified experience is possible according to these traditions because of the presence of an aspect of our consciousness that does not rely on dualistic conceptual constructs and symbolic representations in order to cognize. Taxonomies of consciousness developed in these traditions recognize different levels of mental functioning, corresponding roughly to perceptual, affective, and cognitive contents and to the global states of arousal, such as waking, dreaming, and deep sleep. To these, they add various altered states of consciousness encountered in meditative absorption; a substrate consciousness thought to be involved in retention of memories; and a nonconceptual nondual awareness (NDA) that abides, ordinarily unrecognized, in the background of all conscious experiencing.[37] This background awareness appears in meditation to be unitary and unchanging—a cognizance that is in itself empty of content, yet clearly aware and blissful—whereas various sensory, affective, and cognitive contents, and the various states of arousal appear to it as dynamic processes or, as a well-known metaphor states, like images in a mirror.[38] NDA is characterized, among others, by its reflexive property—it knows itself to be conscious without relying on subsequent moments of conceptual cognition.[39] According to some traditions, our inability to ordinarily detect NDA is due to an obscuration of this reflexive property by mistaken cognitions arising from substrate consciousness. Although NDA is experienced in meditation as a vivid presence of empty awareness that knows itself directly without mediation by conceptual thought, substrate consciousness is experienced as a pleasantly restful absorbed state, akin to deep sleep yet not entirely unconscious, which one knows retroactively. The question of what may be the relationship of NDA to subjectivity and a sense of self has been a matter of considerable debate among various Asian philosophies and is beyond the scope of this review.[35–40]

Defining NDA in terms of existing constructs of cognitive science is challenging, as it is an aspect of consciousness that has not yet been sufficiently researched. Attempts have been made to classify different meditation techniques into two broad categories on the basis of the attentional mechanisms they engage: focused attention (FA) and open monitoring (OM), with NDA meditation (Tib. rig-pa) being classified in this second category.[41] As pointed out by our group and others, key features of NDA differentiate the NDA meditation style as a third category of meditation.[42,43] These differences will be discussed in the subsequent section.

Approaches to meditation practice

Over many centuries, different approaches for dealing with the problem of duality have emerged in various contemplative traditions. Some approaches have opted for a monistic solution, by attempting to abolish one side of experience or the other, for example, de-emphasizing the subjective in favor of the objective or vice versa. Other approaches have attempted to do away with both subjective and objective aspects of experience, and aim for a

complete cessation of experiencing, akin to a deep sleep. Finally, in nondual approaches, the subjective and objective poles of experience are recontextualized within the basic space of NDA, and in doing so, realized to be the two sides of one unified field of experiencing. Some contemplative traditions see aspects of these different approaches as stages of progress in the practice of meditation, with the nondual approach being the actual goal.[35,36,44]

Subject-only approach

The idea of a subject-only approach is to inhibit the arising of extrinsic mental processes related to the experience of environment, usually through focusing on some internal self-related aspect of experience, either perceptual, affective, or cognitive. Such an approach is found, among others, in some schools of Vedanta and Sankhya yoga.[45] Research on techniques that have this objective has shown increased activity of nodes in the intrinsic or default network, in particular, the medial prefrontal and medial parietal cortices.[46–48] The goal of such meditations has been traditionally spoken of as "increasing self-awareness" or "realizing the pure consciousness or the self." This dovetails with contemporary findings on the role of the intrinsic network in self-awareness and organization of experience.[49,50] An important insight that comes from such meditation practices that parallels the contemporary understanding of brain functioning is the realization that one's experiences are dependent on one's mind.[51] In some traditions this realization has been extended into an idealistic view that the physical world itself is unreal and merely a construct of one's mind.[52]

Object-only approach

The idea underlying an object-only approach is to inhibit the subjective side of experience and the self-related mental processes, and emphasize the objective extrinsic side, usually through focus on the momentary nature of sensory experience.[53] This approach is found predominantly in the earlier Buddhist traditions, such as Theravada and Zen, though as a basic form of Buddhist practice, it is common to all Buddhist schools, as some degree of attentional stability is necessary for accuracy in observing one's cognitive and affective processes. The method consists of cultivating FA starting with one's breath as the object of focus, usually followed by the practice of open-ended nonjudgmental monitoring of whatever arises in one's experience from moment to moment.[54] Such attentional focus on the sensory dimension of experience de-emphasizes subjectivity and self-related meaning in favor of objective perception. This emphasis has also been expressed in terms of a hypothesized shift from egocentric to allocentric spatial processing.[55] Spontaneous thinking or mind wandering is discouraged, and one's progress is measured in stages that are mostly indicative of one's capacity for attentional absorption.[56] In the context of Tantric Vajrayana practice, this method has been refined to allow for isolating of NDA, or "clear light" from phenomenal contents, and in this way to introduce the meditator to this aspect of his or her mind.[38]

