



The Tri-Modal Reaction (T-MR) Model of Complex Trauma and Dissociation: A Proposal

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Abstract

This paper proposes a model that explains the response to complex psychological trauma and dissociation. This tri-modal reaction model tries to account for the mental striving of the traumatized individual in dealing with unbearable pain when fighting for overall survival. Rather than conceptualizing this process in consecutive phases, the response of the individual to developmental trauma is described in three modes which often co-occur: Acute reaction, chronic process, and alienation. Each mode operates in a window of overmodulation and undermodulation of emotions. This tri-modal model resembles medical conceptualizations of injury, response, and illness as they occur to the body. Psychotherapeutic intervention to trauma-related conditions has to consider the possible co-presence of the three modes. Such three-dimensional understanding of response to trauma has also implications for mental integration. Namely, the latter is a multidimensional phenomenon rather than a linear sum of parts.

Key words: trauma, memory, consciousness, awareness, dissociation.

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Sommario

Modello di reazione tri-modale (T-MR) al trauma complesso e alla dissociazione: una proposta

Il presente articolo propone un modello di spiegazione della risposta a traumi psicologici complessi e dissociazione. Questo modello di reazione trimodale cerca di spiegare lo sforzo mentale degli individui traumatizzati necessario ad affrontare il dolore insopportabile della lotta per la sopravvivenza. Piuttosto che concettualizzare il suddetto processo in fasi consecutive, l'articolo fornisce una descrizione della risposta individuale al trauma dello sviluppo in tre modalità, spesso coesistenti: reazione acuta, processi cronici e alienazione. Ognuna di queste modalità opera all'interno di una finestra di ipermodulazione e ipomodulazione delle emozioni. Questo modello trimodale rassomiglia alla concettualizzazione medica della lesione, della risposta e della malattia fisica. L'intervento psicoterapeutico sulle condizioni correlate al trauma, deve considerare la possibile coesistenza delle tre modalità. Questo paradigma di comprensione tridimensionale della risposta al trauma ha anche delle implicazioni nel processo d'integrazione mentale. Vale a dire, quest'ultimo è un fenomeno multidimensionale, piuttosto che una somma lineare di parti.

Parole chiave: trauma, memoria, coscienza, consapevolezza, dissociazione.

Introduction

In contrast of the immediate meaning implied by the term *post-traumatic* stress disorder (PTSD), psychological trauma is not identical with a noxious event or stressor (Fischer and Riedesser, 1999). Trauma covers both the biopsychosocial *injury* caused by the stressor as well as the *response* of the affected subject to this threat. Some traumatic stressors may objectively overwhelm the capability of an average individual. However, in certain cases the impact may be equally traumatic if the threat targets a fragile aspect of the person – such are events during early developmental period or the resonance of the experience with the cumulative effect of previous traumatizations. Hence, psychological trauma is related to both subjective and objective components of a stressful condition. Accordingly, Fischer and Riedesser (1999) have defined trauma as the experience of vital discrepancy between threatening factors in a situation and individual coping abilities.

Although the initial reaction of the individual to the stressful experience may be one of no response-- in fact, per definition, no adequate response is possible in a traumatic situation- often a creeping process may take hold in subsequent stages of mental operations that necessarily go beyond. Hence, trauma is not merely a situational phenomenon, but a socio-psychological

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process which develops in time and follows a course. Psychological trauma is not limited to the time period when the stressor is actually present either. Both the psychological impact and the response to the threat may surpass this period. Although trauma usually remains in the past (Van der Kolk and Van der Hart, 1991), the *disillusion* created by the experience may influence one's future (Fischer and Riedesser, 1999).

Contrary to the popular misconception about trauma that depicts it as an anxiety dominated response to a single traumatic event in an isolated fashion, a growing body of evidence drives clinicians and researchers to conceptualize PTSD also in terms of a longlasting and multi-dimensional consequence of chronic, early, and interpersonal (developmental) traumatization that is known to be the essence of Complex PTSD (Şar, 2011). Developmental trauma refers to a type of stressful event that occurs repeatedly and cumulatively, usually over a period of time, and within specific relationships and contexts (Courtois, 2004). Childhood abuse (sexual, emotional, and physical) and neglect (physical and emotional) constitute typical forms of chronic traumatization. Neurobiological impact of Complex and Simplex PTSD also differ. For example, unlike claims about consequences of chronic traumatization, a recent meta-analysis on Simplex PTSD revealed no significant changes in grey matter volume (Tench *et al.*, 2018).

Stress is part of life. There is even evidence that a certain level of acute (but not chronic) stress may have positive effects on immunity and mental and physical performance (Dhabbar, 2018). Hence, living organisms are evolved to a capacity of coping by responding to stressors with adaptation. Trauma is, however, a threatening experience which turns an adaptive process to a *maladaptive* one (Şar and Öztürk, 2005). This is the condition when upsetting and unpredicted situational and/or enduring factors interrupt the psycho-sociological experiencing significantly and interfere with the coping capacity of the person at least for a period of time.

Traumatic Memories and Repetitions

The hallmark of trauma resolution is the ability and opportunity of the subject to respond to a traumatic experience adequately. The available responses in a traumatic situation, however, may be rather limited. First, a person may escape from a traumatic situation. Second, the subject may process the situation until it is resolved. A third possibility is to deny some

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aspects of the experience. The latter results in inadequate processing of the traumatic experience. Past trauma is then repeatedly handled in the context of present time in the person's active memory (Şar and Öztürk, 2005). Hence, in their "preliminary" publication on traumatized dissociative patients, Breuer and Freud (1893) stated: «*the hysterick suffers mainly from reminiscences*».

The need to match new information with inner models based on older information, and the revision of both until they agree, is called a *completion tendency* (Horowitz, 1986). The completion principle summarizes the human mind's intrinsic ability to continuously process new information in order to reconcile the inner schemata about the self and with the outside world. Hence, completion tendency drives the repetition of traumatic material in active memory. Different psychological realities emerge following each repetition driven by the completion tendency. By definition, any change in the perception of traumatic experience leads to the emergence of a new internal and external world (i.e. a change in reality and its perception). The double-bind inherent to the trauma experience also contributes to multiple perceptions of reality in the internal world (Şar and Öztürk, 2005).

These new psychological realities contain cognitions which are attempts to provide solutions for the perceived traumatic impasse. However, the existence of multiple versions of perceived reality make the processing of the original trauma difficult. On the other hand, these cognitions typically suggest that a solution is not available or they do not provide one. These cognitions and related "realities" can not solve the traumatic impasse because they are formed during the moment when the processing was interrupted and/or in a phase of the processing in which the subject remained stuck (Şar and Öztürk, 2005). Consequently, the subject remains unable to complete the process.

