The integration of sensations and mental experiences into a unified experience: A neuropsychological model for the “sense of self”

Brick Johnstone, Daniel Cohen, Andrew Dennison

A continued weakness in the cognitive neurosciences is the lack of a model to explain the phenomenological experience of the “self.” This article proposes a model that suggests that the right hemisphere association area integrates physical sensations and mental experiences into a unified experience (i.e., a “sense of self”) that is best conceptualized and understood as the subjective experience of “mineness.” This model presents a unifying framework for neurologic and psychiatric disorders of the self (i.e., dis-integrated sense of “mineness”), as well as a neuropsychological framework to explain several human characteristics and experiences. Research is reviewed that indicates the sense of self can be activated to serve as the neuropsychological foundation of “self-integrated” character traits such as empathy (i.e., experiencing other’s thoughts/emotions as “mine”), and conversely, the inhibition of this integrative process which can serve as the foundation of “selfless” experiences such as transcendence and forgiveness. Future research and clinical applications are discussed.

1. A neuropsychological model of the self

A major weakness in the study of human cognition relates to the lack of a model to explain the neuropsychological foundations of the “self.” Over the past century other distinct neuropsychological processes and their neural and neurochemical correlates have been delineated, including sensory (i.e., tactile, auditory, visual, olfactory, gustatory, proprioception), cognitive (e.g., memory, attention, language, spatial perception, executive skills), emotional (e.g., fear, anger, worry, grief, sadness), and behavioral processes (e.g., initiation, inhibition). However, continued ambiguity exists related to our understanding of what constitutes the self.

Up until the twentieth century, the self was a concept that was primarily addressed by philosophers and theologians with a general consensus that it is a permanent, unchanging entity that is associated with a psyche, soul, or spirit (Barresi and Martin, 2011; Gallagher, 2000). However, with increased advances in the neurosciences, research has increasingly conceptualized the self in terms of specific self-related neuropsychological processes (e.g., self-awareness, self-recognition, self-regulation) and modalities (e.g., physical, psychological, narrative selves). Such conceptualizations are limited, however, as they generally suggest the existence of a permanent self that directs specific cognitive processes back upon the self (i.e., the self is aware of, recognizes, and regulates the self).

More recently, interdisciplinary research is suggesting that the self is best considered to be the subjective experience that results from the integration of multiple neuropsychological processes, although the subjective nature of such integrative experiences remains unclear. This article proposes a neuropsychological model that suggests that the right hemisphere in general, and the right hemisphere association area specifically, integrates externally processed sensations (i.e., sight, sound, touch, taste, smell, proprioception) and internally generated mental experiences (i.e., thoughts, emotions, cognitive schema) into a unified experience that can be conceptualized as a “sense of self” (Johnstone and Cohen, 2019). [Note: this article focuses on the neuropsychological, rather than the neuroanatomical, foundations of the sense of self]. It is suggested that this sense of self is subjectively experienced as a sense of “mineness” that is typically experienced and expressed in terms of I, me, and mine. As a neuropsychological process this sense of self can be activated, inhibited, or distorted. Impairment in this process can explain the diverse nature of what have been labelled as both neurologic and psychiatric “disorders of the self” in which different sensations and mental experiences are not integrated into the unified experience. Furthermore, it is proposed that inhibition and activation of this process...
lead to different positive (i.e., virtues such as empathy, altruism, forgiveness, etc.) and negative character traits (e.g., self-conscious emotions such as jealousy, resentment, etc.).

1.1. Previous neuropsychological models of the self

In order to understand current conceptualizations of the self, it is necessary to review earlier models that investigated self-related neuropsychological processes, as well as disorders of the self. In *Awareness of Deficit after Brain Injury* (1991), one of the first textbooks focused specifically on disorders of the self, Prigatano and Schacter identified “self-awareness” as a primary neuropsychological process associated with the self. They presented the first summary of case studies of disorders of the self in the 19th century (e.g., cortical blindness), as well as the reasons it ceased to be studied systematically until the end of the twentieth century (i.e., that such problems were more generally understood as related to psychodynamic processes of unconscious denial). Although the book focused on relationships between self-awareness and different neuropsychological disorders (e.g., frontal lobe injury, dementia, schizophrenia, traumatic brain injury), no neuropsychological model was offered to adequately explain the nature of the self.

In *The Lost Self*, Feinberg and Keenan (2005) also described a variety of disorders of the self and their proposed neural correlates, including more diverse conditions as asomatognosia, anosognosia, mirror misidentification disorder, delusional misidentification disorders, and depersonalization disorders. However, a unifying model to explain these processes and disorders was not presented. A subsequent special issue on the self in *Consciousness and Cognition* (2011) described a broad array of neurobiological and neuropsychological topics related to the self, including self-facial recognition, nested neural hierarchies of the self, embodiment and self-ownership, mind blindness and autism, and legal aspects of the self. Although many diverse disorders and processes were described, Feinberg (2011) acknowledged that “we currently lack unifying models that ‘bridge the gap’ between the microstructure, macrostructure, connectivity and physiology of the brain and the unified sense of self as subjectively experienced” (p. 4; emphasis added). Similar weaknesses in the neuroscientific study of the self have been reported, and specifically that “the various self-related research programs do not seem to be illuminating a unitary, common system, despite individuals’ subjective experience of a unified self” (Gillihan and Farah, 2005, p. 76; emphasis added). In essence, it has been suggested that a “self” exists, but that its neurologic foundations and experiential nature remain difficult to conceptualize and understand. However, it is clear that research should focus on identifying the how neuropsychological processes are integrated into a unified experience which results in the subjective experience of a self.

2. Self-referential neuropsychological processes

Research towards the end of the twentieth and into the twenty-first century attempted to identify specific aspects of the self, but the models generated continued to lack a productive working explanation of the experiential nature of the self. For example, research has often focused on what have been proposed theoretically to be distinct “self-referential” neuropsychological processes, such as “self-awareness,” “self-regulation,” “self-monitoring,” and “self-recognition” (e.g., see Consciousness and Cognition, 2011; Gallagher, 2011; Heilman, 1991; Prigatano and Schacter, 1991; Root Luna et al., 2017; Jeannerod, 2003; Gallup et al., 2011; McCullough and Willoughby, 2009). However, each of these “self-referential” neuropsychological processes generally suggest the existence of an embedded self that directs specific neuropsychological processes back onto some form of a permanent self (i.e., a self that is aware of the self, that recognizes the self, that monitors the self, that regulates the self). The problem is that these types of conceptualizations suggest that the impairments reside with the specific neuropsychological process (i.e., awareness, regulation, monitoring, recognition) and not in a broader integrative self (see Kuhl et al., 2015). As such, these conceptualizations have directed attention away from consideration of the “sense of self” as a more dynamic neuropsychological process.

