Heart rate variability during rest and stress in trauma patients with dissociative symptoms

An explorative study

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Preface:

This is a final written assignment for the course of clinical psychology at UiT, The Arctic University of Norway. Data presented in this study was obtained in cooperation with Modum Bad`s outpatient Trauma clinic, which offers clinical assessment and group based treatment in form of psychoeducation for trauma related disorders. One of the authors did her main practical training at the clinic, which sparked the interest for the subject in question.

Through her practical training, Gosain collected some of the data used in this study. Her knowledge and passion for the field of complex traumatization has been important in developing the theoretical foundation of this study, especially concerning the topics complex trauma and dissociation. Kongsvik conducted the statistical analyses, and wrote about method and results. The introduction and discussion parts were written by both authors in cooperation.

We want to thank our supervisors, Jens Thimm and Eva-Therese Næss. They have shown a great interest in our assignment and have been very helpful. They have given us constructive feedback and have been a source of motivation. We want to thank to the contact person at Modum Bad, Harald Bækkelund for providing us with the data, and guiding us within this complex topic. We also want to thank our spouses for being supportive and motivating us during this process. Finally, we want to thank each other for a great teamwork. Working as a team has been educational, we have used our different qualities as a strength during this process.

Abstract

The aim for this explorative study is to investigate the relationship between dissociation and a psychophysiological measure, namely Heart Rate Variability. Dissociation can be understood as a continuum ranging from non-pathological to pathological phenomena. In adverse circumstances, dissociation can serve as a coping strategy. *Heart Rate Variability* (HRV) refers to the variation in beat-to-beat intervals in the heart. As heart rate is controlled by the autonomic nervous system, HRV measurement is considered as a measure of autonomous regulation. A high HRV is associated with good physical and mental health, the opposite is true for low HRV. *Method*: 41 patients from Modum bad`s outpatient trauma clinic participated. They were 2 males and 39 females, ranging in age from 22 to 59 years (mean age = 35.8 years, SD=9.7). Dissociative symptoms were assessed using the *Multidimensional Inventory of Dissociation (MID)*. HRV measurements were obtained across four conditions (*rest*, *mild stress*, *stress* and *cool-down*). *Results*: We found a negative relationship between dissociative symptoms and HRV. This relationship was the strongest in the *rest* condition. *Conclusion:* Our findings confirm the psychophysiological nature of dissociation. Efforts to improve health can be directed at increasing HRV or decreasing dissociative symptoms. Learning better affect regulation skills through meditation or mindfulness-based therapy may be a way to combine these approaches. More research is needed to investigate whether such treatment is appropriate for patients with dissociative symptoms.

Introduction

The aim for this explorative study is to investigate the relationship between dissociation and a psychophysiological measure, namely Heart Rate Variability. The introduction will start by describing the phenomena of dissociation and dissociative disorders. We will see how traumatization can be detrimental to the development of affect regulation, and how dissociation can be understood as a coping strategy during adverse circumstances. Finally, we will explain how Heart Rate Variability can be used as a measure to investigate psychophysiological factors associated with affect regulation.

Dissociation

Dissociation represents a disruption in the normal integration of psychological and somatic functions, which may include memories, emotions, motor control, perception or even sense of identity (American Psychiatric Association, 2013). In a broader understanding of the term, most people have probably experienced something similar; missing the off-ramp at the highway and only realize much later because you were thinking of something else, losing your sense of time while playing a computer game or even forgetting about physical pain because you are so involved in a task. These are all examples of "everyday dissociation" or *absorption*, which is usually neither harmful nor disruptive (Anstorp &Benum, 2014).

Dissociation can be understood as a continuum. Opposite absorption, we find *pathological dissociation*. This represents an involuntary disruption of consciousness and control over mental processes, associated with loss of continuity in subjective experience. It can affect all areas of functioning (Spiegel, 2011). These symptoms in adulthood are often associated with a history of *psychological trauma* in childhood, in response to experiences such as

physical/sexual/emotional abuse or neglect, but can also occur in response to a single traumatic event in adulthood (Briere & Spinazzola, 2005). Psychological trauma is *emotional damage in response to a terrible event*. It is important to note that experiencing such an event (terrorist attack, rape, car accident or mugging) does not automatically result in a trauma response. Trauma occurs when the situational demands are bigger than the resources available to cope with the situation. The individual becomes overwhelmed and unable to integrate and process what is happening. This lack of integration and processing is what differentiates a memory and a trauma (Anstorp & Benum, 2014).

Dissociation as a defence strategy

Though often associated with pathology and maladaptation, dissociation may have helped some of our ancestors survive. Dissociation can serve as an adaptive and final remaining survival response when the situation or executor is dominated by helplessness (Schauer & Elbert 2010), and could therefore be an important function to pass on through evolution. When faced with a sabretooth tiger, an individual that responded with dissociation (being numb or completely frozen) may have had a bigger chance of survival than the alpha male trying to fight the bear with his fists. Even though the chances of being eaten by a sabretooth tiger in our time are slim, dissociation could serve as an important "last resort" coping strategy when faced with an overwhelming, adverse experience.