Dissociation in Trauma: Confounder or Common Denominator?

As a way of coping with unbearable pain, dissociation is increasingly recognized as a common feature of trauma-related conditions (Şar, 2011). For example, both peritraumatic and persistent dissociation have been considered as components of PTSD with variability between individuals (Briere, Scott and Weathers, 2005). Both retrospective and prospective studies reveal that dissociation is one of the consequences of chronic developmental trauma in particular (Lewis *et al.*, 1997; Ogawa *et al.*, 1997).

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Dissociation is characterized by disruptions or discontinuities in usually integrated psychological functions such as memory, consciousness, perception, sense of self and agency, and sensori-motor abilities (American Psychiatric Association, 2013). In its most dramatic form, this fragmentation may take the scope of marked disruptions of identity. On the other hand, this definition of dissociation as a type of mental fragmentation is still mostly based on its phenomenology rather than its true nature about which we still have a limited understanding. Hence, the search for an ultimate definition of dissociation is a still ongoing pursuit. For example, Schimmenti and Sar (in review) propose that, in addition to fragmentation, absorption trance may also be a form of pathological dissociation.

Besides constituting a disorder on its own, dissociation may accompany several psychiatric disorders including PTSD. When it does, concurrent dissociation is usually linked to a history of chronic developmental trauma independent of the accompanying psychiatric disorder (Sar and Ross, 2006). In fact, clinical dissociation covers a diagnostic spectrum between mild and severe poles covering acute dissociative reaction to stressful events, acute stress disorder, Simplex PTSD, dissociative subtype of PTSD, Complex PTSD, chronic dissociative disorders such as dissociative identity disorder, respectively (Sar, 2011).

There are ongoing debates on whether dissociation is the common denominator (Nijenhuis, 2017) or a confounder of the entire trauma-spectrum (Sar, 2011). The latter stance is represented by the newly introduced dissociative *subtype* of PTSD (American Psychiatric Association, 2013) which is a construct defined by negative symptoms of dissociation: depersonalization and derealization. This view is challenged by the defenders of the theory of *structural dissociation* (Van der Hart, Nijenhuis and Steele, 2006) which proposes that dissociation also appears in positive symptoms (e.g. flashbacks, intrusive memories). While assuming dissociation as the central mechanism rather than a peripheral feature of PTSD, these authors propose that Complex PTSD involves a more complex structural dissociation than Simplex PTSD (Van der Hart, Nijenhuis and Steele, 2005).

Post-Traumatic Alienation

The individual's understanding about the trauma experience may alter after each repetition and may detach from its original form gradually, so that the affected person may develop *isolated subjectivities* (Chefetz and

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Bromberg, 2004). Usually, the most recent version of these re-enactments remains as the final form for a certain period of time. In fact, the main difference between past experience and its altered re-enactments, which continue to be processed in the present time, are usually heavily dependent on time and context. Overall, time is one of the perspectives trauma experience is embedded in (Şar and Öztürk, 2005). Namely, while processing the trauma experience, the subject concentrates on the past experience in the present. This leads to *detemporalization* (Şar and Öztürk, 2005).

As mentioned, the repetitive representations of these operations in the active memory is an attempt to resolve the trauma. Representations of inadequate operations in other past problematical experiences are utilized to vast proliferation (inflation) of operational options in the subject's mind in the aftermath of a traumatic experience. One of these options takes the priority when dealing with the actual trauma experience. However, this option usually does not lead to a solution. Various solution methods for recurrent traumatic experiences and repeated cognitions detach from each other. They become autonomous and reveal separate domains.

During these repetitions, all operations that are excluded (from the perspective of time dimension that remain in the past) are transferred to inactive memory either partially or entirely. The excluded operations may lay the foundation for the immediate or future development of *distinct behavioral states* (Putnam, 1997) or *parallel-distinct mental structures* (Şar, 2017a) observed among dissociative individuals. Excluded operations, when formed to distinct personality states, are then tried to be utilized as solution methods in further domains of life problems (Şar and Öztürk, 2005). Not only the perception of the trauma experience but also the perception of the subject about oneself is affected by this process.

The traumatized subject evaluates oneself from the varying perspective of multiple versions of reality (Bromberg, 1998). Although these perceptions may create opportunities for progression in a few matters, they lead to impasses and negative cognitions in many areas. To cope with this, the traumatic fact (person, idea, situation, etc.) is kept at a distance, or, alternatively, the subject remains in an oscillating relationship with it. If the subject can enter a dialectical process (thesis-antithesis-synthesis) in the face of trauma, he/she may have the power of turning the situation to his/her favor at least in a limited extent. Otherwise, this incomplete process may lead to the generalization of the double-bind inherent to the traumatic experience to his or her entire life (Şar and Öztürk, 2005).

With contribution of dissociative amnesias, perceptual fragmentations

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lead to depersonalization, derealization, and identity alterations (Şar, Alioglu and Akyüz, 2017; Şar *et al.*, 2014a; Şar *et al.*, 2017) because multiple perceptions of reality may destroy personalization, *i.e.*.. one's experience that all psychological faculties (perception, body perception, memory retrieval, imagination, thought, feeling, etc.) belong to oneself (Jaspers, 1913). Depersonalization is the core element of clinical categories, which are considered to be trauma-related conditions, *i.e.*., dissociative, borderline personality, conversion, and certain types of depressive disorders (Şar *et al.*, 2017; Şar *et al.*, 2004; Şar *et al.*, 2006; Şar *et al.*, 2015; Şar, Akyüz and Öztürk, 2014).

DePrince, Huntjens and Dorahy (2015) found that alienation was the only cognitive appraisal variable to differentiate DID from PTSD. While the groups had similar appraisals of shame, betrayal, self-blame, anger, and fear, the DID participants appraised themselves more frequently as experiencing alienation. This construct is associated with feeling alone, disconnected, and different. Dissociative patients often feel very isolated and lonely, in the sense that they believe they are the only one in the universe who is “different” from others, and that they do not understand themselves (Şar, Dorahy and Krüger, 2017). Hence, they experience depersonalization and derealization which may go back to their childhood. This may lead to biased processing of social inclusion (Weinbrecht *et al.*, 2018).

Alterations of Consciousness

In their 4-D model of consciousness, Frewen and Lanius (2014) differentiated trauma-related altered state of consciousness (TRASC) from normal waking consciousness (NWC). These two opposit poles of experiences can be observed in consciousness of time-memory (flashbacks versus intrusive recall & distressful reminders), thought (voice-hearing versus negative self-referential thinking), body (disembodied versus embodied experiences of distress), and emotions (numbing and affective shutdown versus non-dissociative forms of negative emotionality). In fact, all these four dimensions reflect cognitive-emotional and bodily aspects of depersonalization; *i.e.* alienation, self-detachment, or estrangement (Şar *et al.*, 2017).