Other areas of neuropsychological research and theories have focused on identifying different “modalities” associated with processing a sense of the self. For example, Northoff et al. (2006) published a meta-analysis that described the numerous conceptualizations of the self that have been proposed in the neurosciences including: the physical self, mental self, spiritual self, proto-self, minimal self, core self, autobiographical self, narrative self, emotional self, spatial self, facial self, and verbal/interpreting self. They noted that these conceptualizations only present adjective descriptors of a generic “self,” and concluded that it may be better to conceptualize these various types of self more generally as different “self-referential” processes.

These types of models are consistent with other neuropsychological models of memory in which certain neurological networks are associated with specific memory processes (e.g., encoding, consolidation, retrieval) that are dependent on sensory-specific modalities (e.g., verbal memory, visual memory, motor memory, etc.; Squire, 1987). Although such conceptualizations provide a framework that helps explain different modalities/manifestations of the “self,” they do not provide a coherent model explaining how the self is processed neuropsychologically, regardless of the different modalities involved, or how self is experienced subjectively.

Additional research has focused on identifying a general neuropsychological process that differentiates between the self and others (i.e., self/others feels, definition, self/others discrimination, self/others overlap; Decety and Batson, 2009; Decety and Sommerville, 2003; Lombardo et al., 2010; Lou et al., 2004). However, these studies do not clearly define the nature of either the “self” or the “other.” In addition, this research has generally conceptualized a neuropsychological process in which self- and other-processing work on a continuum (i.e., a single self/others spectrum), with high processing of the “self” suggestive of low processing of the “other” and vice versa. However, other research has suggested that these self- and other-related neuropsychological processes operate independently and do not operate on the same continuum (i.e., self/others), and that the sense of self is primarily associated with the right hemisphere, and processing of others is primarily related to the left hemisphere (Lou et al., 2004).

Other research on the sense of self has focused on the different manner by which the brain processes a subjective “I” versus an objective “me” (Hermans, 2011; Tagini and Raffone, 2010). In general, “I” is conceptualized as the subjective experiences that are associated with a physical body (i.e., felt and experienced sensations), while “me” is conceptualized as an objective model of one’s personhood (e.g., as a distinct entity with specific physical, psychological, social qualities/attributes). Utilizing this distinction, this article focuses primarily on experiences associated with the conceptualization of a subjective “I,” where the sense of self is experienced as unified.

3. Neuropsychological models of the integrative self

Several neurologists have offered theories on how the brain processes the sense of self, making general distinctions between instinctual and integrative self-related neuropsychological processes. For example, Feinberg (2011) has proposed that the self can be understood in terms of three processes, including intero-self, extero-sensorimotor self, and integrative sensory self-systems. The intero-self system provides homeostatic regulation of bodily systems, the extero-sensorimotor system is associated with the perception of external sensations allowing for distinction between self and other, and the integrative self system (associated with the various heteromodal association cortices) allows for the integration of homeostatic functions and the relation of the self to the external world.

In *Self Comes to Mind* (2010), Damasio has proposed a similar
neuropsychological model that suggests that the brain processes both a core-self and an autobiographical-self. In general, the core self is characterized as instinctual, with reflexive neurologic responses to stimuli (that are evident for all life forms), and that are generally processed in the brain stem. In contrast, the autobiographical-self is generally characterized by the processes that integrate the representational maps of sensory experiences with the encoded experiences (i.e., memories) of our past experiences.

A more recent neuropsychological model of the self based on personality systems interactions theory has been offered (Kuhl et al., 2015; Kuhl, 2000). Specifically, Kuhl and colleagues have proposed a model which suggests that the brain separately processes a conceptual self and an integrative self. Their model distinguishes between an “integrated self” which “is based on parallel processing that integrates cognitive, emotional, motivational, and volitional processes within the person” and a “conceptual self” that involves “analytical thinking” (Kuhl et al., 2015 p. 119; also see Koole, 2009; Koole and Kuhl, 2007; Kuhl and Quirin, 2011). While other neuropsychological models of the self focus on the neuropsychological experience of the self, Kuhl and colleagues focus on how the integrated self and different neuropsychological processes/traits are integrated holistically in order to provide existential meaning and purpose for individuals, consistent with the psychological theories of (Jung, 1969) and Frankl (2011). In addition, in analyzing the self in terms of its implicit and explicit states, Kuhl and his associates have found that hemispheric lateralization of circuits in the brain supports the idea that the integrated self is primarily based in the right hemisphere, a result that fits with aspects of the neuropsychological model of the sense of self being developed in this article.

3.1. The neurology of the self

A major reason that the subjective nature of the self has not yet been identified may be due in part to the fact that much of the research in this area has focused on identifying the neural correlates of the self. Because the self is difficult to conceptualize, define, and measure, identification of its neurocorrelates has been inconclusive. Virtually all regions and networks of the brain have, at some point, been hypothesized to be related to the “self,” including: the corpus callosum (Uddin et al., 2006), limbic system and insular cortex (Konrath et al., 2005), right frontal lobe (Platek et al., 2004), frontal regions and right hemisphere (Feinberg and Keenan, 2005), medial prefrontal cortex (Philippi et al., 2012), subcortical-cortical midline structures (Northoff et al., 2011), medial parietal region (Lou et al., 2004), temporoparietal junction (Blanke et al., 2005), right hemisphere (Keenan et al., 2001; Keenan and Gorman, 2007), right medial-frontal and orbitofrontal regions (Feinberg, 2011), and fronto-limbic networks (Sierra and David, 2011). Similarly, a meta-analysis of studies on brain areas related to the sense of self (Northoff et al., 2006) identified the following regions to be associated with self-related processes: medial cortex, ventro- and dorsolateral prefrontal cortex, lateral parietal cortex, bilateral temporal poles, insula, subcortical regions (including the brain stem, colliculi, periaqueductal gray matter), hypothalamus/hypophysis, medial orbital prefrontal cortex, ventromedial prefrontal cortex, sub/pre- and supragenual anterior cingulate cortex, dorsomedial prefrontal cortex, medial parietal cortex, posterior cingulate cortex, and the retrosplenial cortex. There have also been recent suggestions that the default mode network (DMN) is associated with the experience of the sense of self (Carhart-Harris, 2018), although this network is also associated with many brain structures and networks (i.e., medial prefrontal cortex, posterior cingulate cortex/precuneus, angular gyrus). The fact that most of the brain has been shown to be related to the self is not surprising, given the multiple processes associated with creating a sense of self.

