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RESEARCH ARTICLE

The Role of Dynamic Core and Mirror Neuron System in Dissociative Disorder

Kenichiro Okano^{1*}

¹Kyoto University

*kenokano@gmail.com

ABSTRACT

This paper examines the current problems in understanding and conceptualizing the “personalities” of individuals with dissociate identity disorder while seeking a biological correlation of these personalities. First, the current theoretical ambiguity and potential problems regarding how we understand personalities in dissociate identity disorder are delineated by examining current international diagnostic criteria and views proposed by leading experts on the topic. The general trend is not to acknowledge each personality as having an independent sense of self, but rather a partial and fragmentary one, which does not seem to match well with its clinical manifestations. The author subsequently proposes that each personality has an independent neurological correlate, a neural network integrated as a dynamic core, as proposed by G. Edelman and G. Tononi. Although their theory is not designed to explicate personalities in dissociate identity disorder, the biological correlates of the personalities might be approximated to a coexistence of multiple dynamic cores, which was predicted by them, and partially exemplified by brain functions in split-brain experiments. The author then draws on the current understanding of the mirror neuron system discovered by G. Rizzolatti, V. Gallese, et al., which forms a basis for the understanding of how our sense of self is formed. They propose that the potential dysfunction of the mirror neuron system in a traumatic and critical situation might explain how different personalities are formed. Finally, the article discusses how these advances might be incorporated into our understanding and treatment of individuals with dissociate identity disorder.

Introduction

This article aims to seek a hypothesis regarding the way personalities are formed in patients with dissociative identity disorder (DID), with the help of recent biological research and theories such as the “dynamic core model” (1) and the “mirror neuron system” (2). The writing of this paper is motivated by my concern that there is still ambiguity and confusion regarding how clinicians should understand the nature of personalities in DID. The key feature of DID is the existence of “two or more distinct personality states” (3). However, it is counterintuitive to think that there could be numerous personalities or consciousnesses within an individual’s mind. As will be discussed later, our sense of self is heavily sustained by its being unitary and indivisible or by its “unity of empirical existence” (4). Therefore, there is good reason for some clinicians, let alone the general public, to have difficulty accepting the view that each personality is independent and self-standing on its own while simultaneously co-existing with other personalities.

Is the sense of self disturbed in *distinct personality states*?

Dissociative Identity Disorder, a diagnostic condition listed on the DSM-5 (3) and ICD-11 (4), has traditionally been called “multiple personality disorder” and has been the focus of attention for clinicians over the centuries. This concept has historically evolved (6), and reached its current definition, according to the understanding of our modern diagnostic system, as follows:

Disruption of identity characterized by the presence of two or more distinct personality states (dissociative identities), involving marked discontinuities in the sense of self and agency (3).

As for the primary disturbance of DID, that is, the *disruption of identity*, it is described as *marked discontinuities in the sense of self and agency* in the DSM-5 and ICD-11. The DSM-5 clarifies its meaning as follows:

Individuals with dissociative identity disorder may report the feeling that they have suddenly become depersonalized observers of their own speech and actions, which they may feel powerless to stop (sense of self). Such individuals may also report perceptions of voices (e.g., a child’s voice; crying; the voice of a spiritual being). In some cases, voices are experienced as multiple, perplexing, independent thought streams over which the individual experiences no control. Strong emotions, impulses, and even speech or other actions may suddenly emerge, without a sense of personal ownership or control (sense of agency) (3).

What these statements in the DSM-5 describe as *marked discontinuities in the sense of self and agency*

are mainly hallucinatory perceptions and ‘made’ experiences (7)(8) according to psychiatric terminology. These are experiences in which personality A is intruded upon by the voices and behaviors of personalities B, C, D ...etc., and the individual thus feels that his/her own mind and body are controlled by those personalities while he/she remains in an observer’s position. The DSM-5’s description assumes that these experiences are essential features for the *marked discontinuities in the sense of self and agency*.

It is certain that these *marked discontinuities* constitute a serious disturbance in their lives, but many individuals with DID do not have these experiences on a daily basis. Quite often when A is active, B, C, D... may be mostly absent (probably in the form of being “asleep” etc.), whereas when B (for example) is active, he feels independent and undisturbed by any other personalities. In fact, the so-called host personality is typically oblivious to the existence of any other personalities and experiences no overt *discontinuities*, while the other personalities communicate and interact with each other.