Dissociation during or soon after the traumatic event is referred to as *peritraumatic dissociation* (Briere, Scott and Weathers, 2005). Peritraumatic dissociation may serve an adaptive purpose, in that the individual is not forced to be "present" for the experience. However, this coping method may hinder proper encoding of memories relating to the event, as well as emotional and cognitive processing (Briere et al., 2005). Dissociation operates in four types of

defence mechanisms. *Automatization* involves redirecting one's conscious awareness away from an activity and during the activity without having control over actions or feelings. *Compartmentalization* is the splitting areas of conscious experiences from each other. *Alteration of identity* refers to isolating the overwhelmed traumatic experiences (ex. Psychogenic amnesia depersonalisation, derealisation, Dissociative Identity Disorder). The last mechanism is *protection from unbearable pain* during stress situations in the form of analgesia and anaesthesia (Martínez-Taboas & Bernel, 2000).

According to psychodynamic thinking, dissociation can be understood as an attempt to resolve a psychological conflict. Feelings of helplessness, humiliation, pain and fear are often associated with trauma. Dissociation can serve as a protection from having to experience such emotions (Atchinson & McFarlene, 1944). A child who is a victim of prolonged traumatization might use dissociation as a coping strategy, allowing the child to act "normal" at school even though terrible things are happening at home.

Dissociative symptoms

Dissociative symptoms can be classified as somatoform or psychoform in nature, as well as being "positive" or "negative" (Anstorp, Benum, & Jakobsen, 2006). The negative/positive description is analogous to the description of psychotic symptoms, in that positive symptoms represent the presence of feelings or behaviour that is not usually there, and negative symptoms display lack of feelings or behaviour that is usually present (Nijenhuis & Hart, 2011). In dissociation, example of positive psychoform symptoms are usually related to traumatic re-experiencing and dissociative flashbacks, whereas negative psychoform symptoms include detachment and amnesia. Positive somatoform symptoms include pain, convulsions and twitching, and negative somatoform symptoms containnumbness and paralysis. (Nijenhuis, Hart

& Steele, 2002). In addition, the patient can experience intruding voices, thoughts, movements and emotional or physical feelings which can be manifested as sensory disturbance, pain, tics and/or panic reactions (Dell, 2006).

Dissociative disorders in the DSM-5

According to Diagnostic and Statistical Manual of Mental disorders, fifth edition (American Psychological Association, 2013) there are five dissociative disorders: Dissociative identity disorder, Dissociative amnesia, Depersonalization/derealisation disorder, other specified dissociative disorder and unspecified dissociative disorder. The total prevalence for these disorders is estimated to be between 9 and 18% (Bailey & Brand, 2017), but for reasons that will be explained later, it is very hard to make an accurate estimation. A brief explanation of the five dissociative disorders will follow.

Dissociative Identity Disorder (DID) is the most well-known Dissociative Disorder (DD), having been described more than a hundred years ago and been portrayed in various films and novels. This is likely due to the interesting and mystical nature of the disorder, and not the prevalence, which is estimated to be only 1% (Bailey & Brand, 2017). The DSM-5 diagnostic criteria include the presence of two or more distinct identities that recurrently take control of the patient`s behaviour. Following is extensive memory loss, and that the symptoms cannot be explained by alcohol/drugs or a neurological condition.

Dissociative amnesia relates to difficulties in remembering episodic biographical memory, often of a traumatic or stressful nature. The memory loss must not be better accounted for by normative forgetting (Bailey & Brand, 2017). In the DSM-5, dissociative amnesia

includes the subcategory of *dissociative fugues*, in which the patient can find him or herself at a place they cannot remember travelling to.

In *Depersonalisation/derealisation disorder*, failure in perceptual integration leads to a subjective feeling of being unreal or detached from oneself or the world. Patients may describe feeling like they're in a dream or a different world, or feel detached from familiar people such as friends or family, or indeed from their own body (Dell, 2006). *Other specified dissociative disorders* include a mixture of dissociative symptoms that look alike DID, without meeting full criteria of this disorder. This disorder includes symptoms of identity disturbances, dissociative trance and acute dissociative symptoms due to stress that has lasted less than one month. *Unspecified dissociative disorder* is diagnosed when dissociation is present but the patient does not meet the diagnostic criteria for one of the listed dissociative disorders (Bailey & Brand 2017). In the following paragraph, we will take a look at why making these diagnoses are so complicated.

Difficulties in diagnosing DD

Dissociative disorders are challenging to diagnose. Patients with diagnoses of depression, anxiety, personality disorders, Post-Traumatic Stress Disorder (PTSD), or psychotic disorders may experience symptoms of dissociation in addition to the symptoms of their primary diagnosis. Dissociative symptoms may be *confused* with psychotic symptoms, resulting in a misdiagnosis of schizophrenia (Anstorp & Benum, 2014). Instead of presenting dissociative symptoms as the problem, patients may seek help for somatic complaints (e.g. headache, visual disturbances and gastrointestinal problems) or other psychiatric complaints like depression and anxiety (Kluft, 1985; Putnam, 1989; Putnam, 1994). Clinicians might struggle to identify dissociative symptoms, because they often expect the most dramatic changes in personality that

are seen in DID, even though this is the rarest form of dissociative disorder (Bailey & Brand, 2017). Eating disorders, self-harm or even somatic illness may obscure the clinical picture and make the dissociative symptoms less protruding. Many, if not most of the patients in question qualify for multiple psychiatric diagnosis in addition to the dissociative disorder diagnosis. This could in part be explained by the fact that early and recurring traumatization central in the aetiology of many, if not all the above-mentioned disorders.