It is noted that many studies have found the right hemisphere and the parietal region (which is conceptualized as being part of the “association” area) as relating to the sense of self, disorders of the self, and many complex human characteristics and behaviors (Devue and Bredart, 2011; Johnstone and Cohen, 2019; Keenan and Gorman, 2007; McGlynn and Schacter, 1989; Platek et al., 2004). It is noted that this article focuses on the neuropsychological processes and subjective experiences associated with the sense of self, with the general understanding that multiple networks, primarily within the right hemisphere, are involved in the integration of various neuropsychological processes to create a sense of self. However, it is acknowledged that although the right hemisphere is related to this integration, it is not entirely sufficient given the complex nature of the different sensations/experiences that are integrated into this sense of self. It is argued that the subjective nature of the experience of the self must first be identified before its neurological correlates can be identified.

4. A universal neuropsychological model of the sense of self

The model proposed suggests that externally perceived sensations (e.g., sight, sound, touch, smell, taste, proprioception), internally generated psychological experiences (e.g., thoughts, memories, emotions), and mentally created schemas/constructs (e.g., abstract concepts) are processed individually throughout the brain but are generally integrated into a unified experience in the right hemisphere association area. The integration of these sensations and experiences into a collective unified experience (that is for the most part unconscious) is the default function of the brain, and as a result all of our perceived sensations and generated mental processes are experienced as being unified and relating to one entity (i.e., relating to a subjective “I”). When these sensations and experiences are not integrated into a unified sense of self (i.e., as belonging to me), this often leads to disorders of the self (i.e., experiences of self-disintegration).

4.1. The experiential nature of the sense of self

In order to understand the model proposed, it is first necessary to better identify and describe the experiential, subjective nature of the self. It has been suggested that this unified experience is best understood as a “sense of self,” but this phrase can be as difficult to understand as a “self.” It has been suggested that the sense of the self may be best described as a sense of ownership or “mineness,” which is expressed in terms of “/me/mine” (de Vignemont, 2011; Frassinetti et al., 2008; Tsakiris, 2011). Similarly, others have suggested that this integrative process gives sensations, objects, and experiences a sense of “personal relevance” or “familiarity” (Van Lancker, 1991). It appears that this integrative self-process generates a sense of unity (i.e., a unified experience) of all the sensations perceived by the body, as well as of the mental experiences generated by the brain.

That this neuropsychological process that integrates sensations and experiences into a sense of self can be altered has been succinctly demonstrated in the “rubber hand experiment” (Botvinick and Cohen, 1998). In this study, individuals had one of their hands hidden behind a screen with a rubber hand placed where their real hand should have been. Their hidden hand and the rubber hand were then brushed simultaneously and individuals reported the sense that the rubber hand was part of their physical “self.” In this experiment it was the feeling of the real hand being touched, while seeing the rubber hand being touched (in the expected spatial position of the real hand), that led to the sensation of the rubber hand as part of the self. This experiment helps indicate how the sense of self is generated through a neuropsychological process, and that the integration of different external sensations into a sense of self can be distorted leading to changed perceptions of what actually constitutes the “self.” The brain would not have perceived the rubber hand as being part of the self if the self was a permanent entity.

Other studies and experiences have also illustrated how the sense of self is a process that can be altered. These include out-of-body experiences (OBEs) where individuals report that their sense of self is positioned spatially apart from the physical body (e.g., patients who reported watching their surgeries from above the operating table;
chological categories because the subjective experience of the sense of mental processes (e.g., memory, language, attention) may be intact, but individual sensory (e.g., tactile sensation, vision, proprioception) and intact ability to integrate sensations and experiences into a unified sense of which have fairly well understood neurological correlates (Lezak, 2012; Blanke et al., 2004; Lenggenhager et al., 2007). Other examples of how the sense of self can be distorted include the use of mirror boxes to give individuals the perception of having sensations in their amputated limbs (Ramachandran and Rogers-Ramachandran, 1996).

4.2. Understanding the sense of self as an integrative neuropsychological process

To better understand the proposed neuropsychological model and how it applies to neurologic/psychiatric disorders and human characteristics and experiences, it is necessary to understand that the neuropsychological process that creates the sense of self operates differently from other neuropsychological processes. For example, the neuropsychological process that creates the sense of self from which to experience and communicate their impairments. In these specific processes but rather in the more general neuropsychological process that integrates these specific processes into a unified sense of self.

Unique neuropsychological difficulties arise, however, when individual sensory (e.g., tactile sensation, vision, proprioception) and mental processes (e.g., memory, language, attention) may be intact, but the neuropsychological process that integrates them becomes impaired leading to experiences of a “dis-integrated” self. Individuals with such impairments have either significant difficulty or are even unable to report the problems that they are experiencing because the integrated “sense of self” is diminished or even not present. How does one describe the experiences of the self when the self is absent? The answer is evident in the manner by which individuals with disorders of the self describe their “dis-integrated” experiences (i.e., not “mine”). For example, in cases of somatoparaphrenia an individual may deny ownership of one of their limbs or even that an entire side of their body belongs to them (Feinberg and Keenan, 2005).

In addition, the “sense of self” has also been difficult to understand because individual cognitive abilities are typically conceptualized and measured in quantitative terms (i.e., as more/less) rather than from a qualitative perspective. Increased ability is generally considered to be positive (e.g., strong memory, language, or attentional skills) and decreased ability as negative and often in relation to a clinical disorder (e.g., amnesia, aphasia, attention deficit disorder). In contrast, the neuropsychological processes that integrate experiences into a unified sense of self are best conceptualized in qualitative terms that are expressed in terms of a sense of “mineness,” “ownership,” “familiarity,” or “personal relevance” (de Vignemont, 2011; Tsakiris, 2011; Van Lancker, 1991). This sense of mineness can be conceptualized best in terms of degrees of relatedness and extends from a greater sense of relatedness (e.g., an increased sense of ownership/mineness such as to immediate family members), to a lesser sense of relatedness (e.g., distant relatives, friends), to no sense of relatedness (e.g., strangers; Lou et al., 2004). Moreover, most neuropsychological processes are differentiated, understood, and generally conceptualized in terms of affect (e.g., depression, anxiety), behavior (e.g., initiation, inhibition), cognition (e.g., memory, attention, language), and perception (i.e., tactile, auditory, visual, smell, taste). However, the sense of self cannot be adequately categorized into any of these more common and separate neuropsychological categories because the subjective experience of the sense of self is related to the integration of all of these singular/modular neuropsychological processes. Thus, although disorders of the self may be related to the disintegration of physical sensations (e.g., somatognosia), emotions (e.g., alexithymia), or cognitive thoughts (e.g., schizophrenia), these impairments do not necessarily reside in the specific processes but rather in the more general neuropsychological process that integrates these specific processes into a unified sense of self.