In some clinical situations, however, the marked discontinuities in the sense of self and agency are complained of by dissociative individuals who do not have a frank DID condition. In the ICD-11 (4), there is a category of “partial DID”, in which this type of intrusion by other personalities is prominent. The ICD-11 states:

One personality state is dominant and normally functions in daily life (e.g., parenting, work), but is intruded upon by one or more non-dominant personality states (dissociative intrusions). These intrusions may be cognitive (intruding thoughts), affective (intruding affects such as fear, anger, or shame), perceptual (e.g., intruding voices, fleeting visual perceptions, and sensations such as being touched), motor (e.g., involuntary movements of an arm), or behavioral (e.g., an action that lacks a sense of agency or ownership). These experiences are perceived as interfering with the functioning of the dominant personality state and are typically aversive. The self-disturbance described in the DSM-5 might apply better to this state of “partial DID”, rather than DID per se.

The question is whether it is rational to consider these hallucinatory and ‘made’ experiences as the essential problem of DID, that is, as a part of the *marked discontinuities in the sense of self*, which are not necessarily present in the sufferer’s daily experiences. So long as personalities A and B (or C or D) can exist without necessarily being disturbed or intruded upon by each other, there may be something else that could be identified as “*marked discontinuities*” in personality in DID.

A close examination of the literature on dissociative disorder reveals that, at least in many clinicians' mind, an individual with DID originally had a hypothetically integrated personality, the one which is often referred to as the "original personality" that might have existed before their identities were split and dissociated. For those who do not believe the notion of personalities breaking off from an original unified personality (9), they might assume that personalities in DID might eventually become integrated into a whole one in the future. This virtual and integrated self suffers these discontinuities as multiple and interchanging identities, which are only partial and incomplete. Thus, the *disruption of identity* appears to be found in their partial and fragmented nature. Not much effort is required to find examples of experts indicating these views, which is enough to believe that this view is shared by probably a majority of clinicians.

It is important to state from the outset that whatever an alter personality is, it is not a separate person. It is a serious therapeutic error to relate to the alter personalities as if they were separate people. Although many alters will emphatically insist that they are separate people, the therapist must not buy into this delusion of separateness [emphasis added]. [...] The global message from the therapist should always be that all of the alters constitute a whole person (p.103) (9).

The most important thing to understand is that alter personalities are not people. They are not even personalities. [...] They are fragmented parts of one person [emphasis added]. There is only one person.... (p.144) (10).

We describe the division of personality in terms of dissociative parts of the personality. This choice of term emphasizes the fact that dissociative parts of the personality together constitute one whole [emphasis added], yet are self-conscious, have at least a rudimentary sense of self [...] and are generally more complex than a single psychobiological state [...] (p.4)(11).

In addition to this concept, van der Hart et al. call the personalities in DID as "parts of personality" ("PP"), indicating that they are not a fully-fledged personality but only a part of it (11).

In comparison, the tone of the guidelines issued by ISSTD are lighter, but perhaps still made in a similar vein.

... [A]ll of the alternate identities make up the identity or personality of the human being with DID (p.120) (12).

The question then rises, as to whether we can speculate a *partial or fragmented personality* either theoretically, experientially, or clinically. Before moving onto the examination on this topic,

let us reflect on our clinical experiences of people with DID and see how their sense of self appears to be experienced and manifested in the eyes of the clinician.

Disruption of identity observed in clinical settings

We have so far discussed that the main component of *disruption of identity* (DSM-5, ICD-11) in DID, namely *marked discontinuities in the sense of self* is not always present among those with DID. However, they certainly suffer from *discontinuity* in another sense: the *discontinuity of time and experience*. Their prominent experiences and difficulties include being amnesic for periods of time in their daily lives. When switching occurs, a personality loses consciousness and experiences a lapse in time until he or she recovers consciousness. Their experiences are closer to our daily experience of going to sleep at night for several hours and waking up in the morning, something that every one of us experiences. Obviously, there are cases in which A, B, and other personalities can be "awake" and active simultaneously. The only difference is that the personalities in DID might "fall asleep" unexpectedly and often beyond the individual's control.

It is often observed that two or more personalities are awake and converse or interact with each other, like two or more people engaging in conversation. They naturally influence each other, but not to the point that their sense of self is threatened by the other's intrusion. Their experiences can be likened to those of conjoined twins: two individuals sharing a single body that converse and negotiate with each other to achieve their common goals.

Many individuals with DID also suffer from conflict among personalities, which might indicate that they are sufficiently emancipated and independent to have their own views, different from those of others, rather than being partial and fragmentary, unable to hold a view or attitude unless they become fused and integrated.

A case vignette

A is a young female adult with DID with several personalities, including B, who is a young boy personality. A has a fiancé C, a young male, a little younger than her. B resents their relationship and feels left out and asks C for a "face time" of his own with C. A is only aware of the existence of B, mainly through what is reported by C, except that she has some queasy feeling in her stomach occasionally while interacting with C. When A is informed of B's resentment, she feels bewildered and bothered, although she has some compassion for B as well. B

himself reports that he is “asleep” (B’s own expression) most time, but sometimes is awake and observes A’s interaction with C “from inside.” B never feels that he is intruded upon by A herself but feels envious and treated unfairly.