Research on meditations using the objective-only approach has found increases in the activity of nodes in the extrinsic network, specifically in the areas related to FA and monitoring,[57] together with decreases in the activity in nodes of the intrinsic network, specifically in the medial prefrontal cortex and posterior cingulate cortex. These changes have been accompanied by increases in anticorrelation between the nodes of intrinsic and extrinsic networks.[58–60] Such increases in anticorrelation have been interpreted as increases in functional segregation between these two networks.

Forgetting the self[61] and being absorbed in object-only sensory experience, or in a task, has been found to be widespread even in nonmeditators, and to confer certain advantages in optimizing performance, in particular in athletics and the arts.[62] Attenuation of the intrinsic system, specifically that of the medial prefrontal cortex, appears to be a common feature of these "flow" states.[63] Although such an abatement of self-evaluative mentation may be similar in flow states and meditation, there are important differences, as both FA and OM meditations lead, in advanced stages, to states of absorption in which phenomenal content is significantly reduced.

Reducing the activity of the medial prefrontal node of the intrinsic system has also been found to alleviate symptoms of some clinical conditions, such as ruminative thinking that accompanies episodes of major depression.[64] Ruminative thinking has been shown to correlate with hyperactivity of the medial prefrontal cortex and with increased connectivity of the subgenual cingulate cortex area of the medial prefrontal cortex to the posterior cingulate cortex, areas that are involved in valuation and episodic

memory.[64] In individuals with attention deficit hyperactivity disorder (ADHD), abnormal intrinsic network organization and activity interferes with sustained attention and task engagement.[65] The effects of FA and OM meditations on attention may be indicative of their possible clinical value as complementary treatment modalities in attention disorders, though there are still insufficient studies to clearly ascertain their effectiveness.[66,67] Despite the positive effects of object-only meditations on certain clinical conditions,[68] it is questionable whether an ongoing suppression of self-related aspects of experience and an attenuation of activity of the intrinsic network can be a healthy long-term strategy. The intrinsic network is critical for a number of cognitive and affective processes that make what we have come to regard as uniquely human conscious experience, and chronically reducing its activity may be responsible for some of the difficulties that have been reported with the practice of this style of meditation.[69,70]

Neither subject nor object

These approaches envision a state of deep absorption (Sansk: Samadhi) akin to deep sleep, in which all mental events, both those related to intrinsic and those related to extrinsic aspects of experience, have ceased.[71] What is left of one's actual cognitive capacity in such absorption, and in what way, if any, this state may be different from deep non-rapid eye movement (REM) sleep, has been a matter of some debate. Some early schools of Buddhism regard such a state of "neither conscious nor unconscious" (Pali: Nirodhasamapatti), in which all sentience has ceased, as the final stage of absorption and the goal of meditation practice, although many later schools dispute this interpretation.[72] Very little reliable scientific research exists on these states,[73] other than the finding of physiological correlates such as spontaneous breath cessation observed with transcendental meditation (TM),[74] though it is questionable whether TM, a subject-only practice, leads to these states, as its stated goal is pure consciousness or the self.[42]

Nondual approach

NDA meditations present an alternative to the abovementioned monistic approaches. Rather than eliminating one or the other pole of experience, NDA meditations facilitate realization of the natural unity of human experiencing, which is free from fragmenting into opposing dualities of, for example, inside–outside, self–other, and good–bad. These meditations rely on a background NDA that precedes conceptualization and intentionality, and cognizes without fragmenting the experience into dualistic opposites, hence the term nondual for this awareness.[3,43]