5. Disorders of the self (see Table 1)

It is possible to understand how this integrative process works by studying disorders of the self, all of which involve a decreased sense of self/mineness/ownership/familiarity/personal relevance. Impairment in the integrative neuropsychological processes leads to a decreased sense of “mineness” in which sensations, mental experiences, and social relationships are not perceived as being related to one’s subjective self. Disorders of the self have primarily been conceptualized as being either neurological, psychiatric, or delusional misidentification disorders (Feinberg and Keenan, 2005; Prigatano and Schacter, 1991; Feinberg et al., 2005). However, these diverse disorders have lacked a conceptual model to explain and unite them, although the proposed neuropsychological model of the sense of self suggested in this article could provide the basis for such a unifying framework. In these unusual disorders, all of which have generally been associated with impairments in the right hemisphere, and often with the association area in particular (Feinberg et al., 2005; Hecht, 2010; Prigatano and Schacter, 1991), individuals lose the ability to recognize, be aware of, or acknowledge what are considered to be essential components of the self (e.g., physical limbs, psychological attributes, known acquaintances). Whereas research has generally focused on describing differences between the disorders of the self in terms of physical (e.g., somatognosia, mirror misidentification disorder, Cotard’s syndrome), psychological (e.g., anosognosia, alexithymia, schizophrenia), or social (i.e., “misidentification”) characteristics (e.g., Capgras and Fregoli’s syndromes), it appears that there is a common foundation in their similar inability to integrate sensations and experiences into a unified self-experience (i.e., a sense of “mine” or “mineness”). Rather than conceptualizing disorders of the self in terms of a “lost self” (e.g., Feinberg and Keenan, 2005), they may be better understood as involving a diminished “sense of mineness” or relatedness to “me” that pertain to specific sensations and mental experiences.

Table 1 categorizes various “disorders of the self” according to the proposed neuropsychological model of the sense of self. For example, anosognosia, which has been described as a physical disorder of the self, involves the lack of recognition or awareness that a body part (usually the left arm) belongs to the self (Prigatano and Schacter, 1991). However, it may be better understood and described in terms of a

| Domain                        | Subjective Experience |
|-------------------------------|-----------------------|
| Sensorimotor/Physical         |                        |
| • Anosognosia                 | not “my” arm           |
| • Mirror misidentification disorder | not “my” reflection |
| • Cotard’s delusion           | “I am dead”            |
| • Anton’s syndrome            | “I am not blind”       |
| • Phonagnosia                 | not “my” voice         |
| • Spatial reduplication       | not “my” home/environment |
| Psychological                 |                        |
| • Anosognosia                 | not “my” characteristic |
| • Alexithymia                 | not “my” emotion       |
| • Schizophrenia               | not “my” thought       |
| • Depersonalization           | not “my” experience    |
| • Dissociative amnesia        | not “my” memory        |
| • Alien hand syndrome         | not “my” behavior      |
| • Obsessive compulsive disorder| too much “self” focus  |
| • Dissociative identity disorder| multiple “selves”     |
| Social Schema                 |                        |
| • Capgras Syndrome            | not “my” acquaintance/family member |
| • Fregoli’s Syndrome          | strangers are “my” acquaintances |
distorted sense of “mineness” involving physical sensations. Specifically, it is proposed that the physical sensation associated with the left arm is no longer integrated into the unified self-experience, and as a result the brain no longer recognizes it as being part of the self (i.e., not “my” arm). If a physical/sensory experience is not integrated into the sense of self, then it is not experienced as part of “me.”

Other disorders involve the denial of different physical characteristics of the self, such as mirror misidentification disorder in which individuals can recognize other’s reflections in the mirror but cannot recognize their own reflection (i.e., not “my” reflection; Breen et al., 2000). Individuals with other types of sensory/physical disorders of the self may describe their impaired sense of self differently in terms other than “not mine.” For example, individuals with Anton’s syndrome are blind but lack recognition of their blindness. However, they will not state, “It is not my blindness,” but rather will state “I am not blind.” Similarly, Cotard’s syndrome is typically considered to be a delusional misidentification disorder but may be better conceptualized as another disorder of the self involving distorted physical sensations. Individuals with this disorder believe that they are dead or that different body parts (often the bowels) are decaying (Enoch and Ball, 2002; Young and Leafhead, 1996). However, these individuals typically do not describe their conditions in terms of “mineness” (i.e., not “my” body), but rather will describe their distorted sense of the physical self in other terms (e.g., “I am dead, or “my” flesh is rotting.”

Similarly, numerous psychological disorders are being conceptualized increasingly as right hemisphere-based disorders of the self in which psychological processes (e.g., thoughts, emotions, experiences, memories) are not perceived as belonging to one’s self (i.e., as “mine”). For example, individuals with anosognosia are unable to identify injury-related impairments or personal characteristics as belonging to their self (i.e., not “my” impairment/attribute; McGlynn and Schacter, 1989; Prigatano and Schacter, 1991). Although anosognosia has been conceptualized as a disorder of self-awareness (i.e., the self is unaware of impairments of the self), it may be better conceptualized as a disorder of dis-integration of personal attributes. Relatedly, schizophrenia is a diverse disorder that involves hallucinations with numerous studies over the past several decades suggesting that it is a disorder of the self primarily related to right hemisphere dysfunction (Kean, 2009; Sass, 1998, 2001, 2014; Sass and Parnas, 2003). The current model proposes that some of the internal thoughts of schizophrenics are no longer integrated into their sense of self and are thus perceived as auditory hallucinations (e.g., voices originating outside of the body/mind), or not “my” thought (Hecht, 2010).