Dissociation is a non-interactive solution (Crandell, Morrison and Willis, 2002). The development of an internal “ghetto” (Frankel and O’Hearn, 1996) leads to emergence of relationships in the internal world which is a system

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prone to evaluate multiple aspects of reality including its diverse perceptions. This is facilitated in dissociative individuals by alterations of consciousness which is common among patients with trauma histories (Ross and Browning, 2018). When a past traumatic experience is reevaluated by the subject in the present time, reality distortions may interfere with the individual's sense of control, vigilance, and awareness, which are components of consciousness. The subject may even alienate against his or her own traumatic experience. As valid for cognitive assessment of trauma experience, perceptual alterations of reality may also serve the purpose of intra-psychic evaluation.

Such alterations of perceived reality may cover five stages: Utopia, fantasy, imagination, daydream, and reality (Öztürk and Sar, 2016a). Utopia is a plan or an idea, which may be dramatic and even creative. Even if constructed by a mentally integrated individual, an utopia cannot become reality in its original form. It serves as a probability to achieve only as a perfect condition. Fantasy is an internally cohesive thought composed of mentally created elements. The force behind fantasy is an unsatisfied and even not yet consciously perceived wish. Imagination is the ability of forming mental images, sensations, and concepts in a moment when they are not perceived through senses (*i.e.*, hearing, seeing). Last but not least, daydream represents wishes and reality represents facts.

Imagination is a fundamental facility through which people make sense of the world. It also plays a role in learning and helps to give meaning to an experience through better understanding the recruited knowledge. Imagination can also serve to fantasies; however, a mentally integrated person is able to differentiate fantasy from imagination. Imagination facilitates awareness about experiences and the process of obtaining the knowledge, which leads to easier utilization of capacities by facilitating reflection. Lack of imagination inhibits this process. Imagination may serve therapeutic purposes. For example, the therapist can benefit from the still existing capacity of imagination in a case with dissociative disorder. In dissociative identity disorder, imagination is predominantly a strength of alter personalities although the host can also utilize it to some degree.

Nevertheless, Sar and Öztürk (2005) propose that the processing of trauma and elimination of the pathological formations require an adequate level of consciousness. In the psychotherapy of stress response syndromes, the process of using conscious awareness of change is of central importance (Horowitz, 1986; Stern, 2004). Hence, while alterations of consciousness and evaluation of perceived reality may be inevitable in a therapeutic process, the ultimate goal is restoring the vigilance, awareness, and control.

Regulation of Perceived Reality: Developmental Resemblances

Regulation of reality perception requires consideration of the mutuality between internal and external world. Childhood abuse, neglect, and insecure attachment disrupt this balance that internal reality becomes more compelling. From developmental point of view, to establish a balance between external and internal world, the caregiver's adequate *mirroring* is necessary. That means, the caregiver's responses should accurately match the infant's mental state. For example, the caregiver should be able to express an affect while indicating she is not expressing her own feelings (*unmarked mirroring*). If this does not occur, the caregiver's expression may seem to externalize the infant's experience and may overwhelm the infant. This makes the experience of the infant contagious and escalating rather than regulating his state (Gergely and Watson, 1999). A preposition of experiencing emotions through other people might be established (Fonagy *et al.*, 2002). This is the first step leading to emotional dysregulation which affects perception of reality further.

The equation of internal and external world which typifies toddlers' and preschoolers' way of thinking is called *psychic equivalence* (Fonagy *et al.*, 2002). This mode does not allow consideration of alternative perspectives on reality. Hence, a fantasy may be experienced as potentially real. This is why the acquisition of a sense of pretend in relation to mental states is essential. In *pretend mode*, thoughts and feelings can be envisioned and talked about, but they do not correspond to real. The *teleological mode*, on the other hand, is based on imputing intention from what is physically apparent. Experiencing internal reality both in *psychic equivalent* and *pretend modes* is typical for dissociation.

Mentalization is a construct which provides clues about developmental and interpersonal origins of perception of reality (Fonagy and Allison, 2012). It is defined as the ability to understand the mental state of oneself or others that underlies overt behavior. Mentalization must be imaginative because we have to imagine what other people might be thinking or feeling (Fonagy and Allison, 2012). When we mentalize we are engaged in a form of imaginative mental activity that enables us to perceive and interpret human behavior in terms of intentional mental states (e.g. needs, desires, feeling, beliefs, goals, purposes, and reasons) (Allen, Fonagy and Bateman, 2008).

In a recent study (Ensink *et al.*, 2017), child mentalization partially mediated the relationship between childhood sexual abuse and depressive

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symptoms. The effects of childhood sexual abuse on externalizing symptoms and sexualized behaviour difficulties were sequentially mediated through mentalization and dissociation. Not rarely, families with dysfunctionalities such as, for instance, affect dysregulation among family members may also be developmentally traumatizing for the later generations (Öztürk and Sar, 2005).

The Trimodal Response: A Proposal

Any living organism is basically programmed for survival, both on an individual level and as species. This striving continuously triggers the principle of *homeostasis*; the tendency of the organism to auto-regulate and maintain its internal environment in a stable state (Martin, 2008). The organism inquires the ways of adaptation to the change in the real world in the aftermath of the traumatic experience. Thus, survival requires an update in the aftermath of major changes while keeping one's unique identity more or less existing (Sar, 2017a; Sar, 2017b). However, the individual seems to be programmed for perception of *uniqueness* to perceive oneself as a living entity. As the principles of homeostasis and adaptation cannot waive this vital need, several biopsychosocial mechanisms of defense and coping intervene as a dynamic consensus.

Pain is a signal of the threat to the homeostasis in context of the supreme mission of survival. Psychological trauma creates *mental pain* which is related to memories, sensations, emotions, and thoughts about the stressful experience. With their painful quality, traumatic memories seem to be the main driver of the “trauma response”. On the other hand, one natural reaction of the organism to pain is avoidance. The three modes elaborated in this paper are concerned with the ways of keeping pain in bearable limits while preserving its signaling function.

The “Tri-Modal Reaction (T-MR) Model” has been inspired by neurobiological, clinical, neuro-psychological assessment of a group of adolescents with chronic PTSD who were exposed to severe sexual abuse (Mutluer *et al.*, 2018). Basically, the formulation of the trimodal model were derived from within-group analysis providing clues on *lateralization* in the response of the brain to developmental trauma. Notwithstanding the methodological limitations of the approach, several speculative hypotheses have been formulated as implied by correlations between volumes of brain regions of interest and clinical variables.

