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***The Relationship Between Memory Control, Emotion
Dysregulation and Subclinical Borderline Symptoms***

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Abstract

This study aims to investigate the relationship between memory control ability and a range of borderline personality symptoms in nonclinical participants. It also aims to explore whether emotion regulation skills are a mediator of this relationship. 61 participants completed an adapted, online think/no think experiment using scene-object picture pairs to investigate their memory control. They also completed questionnaires measuring their emotion regulation skills, borderline symptoms and thought control ability. A within-subjects design was used with mixed-methods data collection. Regression analyses revealed a statistically significant negative relationship between subclinical borderline symptom severity and memory control. Nevertheless, emotion regulation skill was not a mediator of the relationship. However results should be interpreted with care due to the novelty of the method. The results add to previous findings on memory control in borderline diagnosed populations, suggesting that with an increase in subclinical borderline symptoms, memory control worsens. Further research is needed to identify whether memory control can be improved as a skill, thereby potentially providing a simple solution for those without a diagnosis but with symptoms that still reduce quality of life.

Keywords: memory control, borderline personality disorder, emotion dysregulation

The Relationship Between Memory Control, Emotion Dysregulation and Subclinical Borderline Symptoms

“When life gives you lemons, you make lemonade”. A popular saying that represents a healthy way of dealing with difficult situations, in other words, a perfect description of emotion regulation. We strive to flexibly respond to and manage our emotions, however there are many people that have trouble with emotion regulation. So much so that the lack of it, emotion dysregulation, can lead to psychological distress. Emotion dysregulation is a daily source of psychological distress, and it is at the crux of several severe psychological disorders such as depression, anxiety and borderline personality disorder (BPD; Bradley et al., 2011). BPD is a psychiatric disorder characterised by intense emotion dysregulation, unstable interpersonal relationships and polarised thinking (American Psychological Association, 2013b). At least 1% of the Western world is diagnosed with BPD (National Collaborating Centre for Mental Health UK, 2009), and many more suffer from subclinical symptoms that do not reach the diagnostic threshold. To receive a diagnosis the person must reach five of nine specific criteria (American Psychological Association, 2013b), however research shows subclinical BPD symptoms increase an individual’s risk of suicide, hospitalisation and significantly worsen psychosocial functioning (Johnson & Levy, 2020). This paper will focus predominately on individuals with subclinical BPD symptoms.

Exercising cognitive control over specific thoughts and memories has been suggested as an underlying mechanism of emotion regulation in a recent theoretical paper; the authors termed this as “memory control” (Engen & Anderson, 2018). Memory control is defined as the ability to intentionally and actively control which thoughts reach consciousness and which do not (Anderson & Hanslmayr, 2014). Growing evidence suggests that this ability successfully suppresses the retrieval of explicit and implicit memories for specific events, which is an effect referred to as suppression-induced forgetting (SIF; Anderson &

Hanslmayr, 2014). Investigating mechanisms behind emotion dysregulation can go a long way to working towards effective treatments for individuals suffering from symptoms of BPD.

Recent work in memory control is challenging older ideas about the utility of intentional thought suppression within mental health research. Using newer and more refined methods, researchers are providing persuasive evidence for the effectiveness of memory control within therapeutic research (Engen & Anderson, 2018; Wang et al., 2019). Consistent evidence supports memory control as an adaptive strategy to deal with intrusive thoughts which in turn leads to an improvement in well-being (Daches, Mor, & Hertel, 2019). Managing the negative consequences of maladaptive strategies, such as self-harm, substance abuse and aggression, is essential for the wellbeing of individuals particularly those with BPD symptoms but also society in general. After reviewing the literature, no research has provided explicit evidence linking emotion regulation and memory control, despite there being a good foundation for such a relationship highlighted in the theoretical review by Engen and Anderson (2018). Additionally, no research was found regarding individuals suffering subclinical BPD symptoms and their memory control ability. This paper will look at both these areas in order to identify potentially underlying difficulties in this population and to test the theoretical link between emotion regulation and memory control.

Memory Control Theory and Evidence

Neurological evidence shows that memory control impacts the brain at the most fundamental levels of processing. Deliberate cognitive control over thoughts has been shown to downregulate both the hippocampus, the “memory index” area of the brain, and emotion-regulated activity in the amygdala (Gagnepain, Hulbert, & Anderson, 2017; Levy & Anderson, 2008). However, this ability seems to be deficient in those with psychological

diagnoses involving intrusive thoughts and the ability is more present in those with better emotion regulation skills and higher psychological wellbeing; implying that it is a part of a healthy emotion regulation strategy (Sala, et al., 2009; Stramaccia et al., 2019).