Controversy in the field

Dissociative symptoms and disorders have been the subject of much controversy in the clinical field. Sceptics believe symptoms to be due to cognitive distortions, or even confabulations or fantasy Even though the disorders can be found in the DSM and ICD manuals of diagnoses, some clinicians are very sceptical of them, particularly of the DID. In contrast to the *posttraumatic model* (connecting dissociative symptoms to childhood trauma, moderated by factors such as genetic vulnerability) is the *fantasy model* (Dalenberg et al., 2012)*.* According to this model, dissociation is an innate characteristic, resulting in dissociation that could be pathological or non-pathological in nature. Moderated by absent-mindedness, fantasy proneness and executive dysfunction, dissociation can result in the presentation of false memories and acceptance of external suggestions. Though Dahlenberg et al. (2012) note that fantasy proneness may serve as an escape from adverse childhood experiences, and thus be a result of trauma, there is no causal link between childhood trauma and dissociation in the fantasy model.

Some believe DID to be the result of *iatrogenic* factors, meaning that it is a result of therapy (Piper and Merskey, 2004). This could be the result of *recovered memory therapy*, a form of psychotherapy that received much attention in the 80s and 90s (Ofhse and Watters, 1994). The underlying theory was that supressed traumatic experiences were the underlying

cause for many types of disorders, ranging from headaches to schizophrenia. Recovering these supressed memories (often regarding sexual abuse by a caregiver) were supposed to result in a form of *catharsis*, treating or curing the condition. Eventually however, it became clear that some of the "memories" recovered were simply untrue, and had been "inserted" by the therapist. The number of DID cases had a surge in this period, and family members of the patients reported that they had not observed multiple identities in the patients until *after* they had started therapy, suggesting a link between therapy and the development of DID symptoms (Ofhse and Watters, 1994).

The "haziness" surrounding DID has led to scepticism of the entire concept of dissociation. The psychodynamic tradition has been the most interested in explaining DID, but the subject is receiving increased attention from clinicians in the fields of cognitive psychology, behaviourism and biological psychology. Dissociative disorders have also been the subject of controversy in court, in cases where perpetrators claim that another identity committed the crime in question (Steinberg, Bancroft and Buchanan, 1993).

The developmental trauma that is thought to be central to the development of dissociative disorders also complicates the picture. Such traumatization is thought to make individuals vulnerable to many different psychiatric disorders, confirmed by the high degree of comorbidity in patients with dissociative disorders. In the following we will look at how developmental trauma can impact an individual`s affect regulation abilities.

Complex traumatization and its effect on the development of affect regulation skills

The trauma field has traditionally been concerned with trauma response after a single event, such as warfare, natural disaster or rape in adulthood. However, our ability to cope with

stress is developed in early childhood, and patients that have trauma related disorders commonly

report multiple accounts of traumatization (Cloitre et al., 2009). Van der Kolk (2005) introduced

a new term "complex trauma", which refers to the experiences of multiple, chronic and

prolonged, developmentally adverse traumatic events. Children are vulnerable to this type of

traumatization, due to their position of dependency to caregivers. Developmental trauma regards

events that are experiences at early age, affect and hinder the normal development of the child

(Anstorp & Benum, 2014).

Ideally, the caregiver should function as a "regulation system" as the child develops

(Mikulincer, Shaver and Pereg, 2003), in that the caregiver teaches the child how to understand

and endure its own emotions. The caregiver helps the child to quiet down when it is overly

excited, by holding it close, lulling it or singing to it. The caregiver can engage the child in times

when it is inactive, or explain to the child what it is feeling; "you are feeling *sad* because you are

sleepy" or "did it make you feel *angry* when he took your toy from you?". By explaining, giving

examples and showing interest in the child's emotions, the caregiver can help the child develop

an understanding of his or her emotions. This makes the child more capable of tolerating strong

emotions and less vulnerable to being overwhelmed by them, even as an adult. Good *affect*

regulation skills allow a person to understand and accept their own emotions, and to actively try

to regulate their own emotions.

Sometimes, however, the caregiver may be unable to provide the type of emotional

support that the child needs. This may be due to lack of time, psychiatric illness or substance

abuse, or poor parenting skills. Even worse, the caregiver may actively harm the child in place of

supporting it, through sexual or physical abuse, or neglect. In this case, the child may not

develop good affect regulation. Regulation support plays an essential role for how the brain and

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the nervous system connects, strengthening the connection between the parts of the brain that control how we deal under stress and threat situations (Mikulincer et al., 2003).

Through its interaction with the environment aided by the support of a caregiver, the child learns to respond to environmental demands. This includes developing adequate stress responses and the capability to restore rest functions after the source of stress has been eliminated. When good emotion-regulation is not properly developed in childhood, the individual may struggle with affect dysregulation well into adulthood. Affect dysregulation includes difficulties in modulating anger, chronic self-destructive and suicidal behaviour, difficulty modulating sexual engagement and impulsive risking behaviour (Van der Kolk et al., 1996).

Opposed to the mind-body dualism theories that were dominant for the better part of the last millennium, we now know that the processes of the mind and body are closely linked, affecting and depending on one another. Affect dysregulation therefore, in addition to being a subjective, emotional experience is also an observable, bodily process. In the following we will briefly explain the physical side of affect regulation.

Autonomic regulation

The Autonomic nervous system controls the heartbeat and consist of a sympathetic and a parasympathetic branch. Sympathetic activation prepares the body to respond to threatening situations, through elevated heart rate and increased blood pressure. This enables the body to *fight* or *flight* in response to the threat. The parasympathetic branch controls the activity of the body under normal conditions, and helps the body to recover and rest by reducing heart-beat (Appelhans & Luecken, 2006). In traumatized patients, a paradoxical activation of the ANS may

occur; increased sympathetic-activation in times of rest, or the parasympathetic branch taking over in a time of stress. The latter can be seen when the individual *shuts down* in response to the threat.