NDA meditations can be differentiated from FA and OM meditations through several key features.[35] In terms of the method of practice, NDA meditations are thought to not involve intentional effort.[35,42] Both FA and OM meditations rely on some degree of effort, which decreases with proficiency, leading to effortlessness in more advance stages. However, effortlessness in NDA meditation is of a different kind from that of mastering a skill. Rather, it is akin to that of ceasing the effort of searching for one's keys upon finding them in one's pocket. Although FA and OM meditations are traditionally regarded as constructed states created through deployment of specific attentional strategies, NDA meditations are based on identifying a reflexive awareness that is regarded as innate and unconstructed.[35,75] Additionally, NDA meditations could be seen as primarily context-oriented, concerned with NDA as a context of experience rather than with attending to specifics of experience. Thus, they differ from meditations based on focusing attention or monitoring experience, which are content driven and thought to involve networks for endogenous and exogenous attention and salience.[76,77] These differences also include more subtle ones, such as between NDA meditation and objectless shamatha or concentration meditation, in which the mind is emptied of content and held in an empty state through the force of concentration. Such meditation depends on deployment of endogenous attention and is a form of FA meditation. In current meditation research, NDA meditation is also often confused with open nonjudgmental or choice-less awareness meditation, a form of mindfulness meditation in which one monitors or follows whatever becomes a salient feature of one's experience from moment to moment, without engaging it or interfering with it. This type of meditation is a form of OM meditation that relies on vigilance and the exogenous attention system. It is primarily oriented toward attending to specifics of one's experience, and, like other OM meditations, it does not include

the reflexive self-knowing that characterizes NDA.[44] Furthermore, NDA is regarded by the contemplative traditions as different from bare attention to sensory experience, or phenomenal awareness, as it can contextualize both the bare phenomenal awareness and at the extended consciousness.[78,79]

Establishing the neural correlates of NDA and differentiating them from those of endogenous and exogenous attention may prove to be an exceedingly complex task, as evidenced by the efforts to differentiate attention and visual awareness.[80,81] In the following section, we show one possible approach by exploring changes in the functional connectivity of globally distributed networks. There has been a paucity of research on NDA. Previous research has found increased gray matter density in the brain stem,[82] downregulation of anticipatory representation of aversive stimuli and increased recruitment of attentional resources during pain,[83] and increased electroencephalogram (EEG) amplitude and coherence during contingent negative variation tasks.[84] Whether nonreferential love and compassion[85] implicitly entail some degree of NDA has not yet been established scientifically. This issue has been a focus of longstanding debates in the Tibetan Buddhist tradition that center on the question of whether such positive qualities are innate in NDA and manifest spontaneously once NDA is realized, or whether they are constructed states that require ongoing conditioning in order to manifest in one's experience and behavior.[35]

Neural correlates of NDA

The practice of NDA meditation is characterized, after an initial activation of its reflexive property, by a progressive decrease in habitual fragmenting of the field of experience into self-related versus other-related processes. Because of this, we hypothesized that its effect on the global connectivity patterns between intrinsic and extrinsic systems would be different than that of either subject-only or object-only meditations. As reviewed in previous sections, research on FA and OM meditations has found increased anticorrelations between nodes of intrinsic and extrinsic networks.[58–60] However, other research found no changes in any correlation levels for either FA or OM meditation.[86] Our research was the first to examine such changes during NDA meditation.

We tested experienced practitioners (4000–37,000 h of practice) in the Tibetan Buddhist tradition, most of whom were able to do both NDA and FA meditations, in three conditions: NDA, FA, and passive fixation, while they held their gaze steady at a fixation point at the center of the screen.[87] Fixation was used to control for large effects of spontaneous saccades on the functional magnetic resonance imaging (fMRI) signal. Using passive fixation as a rest condition is somewhat problematic with subjects who practice meditation, as meditation over time produces trait effects that carry into the rest state.[88] Furthermore, NDA once realized cannot be unrealized. Thus, our instructions to participants in the passive fixation condition were to allow their dualistic minds to wander freely and to avoid engaging in any type of meditation.

As an overall measure of the level of anticorrelation between the two networks, we computed the grand average time series for all voxels in the extrinsic and intrinsic regions of interest (ROIs) and then computed the correlation between those two grand average time series. As hypothesized, NDA meditation resulted in a significant decrease in the anticorrelation between intrinsic and extrinsic networks compared to rest. In other words, its effect was to increase functional connectivity between the two networks. In contrast, FA meditation resulted in the opposite effect, significantly increasing the anticorrelation between the two networks ($P < 0.001$, paired t-tests; $P < 0.005$, phase-randomization test; Fig. 1).[87]

These differences in anticorrelation were specific to interactions between the extrinsic and intrinsic systems. There was no evidence for differences in correlations between pairs of intrinsic ROIs, or between pairs of extrinsic ROIs. Likewise, there were no differences between conditions in the modulation of brain activity in either network, as assessed through testing the variance of the response time series.[87] Our results indicate that anticorrelation between intrinsic and extrinsic networks can be influenced in profoundly different ways through meditation, and that NDA meditation is different from FA and OM meditations in that it enables a state of mind in which extrinsic and intrinsic experiences are increasingly synergistic rather than competing.