Let us consider whether A or B suffers any type of *disrupted identity*. Neither A nor B appear to experience *marked discontinuities in the sense of self*, as described in the DSM-5. Do they have a partial and fragmented personality? Some might argue that A might be missing a child-like, emotional, and tomboyish part of herself that B might aptly represent, while B might be missing the social capacity with more mature defense mechanism that A might possess. However, a difficult question to answer is whether A, B, and possibly other parts would constitute *one whole* if they were united. The concept of a whole/partial personality itself should be looked into more closely before arguing before arguing whether each of the alters of DID can be considered a personality whether the before arguing whether each of the alters of DID can be considered a personality. Could, for example, a 30-year-old female personality (like A in the above case vignette) and a 6-year-old child personality (like B) be integrated to become a “whole”? Should other personalities be integrated to be considered a real whole? etc.

If a therapist takes an attitude regarding each personality as incomplete and not an integrated one, but a “fragment,” this might alienate at least some of these personalities and impair the therapeutic relationship with them. How would some personalities react to the therapist’s statements such as “you are only a part of your host personality and you should eventually become integrated into it, as you broke off from it sometime in the past”. It might be possible for the therapist to practically degrade the sense of self of that personality. It is particularly important to treat each personality respectfully, whether he or she is a child or an adult, male or female, host personality or not, instead of treating them as sub-human or unworthy of having an independent sense of self or autonomy. This is even more so since many personalities function as ordinary people in society. Historically, DID patients are quite often suspected as only pretending to have the condition (5), as they appear to be quite ordinary and inconspicuous citizens in society, capable of feigning a condition as complex as DID.

One candidate for a partial or fragmentary personality state might be what we consider as an insufficiently crystalized or sublimated personality state. It can often be encountered in a dissociative trans state “characterized by acute narrowing or complete loss of awareness of the immediate surroundings that manifest as profound

unresponsiveness or insensitivity to environmental stimuli” (4). However, these states cannot be considered partial or fragmentary, so long as they experience *something*. Their consciousness, as rudimentary as it might be, can be narrowed (e.g., “narrowing of consciousness” as neurologists would put it) while still being private and unique. As Edelman and Tononi described it, “that consciousness may well *shrink* [emphasis added] but always remain integrated and coherent ...” (p. 29) (1).

Disruption of identity and sense of self in DID reconsidered

Do personalities of DID have any serious disruption of identity and the sense of self? Let us take a second look at this issue from the standpoint of psychiatric symptomatology.

Karl Jaspers, Hoenig, and Hamilton (13) delineated the basic sense of self into four domains: living as a *self-present, single, temporally persistent, and bodily and demarcated (bounded)* subject of experience and action. Jaspers indicated that, in schizophrenia, there are serious disturbances across all of these domains.

Consider the clinical example discussed above. In reference to the *sense of self-presence*, it is certain that A and B are going through their respective experiences without any sense of intrusion. It is because of the intact sense of agency that A feels bothered by the complaint of B, who resents A’s active and emotional involvement with C, to whom A feels attracted. B also has his *sense of agency* and feels that he has a right to demand some “face time” with C. Their *sense of agency* enables A and B to assert herself/himself and attempt to protect her/his own interests around the third-party, C. As for their *sense of singleness*, A and B certainly feel that they are on their own, and C feels that she needs to treat A and B separately and independently. In regards to their *sense of temporal continuity*, A would still claim that, even if she is amnesic about events that occur while B is out and active, she could provide an “alibi” for herself, such as that she was “gone” or “asleep”, and therefore she has nothing to do with B’s deeds. B himself would maintain that his own temporal continuity is saved, stating that he was “there” watching the interaction between A and C “from inside” at least during the time that he was not “asleep”. The *sense of demarcation* of A and B certainly exists, although B himself has a peculiarly distorted sense of his own body, as he is not aware that he is “very big” for a six-year-old boy and tries to snuggle up to C’s lap, each time literally knocking her away with his adult body size. Although A does not feel that B is inside

or outside of her body or anywhere else, B feels that he is out of the interaction between A and C and observes them with frustration and jealousy.

In contrast, self-disturbance in schizophrenia has been studied and discussed throughout the history of modern psychiatry. It is often discussed also in the context of ipseity disturbance in recent years.