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The response following a traumatic situation is widely known to be characterized by three stages: shock, grief, and resolution (Herman, 1992). These stages reflect an initial reaction to the stressor, some mental work on the experience, and constructing meaning about what has happened. In tandem with this, psychotherapeutic intervention to clinical consequences of psychological trauma is also known as a tri-phasic process: stabilization, trauma work, and integration. This is the core assumption of phase-oriented trauma psychotherapy (Van der Hart, Nijenhuis and Steele, 2006). However, most clinicians agree that, in fact, the three phases of response and treatment do not necessarily exclude each other. They may temporarily overlap or the sequence may change. Following this line of thought, I propose here that, response to trauma has in fact “trimodal” rather than triphasic quality; *i.e.* the three “modes” of response may co-occur. Clinicians should assess the actual proportions of the three modes carefully to address them in an appropriate fashion. Hence, the clinician should work on all three modes simultaneously.

The three modes of trauma response are in strong analogy with reaction of the body to an intruding foreign entity or to any threat to homeostasis in general (Diehl, 2017; Tursich *et al.*, 2014): an acute and active reaction type (“inflammation”), a chronic and relatively stable baseline of pathological condition (“illness”), and last but not least, an effort of isolation (“sequestration or compartmentalization”) of the threat by detachment from and limiting the effect of it to protect the organism as much as possible.

Each of the three modes of response to trauma are characterized by an interaction between trauma-related *intrusions* and operations of *controlling* the psychological pain initiated by the former to keep the tension inside of a «window of tolerance» (Siegel, 1999). Accordingly, while providing neurobiological underpinnings of a dissociative subtype of PTSD, Lanius *et al.* (2010) described two types of reaction to traumatic stress: overmodulation (inhibition) and undermodulation (arousal) of emotions. Each of the three modes operates between these *two poles*. Denial, avoidance, and alienation are phenomena which dampen the pain of mental intrusions. Each of them represents overmodulation in one of the three modes: Denial is covered by the first mode only, avoidance by the second mode, and alienation is considered as the main feature of the third mode. Dissociative amnesia may, however, operate with all modes.

The two poles of the *primary mode* (“Inflammation”) cover hyperarousal and re-experiencing of the trauma-related content as retrieved from memory versus denial of at least some components of the experience (*i.e.*, emotions,

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thoughts, acts). The *secondary mode* (“Trauma Illness”) is composed of polymorphous trauma-related symptoms and syndromes: current hyperarousal, lifetime and current avoidance, depression, passive influence experiences and absorption trance (Mutluer *et al.*, 2018). These phenomena represent clinically both Simplex and Complex PTSD, as well as «dissociative depression» (Şar *et al.*, 2013), and some types of partial (other specified) dissociative disorders or borderline phenomena. The *tertiary mode* (“Alienation”) is characterized by experiences representing the dissociative subtype of PTSD or dissociative identity disorder (American Psychiatric Association, 2013); i.e., depersonalization, derealization, and identity alteration (Şar *et al.*, 2017; Şar, Alioğlu and Akyüz, 2017).

The tertiary mode may represent both state and trait dissociation. In a recent study (Kleindienst *et al.*, 2016), state dissociation during psychotherapy sessions predicted improvement after dialectical behavior therapy (DBT)-PTSD: patients with low state dissociation during treatment had a higher chance to show substantial improvement. This relation consistently emerged across subgroups of PTSD patients with and without borderline personality disorder. The operationalization of dissociation as state versus trait dissociation made a difference as improvement was not significantly predicted from trait dissociation.

Neurobiological Repercussions: Lateralization

In survivors of complex trauma, hyperarousal and reexperiencing seemed to be predominantly driven by right hemisphere structures (*i.e.* amygdala, hippocampus, and anterior cingulate) (Mutluer *et al.*, 2018). Possibly joining right hippocampus and anterior cingulate in “remembering” traumatic memories, *right amygdala* seemed to be the main driver of the primary mode. In contrast of this (representing operations of control), denial of trauma was associated with (thinner) right prefrontal cortex and (larger) right thalamus which may dampen the perception of the psychological pain. Suggesting possible interaction, right amygdala was also associated with right prefrontal cortex in size.

The most consistently implicated structure of the *secondary mode* seemed also to be the right amygdala which was related to both current re-experiencing as well as current and lifetime avoidance of traumatic memories, and current hyperarousal. This pattern clearly represented the basic phenomenology of Simplex PTSD. The size of the right amygdala was

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also correlated with depression, passive influence experiences, and absorption trance which represent «dissociative depression» (Şar *et al.*, 2013), including negative affect intrusions (DePierro *et al.*, 2018). Overall, these patterns related to right amygdala also covered Complex PTSD.

In contrast to the previous ones, the *third mode* (alienation) appeared to be related to the *left hemisphere*. In contrast to the general volume decrease in structures, thickness of *left prefrontal cortex* was correlated with dissociative phenomena, suggesting a possible neuro-protective phenomenon. Schore (2009) stated that «the right brain is fundamentally involved in an avoidant-defensive mechanism for coping with emotional stress, including the passive survival strategy of dissociation». Mutluer *et al.* (2018) pointed to a bilateral impact of PTSD on the brain with a predominant role of the right hemisphere in primary and secondary modes of reaction. However, unlike proposed by Shore, *core symptoms of dissociation seemed to be related to left brain*, to the *left prefrontal cortex* in particular. Left prefrontal cortex was involved with symptoms representing dissociative subtype of PTSD or dissociative identity disorder (American Psychiatric Association, 2013). Considering both findings on lateralization and connectivity, Mutluer *et al.* (2018) study led to the speculation that diminished connectivity may be part of the “protective” response among traumatized adolescents to “quarantine” left hemisphere while right hemisphere was operating in “frontline” (Ross, Goode and Schroeder, 2015; Mutluer *et al.*, 2018), at least through adolescence. Although the thicker left prefrontal cortex is not an absolute neurobiological marker of mental health, the obvious relationship between psychopathology and the downsizing of all evaluated brain regions in PTSD support this proposal.

Although there was no significant correlation between right amygdala and dissociative amnesia directly, such correlation existed in relation (proportion) of the right amygdala to both right and left prefrontal regions and to right thalamus. Unlike the right prefrontal cortex (associated with denial), the thickness of the left prefrontal region (associated with alienation) and of the right thalamus (associated with less pain) were related to dissociative amnesia. *Denial* (thinner right prefrontal cortex), *avoidance* (smaller right amygdala), and *alienation* (thicker left prefrontal cortex) seem to have different neurobiological associations. Representing the distinctness of these dimensions, these regions were not correlated with each other in size either. Interestingly, both right and left *prefrontal cortex* were involved with *altered awareness* of traumatic experiences but not with symptoms of PTSD (see also Depue, Curran and Banich, 2007). Thus, subcortical

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structures (as triggers) seemed to be better involved with re-evaluation of reality. Related with a thinner right prefrontal cortex, denial seemed to represent the worst scenario (Mutluer *et al.*, 2018).