Precuneus awareness network

In a follow-up fMRI study that we are currently conducting on NDA with minimized phenomenal

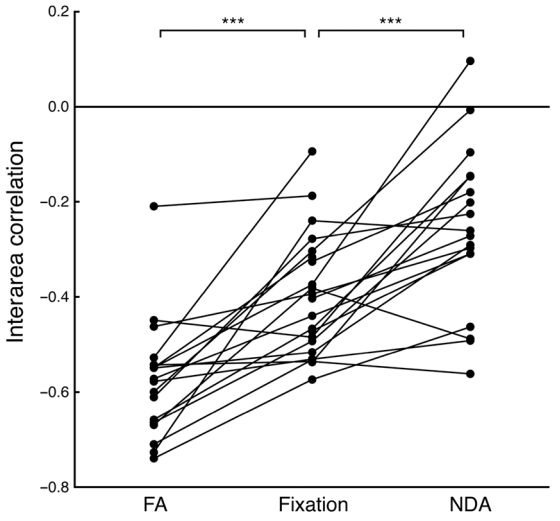

Figure 1. Anti-correlation between extrinsic and intrinsic systems. Fixation refers to fixation without meditation. Each data point corresponds to fMRI responses from one participant, averaged across all voxels in each of the two systems (extrinsic, intrinsic). Lines connect correlations from the same participant across conditions. Asterisks indicate statistically significant differences in correlation across participants ($P < 0.005$, randomization test). Mean correlations across participants: FA, $r = -0.58$; fixation, $r = -0.41$; NDA, $r = -0.22$. FA, focused attention; NDA, nondual awareness.

content, participants meditate with eyes closed, reducing the phenomenal content, either in a relaxed restful state or in NDA meditation. We are specifically interested in the functional connectivity changes in the nodes of the network formed by the cognitive/associative central precuneus region.[89] This area of the precuneus is located around the precuneal sulcus, dorsal to the subparietal sulcus, and ventral to anterior sensorimotor and posterior visual regions of the precuneus. It projects to the dorso-lateral prefrontal cortex (dlPFC), dorsomedial prefrontal cortex, and angular gyrus in the inferior parietal lobe (for a detailed anatomical definition of this area and its network of projections, see Ref. 89). The central precuneus is both functionally and anatomically distinct from the posterior cingulate gyrus (PCC), which has been the usual focus of studies on functional connectivity changes during meditation.[59,89] An interesting feature of this network is that its nodes span across both the intrinsic and extrinsic networks (but see Ref. 15). No research to date has specifically addressed the cognitive role of the central precuneus to differentiate it from that of the more dorsal areas involved in sensorimotor and visual processing, as well as from the self-related functions of the posterior cingulate gyrus. Together with other areas of the medial parietal cortex, it has been found to be involved in egocentric spatial reference frames, episodic memory retrieval, and self-related processing.[33,90] Functional connectivity of the precuneus to other nodes in the intrinsic system is indicative of the overall level of consciousness.[31,91] It is also the area with the largest activity increase upon attainment of lucidity during dreaming.[92] The main areas that receive projections from the central precuneus point to its role in cognition: the dlPFC involved in working memory;[93] and the angular gyrus involved, among other functions, in mental representation and integration of multisensory information, in attention and spatial cognition, and projecting oneself into the future.[16,94] Although our previous study did not find statistically significant differences in connectivity of individual ROIs, the connectivity of the central precuneus ROI was marginally higher for the NDA condition.[87] The above statement has led us to hypothesize that the central precuneus network might be significantly involved in NDA. Our interest in this region was furthered by participants' reports of the presence of two particular features of NDA: reflexivity, traditionally described as awareness being aware of itself; and spatial extendedness, described as the sameness of space inside and outside of one's body.

Preliminary data from this study indicate that NDA resulted in an increase in connectivity between the central precuneus and the dlPFC, accompanied by a decrease in connectivity between the central precuneus and the right angular gyrus (rAng), whereas the connectivity of the rAng to the right dlPFC and left dorso-medial prefrontal cortex increased, and the interhemispheric connectivity between the left and right dlPFC decreased (Fig. 2). Interestingly, no significant changes in connectivity have been observed between the central precuneus and the medial prefrontal cortex, and between the dorsal anterior cingulate (ACC) and other ROIs.