"Shutting down" refers to numbness of emotions, pain, fear and sensations, as can be seen in dissociation (Schauer & Elbert, 2010). As for our ancestors when faced with the sabretooth tiger, this can serve as a last resort survival response to overcome an overwhelming situation. A child who is being sexually abused by caregiver may not have the opportunity to use neither *fight* or *flight* successfully. *Shutting down* could then be the only available strategy. In the beginning the child might shut down during abuse, after a while it might happen whenever the child hears that the caregiver is coming towards his/her room.

Living under these circumstances, under constant threat that requires a survival response, can have adverse effect on the individual`s affect regulation. Even when the threatening situation is over, the body struggles to return to a "normal" ANS regulation. The body becomes *threat-sensitized*, resulting in a lower threshold for arousal and a higher sensitivity to new stressors. *Chronic hyperarousal* has been demonstrated through abnormal levels of stress hormones in PTSD patients (Kendall-Tucket, 2000). Traumatized patients often do not find themselves having enough time to analyse the situation, and may respond with automated behaviour. Threat sensitization was paramount for our ancestors; two seconds to decide whether a snake was poisonous or not could mean the difference between life or death, so a constant vigilance and fast response was of the essence. In our times, threat sensitization can mean constant stress, poor affect regulation as well as hasty and exaggerated responses.

In response to the findings of chronic hyperarousal in PTSD patients, Cohen and colleagues (2014) wanted to investigate autonomic regulation in such patients in response to a

trauma-reminder. Patients were asked to recount the traumatic experience that was the presumed to be the underlying experience to their clinical disorder. Controls were asked to recount a "significant stressful life event". Meanwhile, their heart rates were measured in order to obtain *heart rate variability,* a measure of autonomic regulation that will be explained in detail at a later stage. Contrary to expectation, the researchers found that the *control subjects* demonstrated significant autonomic response while recounting the negative event, whereas the patient group did not. Instead, the patient group displayed similar autonomic dysregulation in a state of rest as the control group did during the recount.

A flexible autonomic regulation characterized by influx from both parasympathetic and sympathetic branches of the nervous system is needed to ensure the right level of activation. This level of activation, between the sympathetic *hyperarousal* and parasympathetic *hypo-arousal*, has been called *the window of tolerance*. In this "window", emotions are tolerable and one can integrate new experiences. People who have been victim of prolonged trauma have a narrower "window", meaning that small amounts of stress can result in hyper or hypo-activation (Corrigan et al., 2011).

Hyperactivation is associated with difficulty in performing tasks or rash behaviour/impulsiveness; hypoactivation may cause the body to "freeze" or even collapse. This can result in chronic stress or conversely, numbness or other submission responses when a survival response is needed, due to exaggerated parasympathetic activation. An illustration of the window of tolerance with symptoms and behaviours associated with the hyper- and hypo-arousal states can be seen in *figure 1*. These states can last for a shorter or longer time, and one person may move in and out of the "window", or from hyperarousal to being hypo-activated.

Sympathetic-dominant Hyperarousal: Emotionally flooded, reactive, impulsive, hypervigilant, fearful, angry. Intrusive imagery and affects, racing thoughts Flashbacks, nightmares, high-risk behaviour Efforts to reduce this state may include suicide planning, self harm, compulsive cleaning, abuse of alcohol or opiates	Freeze Mute, terrified, frozen defence responses. High arousal coupled with physical immobility*
Window of Tolerance Optimal arousal zone, encompassing both intense emotion and states of calm or relaxation, in which emotions can be tolerated and information integrated	
Parasympathetic-dominant Hypoarousal: Flat affect, numb, "empty" or "dead" Cognitively dissociated, inability to think Collapsed, disabled defensive responses Helpless and hopeless Efforts to reduce may include suicide planning, self-harm, compulsive	

Figure 1. States of hyper- and hypo-arousal and the Window of tolerance. Reprinted from Autonomic dysregulation and the Window of Tolerance model of the effects of complex emotional trauma by F.M. Corrigan et al., 2010, *Journal of Psychopharmacology*, *25*(1), pp. 17-25.

Therapeutic interventions that aid tolerance of emotions and psycho-physiological relaxation can be helpful in treating trauma-related disorders, through "widening the window". Mindfulness-based cognitive therapy (MBCT) has been shown to reduce both PTSD symptoms and negative cognitions (King et al., 2015). Efforts are currently made to see if mindfulness can be used in the treatment of dissociative disorders as well (Zerubavel & Messman-Moore, 2015).

Heart Rate Variability

Understanding the physiological aspect of dissociation is of great interest to clinicians and researchers alike. Van der Kruijs and colleagues (2012) give an overview of the findings using different measures used to investigate this. According to their findings, there is indeed a pattern of altered brain connectivity (as shown by EEG), a pattern of brain activity (shown by

functional imaging) and a pattern of suboptimal regulation (measured by HRV) associated with dissociative disorders. In the following, we will explain the workings of Heart Rate Variability.