Disruption of the sense of self in schizophrenia is far more distinct and severe. Take, for example, D, a person with schizophrenia. He observes a man walking on a street, noticing another pedestrian, a stranger approaching him from a different direction. Suddenly, a voice in his head says, "He is an enemy. He will attack you!" D immediately takes offense at that person, as though the voice is his own thought. This type of voice hallucinations, often referred to as "command hallucinations," characterize the nature of the self-disturbance of schizophrenics, in which the content of the voice of someone is seamlessly merged with his own thought. This condition might instantly meet the criteria of self-disturbance in the four domains delineated by Jaspers.

Neurological basis of dissociative symptoms

The problems we discussed above, as to whether we should understand personalities in DID as independent, partial, or fragmentary can be more than speculative without any neurological basis or "neural correlate" of these personalities. If a personality A happens to be located in one area of either hemisphere (based on fMRI imaging reflecting their activities, etc.), whereas personality B resides in the contralateral hemisphere, without any apparent overlap or communication between them, we have more reason to believe that each of them may have a distinct and independent consciousness. Unfortunately, no study has so far indicated that each personality in DID has a distinct localization or neural network independent of others.

Nonetheless, there have been a considerable number of studies that inform us of the biological basis of trauma-related or dissociative symptoms. In the 1990s, Bessel van der Kolk (14) discussed the biological basis for the formation of traumatic memories and flashbacks. He stressed that intense emotional experiences affect the amygdala and hippocampus, and trauma-related memories are dissociated on the body at a visceral level in a way quite different from the normal formation of episodic memories.

More recently, dissociative symptoms in PTSD have been the focus of study, which led to the notion of the dissociative subtype of PTSD (PTSD + DS) in the DSM-5 (3). This study suggests that PTSD + DS

has a mean prevalence of 20.35% in the PTSD population (15) and is found to be related to increased symptoms recurrence, male sex, history of childhood trauma, and history of trauma prior to the index trauma (16). Studies have found that PTSD + DS is associated with greater activity of areas of the frontal cortex that are involved in inhibiting brain areas that coordinate fear responses, such as the amygdala, as suggested by van der Kolk, but also spans multiple brain areas, particularly those involved in sensory integration, giving rise to the complex subjective sense of dissociation.

Along with these studies, the "Polyvagal theory" proposed by S. Porges (17) made a major contribution to the elucidation of the close relationship between the autonomic nervous system and dissociation. He proposed three branches of the autonomic nervous system, including what he calls the ventral vagal system (VC), which was already known as a feature of mammals but had not been delineated until his discovery. When in crisis, this VC might shut down, and if the fight-flight response based on the sympathetic nerve also fails, the dorsal vagal system (DS), which is largely responsible for freezing and dissociative processes, is activated. Recent biological studies, including Porges's research, help us to understand how much of the dissociative mechanism is involved in our traumatic response. These studies led to the proposal of a dissociative type of PTSD that now appears in the last version of the DSM (3).

Although these studies help clinicians to better understand the involvement of different areas of the brain in the formation of dissociative experiences, it remains unclear how these mechanisms are translated into a massive entity such as a dissociated personality structure, as in the case of DID. In DID, the dissociative phenomena are not limited to traumatic memories, but "occur throughout the brain, including all regions of the limbic system, cortex, and reticular activation system" (p.118) (10).

In this context, studies by Reinders et al. (18) (19) are quite informative as the target of their studies are the personalities themselves in individuals with DID. In their studies in 2003, Reinders et al. used functional neuroimaging (PET scan) and demonstrated particular changes in localized brain activity and other biological markers of eleven individuals with DID. Reportedly, these individuals were able to switch between their normal personality state (NPS) and traumatized personality state (TPS). In the TPS state, they exhibited deactivation of brain networks, including the mPFC, which is involved in conscious processing of experiences. In contrast, in the NPS, they demonstrated disturbances in the parietal and occipital blood flow, indicating an inability to

integrate visual and somatosensory information. In this way, the NPS in DID exerts a defense mechanism against traumatic stimuli that prevents further emotional processing.

In 2006, Reinders et al.(19) had their DID individuals listen to trauma scripts as well as neutral scripts in their NPS and TPS states. They found that in response to the trauma script, the TPS showed increased heart rates and blood pressure as well as strong emotions and sensory reminders of the traumatic event. In their NPS, however, they did not show these responses, possibly due to the built-in defense mechanism discussed above. When the neutral script was shown, reportedly neither TPS nor NPS displayed any cardiovascular activation.

In this author's view, Reinders et al.'s studies suggest that these two personality states might involve two distinct neural networks (or "dynamic cores," as discussed below). This would explain why the NPS state shows no difference in response to either the trauma script or neutral script. Reportedly, the NPS shows practically no response to the trauma script, indicating that it does not particularly inhibit (or "repress") those stimuli. Thus, NPS acts as a bystander or individual unrelated to past traumatic events.