Although it is too early to interpret these results, some, however tentative, speculations could be offered: an increase in functional connectivity between the central precuneus and dlPFC could be indicative of a degree of unity of awareness[95] and related to the reflexivity of NDA, as information

	Precuneus	lAng	rAng	lDMPFC	rDMPFC	ldACC	rdACC	lDLPFC	rDLPFC
Precuneus	NaN								
lAngularGyrus	1.24	NaN							
rAngularGyrus	**-3.76**	-0.03	NaN						
lDMPFC	-0.97	0.24	3.17	NaN					
rDMPFC	-1.43	0.00	0.76	0.07	NaN				
ldACC	1.55	1.50	2.56	-0.61	-1.44	NaN			
rdACC	2.46	1.47	0.64	-0.49	-0.83	-0.65	NaN		
lDLPFC	**3.53**	-1.03	1.21	0.53	-0.42	-1.89	-1.40	NaN	
rDLPFC	**4.16**	1.62	**3.59**	0.38	0.75	-0.26	-0.27	-2.14	NaN

Figure 2. Central precuneus connectivity in nondual awareness. Connectivity difference matrix (difference in cross-correlation in nine nodes between nondual awareness and rest for three subjects); uncorrected two-tailed *t*-test, $P < 0.05$ df(702). FDR ($P < 0.05$) corresponds to statistics with absolute value ≥ 3.17. For each of the separately defined regions of interest (defined using NeuroSynth maps, http://www.neurosynth.org/), time courses were extracted for all voxels within each ROI in turn and averaged across those voxels, such that for every run, nine time courses were available. Given the limited number of subjects, data were then *z*-transformed (such that the overall variance structure was equivalent across subjects, setting mean to 0 and variance to 1) and then concatenated across subjects to compare differential connectivity patterns (cross-correlation between ROIs). The statistics reported here thus represent the effect size in relation to a fixed-effects error term.

from the central precuneus is maintained online in working memory. The observed decrease in connectivity of the central precuneus to the rAng may be contributing to experiences of spatial extendedness, as the two areas are together involved in integrating spatial reference frames.[90,96] It is quite unlikely that this result is due to a rebound effect in which connectivity in an area increases as the result of activity in that area being suppressed in a previous condition, since the timing of conditions is in the opposite direction, the control condition is at rest, and the effect is observed only in the rAng.

Interestingly, the absence of significant changes in functional connectivity between the central precuneus and the areas of the medial prefrontal cortex may indicate that during NDA, even with minimized phenomenal content, there is no active suppression of self-referential processing such as that seen in FA or OM meditations. Likewise, the absence of significant changes in connectivity of the dorsal anterior cingulate cortex (ACC) may be indicative of the more effortless, less cognitively controlled nature of NDA meditation.

Although these interpretations are highly speculative at this time, functional connectivity changes observed so far suggest that the central precuneus and its network may be significantly involved in NDA. The medial parietal cortex has recently come to be regarded as the most highly connected hub in the cortex, and this suggests that one of the functions of the central precuneus network may be to provide an organizing center,[97] recontextualizing the activity of other networks involved in representing experiences during NDA meditation. A key feature of such a network, in addition to integrating informational content, would need to be an ability to represent its own state. This could enable the network to mediate awareness independently of phenomenal content. It is of course possible that the putative neural mechanisms for NDA involve other areas of the brain as well.[98]

Although we have not yet explored subcortical structures, it is possible that connectivity changes may also be observed for some areas of the thalamus and brain stem, especially those that project to the precuneus. However, while thalamo-cortical connections form the necessary backbone that enables such a network to function, previous research indicates that a level of consciousness in such a network will be primarily determined by cortico–cortical connections.[91] Thus, the areas of the brain stem and thalamus involved in general arousal are a necessary, but not sufficient, neural correlate of NDA. Here it is important to note that NDA is not basic in the same sense as biological primitives of consciousness, such as, for example, proto self or core self, as it can contextualize primary, secondary, and tertiary[99] affective and cognitive processes. Thus, NDA is much more than a basic vigilance such as that encountered in proto or core consciousness.[100] It is a higher order awareness that appears to be inherently present as a potential in all of us.

Conclusion

The results of our study of NDA meditation support the intuitive, but speculative, idea that the typical anticorrelations between the intrinsic and extrinsic networks might reflect the duality of internal

self-related and external other-related mentation, and that the higher degree of functional integration between these two networks observed during NDA meditation may be related to the reported decrease of fragmentation of experience into subjective versus objective, or self versus other, poles encountered in mystical states of union or nonduality. Our present research points to the central precuneus network as being significantly involved in these changes and perhaps a neural correlate of NDA. Establishing this will require further research, as will determining whether the degree of correlation/anticorrelation between intrinsic and extrinsic networks or their specific nodes could be used as an indicator of the level of integration of subjective and objective aspects of one's experience.

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Conflicts of interest

The author declares no conflicts of interest.

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