Heart Rate Variability refers to the variation in beat-to-beat intervals in the heart, i.e. changes in time between each heartbeat. This variation is due to a complex interplay and coordination of autonomic, respiratory, circulatory, endocrine and mechanical influences over time (Quintana, Alvares, & Heathers, 2016). The *sinoatrial node,* (the heart`s "pacemaker") affects the heart rate via membrane processes*,* that in turn are modulated by continuous input from the autonomic nervous system. Parasympathetic and sympathetic terminals, under the influence of acetylcholine and nor-epinephrine respectively, decrease and increase the heart rate (Tarvainen et. al., 2014; Berntson et al., 1997).

HRV is considered an indirect measure of *vagal tone*, which represents the amount of parasympathetic nervous system contribution to cardiac regulation, and is thus an important measure relating to affect regulation (Laborde, Mosley, & Thayer, 2017). Electric stimulation of the vagal nerve is associated with a temporary increase in HRV (Quintana et al., 2016), as is meditation (Braboszcz, Hahusseau and Delorme, 2010). Simply put; a *high variability* is linked to good health, as a *low variability* is linked to poor health. Healthy individuals usually display a high variability, with a significant decrease in variability during stress.

Certain personality traits are associated with a higher HRV, highlighting the interplay of psychological and physical health. Svendsen et al. (2016) concluded that high levels of *self-compassion* predicted participants having a better ability to physiologically adapt emotional responses to contextual demands, due to their finding that self-compassion and HRV correlated positively. Studies have reported on the relationship between emotion regulation and HRV (e.g.,

Berna et al., 2014, Williams et al., 2015; Visted et al., 2017). They all found a positive

relationship, meaning that difficulties in emotion regulation was associated with a lower HRV.

Williams et al. (2015) found that all but one facets of the Difficulties in Emotion

Regulation Scale (DERS) were associated with a lower HRV. This was particularly related to the

facets *emotional clarity* and *emotional impulse-control*, and Williams et al. (2011) note that

individuals with a lower HRV may find it "*difficult to identify (...) emotional responses and thus,*

are unable to inhibit and/or regulate them adaptively and consistently" (p. 5).

Conditions associated with a lower HRV include artery disease, congestive heart failure,

myocardial infarction and depression (Kleiger, Miller, Bigger and Moss, 1987). Lower HRV has

also been found in PTSD patients, and increasing HRV through respiratory biofeedback has been

shown to decrease pathological symptoms in these patients (Zucker, Samuelson, Muench,

Greenberg and Gevirtz, 2009). Health behaviours related to smoking, alcohol use, overweight,

and sleep disturbances are also related to lower HRV (Dennis et al., 2014).

A non-invasive and non-expensive procedure, HRV has gained interest as a measure of

autonomous regulation, in fields ranging from cardiology to psychophysiology. Participants

generally wear a chest strap or similar simple apparatus to measure cardiac activity. As

Tarvainen (2014) notes "*The aim in HRV analysis is to examine the sinus rhythm modulated by*

the autonomic nervous system. Therefore, one should technically detect the occurrence times of

the SA-node action potentials" (p. 8). This posing a technical challenge, Tarvainen (2014) goes

on to describe that "*The nearest observable activity in the ECG compared to SA-node firing is*

the P-wave resulting from atrial depolarization and, thus, the heart beat period is generally

defined as the time difference between two successive P-waves" (p. 8). P-waves being prone to

noise and hard to detect, heart beat period is more commonly defined as the interval between

QRS complexes, which primarily stem from ventricular depolarization (Tarvainen, 2014). An

illustration of these waves can be seen in *Figure 2.* After recording, data is typically run through

a program to be analysed and quantified. There are about 40 different ways to quantify HRV, but

most studies only use a few of the available measures. Low frequency, high frequency and root

square means of successive differences (RMSSD) are among the most used measures in research.
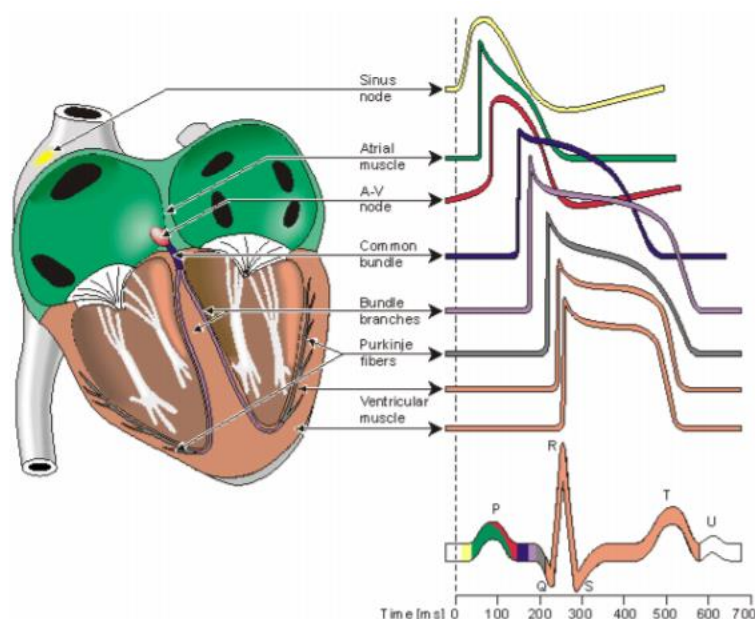

Figure 2: Electrophysiology of the heart. Reprinted from Kubios HRV-heart rate variability analysis software by M. P. Tarvainen et al., 2014. *Computer Methods and Programs in Biomedicine*, 113, p. 210-220.