Clinical studies have demonstrated that at least a subgroup of patients tend to minimize the traumatic quality of their childhood (MacDonald *et al.*, 2016; Sar *et al.*, 2004; Sar, Akyüz and Öztürk, 2004). This observation may be related to a relatively blank response (e.g. dissociative amnesia and absorption) due to the “betrayal” (Freyd, 1994) in ongoing attachment (Freyd, Deprince and Zurbriggen, 2001). Cohen *et al.* (2006) could not determine the relative importance of specific types of events in neurobiological variables. In the Mutluer *et al.* (2018) study, there was no correlation between specific or total childhood trauma scores and volumes of brain structures either. However, earlier age and more severe type of childhood sexual abuse (i.e. involving coitus) were associated with a larger left anterior cingulate, while the opposite was valid for sexual abuse conducted by a perpetrator in a close relationship with the victim. Those adolescents who were sexually abused by their biological father or brother also reported more dissociative amnesia and absorption compared to that of the victims of other perpetrators. Hence, these phenomena possibly serve in alleviating the stress by facilitating the «attachment to the perpetrator» who was also a “caretaker” (Ross, 1997).

One of the concepts to inquire lateralization is the frontal EEG asymmetry, known as FEA shortly (Coan and Allen, 2004). In a recent study on patients with borderline personality disorder, childhood trauma and sensorimotor dissociation (conversion) symptoms predicted a significant shift from left- to right-sided asymmetry over prefrontal electrodes (Popkirov *et al.*, 2018). This seems to be both a state (e.g. in PTSD, see Meyer *et al.*, 2015) and trait measure (e.g. in depression, see Quinn *et al.*, 2014) which is related to all three modes described in the present paper (i.e. mode 1 being a state and mode 2 a trait while mode 3 may be both).

Neurobiological Considerations: Connectivity

Decreased right/left cortical integration has been proposed as associated with childhood sexual abuse and/or physical abuse (Teicher *et al.*, 1994). Corpus callosum is the major neural pathway that connects homologous cortical areas of the two cerebral hemispheres both in an excitatory and inhibitory role (Bloom and Hynd, 2005). The total corpus callosum area of

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the abused/neglected patients was smaller than in controls and psychiatric patients who had not been abused or neglect (Teicher *et al.*, 2004). Sexual abuse was the strongest factor associated with reduced corpus callosum size in girls. In a diffusion tensor imaging (DTI) study, adolescents with childhood sexual abuse-related PTSD showed decreased fractional anisotropy (i.e. white matter integrity) in corpus callosum (Rinne-Albers *et al.*, in press). Abnormalities in the integrity of the corpus callosum were related to anger. Another DTI study documented significantly decreased fractional anisotropy in right anterior corona radiata of dissociative patients (Basmaci-Kandemir *et al.*, 2016). An association between bad paternal relationships and lower fractional anisotropy in the genu of the corpus callosum was shown in female patients who were maltreated by their fathers.

Farina *et al.* (2014) demonstrated that, compared to the controls, dissociative individuals did not show an increase in EEG connectivity after administration of an interview triggering memories of early attachment; i.e. the brain's overall response lacked the integrative reaction shown in healthy controls. Being in accordance with basic principles of trauma treatment composed of stabilization, trauma processing, and integration (Van der Hart, Nijenhuis and Steele, 2006), the trimodal model is inspiring for further research on EMDR covering bilateral stimulation of the brain (Laugharne *et al.*, 2016) and neurobiologically informed mindfulness therapies addressing inter-hemispheric equanimity (Siegel, 1999).

Two previous studies using SPECT on patients with dissociative identity disorder also reported bilateral perfusion changes in frontal regions (Şar *et al.*, 2001; Şar, Ünal and Öztürk, 2007). Suggesting a partial concordance between structural and functional imaging, the second study (Şar, Ünal and Öztürk, 2007) yielded bilateral increased perfusion in prefrontal areas beside bilateral perfusion deficit in inferior (orbito-) frontal regions seen in both studies. Individuals with childhood trauma have inhibitory failure and frontal lobe dysfunction in regions related to Nogo-P3 in EEG (Kim *et al.*, 2017).

Integration as Healing

Researchers agree on the significant role of connection between amygdala and the frontal lobes in PTSD (Gard *et al.*, 2018; Lobo *et al.*, 2011). Hence, interaction between frontal lobe and amygdala seems to be crucial in establishment of mental integration. However, this connection

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seems to be more complex than establishment of a simple balance between and excitatory and inhibitory functions (Solms and Panksepp, 2012). For example, alongside its contribution to the integration of emotion with its role as a “hub” embedded in numerous structures of the limbic system, perception and cognition (including memories of past autobiographical events), amygdala does not only play a role in intrusive phenomena but it also forges the establishment and maintenance of an integrated self (Markowitsch and Staniloiu, 2011).

Dissociative symptoms cannot be considered as an expression of good mental health. However, the possibility of successful treatment (“*restitutio ad integrum*”) of dissociative disorders by means of psychotherapy (Brand *et al.*, 2009) even at a later time in life and the probable positive natural course of dissociative disorders in a subgroup of adolescents (Şar *et al.*, 2014b) support the possible role of dissociation in mental survival (Şar and Öztürk, 2007; Mutluer *et al.*, 2018). Given the perspective of the elaborations of this paper, a definition of dissociation may be as follows: Traumatic experiences and consequently altered self-perceptions contribute to the impairment of the mutuality between internal world and external reality. This is accompanied by a renewed perception of the self in the context of a different reality accompanied by altered vigilance, awareness, control (agency), and concentration. Depersonalization is the core clinical element of this condition.

The model of Tri-Modal Response to trauma inspires a non-mechanistic understanding of integration which is the ultimate goal in trauma therapies, for dissociative clients, as well as for mental health in general. Namely, integration is *more than the sum of parts*. One particular reason of this non-linear quality of integration is the multimodal contextualization of trauma-related mental content. Based on these descriptions, integration takes place by *letting the individual perceive oneself as oneself in the face of each diverse reality while developing sociopsychological connections between these realities and kernels of self* (Şar and Öztürk, 2005; Şar, 2017a).