When we hypothesize the presence of only one mind or a single neural network shared by different personalities in DID, we should consider the possibility of some type of communication on a sub-conscious or unconscious level; in this case, between TPS and NPS, as they might communicate their experiences to each other, at least on an unconscious, physiological, or emotional level. The nonchalant response of NPS to trauma-related stimuli strongly suggests that the biological correlates of two different personality states are two independent neural networks.

Dissociation and "dynamic core" hypothesis

Okano (20) approached the issue of neurological correlates of personalities in DID with the concept of the "dynamic core (DC)" model proposed by Edelman and Tononi (1) and Edelman (21). DC represents a neural network system consisting of reentrant neural activity in the thalamo-cortical system, which produces conscious existence (22)(23). In that network, bi-directional frequent information exchange in DC occurs, "strikes an optimal balance between segregation and integration of function (p.136) (1)."

What is particularly relevant about their theory is the concept of mind and consciousness. They especially stress the singleness of mind that each DC harbors. Following W. James (24) and C.

Sherrington (24)'s statement on the unitary and private nature of consciousness being its foremost property, Edelman and Tononi (1) consider that a conscious state is unified and integrated, which simply means that the whole experienced conscious state is always more than the sum of its parts. They proposed a hypothetical N-dimensional neural space (with N being a large number representing the number of neural groups involved) and that each experience corresponds to a single point.

From the view of Integrated Information Theory, Tononi and Koch state the same point as follows: (25)

Consciousness is unified [emphasis added]; each experience is irreducible to non-interdependent subsets of phenomenal distinction (p.6) (26).

The concept of DC presented by these authors provides a robust tool to consider whether personalities can be partial, fragmented, or irreducible and unified. According to Tononi and Koch, if a personality has an experience or qualia, this attests the wholeness of the neural network or DC involved. Based on their DC model, we could assume that if a personality in DID experiences something, that is enough to assume that it has an integrated mind, if not an altogether elaborated and sophisticated one. In fact, there could not be any partial or fragmentary consciousness whatsoever, as consciousness presumes an integrated N-dimensional neural space.

There is another point to stress, which is that there is enough reason to believe that the theory of DC can be applied to DID, as Edelman and Tononi themselves suggest the existence of multiple DCs. In their Information Integration Theory (IIT), Tononi and Koch propose the existence of multiple consciousnesses, stating that IIT allows for the possibility of two or more complexes within a single system. It is to be reminded, however, that these consciousnesses are not partial or fragmentary; each standing alone as an independent IIT. This view was echoed by Edelman and Tononi, who proposed that mental disorders, such as dissociative disorders and schizophrenia, "should be reflected in abnormalities of the DC and may result in the formation of *multiple cores* [emphasis added](p.154) (1)."

Thus, the DC hypothesis practically anticipated two of the points that we have dealt with so far: the uniqueness and wholeness of the personality and the possibility of multiple existences in a condition such as DID.

Split brain - A putative biological model for the multiplicity of personality

Another topic to be discussed in this context is the “split brain” syndrome, a group of symptoms produced by a disconnection of brain hemispheres performed in 1960s’, often as a result of the treatment of refractory epilepsy. There seems to be an increase in attention to this topic (27). M. Gazzaniga, a leading researcher in this area, believes that the split-brain paradigm creates a splendid opportunity to study the neurological mechanisms of consciousness in its potential dual states (28). Edelman and Tononi agree with his view from the standpoint of DC theory, as follows:

“The similarity between psychiatric dissociation syndrome and neurological disconnection syndromes is remarkable” although “unfortunately no data exist about the neuronal basis of psychiatric dissociative disorders...” (p.67) (1).

Okano (20) also indicates that split-brain syndrome can be something akin to the multiplicity of the DC within an individual and considers this state as a step towards the biological model of DID.

It might be worth revisiting this split-brain paradigm as there could still be much more to learn from it in our search for the neurological correlate of personalities in DID. After surgical intervention resulting in the disconnection of the two hemispheres, the verbal IQ of a patient remains remarkably intact (29). The problem-solving capacity remains unchanged for the left speaking hemisphere (30). However, under proper examination, each hemisphere appears to have a separate mind. “Cortical disconnection produces two independent sensory information processing systems (...)” (31), with each hemisphere having its own set of specialized capacities; for example, language, speech, and problem-solving capacities in the left hemisphere, and facial recognition, attentional monitoring, etc. in the right hemisphere. When tested separately, the right hemisphere is seriously impoverished in cognitive tasks. It is poor at problem solving and many other mental activities (29). Therefore, it is debatable whether the right, mute hemisphere has a consciousness as that of its left counterpart.