Scope

The aim of this study is to explore the relationship between dissociative symptoms, as

measured by frequency scores on the *Multidimensional Inventory of Dissociation* and

autonomous regulation, as measured by HRV. Based on the research discussed, we predict a

negative relationship between these two measures, and based on the findings of Cohen and

colleagues (1998), we expect to find this relationship to be strongest when patients are at rest.

Method

Participants

Data presented in this study was obtained in cooperation with Modum Bad`s outpatient Trauma clinic, which offers clinical assessment and group based treatment in form of psychoeducation for trauma related disorders. The data were gathered from a larger study investigating the effect of stabilizing group treatment for patients diagnosed with PTSD and dissociative disorders. Patients referred to the clinic were invited to participate in the study upon commencing treatment.

To be included for participation in a group program and subsequently the study, patients had to report a history of childhood abuse. They had to be between ages 18 and 65 years, and have enough competence in Norwegian language to be able to participate in a psychoeducational group. They also had to fill the diagnostic criteria for a DSM-V diagnosis of Post-traumatic stress disorder, Dissociative Identity Disorder (DID) or Dissociative Disorder Not Otherwise Specified (DDNOS).

The exclusion criteria were acute suicidality, serious substance abuse interfering with treatment, serious psychotic symptoms, current life crisis interfering with therapy (ongoing abuse, divorce, court case, somatic disease in spouse or children etc.), and neurological disease, mental disability or life threatening somatic disease. The participants handed written consent, and the study was approved by the Regional Committee for medical and health research ethics. Participants could withdraw from the study whenever they wished to do so, without giving any reason.

Initially there were 123 participants in the dataset we obtained. After removing cases with missing values on either MID or HRV, we were left with 41 participants. The sample was overwhelmingly female, with 2 males and 39 females (95.1%), ranging in age from 22 to 59 years

(mean age = 35.8 years, SD=9.7). This was in accordance with the original dataset, which was 91.2% female and had a mean age of 38 (SD=11).

Procedure

Upon arriving at the clinic, patients underwent a diagnostic evaluation consisting of several self-report scales and clinical interviews conducted by psychologists and psychiatrists. HRV measurement was then obtained through recordings of blood volume and pulse using a standard three-channel ECG recorder (*eMotions Faro 360),* digitized in 500 Hz. HRV was measured in four instalments, each lasting about two minutes. They can be described as follows: 1) *rest test*. Patients were looking at a green circle on a screen for the two minutes the measurement lasted. 2) *mild stress*. Patients were asked to count only yellow triangles while triangles of different colours were shown on the screen. 3) *stress test*. Patients were asked to perform arithmetic in the form of subtraction. 4) *cool-down.* Two-minute measurement without any task.

After being manually checked for errors, the data was analysed using the software Kubios 2.0 (Tarvainen, 2014), yielding mean heart rate, LF, HF, RMSSD, NN50 and pNN50 (%). This was done separately for each of the four conditions of the experiment. The applied measure was root mean square of successive differences (RMSSD), which is considered to be a stable and valid measure of HRV (Svendsen et al., 2016).

The Multidimensional Inventory of Dissociation (MID)

In response to the diagnostic challenges described in the introduction, Dell (2006) developed the MID. He sought out to comprehensively cover the *phenomenological domain of dissociation,* which is the assumption that dissociation is *"recurrent, jarring intrusions into executive functioning and sense of self"* and that "*every aspect of human experience is subject to*

dissociative invasion" (Dell, 2006, p.79). By this definition, the phenomenon of "normal dissociation", such as absorption, is excluded. As opposed to clinical screeners of dissociation, the MID subscales designed to detect symptoms of borderline personality disorder and psychotic symptoms, to aid differential diagnostics.

The MID is a tool designed for research and diagnosis of patients that have a mix of dissociative, post-traumatic and borderline symptoms. It is a 218-item self-report questionnaire, including 168 dissociation items and 50 validity items (Dell, 2006). On each item, the patient is to describe how often they experience symptoms on an 11-item Likert scale (0-10, anchored by never and always on the form). The questionnaire is written in a 7th grade reading level.

The overall score on the MID is the *mean MID*. The mean score describes the frequency of dissociative symptoms, yielded by an average of responses from the 168 dissociation items. It is therefore quite a coarse measure for the presence of dissociative symptoms. The mean MID had an alpha value of .99 and a test-retest vale of .97 (Dell, 2006). The MID has shown good reliability and internal reliability, temporal stability, convergent validity, discriminant validity and construct validity.

More refined than the mean MID are the *facet scales*, which are grouped into three clusters. Each facet yields a mean of the items it consists of. The *dissociation facet scales* (see table 2) concern core features of dissociation and consist of 12 items each. The *partially dissociated intrusion facets* are concerned with symptoms that are associated with dissociation of the self (see table 3). These facets rely on fewer items (some as few as 3). The *fully dissociated intrusion facets* or *recurrent amnesia* concerns amnesia following such dissociation. These facets can be seen in table 4, and they also rely on fewer items (4-5).

Analysis

To investigate the relationship between HRV and dissociation, we conducted correlation analyses for HRV from each of the four conditions and Mean MID, using IBM SPSS Statistics for Windows, version 24. Our initial hypothesis, namely a negative relationship between HRV and Mean MID score was confirmed. We then went on to analyse correlations between RMSSD and the different sub facets (see figure 2).