Whereas schizophrenia involves dis-integrated thoughts, alexithymia is a condition that involves dis-integration of emotions in which individuals cannot identify or label emotions as being their own (i.e., not “my” emotion; Neumann et al., 2014). Similarly, depersonalization disorder is a psychiatric condition that involves the lack of integration of global perceptions and experiences into one’s sense of self (Radovic and Radovic, 2002; Simeon and Abigel, 2006). For these individuals, various experiences are processed but they lack the typical feeling of “mineness.” This lack of integration leads to experiences of derealization (i.e., “my” experiences do not feel real) or depersonalization (i.e., these experiences do not feel as if they are “mine”). Of note, items from the Cambridge Depersonalization Scale (Sierra and Berrios, 2000) are purported to measure depersonalization disorder, but can also be used to assess specific symptoms associated with neurological and psychiatric disorders. For example, specific items from this depersonalization questionnaire assess symptoms that are consistent with anosognosia (i.e., “Parts of my body feel as if they don’t belong to me”), alexithymia (i.e., “I feel that I can turn off or detach from my emotions”), schizophrenia (i.e., “I feel so detached from my thoughts that they seem to have a ‘life’ of their own”), Capgras syndrome (i.e., “Though I am intellectually aware of who my relatives are, I have felt as if they were not really related to me”), mirror misidentification disorder (i.e., “I have had the feeling that I was a stranger to myself or I have not recognized myself in the mirror”), and dissociative amnesia (i.e., “I feel detached from memories of things that have happened to me—as if I had not been involved in them”). It is notable that the general symptoms of depersonalization disorder are consistent with the individual symptoms of the diverse disorders of the self, indicating that the sense of self can be affected globally (i.e., depersonalization disorder) and in terms of specific neuropsychological processes (i.e., sensations, thoughts, emotions, etc.).

More severe psychiatric disorders, such as the dissociative disorders, are relatively rare but can also be conceptualized as disintegrative disorders of the self. In fact, it is suggested that many of the psychiatric disorders that have been classified as “dis-associative” disorders may be more appropriately conceptualized as “dis-integrative” disorders. For example, dissociative identity disorder, previously conceptualized as multiple personality disorder, is a severe psychiatric disorder in which individuals are unable to integrate sensations and experiences into a unified personality (i.e., a dis-integrated self), thus leading to the experience of multiple personalities/selves (Coons, 1998). Similarly, dissociative amnesia can be conceptualized as involving the dis-integration of memories from one’s “sense of self” (i.e., memories don’t have relevance to “me”). These examples support the contention that the current neuropsychological model is appropriate for both neurologic and psychiatric disorders of the self.

The current model can also be applied to a group of unusual disorders that have been described as delusional misidentification disorders and reductive paramnesias/delusions. Indicative of the uncertainty in defining disorders of the self, it is noteworthy that delusional misidentification disorders have been conceptualized as involving a wide array of impairments, including delusions, misidentifications, reduplications, and amnestic distortions. As the current model proposes, they may be best conceptualized as disintegrative disorders that involve a distorted sense of “mineness.” These delusional misidentification disorders are also primarily associated with right hemisphere dysfunction (Feinberg et al., 2005). They involve distortions in individuals’ sense of social relatedness to others (conceptualized as disorders of the social self) and include examples of distortions in the cognitive schema (i.e., abstract constructs) generated by the brain. One example, Capgras syndrome is a disorder in which individuals recognize the physical characteristics of family members but believe they are imposters (Alexander et al., 1979). According to the current model, these individuals may recognize the physical attributes of known others but have lost the sense of “personal relevance” (e.g., social relatedness to a close family member) in terms of “mineness” (i.e., I recognize them but they are not “mine”). Conversely, Fregoli’s syndrome is the opposite in that individuals identify strangers as known acquaintances (i.e., that stranger is “my” acquaintance; Ruff and Volpe, 1981; Feinberg and Keenan, 2005). This condition appears to be related to an over-developed sense of “mineness,” consistent with conditions in which individuals report an over-developed sense of self, including the experience of prosthetics belonging to the self (Botvinick and Cohen, 1998).

6. Sense of self and neuropsychological foundations for personality characteristics and experiences

In addition to providing a framework for understanding diverse disorders of the self, the current neuropsychological model also offers an explanation for how the unified sense of self serves as the neuropsychological foundation for many personality traits and characteristics that have been difficult to conceptualize to date. Scholars have attempted to identify a common neuropsychological process which could explain a variety of human virtues and experiences (e.g., empathy, altruism, transcendence), but a universal mechanism has not been identified (Root Luna et al., 2017; Schjoedt, 2009). However, research is suggesting that the ability to integrate sensations and experiences into a unified sense of “mineness,” or at other times to reduce this sense of “mineness,” may be associated directly with the manner by which
individuals relate to others in terms self-integrated or selfless relational dispositions (Johnstone and Cohen, 2019; Urgesi et al., 2010). Fig. 1 presents a depiction of this neuropsychological model, and specifically the manner by which different sensory and mental experiences are integrated into a sense of self and how activation or inhibition of this process can lead to different behavioral characteristics and unique human experiences.

6.1. Inhibition of the sense of self

Although a decreased sense of self has been most commonly associated with negative connotations and a variety of “disorders” of the self, recent research is indicating that a decreased sense of self may at times be associated with positive human characteristics and experiences. For example, a series of studies of individuals with brain dysfunction has demonstrated that injury to the right hemisphere in general, and the right hemisphere association area specifically, are related to increased self-reported spiritual transcendence. An initial study of individuals with traumatic brain injury (TBI) showed that increased spiritual transcendence was associated with decreased performance on the Judgment of Line Orientation test (JOLO; Johnstone and Glass, 2008). The JOLO has been shown to be one of the neuropsychological tests that is associated with right inferior parietal lobe (RIPL) lesions (Tranel et al., 2009), and the RIPL is considered to be part of the right hemisphere association area where the sense of self is processed/integrated (Johnstone and Cohen, 2019). The results obtained were interpreted to suggest that decreased functional integrity of the right hemisphere association area is related to a reduced sense of self (i.e., increased ‘selflessness’) and an increased propensity for experiences of transcendence. In fact, mystical religious and spiritual experiences have been described in term of ‘selflessness’ or the loss of the sense of the self for individuals from multiple faith traditions throughout history (Johnstone and Cohen, 2019; Johnstone et al., 2016a). These studies were also consistent with a study that demonstrated that individuals who had neurosurgery to remove brain tumors from posterior (i.e., parietal, occipital) regions of the brain reported increased spiritual transcendence following surgery, compared to those with anterior tumors (i.e., frontal, temporal; Urgesi et al., 2010).

In a follow-up study, individuals with brain dysfunction again showed similar results, but this time with multiple measures of right parietal lobe functioning (i.e., JOLO, left-handed finger agnosia) correlating negatively with multiple measures of spirituality and transcendence (Johnstone et al., 2012). A similar study was completed with individuals diagnosed with TBI from different cultural (i.e., U.S., India), ethnic (i.e., African Americans, Caucasians, South Asians), and religious backgrounds (i.e., Hindus, Muslims, Christians) to determine if selflessness might be a universal neuropsychological process associated with transcendence (Johnstone et al., 2016b). The results were generally consistent with the previous studies, again suggesting that reduced functioning of the right hemisphere association area is associated with increased spiritual transcendence (and an inferred reduced sense of self) for these diverse groups, regardless of specific religious orientations. It was suggested that experiences of unitary consciousness associated with transcendent experiences (however interpreted by those involved) are facilitated by a significant reduction in the sense of self. This cross-cultural study was important in demonstrating that neuropsychologically these experiences appear to be similar, but their contextual interpretations vary widely based on differing cultural and religious backgrounds.