REFERENCES

- Allen J., Fonagy P., Bateman A. (2008). *Mentalizing in clinical practice*. Washington: American Psychiatric Press.
American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders (DSM-5)* (5th ed.). Washington, DC: American Psychiatric Association.
Basmacı-Kandemir S., Bayazit H., Selek S., Kılıçaslan N., Kandemir H., Karababa

- I. F., Cece, H. (2016). Tracking down the footprints of bad paternal relationship in dissociative disorders: a DTI study. *Journal of Trauma & Dissociation*, 17(3): 371-381. doi: 10.1080/15299732.2015.1111282
- Bloom J.S., Hynd G.W. (2005). The role of the corpus callosum in interhemispheric transfer of information: excitation or inhibition? *Neuropsychology Review*, 15(2): 59-71. doi: 10.1007/s11065-005-6252-y
- Brand B.L., Classen C.C., McNary S.W., Zaveri P. (2009). A review of dissociative disorders treatment studies. *Journal of Nervous and Mental Disease*, 197: 646-654. doi: 10.1097/NMD.0b013e3181b3afaa
- Breuer J., Freud S. (1893). On the psychical mechanism of hysterical phenomena: preliminary communication. *The standard edition of the complete psychological works of Sigmund Freud, volume II (1893-1895): Studies on Hysteria*, 1-17.
- Briere J., Scott C., Weathers F. (2005). Peritraumatic and persistent dissociation in the presumed etiology of PTSD. *American Journal of Psychiatry*, 162: 2295-2301. doi: 10.1176/appi.ajp.162.12.2295
- Bromberg P.M. (1998). *Standing in the spaces. Essays on clinical process trauma & dissociation*. Hillsdale, NJ: The Analytic Press.
- Chefetz A.R., Bromberg P.M. (2004). Talking with “me” and “not-me”. A dialogue. *Contemporary Psychoanalysis*, 40: 409-464. doi: 10.1080/00107530.2004.10745840
- Coan J.A., Allen J.J. (2004). Frontal EEG asymmetry as a moderator and mediator of emotion. *Biological Psychology*, 67(1): 7-50. doi: 10.1016/j.biopsych.2004.03.002
- Cohen R.A., Grieve S., Hoth K.F., Paul R.H., Sweet L., Tate D., Hitsman B. (2006). Early life stress and morphometry of the adult anterior cingulate cortex and caudate nuclei. *Biological Psychiatry*, 59(10): 975-982. doi: 10.1016/j.biopsych.2005.12.016
- Courtois C.A. (2004). Complex trauma, complex reactions: Assessment and treatment. *Psychotherapy: Theory, Research, Practice, Training*, 41(4): 412- 425.
- Crandell J., Morrison R., Willis K. (2002). Using psychomotor to treat dissociative identity disorder. *Dissociation*, 3: 57-80.
- DePierro J., D'Andrea W., Frewen P., Todman M. (2018). Alterations in positive affect: relationship to symptoms, traumatic experiences, and affect ratings. *Psychological Trauma: Theory, Research, Practice, and Policy*. doi: 10.1037/tra0000317
- DePrince A.P., Huntjens R.J.C., Dorahy M.J. (2015). Alienation appraisals distinguish adults diagnosed with DID from PTSD. *Psychological Trauma: Theory, Research, Practice and Policy*, 7: 578-582. doi: 10.1037/tra0000069
- Depue B.E., Curran T., Banich M.T. (2007). Prefrontal regions orchestrate suppression of emotional memories via a two-phase process. *Science*, 317(5835): 215-219. doi: 10.1126/science.1139560
- Dhabbar F.S. (2018). The short-term stress response- mother nature's mechanism for enhancing protection and performance under conditions of threat, challenge,

*The Tri-Modal Reaction (T-MR) Model
of Complex Trauma and Dissociation: A Proposal*

- and opportunity. *Frontiers in Neuroendocrinology*, 49: 175-192. doi: 10.1016/j.yfrne.2018.03.004
- Diehl R.R. (2017). The target of vasovagal syncope is homeostasis and not heart protection. *Clinical Autonomic Research*, 27(4): 215-217. doi: 10.1007/s10286-017-0450-6
- Ensink K., Bégin M., Normandin L., Godbout N., Fonagy P. (2017) Mentalization and dissociation in the context of trauma: Implications for child psychopathology, *Journal of Trauma & Dissociation*, 18, 1: 11-30. doi: 10.1080/15299732.2016.1172536
- Farina B., Speranza A.M., Dittoni S., Gnoni V., Trentini C., Vergano C.M., Della Marca G. (2014). Memories of attachment hamper EEG cortical connectivity in dissociative patients. *European Archives of Psychiatry and Clinical Neuroscience*, 264(5): 449-458. doi: 10.1007/s00406-013-0461-9
- Fischer G., Riedesser P. (1999). *Lehrbuch der Psychotraumatologie (Textbook of psychotraumatology)*. München: Ernst Reinhardt Verlag.
- Fonagy P., Allison E. (2012). What is mentalization ? The concept and its foundations in developmental research. In: Midgley N., Vrouva I. (eds.), *Minding the child: mentalization-based interventions with children, young people, and their families*. Routledge Press, New York, pp. 11-34.
- Fonagy P., Gergely G., Jurist E., Target M. (2002). *Affect regulation, mentalization, and the development of the self*. New York: Other Press.
- Frankel A.S., O'Hearn T.C. (1996). Similarities in responses to extreme and unremitting stress: Cultures of communities under siege. *Psychotherapy: Theory, Research, Practice, Training*, 33: 485-502. doi: 10.1037/0033-3204.33.3.485
- Frewen P.A., Lanius R. (2014). Trauma-related altered states of consciousness (TRASC): Exploring the 4-D model. *Journal of Trauma and Dissociation*, 15(4): 436-456. doi: 10.1080/15299732.2013.873377
- Freyd J.J. (1994). Betrayal trauma: Traumatic amnesia as an adaptive response to childhood abuse. *Ethics & Behavior*, 4(4): 307-329. doi: 10.1207/s15327019eb0404_1
- Freyd J.J., DePrince A.P., Zurbriggen E.L. (2001). Self-reported memory for abuse depends upon victim-perpetrator relationship. *Journal of Trauma & Dissociation*, 2(3): 5-15. doi: 10.1300/J229v02n03_02
- Gard A.M., Waller R., Swartz J.R., Shaw D.S., Forbes E.E., Hyde L.W. (2018). Amygdala functional connectivity during socioemotional processing prospectively predicts increases in internalizing symptoms in a sample of low-income, urban, young men. *NeuroImage*. doi: 10.1016/j.neuroimage.2018.05.079
- Herman J. (1992). *Trauma and Recovery*. Basic Books, New York, NY.
- Horowitz M.J. (1986). *Stress response syndromes* (2nd ed.). Northwale NJ: Jason Aronson Inc.
- Jaspers K. (1913). *Allgemeine Psychopathologie* (General psychopathology), Berlin: Springer Verlag.