Joseph Ledoux, however, maintains that brain bisection produces a state of double consciousness (32). Through their experiments in “P.S.,” a patient with split brain, they concluded that the right hemisphere of “P.S.” had a sense of self with its own feelings. LeDoux states that the speaking left hemisphere appears normal with intact intelligence, and is largely unaware of its right counterpart, except for the “emotional significance” of its experience (32). This experience may be limited in verbal expression, which could make the left brain seem mindless. The best assumption is that *the left brain often does not have a sophisticated mind, but*

rather a narrow and shrunk one (1), if not partial or fragmentary.

This split-brain study raises a couple of interesting points in our attempt to seek neurological correlates of DID. When dissected, the neural network previously consisting of two hemispheres become two different, and possibly independent, minds, hence the double personality. According to Edelman and Tononi, for a neural network to be conscious, that is, being a DC, it primarily consists of a thalamocortical reentrant system. As this system is still preserved after dissection, this explains very well why the two hemispheres have their own independent mind, and this explanation can be applied to personalities in DID. They might need to be furnished with this thalamocortical reentrant system to be an independent DC. It might not be reasonable to assume that these neurological correlates of personalities reside in multiple locations in the CNS. Tononi’s information system (33) asserts that it is not the localization but the connection of the system that creates the mind. The co-existence of multiple DCs, as Edelman and Tononi predicted, can be most reasonably conceived as entangled or superimposed on one another.

Based on these discussions, Okano (20) presented a schematic diagram of multiple overlapping DCs, each representing a neurological basis for a personality. It is still unclear how these DCs are segregated from each other to form their own experiences, an issue that will be addressed later in the discussion section.

Dissociation and mirror neuron system

We could hypothesize, as we did above, that each personality has its own dynamic core as its neurological correlate, but it is still unknown how and in what situation these multiple dynamic cores are formed. It is our clinical observation that many personalities appear rather suddenly in a critical and traumatic situation in which an individual is under extreme stress. When an extreme emotion is experienced and dissociated, they become a part of “some personality” who came for rescue (34)(11); this is how a personality is considered to be formed. But how does this happen?

There are several theories regarding the process of “identification” as a crucial mechanism for the formation of personalities in DID (9)(35), especially aggressive ones, when abusive situations occur. Although the original notion, such as “the identification with the aggressor” (36) has a psychodynamic basis and not a biological one, some type of identification process at a neurological level might occur, giving rise to a new formation of DC. Theoretically, this process should involve practical

“copying” of the aggressor’s various characteristics. However, do we really have this miraculous copying capacity? Fortunately, in modern days, we are aware of a specific neural mechanism enabling us to miraculously “copy” others; the so-called “mirror neuron” system.

There has been an explosion of studies related to mirror neurons in past decades. Mirror neurons were discovered in 1996 by Italian neurophysiologists at the University of Parma, led by Giacomo Rizzolatti, Leonardo Fogassi, and Vittorio Gallese (2)(37). They found that some neurons in the ventral premotor cortex of macaque monkeys responded when the monkeys observed a person picking up food: these are the same neurons that are activated when monkeys perform the same behaviors. By definition, a mirror neuron is a neuron that gets activated when an animal acts an action while observing the same action being performed by another individual, thus “mirroring” the other’s behavior, as though the observer him/herself is acting vicariously (2). Mirror neurons have been found in humans, primate species, and birds.

Iacoboni (38) indicates that the mirror neurons form a system of neurons (Mirror Neuron System, MNS, hereafter) with relationships with various brain regions, that allows the subject to differentiate between the self and others, active and passive voice, and fantasy and imagination. What is to be stressed is that we acquire these distinctions through imitative activities (38).

Studies have indicated that MNS is closely related to imitation (39). Among primates, there are species that are good at imitation (e.g., orangutans) and others that are not so good (e.g., monkeys) (40). Human beings are extremely good at imitating others, an ability considered to be related to our highly elaborated and sophisticated social and communication skills (41).

Let us examine more closely how mirror neurons are involved in the act of imitation. When person A smiles at person B, naturally B shares this experience as the receiver of the action; he has the experience of being smiled at. However, at the same time, B is also observing A actively smiling and, with the help of his MNS, B is also experiencing A’s smiling vicariously, ready for the imitation of A’s smiling. Thus, if B observes A doing something towards B, his experience is always twofold, and what is important is that when B actually imitates A’s behavior by smiling back at A, it is no longer a simple imitation, but the beginning of A and B’s bi-directional chain of interactions. This interaction may continue with A smiling back at B, followed by B’s response, and so on. In order to show that this imitative exchange is based on the MNS and involves multimodal

experiences and a reward system, let us make this interaction more concrete.