These studies also connected logically with earlier research which suggested that the sense of self can be reduced and lead to transcendent experiences through behavioral practices, and particularly specific religious and spiritual rituals. For example, several studies have indicated that reduced cerebral blood flow (as per SPECT imaging) to the parietal lobes is associated with increased spiritual transcendence during meditation for Buddhists and centering prayer for Catholic nuns (Newberg et al., 1997; Newberg et al., 2003). These results are important as they suggest that the neuropsychological capacity for spiritual transcendence may have universal neuropsychological correlates (i.e., increased selflessness) for both theistic (i.e., Christians) and non-theistic religious traditions (i.e., Buddhists), even when the interpretations of these experiences differ based on cultural/religious influences. A meta-analysis of neuroscientific studies of spiritual and meditative states further confirmed that spiritual transcendence is primarily associated with reduced functioning of the right inferior parietal lobe (Barnby et al., 2015). Collectively, all, these studies suggest that individuals from different cultures and faith traditions can learn to ritually inhibit the sense of self and attain transcendent states (Johnstone and Cohen, 2019).

Other research indicates that inhibiting the functioning of the right hemisphere association area through technology can induce spiritually transcendent experiences. One study which used repetitive transcranial magnetic stimulation (rTMS) to temporarily inhibit the functioning of the right inferior parietal lobe found increased subjective reports of transcendence (Cresczeniti et al., 2014). Conversely, a related study found that exciting the right inferior parietal lobe and increasing the sense of self was associated with reduced capacity for spirituality and transcendence (Cresczeniti et al., 2015). These studies further support the conceptualization of the sense of self as a neuropsychological process that can be altered and that may lead to transcendent experiences.

In addition to spiritual experiences such as transcendence, reduced right hemisphere association area functioning has also been shown to be associated with certain character traits and virtues. For example, in a study of individuals with TBI (Johnstone et al., 2012), the willingness to forgive was shown to be related to decreased right parietal lobe functioning. This result was replicated in a study of individuals with seizure disorders (Johnstone et al., 2014a). Furthermore, the previously cited study involving different U.S. and Indian populations with TBI indicated

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**Fig. 1.** Neuropsychological mechanism for character traits.
that decreased right inferior parietal lobe functioning was associated with increased willingness to forgive for individuals from both cultures (i.e., U.S., India) and all religious groups (i.e., Christian, Hindu, Muslim). The results appear to suggest that individuals must give up the focus/rumination on perceived wrongs to the self in order to become forgiving of others. Of note, these findings are also consistent with a recent study which indicated that the willingness to forgive is associated with reduced blood flow to the inferior parietal lobes for Chinese students (Li and Lu, 2017).

6.2. Activation of the sense of self

In addition to demonstrating that a decreased sense of self can be related to transcendental experiences and certain positive character traits (i.e., forgiveness), recent research is also suggesting that increased activation (or intact integration) of sensations and mental experiences into a sense of self may serve as the neuropsychological foundation for other personality traits and characteristics. For example, research is indicating that increased functioning of the right hemisphere association area is associated with increased empathy. Specifically, a study of individuals with TBI sought to identify relationships among empathy and structural (i.e., MRI) and functional indices of brain functioning (Johnstone et al., 2014b). Although empathy was not related to any structural MRI indices, increased empathy was associated with increased measures of right hemisphere functioning, and particularly the JOLO, suggesting a stronger integrated sense of self. Although the study originally hypothesized that empathy would be related to a reduced sense of self (i.e., a “selfless” virtue), the results in fact suggested that in order to be able to relate to the thoughts and emotions of others it is necessary to have an intact sense of self. According to the proposed neuropsychological model, empathy requires individuals to experience the thoughts, emotions, and experiences of others as if they were their own (i.e., as ‘mine’). Overall, these findings are consistent with social psychological models of empathy which suggest that “(i)n order to have empathy, we need to maintain an awareness of our inner world as we imagine the inner world of the other” (Cozolino, 2006, p. 203).

Earlier neuropsychological studies of empathy with individuals with TBI appear to support these results and their interpretation, showing that increased right hemisphere functioning (i.e., measures of spatial perception including the JOLO) is consistently associated with increased empathy (Grattan and Eslinger, 1989; Shamay-Tsoory et al., 2004). These earlier studies generally interpreted results to suggest that increased empathy was related to increased visual-spatial processing, although such visuospatial-empathy relationships are difficult to explain. However, when these neuropsychological measures of visual-spatial abilities are re-conceptualized as indices of the functional integrity of the right hemisphere association area (i.e., the region that integrates sensations/experiences into a sense of self), the studies then suggest that empathy requires an intact sense of self in order for individuals to better experience the thoughts and emotions of others as if they were one’s own.

Additional cross-cultural research has also suggested that an increased sense of self may serve as a universal neuropsychological foundation for empathy across different ethnicities, cultures, and religions. Specifically, a study based on the previously described sample of individuals from the U.S. and India also indicated that increased right hemisphere functioning was associated with increased empathy for Christian and Muslim groups, but not for the Hindu sample (Cohen et al., 2020). These results support the model in general, but also suggest that cultural factors may influence the manner by which individuals relate to others empathetically.

Table 2 presents a framework to help explain the possible neuropsychological foundations of different character traits and experiences, according to proposed activation or inhibition of the integration of sensations and experiences into a unified experience, and whether they are conceptualized in terms of positive or negative attributes.