Results

We first did a correlation analysis investigating the relationship between mean MID and HRV for each of the conditions. As can be seen in *Table 1*, there was a negative relationship between the two variables, although not significant for any of the conditions. As RestHRV was near significant (p=0.054), we went on to investigate the relationship between condition RestHRV and the MID sub facets.

Table 1.
 Pearson`s correlations between Mean MID score and HRV for the different conditions of experiment

	Mean MID
RestHRV	-.30
Mild stressHRV	-.25
Stress testHRV	-.06
Cool downHRV	-.11

Note. N = 41.

Table 2. *Pearson`s correlations between the Dissociation facet scales of the MID and HRV of the rest condition of the experiment*

Dissociation facet scales	RestHRV
Memory problems	-.26
Depersonalization	**-.32***
Derealization	-.28
Flashbacks	-.22
Somatoform	-.24
Trance	-.16
Identity confusion	**-.34***
Voices	-.20
Ego alien	**-.32***
Self-alteration	**-.33***
Self-states alters	-.19
Discontinuity of time	-.22
Ancillary	-.29

Note. Top six facets in table are "general dissociative symptoms". * *p* < .05

Table 3.

Pearsons correlation between "partly dissociated intrusions" facet scales of the MID and HRV from the rest condition of the experiment

Partly dissociated intrusions facet scales	RestHRV
Child Voices	-.16
Voices/internal struggle	**-.32**[*]
Persecutory voices	-.22
Speech insertion	**-.33**[*]
Thought insertion	-.27
Intrusive emotions	-.26
Intrusive impulsions	-.30
Intrusive actions	-.31
Temporary loss of knowledge or skills	-.19
Puzzlement about oneself	-.27

Note. [*] $p < .05$

As shown in tables 2 and 3, certain sub facets of the MID correlated significantly with RMSSD. In the *Dissociation facet scales,* they were *depersonalization, identity confusion, ego alienation* and *self-alteration.* Of the *partly dissociated intrusions facet scales, voices/internal struggle* and *speech insertion* had a significant negative correlation with HRV.

Table 4

Pearsons correlation between "fully dissociated intrusions" facet scales of the MID and HRV from the rest condition of the experiment

	RestHRV
Time loss	-.23
"Coming to"	-.20
Fugues	-.33*
Being told of disremembered actions	-.27
Findings objects–can't account for	-.33*
Finding evidence of recent actions	-.23

Note. * $p < .05$

Discussion

The aim for this study was to investigate the relationship between dissociative symptoms and HRV in a group of trauma patients under treatment at an outpatient clinic. Our findings suggest that a higher frequency of dissociative symptoms is associated with a reduced capacity to regulate emotional responses to environmental demands, in that higher MID scores were negatively correlated with HRV.

In accordance with our hypothesis, the "*rest*" HRV condition had the highest correlation with MID. The other conditions (*mild stress, stress* and *cool-down*) did not seem to correlate with MID. This is in line with what Cohen et al. (2014) found, and suggests that patients that are not engaged in a task may be vulnerable to dissociative experiences. In the following we will describe the MID sub facets that had a significant correlation with HRV.

Facets correlating significantly with HRV in the rest condition

The *general dissociative symptoms* (see table 2) are not uniquely found in patients with dissociative disorders. As Dell (2006) notes, they also occur in PTSD, somatization disorder, conversion disorder, panic disorder, schizotypal personality disorder, and borderline personality disorder. As previously noted, lower HRV has been found in PTSD patients (Zucker et al., 2009), and even though it has not been researched, one can theorize that the other disorders mentioned by Dell (2006) may be associated with a lower HRV. It is therefore interesting to see that out of the six "general symptoms", the only one to correlate significantly with HRV is that of *depersonalization*, a central feature of dissociative disorders. This facet includes items like "*Feeling as if you are two different people -one who is going through the motions of daily life and the other who is just watching*" and "*Feeling distant or removed from your thoughts and*

actions". In the *other dissociation facets, identity confusion, ego-alienation* and *self-alteration* correlated significantly with HRV. These facets include items like "*Your thoughts and feelings are so changeable that you don't understand yourself*", "*feeling like you are often different from yourself*" and "*feeling like some of your behaviour isn't really 'yours.'*".

In the *partially dissociated intrusions facets*, significant correlations were found between HRV and *voices/internal struggle* and *speech insertion* facets, but not to seemingly similar *persecutory voices* and *thought insertion.* The two former facets included the items *"Feeling a struggle inside you about what to think, how to feel, what you should do"* and "*Words just flowing from your mouth as if they were not in your control*" respectively, whereas the two latter facets included items like "*Hearing a voice in your head that wants you to die*" and "*Having thoughts that don't really seem to belong to you*".

Out of the *fully dissociated intrusions, fugues* and *finding objects one can`t account for* correlated significantly with HRV, whereas seemingly similar facets like *finding evidence of recent actions* did not. When looking closely at the items however, the items on *finding evidence* was a lot more extreme in nature than the *finding objects.* The items in *objects* were concerning things like: "*Finding things at home (for example, shoes, clothes, toys, toilet articles, etc.), that you don't remember buying*", whereas items from *evidence* were like this: "*discovering that you have attempted suicide, but having no memory of having done it*".

One common theme among the sub facets that correlated significantly with HRV seems to be *diminished or fragmented feeling of identity* - a core feature both in DID and, indeed, the other dissociative disorders. As aforementioned, everyone in our sample were diagnosed with PTSD or a dissociative disorder, and can therefore be assumed to have a lower HRV than healthy controls. The significant correlations that we found can therefore suggest that certain dissociative

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symptoms relating to depersonalization are *more* related to a lower HRV than others, and seemingly more so than are PTSD symptoms. Supporting this notion is the fact that somatoform symptoms and flashbacks, symptoms not specifically associated with DD did not correlate significantly with HRV.