Suppose that this interaction is between a mother and her baby boy. The baby is on the receiving end of the mother’s smile, while at the same time, with the help of his MNS, he vicariously experiences the mother’s active smiling at him. Most likely, the baby feels good, as the mother’s smile might be accompanied by her tender tone of voice, the gentle sensation of her stroking hand, the warmth of her body, and good smell, which are all experienced with pleasure by the baby in a multi-modal sensation. He then smiles back at his mother, and their mutual smiling begins to form their emotional exchange. As was suggested previously, this interchange is strongly mobilized by the involvement of their reward system: they repeat it as it feels very good. When the baby smiles back at his mother, he also gives her that multimodal sensation of pleasure, and he experiences the mother’s experiences vicariously through his MNS.

Thus, the baby experiences this bi-directional exchange with his mother (or any significant caretaker) with all the necessary elements for the child to gain a sense of self, sense of agency, and self-other differentiation with the help of a mirror system; his passive experience is backed by all of the additional sensations mentioned above. He thus experiences a sense of agency by vicariously experiencing the mother’s reception of the sensation, all caused by his own action. He feels that he and his mother are different subjects, as his observation of an action and his actual performance of it are sensed differently. Studies report that this last experience is also reinforced by μ neurons, which are activated when he is actually behaving, but not when he is just observing.

Mirror Neuron System failure in a traumatic situation

Let us imagine a traumatic situation in which a baby is harshly beaten by the mother, instead of engaging in mutual smiling with her. The baby might experience serious emotional trauma with intense fear and anxiety. As we saw above, in such situations in dissociative cases, some areas of the baby’s brain, especially the prefrontal cortex, are activated in order to suppress related areas, such as the amygdala in his limbic system, in order to avoid sensual and emotional experiences (42)(18)(19). The baby might be “dazed” and in a trance-like dissociated state, preventing the passive experience of being beaten to be formed properly because of the lack of sensations, such as pain, terror, or anxiety, due to the activation of a *dissociative mechanism*. The baby might feel that he

might not be living that experience, as if his hand were anesthetized and he were unable to experience the feeling of being touched.

In this situation, where the MNS faces the paradoxical input of the visual information of being beaten with no matching pain sensation, preventing the formation of a passive experience, suddenly a new center of consciousness might be formed on an emergency basis, which observes himself from outside, in the form of an out-of-body state. It is suggested that many reports of “out of body experiences” are related to patients who undergo surgical operation with general (but probably insufficient) anesthesia.

Another situation that might occur in more severe cases is that the baby’s passive experience of being beaten might translate into the baby’s active experience of beating. As the passive experience is obliterated in the process discussed above, while the baby’s vicarious experience of being beaten is still alive through the MNS, another consciousness is newly formed in the boy’s mind, in which he becomes the agent of the action of beating. This process is equivalent to the process of the “identification with the aggressor” discussed in the psychoanalytic literature (35)(36) with its neurological correlate and formation of new DC.

In this situation, the imitative process (as in the above example of mutual smiling) is not established at all. It is easy to imagine that when a baby is frowned at by his mother, he might imitate that expression and direct the same action to his mother. However, in a traumatic situation, the fluid activity-passivity dual relationship is disrupted, as the baby is no longer aware of what has happened to him.

Discussion

So far, the author has taken a second look at how personalities in DID are conceptualized in modern psychiatric diagnostic criteria such as the DSM-5 and ICD-11. He has also delineated the current trend regarding the identities in DID as partial and fragmentary.

Presumably, DID is characterized by a *disruption of identity* (DSM-5, ICD-11 draft), which is cogently expressed in the name of the “dissociative identity disorder”, a diagnostic nomenclature which first appeared in 1994 (43) and seems to have gained its acceptance well enough afterwards. If we trace the manner in which the diagnostic naming was switched from MPD (multiple personality disorder) to DID, the rationale was to remind clinicians that patients’ do not have multiple real personalities as MPD connotes, but rather an inability to express a wholesome personality (i.e.,) as a result of the failure of integration.

D. Spiegel, who chaired the committee for DSM-IV dissociative disorders, explained the rationale for the change from MPD to DID, in a rather pejorative tone, as follows:

Indeed, the problem is not having more than one personality, it is having less than one (p. 567) (44).

This view may surprise those who are used to the diagnostic name of the condition (DID), which implies that personalities are parts or fragments, as this view might not be consistent with their clinical manifestations. The author imagines that many clinicians, including myself, treat these personalities as regular and wholesome human beings, until they are made aware of the experiences reflecting the *disruption of identity* in one way or another.

The author would venture and asks if it is really a problem for a person to have more than one mind so long as he/she is coping well with the condition. Some might argue that it is a problem or disorder, as these people are “not normal”, and because their condition can be compared to the state of Siamese twins, a comparison that the author already made to the state of DID earlier in this paper. In fact, the well-known case of the Hensel sisters seem to be quite healthy and normal, despite them sharing a single body (45).