### Table 2

| Positive                      | Negative                      |
|-------------------------------|-------------------------------|
| **Empathy**                   | **Realogy**                  |
| **Altruism**                  | **Resentment**               |
| **Greed**                     | **Hypochondriasis**          |
| **Forgiveness**               | **Transcendence**            |
| **Transcendence**             | **Disorders of Self**        |
| **Positive**                  | **Negative**                 |
| **Increased Sense of Self**   | **Distorted Sense of Self**  |
| **Experience other’s thoughts/emotions as ‘mine’** | **Reduced focus on the perceived wrong to the self** |
| **Behavioral action of empathy (i.e., “me” acting on behalf of you)** | **Reduced sense of self allowing for connection beyond the self** |
| **Desiring other’s attributes as ‘mine’** | **Increased desire for other’s attributes/objects to be ‘mine’** |
| **Heightened sense of the self being wronged** | **Hyper-focus on physical concerns of the self** |
| **Reduced sense of self**     | **Asomatognosia**            |
| **Multiple “selves”**         | **Alexithymia**              |
| **Out of body experience**    | **Dissociative identity disorder** |
| **Sense of self**             | **Rubber hand experiment**   |
| **In spatial position outside of body** | **Phantom limb syndrome** |
| **Sense of amputated limb as part of self** | **Deja vu** |
| **Sense of familiarity (i.e., “mine”) for unknown experiences** | **Jamais vu** |
| **Sense of unfamiliarity (not “mine”) for known experiences** | **Distorted Sense of Self** |

### 7. Future research

Opportunities for future research to validate this neuropsychological model of the sense of self are vast and will benefit from collaboration involving multiple disciplines that have value in explaining different aspects of the self (e.g., neurology, psychiatry, cognitive neuroscience, psychology, cultural anthropology, developmental psychology, sociology, philosophy, theology, religious studies).

#### 7.1. The subjective nature of selfless and self-integrated experiences

In order to understand how the brain integrates information into a unified experience, it will be necessary to better understand the personal, subjective experience of “selfless” and “self-integrated” experiences. In part, this can be best achieved by studying persons with disorders of the self, including through neurological study as well as subjective interviews. Specifically, how do such individuals describe their experiences if they have a significantly reduced sense of self from which to relate? This type of information can assist in developing a better understanding of how the sense of self is generated, as well as how it interconnects with other human characteristics and experiences.

The subjective experiences of numerous individuals with disorders of the self have been described, including asomatognosia (Feinberg and Keenan, 2005), mirror misidentification disorder (Breen et al., 2000), depersonalization disorder (Radovic and Radovic, 2002), schizophrenia (Keen, 2009), Anton’s syndrome (Feinberg and Keenan, 2005), and the delusional misidentification disorders (Feinberg et al., 2005). For example, individuals with depersonalization disorder often report their experiences in terms of ‘as if’ statements (e.g., ‘it is as if I am experiencing …… ’; Radovic and Radovic, 2002). Individuals with Cotard’s syndrome often stop using the ‘I’ pronoun and sometimes describe parts of their bodies as rotting (Enoch and Ball, 2002; Young and Leafhead, 1996). In a case study of a woman with a right hemisphere TBI and disorder of the self, it was noted that she frequently answered questions posed to her in terms of “Others tell me …. ,” or “I think that …. ,” as if
she could not relate to her experiences and thoughts from the “normal” perspective of the self (Johnstone et al., 2020). In addition, her family stated that she appeared to have “memory without a context” as her recalled memories did not have relevance to her “self.” By investigating the experiences of individuals with a highly diminished sense of self, it will be possible to better understand the processes by which sensations and experiences are integrated into a unified self-experience.

7.2. Developing a universal neuropsychological model for disorders of the self

This model can provide a unifying conceptual framework to explain both neurologic and psychiatric disorders of the self, including delusional misidentification disorders, associated with impairment in the subjective experience of “mineness.” For example, the proposed model can account for identified disorders related to externally perceived sensations, including disorders of physical/tactile sensation (e.g., asomatognosia, Cotard’s syndrome), sight (e.g., Anton’s syndrome), and proprioception (e.g., left sided neglect syndrome, out-of-body experiences). Related disorders have been suggested to occur with difficulty in identifying one’s own voice (i.e., phonagnosia; Kaplan et al., 2008), and theoretically should also exist for taste and smell.

This model can help explain disorders of disintegration for internally generated mental experiences, including cognition, affect, and behavior. For example, schizophrenia may be most appropriately conceptualized as the disintegration of cognitive thoughts, alexithymia may be best understood as the disintegration of emotions, and alien hand syndrome may be best understood as the disintegration of behavioral processes into a unified experience (i.e., individuals acknowledge the existence of their hand but deny having control over its behavior). Other disorders of the self may be conceptualized as relating to the disintegration of cognitively created schema, such as personal attributes including personal characteristics (e.g., anosognosia) and physical attributes (e.g., mirror misidentification disorder). Similarly, delusional misidentification disorders may be conceptualized as the disintegration of cognitively created social constructs/schema (e.g., social acquaintances), including Capgras’ and Fregoli’s syndromes.

Whereas these disorders may be conceptualized as disorders of the disintegration of singular sensations and mental processes, other disorders of more general disintegration of all sensations and mental experiences may exist, such as in dissociative identity disorders (e.g., there is no one unified experience) or depersonalization disorders (i.e., no experiences feel related to a unified experience). Relatedly, as has been proposed by others (Sass, 1998, 2001, 2014; Sass and Parnas, 2003), it may be beneficial for the Diagnostic and Statistical Manual-V (DSM-V; American Psychiatric Association, 2013) to create a new category of psychiatric disorders conceptualized as disintegrative disorders, rather than thought disorders (e.g., schizophrenia) or dissociative disorders (e.g., dissociative identity disorder, dissociative amnesia, depersonalization disorder). It is noteworthy that although the DSM-V continues to classify dissociative identity disorder as a dissociative disorder, it also lists a diagnosis for “child disintegration disorder.”

In addition to the specific and diverse disorders of the self, this model may also provide a framework by which to identify the neuroanatomical correlates of the “sense of self” as well. For example, impairments in integration may occur in the primary cortical areas where sensations are processed (e.g., primary auditory cortex, primary visual cortex, primary sensorimotor cortex), in diverse cerebral regions associated with the generation of mental experiences (e.g., thoughts, emotions, constructs) evident throughout the brain, in the heteromodal association cortices that integrate various sensory inputs (Mesulam, 2000; Tononi et al., 1998), or in the networks that connect all of these regions to the right hemisphere association area.

Based on the proposed model, different neuroanatomical networks are expected to be impaired for different disorders of the self, including ones that primarily involve the processing of physical sensations (e.g., asomatognosia), visual sensations (e.g., Anton’s syndrome), thoughts (e.g., schizophrenia), emotions (e.g., alexithymia), and cognitive schema (e.g., Capgras and Fregoli’s syndromes). This hypothesis is consistent with studies that suggest there are two distinct neural pathways for cognitive and affective empathy (Shamay-Tsrorry et al., 2009), as well as factor analyses of self-report measures that have been shown to assess distinct cognitive, affective, and physical aspects of the self (Self Awareness Scale; Sherer et al., 1998). Additional research on coherence and entropic states of the brain as they relate to consciousness of the self should also be explored (Carhart-Harris, 2018).