Vedat Sar

- Kim S., Kim J.S., Jin M.J., Im C.-H. Lee S.-H. (2017). Dysfunctional frontal lobe activity during inhibitory tasks in individuals with childhood trauma: An event-related potential study. *Neuroimage:Clinical*, 17: 935-942. doi: 10.1016/j.jiclin.2017.12.034
- Kleindienst N., Priebe K., Görg N., Dyer A., Steil R., Lyssenko L., Winter D., Schmahl C., Bohus M. (2016). State dissociation moderates response to dialectical behavior therapy for posttraumatic stress disorder in women with and without borderline personality disorder. *European Journal of Psychotraumatology*, 7: 30375. doi: 10.3402/ejpt.v7.30375
- Lanius R.A., Vermetten E., Loewenstein R.J., Brand B., Schmahl C., Bremner J.D., Spiegel D. (2010). Emotion modulation in PTSD: Clinical and neurobiological evidence for a dissociative subtype. *American Journal of Psychiatry*, 167(6): 640-647. doi: 10.1176/appi.ajp.2009.09081168
- Laugharne J., Kullack C., Lee C.W., McGuire T., Brockman S., Drummond P.D., Starkstein S. (2016). Amygdala volumetric change following psychotherapy for posttraumatic stress disorder. *Journal of Neuropsychiatry and Clinical Neurosciences*, 28(4): 312-318. doi: 10.1176/appi.neuropsych.16010006
- Lewis D.O., Yeager C.A., Swica Y., Pincus J.H., Lewis M. (1997). Objective documentation of child abuse and dissociation in 12 murderers with dissociative identity disorder. *American Journal of Psychiatry*, 154: 1703-1710. doi: 10.1176/ajp.154.12.1703
- Lobo I., de Oliveira L., David I.A., Pereira M.G., Volchan E., Rocha-Rego V., Figueira I., Mocaiber I. (2011). The neurobiology of posttraumatic stress disorder: dysfunction in the prefrontal-amamygdala circuit? *Psychology & Neuroscience*, 4, 2: 191-203. doi: 10.3922/j.psns.2011.2.004
- MacDonald K., Thomas M., Sciolla A., Vogel M., Wingenfeld K. (2016). Minimization of childhood maltreatment is common and consequential: results from a large, multinational sample using the Childhood Trauma Questionnaire. *PLOS ONE*, 11(1): e0146058. doi: 10.1371/journal.pone.0146058
- Markowitsch H.J., Staniloiu A. (2011). Amygdala in action: relaying biological and social significance to autobiographical memory. *Neuropsychologia*, 49: 718-733. doi: 10.1016/j.neuropsychologia.2010.10.007
- Martin E. (2008). *A dictionary of biology* (6th ed.). Oxford: Oxford University Press, pp. 315-316.
- Meyer T., Smeets T., Giesbrecht T., Quaedflieg C.W., Smulders F.T., Meijer E.H., Merckelbach H.L. (2015). The role of frontal EEG asymmetry in post-traumatic stress disorder. *Biological Psychology*, 108: 62-77. doi: 10.1016/j.biopsych.2015.03.018
- Mutluer T., Sar V., Kose-Demiray C., Arslan H., Tamer S., Ünal S., Kaçar A.Ş. (2018). Lateralization of neurobiological response in adolescents with PTSD related to severe childhood sexual abuse: the tri-modal reaction (T-MR) model of protection. *Journal of Trauma and Dissociation*, 19(1): 108-125. doi: 10.1080/15299732.2017.1304489

*The Tri-Modal Reaction (T-MR) Model
of Complex Trauma and Dissociation: A Proposal*

- Nijenhuis E.R.S. (2017). Ten reasons for conceiving and classifying posttraumatic stress disorder as a dissociative disorder. *European Journal of Trauma and Dissociation*, 1: 47-61. doi: 10.1016/j.ejtd.2017.01.001
- Ogawa J.R., Sroufe L.A., Weinfield N.S., Carlson E.A., Egeland B. (1997). Development and the fragmented self: Longitudinal study of dissociative symptomatology in a nonclinical sample. *Development and Psychopathology*, 9: 855-879.
- Öztürk E., Sar V. (2005). Apparently normal family: A contemporary agent of transgenerational trauma and dissociation. *Journal of Trauma Practice*, 4(3/4): 287-303. doi: 10.1300/J189v04n03_06
- Öztürk E., Sar V. (2016a). Formation and functions of alter personalities in dissociative identity disorder: A theoretical and clinical elaboration. *Journal of Psychology and Clinical Psychiatry*, 6, 6: 00385. doi: 10.15406/jpcpy.2016.06.00385
- Öztürk E., Sar V. (2016b). The trauma-self and its resistances in psychotherapy. *Journal of Psychology and Clinical Psychiatry*, 6, 6: 00386. doi: 10.15406/jpcpy.2016.06.00386
- Popkirov S., Flasbeck V., Schlegel U., Juckel G., Brüne M. (2018). Childhood trauma and dissociative symptoms predict frontal EEG asymmetry in borderline personality disorder. *Journal of Trauma and Dissociation*. doi: 10.1080/15299732.2018.1451808
- Putnam F.W. (1997). *Dissociation in children and adolescents: A developmental perspective*. New York, NY: Guilford Press.
- Quinn C.R., Rennie C.J., Harris A.W., Kemp A.H. (2014). The impact of melancholia versus non-melancholia on resting-state, EEG alpha asymmetry: Electrophysiological evidence for depression heterogeneity. *Psychiatry Research*, 215(3): 614-617. doi: 10.1016/j.psychres.2013.12.049
- Ross C.A. (1997). *Dissociative identity disorder: Diagnosis, clinical features, and treatment of multiple personality*. New York: Wiley Press.
- Ross C.A., Browning E. (2018). Altered states of consciousness among inpatients in a trauma program. *Journal of Trauma and Dissociation*. doi: 10.1080/15299732.2018.1451807
- Ross C.A., Goode C., Schroeder E. (2015). Hippocampal volumes in a sample of trauma patients: a possible neuro-protective effect of dissociation. *The Open Psychiatry Journal*, 9(1): 7-10.
- Sar V. (2011). Developmental trauma, complex PTSD and the current proposal of DSM-5. *European Journal of Psychotraumatology*, 2: 5662. doi: 10.3402/ejpt.v2i0.5622
- Sar V. (2017a). Parallel-distinct structures of internal world and external reality: Disavowing and re-claiming the self-identity in the aftermath of trauma-generated dissociation. *Frontiers in Psychology*, 8: 216. doi: 10.3389/fpsyg.2017.00216
- Sar V. (2017b). Identity revised: a clinician's perspective on how an identity-based