So why did not all facets correlate significantly with rest HRV? There may be multiple explanations for this. Some of the facets included more "extreme" items, as mentioned above. Although one could expect that patients with high scores on facets like *persecutory voices*, *thought insertion* and *finding objects* to have a lower HRV, the opposite was found. The patients may have not identified with the items even if they had had similar experiences. The specificity of the questions might have led patients to rate them as "seldom", yielding a low facet scale. Another explanation might be that patients that frequently have experiences such as "*discovering that you have attempted suicide, but having no memory of having done it*" may not be receiving a higher level of care than our outpatient sample. Chance could also play a part in determining which facets came out with significant correlations and not, as the statistical analysis could be affected by the small number of items in the *partly* and *fully dissociated intrusions scales* as well as the small sample size.

Practical applications

A higher frequency of dissociative symptoms is related to a lower HRV; a low HRV is associated with poor mental and physical health. There seems to be two possible strategies to improve health given this conclusion; increasing HRV in the hope that this will lead to a decrease in dissociative symptoms, or reducing dissociative symptoms in the hope that it will increase HRV.

The first strategy is inspired by the findings of Zucker et al. (2014), that increasing HRV in PTSD patients leads to a reduction in symptoms. A biological approach in the form biofeedback or health changes (as in Dennis et al., 2014) could be a fast and low-cost approach. Psychotherapy focusing on symptom reduction (by means of psychoeducation or cognitive behavioural interventions) may lead to an increase in HRV, given the negative correlation.

Meditation- and mindfulness-based treatments might be a way to address both issues at the same time. As we have seen, meditation can improve HRV (Braboszcz et al., 2010). Self-compassion, a central concept in mindfulness, is associated with higher HRV (Svendsen et al., 2016). Mindfulness-based therapy (MBT) can help reduce PTSD symptoms (King et al., 2013) and perhaps dissociative symptoms too (Zerubavel and Messman-Moore, 2015). Meditation and mindfulness could help patients learn more appropriate affect regulation strategies through "widening" the window of tolerance., making the patient better equipped for handling stress.

Meditation can help patients to focus more on "here and now", as they get overwhelmed over the past traumatic experiences. *Anchoring* is a well-known term in trauma treatment, and involves helping the patient to achieve an arousal level within the window of tolerance. Our findings show that the patients had a significantly poorer autonomic regulation during the rest condition, potentially making them vulnerable to affect dysregulation. When distracted by the arithmetic questions (which were supposed to make them stressed!), this effect went away. This is in accordance with what is seen in the clinic; a patient that is outside their *window of tolerance* can be helped "inside the window" through simple tasks. Whether hyper-aroused and vulnerable to re-experiencing a trauma or hypo-activated and vulnerable to dissociation, tasks such as counting the number of blue things in the room or naming the days of the week might help the patient return to within the window.

None of these strategies address the underlying function of dissociative symptoms. Increasing HRV by the methods described may make the individual more able to *withstand* stress, but they might still rely on dissociation as a coping strategy when they do get stressed. Symptom reduction may reduce dissociative symptoms, but does not teach the individual more appropriate coping strategies.

It can, however, be dangerous to make assumptions about treatment based on results from PTSD studies. Though the patient groups have a lot in common, good treatment for the one is not necessarily good treatment for the other. Since we found that the patients were vulnerable to hypoactivation during inactivity, they might respond different than the "hyper-aroused" PTSD patients. Meditation could result in dissociative symptoms for our participants. Instead they might need to be distracted or *anchored.* More specific research on dissociation and different treatments are therefore needed.

Limitations

The generalizability of the study is uncertain as the sample contained almost exclusively female participants. This could be due to a selection effect in the recruitment of participants through a trauma clinic; females are more likely to fall victim to sexual and non-sexual abuse, and are also more likely to take contact with psychiatric services than men. One can theorize that men that have experienced complex traumatization may be found in other places, such as correctional facilities or rehab clinics. Another limitation in this study is that there is no control group, which makes it impossible to compare the HRV of patients with a history of childhood maltreatment to other groups, e.g. nonclinical participants.

Future directions

This study being an explorative one, more research is required to support its conclusions, preferably in a bigger, more gender-balanced sample with a matched control group. However, other studies have confirmed the neurophysiological basis for dissociative disorders, and evidence-based treatment for trauma related disorders is centered around a neurobiological framework. Therefore, future research should investigate whether psychoeducation, group therapy or other therapeutic interventions have a positive impact on HRV. The effect of increased HRV on dissociative symptoms should also be further investigated. In addition, more research concerning patients with dissociative symptoms is needed, as results from studies conducted with PTSD patients may not be generalizable to patients that have such symptoms.

Conclusion

The findings in this study confirm the strong link between mind and body in affect regulation and, more specifically, dissociative symptoms. Cognitive distractions or anchoring can help patients avoid immediate dissociation, as they are more vulnerable to this when inactive. Interventions founded in either the somatic or psychological domain of such symptoms might prove to be efficient to both domains, but may leave patients still relying on dissociation as a coping strategy. Mindfulness and meditation may prove to simultaneously improve HRV *and* dissociative symptoms, but more research is needed to determine whether this approach is suitable for patients with dissociative symptoms.

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