7.3. Self-integrated versus selfless characteristics

Interdisciplinary research can assist in identifying the different characteristics that are related to: a) “self-integrated” experiences (e.g., empathy); b) “selfless” experiences (e.g., transcendence, forgiveness); or c) distorted experiences of the self (e.g., OBs). Research is needed to identify other positive character traits that may be associated with an increased sense of “mineness,” similar to what occurs in empathy in which individuals integrate the experiences of others into their own sense of self. Such characteristics may include altruism, compassion, gratitude, and generosity, or many of the other character traits identified in the Virtues in Action model (Peterson and Seligman, 2004).

In addition, research can also identify the different manifestations of an increased sense of self that may be associated with negative characteristics. For example, an increased sense of self may be associated with what have been referred to as “self-conscious” emotions including embarrassment, shame, guilt, resentment, pride, jealousy, or greed. Similarly, it has even been suggested that hypochondriasis involves an increased focus on the physical ailments of the self, which may in some ways be conceptualized as the opposite of asomatognosia (Heilman, 1991). Other medical conditions such as autism and psychological conditions such as psychopathy may be associated with an over-developed sense of self in which only aspects of the personal self are processed without adequate processing of the other.

Conversely, research can identify other positive human characteristics and experiences that are associated with inhibition of the sense of self, similar to transcendence and forgiveness. For example, it has been hypothesized that flow states, in which individuals may have a decreased sense of self as they become absorbed in actions/thoughts/experiences (Csikszentmihalyi, 1990; Csikszentmihaly & Csikszentmihalyi,1992), may also be related to a decreased sense of explicit self, as well as an increased sense of the implicit self (Schuler, 2010; Baumann and Scheffer, 2010, 2011). Additional research can also identify how a reduced sense of self can lead to the experience of transcendent connection with a universal consciousness (however so conceived), and how cultural and religious factors influence the interpretation of such selfless experiences.

Similarly, research is also needed to determine relationships between self-integrated (e.g., empathy) and selfless characteristics (e.g., forgiveness), and particularly given studies that have demonstrated that these self-integrated and selfless characteristics are positively correlated (Macaskill et al., 2002; Riek and Mania, 2011). The role of religious, philosophical, and cultural teachings in promoting such theoretically opposing characteristics may be particularly important to investigate.

Whereas the current model focuses on the neuropsychological mechanisms associated with individual personality and character traits (e.g., empathy, forgiveness), other models of an integrated self (e.g., personality systems interactions; Kuhl et al., 2015) may provide a framework for how different neuropsychological processes are integrated so that individuals can develop positive personality characteristics and achieve purpose, meaning, and/or an inner balance in their lives (Koole et al., 2010). Such models can provide insight into how the integration of different cognitive processes (e.g., attentional vigilance, unconscious processing) and characteristics (e.g., emotional connectedness, resilience, trust) interact to lead to optimal personal
development and interpersonal relationships.

7.4. Evolution of the sense of self

Research from other disciplines within the humanities may also assist in understanding how the brain integrates information to create a unified experience. For example, a series of articles by cultural anthropologists suggest that the parietal lobes have evolved as much if not more than the frontal lobes in homin sapiens (Bruner et al., 2018; Bruner and Iriki, 2016; Bruner and Pearson, 2013; Bruner et al., 2017). It has been hypothesized that this evolutionary increase in the size of the parietal lobes may be related to humans’ evolved visual-spatial abilities and tool making skills, but the current model suggests that it may also be connected to the development of an evolved “sense of self,” allowing humans to incorporate the experience of others into their own experience (i.e., to make “mine”), allowing greater benefits from increased socialization (e.g., child rearing, cooperative group activities). This hypothesis is consistent with research that suggests, for example, that neandertals may have developed the ability to be empathetic, as evidenced by skeletal remains of a child with a cranial abnormality who had been cared for over several years, as well as many older adults with physical disabilities who also were obviously cared for (Spikins et al., 2010). This theory is also consistent with indications that the neuropsychological process that creates a sense of self has also evolved and developed in other species (e.g., bottle nose dolphins, chimpanzees, elephants, crows; Reiss and Marino, 2001).

Developmental sciences can also help provide insight into how this sense of self operates as a neuropsychological process that develops over time in humans. Specifically, research suggests that infants begin to recognize their “self” in the mirror at 18–24 months of age (Lewis et al., 1989). Relatively, research is suggesting that teenagers who demonstrate impairments in the “sense of self” are more likely to develop schizophrenia than teens without such difficulties (Hartmann et al., 1984). As such, research can determine the manner by which the brain matures to integrate sensations and experiences into a healthy sense of self, and how this is manifested at different developmental periods. Research can also determine if disruption in the development of this integrative process may lead to different disorders (e.g., schizophrenia, depersonalization disorder, psychopathy) as well as self-integrated and selfless character traits (e.g., empathy, compassion, jealousy, etc.).

7.5. Clinical applications

Although research can demonstrate the neurological foundations of the sense of self and its related characteristics, it is also important to identify methods by which this information can inform clinical, behavioral, educational, and social practices to improve individual and societal health, functioning, and relationships. From a clinical practice perspective, it will be important to determine how individuals can influence (i.e., increase, decrease) this integrated sense of self through behavioral practices, including psychological therapies, religious and spiritual rituals, social reconciliation programs, novel technologies (e.g., transcranial direct current stimulation, repetitive transcranial magnetic stimulation), and entheogens (i.e., Peyote, mescaline, psilocybin, ayahuasca). It will be particularly important in developing strategies to improve our relationship with others (i.e., humans, other species) including the environmental crisis that humanity is facing currently.

Opportunities may also exist to determine how this integrative neuropsychological process can impact individuals on a societal level, and particularly in terms of individualistic versus collectivist societies. For example, in individualistic societies (i.e., primarily Western cultures) the self is typically defined as relating only to the individual. Conversely, in collectivist societies (i.e., primarily Eastern and African cultures) the self is typically defined more broadly as relating to the individual, their family, their community, and the collective land (Long, 2019). This sense of self apparently has even influenced the manner in which different democratic societies have developed. For example, Bhutan’s democracy is generally based on Buddhist and collectivist philosophies that focus on the needs of the community and environmental policies (i.e., the Bhutan constitution ensures that 60% of the land is forested). Differences between individualistic and collectivist outlooks may be best illustrated by comparing how these different cultures measure success. Specifically, individualistic societies focus on Gross National Product while collectivist societies focus on Gross National Happiness, emphasizing the success of the group over the success of the individual (Long, 2019).

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