Looking at this issue from a biological perspective is helpful but far from being an easy task. The biological mechanism underlying personality formation in DID is so complicated that the best approach available can be conceived as a rough sketching with a broad-brush. In modern psychiatry, brain function should be understood using a neural network approach instead of focusing on anatomically separated areas (46). The author indicated that one of the most robust candidates describing the underlying methodology is the DC model proposed by Edelman and Tononi. That model predicted multiple minds and provided us with the neurological basis of the personalities in DID. During the co-existence of plural DCs in the central nervous system, each DC correlates with a personality. This provides evidence of a private and wholesome personality, instead of a partial and fragmentary one.

What could we learn from these theories on the biological basis of personalities in DID? Perhaps, we should assume that our neural system has a readiness, or a leeway for the multiple existence of conscious minds. Many phenomena—including imaginary companionship, possessing phenomena, and hidden observers—described by Hilgard (47) and the rather sudden formation of personalities in DID might corroborate this situation.

In a situation such as the one that Porges (17) suggests, in which the two other autonomic systems fail and the remaining dorsal vagal system gets

activated, there could be an extra dynamic core ready for the emergency (as a “spare” network) and get activated and function in the frozen subject. DID can occur multiple times due to repeated crises, each producing an extra dynamic core. The theory of mirror neurons gives us a tool to speculate how our mind can host other minds virtually (Ramachandran) and allows us to imagine what can happen if the MNS fails, as explained previously in this paper.

How can these multiple DCs coexist? This is a difficult question to answer. One metaphor for describing this situation is radio stations. Each station broadcasts programs using a specific radio frequency assigned by the authority. If station A is joined by station B, which has a different frequency band, it can start its broadcasting activity without

hindering A’s program. They can coexist in concert, with multiple other stations following suit at different radio frequencies of their own. If you allow me to expand my imagination and share the fantasy that our brainwaves are Fourier series and can be divided into different waves with different frequencies; could they harbor multiple selves? In this case, practically two dynamic cores, each functioning at the frequencies of 40 and 42 Hertz, for example, can coexist in a single anatomical structure. The author presents two diagrams of the way multiple DCs co-exist. Figure 1. is what is proposed this author (20) where several CDs superimpose. Figure 2. represents the way a single DC harbors multiple neural networks with different frequencies.

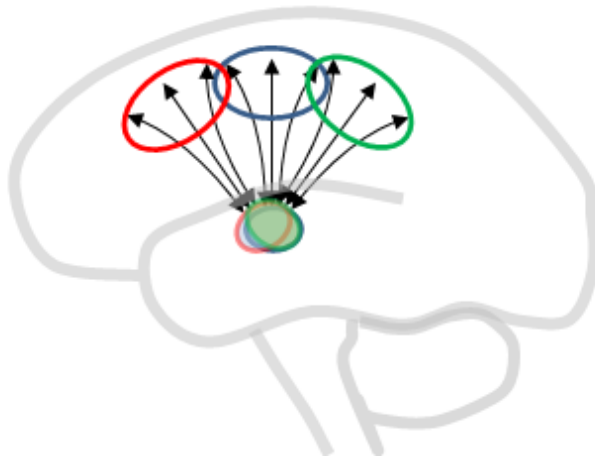


Figure 1.



Figure 2.

The author considers that this biological model, while still on a speculative level, can help to better and more realistically understand DID by assuming that each personality possesses a DC, an independent neural system that is basically isomorphic to our own. We can thus more readily accept a personality as another human being with a stand-alone mind, like ourselves. It is not proper to imagine that each personality is a part or a fragment, waiting for re-integration, as they did not break off from the original one, but were created de novo with their own integrity and sense of self, even if they are not as sophisticated.

Conclusion

In this paper, the author examined the current problems in understanding and conceptualizing “personalities” of individuals with DID (dissociative identity disorder). In seeking the biological correlates of these personalities, an attempt was made to give a second look at the current

understanding of these “personalities.” The general trend is not to acknowledge each personality as having an independent sense of self, but rather a partial and fragmentary one, which the author does not think matches well with their clinical manifestations. Therefore, he proposed that each personality has an independent neurological correlate, a neural network that is proposed with the notion of a dynamic core. In fact, the author believed that Edelman and Tononi predicted this idea. He then drew on the current understanding of the mirror neuron system, which forms a basis for understanding how our sense of self is formed. The author proposes that the potential dysfunction of a mirror neuron system in a traumatic and critical situation might explain how different personalities are formed. Finally, the author discussed how this neurological understanding might be reflected in our understanding and treatment of individuals with DID.

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