Vedat Sar

- model of mind would look like. In: *Identity flexibility during adulthood: perspectives on adult development*, Jan Sinnott (ed.), Springer Publ., New York.
- Sar V., Akyüz G., Öztürk E., Alioğlu F. (2013). Dissociative depression among women in the community. *Journal of Trauma & Dissociation*, 14(4): 423-438. doi: 10.1080/15299732.2012.753654
- Sar V., Alioğlu F., Akyüz G. (2017). Depersonalization and derealization in self-report and clinical interview: the spectrum of borderline personality disorder, dissociative disorders, and healthy controls. *Journal of Trauma and Dissociation*, 18(4): 490-506. doi: 10.1080/15299732.2016.1240737
- Sar V., Alioğlu F., Akyüz G., Karabulut S. (2014a). Dissociative amnesia in dissociative disorders and borderline personality disorder: self-rating assessment in a college population. *Journal of Trauma and Dissociation*, 15(4): 477-493. doi: 10.1080/15299732.2014.902415
- Sar V., Alioğlu F., Akyüz G., Tayakısı E., Öğülmüş F.E., Sönmez D. (2017). Awareness of identity alteration and diagnostic preference between borderline personality disorder and dissociative disorders. *Journal of Trauma and Dissociation*, 18(5): 693-709. doi: 10.1080/15299732.2016.1267684
- Sar V., Dorahy M.J., Krüger C. (2017). Revisiting the etiological aspects of dissociative identity disorder: a biopsychosocial perspective. *Psychology Research and Behavioral Management*, 10: 137-146. doi: 10.2147/PRBM.S113743
- Sar V., Önder C., Kilinçaslan A., Zoroğlu S.S., Alyanak B. (2014b). Dissociative identity disorder among adolescents: Prevalence in a university psychiatric outpatient unit. *Journal of Trauma and Dissociation*, 15(4): 402-419. doi: 10.1080/15299732.2013.864748
- Sar V., Öztürk E. (2005). What is trauma and dissociation? *Journal of Trauma Practice*, 4(1-2): 7-20.
- Sar V., Öztürk E. (2007). Functional dissociation of the self: a sociocognitive approach to trauma and dissociation. *Journal of Trauma & Dissociation*, 8(4): 69-89. doi: 10.1300/J229v08n04_05
- Sar V., Ozturk E. (2013). Stimulus deprivation and overstimulation as dissociogenic agents in postmodern oppressive societies. *Journal of Trauma and Dissociation*, 14(2): 198-212. doi: 10.1080/15299732.2013.724346
- Sar V., Ross C.A. (2006). Dissociative disorders as a confounding factor in psychiatric research. *Psychiatric Clinics of North America*, 29: 129-144. doi: 10.1016/j.psc.2005.10.008
- Sar V., Unal S.N., Kiziltan E., Kundakci T., Ozturk E. (2001). HMPAO SPECT study of regional cerebral blood flow in dissociative identity disorder. *Journal of Trauma & Dissociation*, 2(2): 5-25.
- Sar V., Unal S. N., Ozturk E. (2007). Frontal and occipital perfusionu changes in dissociative identity disorder. *Psychiatry Research: Neuroimaging*, 156(3): 217-223. doi: 10.1016/j.psychresns.2006.12.017
- Schimmenti A., Sar V. (submitted). Investigating the domains of dissociation: a correlation network analysis of dissociative experiences. *Journal of Trauma and Dissociation*.

*The Tri-Modal Reaction (T-MR) Model
of Complex Trauma and Dissociation: A Proposal*

- Shore A. (2009). Relational trauma and the developing right brain an interface of psychoanalytic self psychology and neuroscience. Self and systems. *Annales of New York Academy of Sciences*, 1159: 189-203. doi: 10.1111/j.1749-6632.2009.04474.x
- Siegel D. (1999). *The developing mind*. New York:Guilford.
- Solms M., Panksepp J. (2012). The “Id” knows more than the “Ego” admits: neuropsychoanalytic and primal consciousness perspectives on the interface between affective and cognitive neuroscience. *Brain Science*, 2: 147-175. doi: 10.3390 /brainsci2020147
- Stern D.N. (2004). *The present moment in psychotherapy and everyday life*. New York: Norton Company.
- Teicher M., Ito Y., Glod C., Schiffer F., Gelbard H. (1994). Early abuse, limbic system dysfunction, and borderline personality disorder. In: Silk K. (ed.), *Biological and neurobehavioral studies of borderline personality disorder*. Washington, DC: American Psychiatric Association Press, pp. 177-207.
- Teicher M.H., Dumont N.L., Ito Y., Vaituzis C., Giedd J.N., Andersen S.L. (2004). Childhood neglect is associated with reduced corpus callosum area. *Biological Psychiatry*, 56: 80-85. doi: 10.1016/j.biopsych.2004.03.016
- Tench C.R., Tanasescu R., Jethwa K.D., Constantinescu C.S. (2018). Coordinate based meta-analysis of whole-brain voxel-based morphometry studies does not show evidence of grey matter loss specific to PTSD. *bioRxiv* 265496. doi: 10.1101/265496
- Tursich M., Neufeld R.W.J., Frewen P.A., Harricharan S., Kibler J.L., Rhind S.G., Lanius R.A. (2014). Association of trauma exposure with proinflammatory activity: a transdiagnostic meta-analysis. *Translational Psychiatry*, 4: e413. doi: 10.1038/tp.2014.56
- Van der Hart O., Nijenhuis E.R.S., Steele K. (2005). Dissociation: An insufficiently recognized major feature of complex posttraumatic stress disorder. *Journal of Traumatic Stress*, 18(5): 413-423. doi: 10.1002/jts.20049
- Van der Hart O., Nijenhuis E.R., Steele K. (2006). *The haunted self: structural dissociation and the treatment of chronic traumatization*. New York: Norton.
- Van der Kolk B.A., Van der Hart O. (1991). The intrusive past: The flexibility of memory and the engraving of trauma. *American Imago*, 48(4): 425-252. https://www.jstor.org/stable/26303922
- Weinbrecht A., Niedeggen M., Roepke S., Renneberg B. (2018). Feeling excluded no matter what? Bias in the processing of social participation in borderline personality disorder. *Neuroimage: Clinical*. doi: 10.1016/j.nicl.2018.04.031