Historically, the use of memory control or thought suppression has been criticised and some studies report a rebound effect whereby the attempt to suppress a thought leads to it arising more often (Rosenthal et al., 2005). The rebound effect does seem to occur in some populations and upon reviewing the meta-analysis by Stramaccia and colleagues (2019), this is likely due to differences in memory control ability, which is poorer in those with psychological disorders. One reason could be the increased cognitive load required to successfully perform memory control. Individuals suffering from intrusive thoughts likely have their cognitive resources used up from managing their other symptoms, leaving less available for memory control (Geiger, Peters, & Baer, 2014). Another reason could be due to the different measures of memory control used in past research. Most commonly, memory control is measured using the white bear paradigm (Wegner et al., 1987), however limitations have been identified suggesting that it does not represent the usefulness of suppression as a tool (Wang et al., 2019; Magee, Harden, & Teachman, 2012). Thus providing evidence for the use of an updated paradigm investigating the concept. One such tool, created by Anderson and Green (2001) is the think/no think (TNT) paradigm.

TNT Paradigm

The TNT paradigm, in part, simulates a situation in which a reminder of an unwanted memory is presented and the participant must attempt to keep it out of consciousness. It consists of three parts: participants must first study and learn pairs of cues and associated targets, then they are instructed to actively forget or remember certain target items, lastly participants are presented with each cue and must recall the target associated with it

originally. The experiment contains three trial types: no-think trials (items suppressed), think trials (items retrieved) and baseline trials (studied but neither suppressed nor retrieved). The number of no-think items retrieved in the final test is then compared to number of baseline items retrieved and think trials, the outcome is the suppression induced forgetting effect (Anderson & Hanslmayr, 2014). Traditionally, it has been researched using word pairs, which has low ecological validity considering that intrusive memories do not tend to be single words and are in fact more likely to be emotional, negatively valenced images (Ehlers & Clark, 2000). More recently, researchers are adapting the TNT paradigm to more naturalistic settings such as using images, valenced stimuli and even autobiographical memories (Küpper et al., 2014; van Schie & Anderson, 2017).

Borderline Personality Symptoms and Memory Control

Current research on memory control focuses on intrusive thoughts in psychopathologies, such as post-traumatic stress disorder (PTSD) and depression. However, when it comes to BPD, there is a stark research gap as the literature shows just one study on memory control using the TNT paradigm on participants with a BPD diagnosis (Sala, et al., 2009). Three additional studies were found looking into BPD diagnosis and directed forgetting tasks, which all found that those with BPD had more difficulty with actively suppressing information than controls (Cloitre & Brodsky, 1996; Domes, et al., 2006; Korfine & Hooley, 2000).). It is important to note the difference between the just mentioned directed forgetting tasks and directed suppression tasks, such as the TNT. Where directed forgetting tasks measure cognitive control of information before a memory has been formed, directed suppression tasks measure cognitive control of information after it has become a memory. Control over intrusive memories is measured by directed suppression tasks therefore, the only research article that has covered the relevant topic is that by Sala and colleagues (2009). They found that the memory control mechanisms were impaired in individuals with BPD after

information storage (even more so if they experienced childhood trauma) compared to healthy controls.

Despite the usefulness of studies looking at memory control in clinical BPD populations, diagnosis-specific research is not necessarily conclusive when investigating underlying mechanisms in a disorder like BPD, due to the heterogeneity found within its diagnosis (Wright, et al., 2013). Therefore, it can be argued that more research is needed looking at nonclinical populations whereby subclinical BPD symptoms can be considered. The literature shows no studies looking at memory control within subclinical BPD populations. Investigating this relationship further has the potential to deconstruct two of BPD's identifying symptoms, intrusive memories and linked emotion dysregulation. Subclinical BPD populations have, however been investigated with regard to emotion dysregulation (Salsman & Linehan, 2012). Salsman and Linehan (2012) found significant emotion regulation difficulties in a subclinical BPD population, in particular concerning problems accessing emotion regulation strategies.

This thesis will look into the relationship between individuals' abilities to control thoughts and memories, their emotion regulation skills and their severity of BPD symptomatology. The first aim is to test whether subclinical BPD symptom severity is directly linked with memory control ability and whether emotion regulation skill moderates this relationship. As a secondary aim, the thesis will test the feasibility of running a TNT experiment online from a distance opposed to in a lab environment. Two hypotheses are as follows:

- As subclinical BPD symptom severity increases, memory control score decreases
- Emotion regulation skills is a mediator of the relationship between subclinical BPD symptom severity and memory control

This thesis will provide empirical evidence to fill in the substantial research gaps where individuals with subclinical symptoms of BPD are concerned. Identifying whether emotion regulation is a mediating factor for the relationship between BPD symptoms and memory control can be useful in further understanding BPD as a psychiatric disorder and the development of treatments to improve wellbeing and mental health. Additionally, the research techniques used to investigate memory control are novel in so far as the experimental TNT paradigm will be implemented through an online platform which has never been done before. Therefore, through investigating the primary aim, a new psychological method of data collection will be tested for its effectiveness. This will contribute to the research field of memory control, by providing a way to collect data from a wider range of participants and without requiring them to be physically present.

Method

To investigate the hypotheses above, a mixed-methods research design was used in order to collect data from standard psychometric questionnaires and a TNT experiment. The TNT task, originally devised by Anderson and Green (2001), was successfully adapted by Küpper et al. (2014) to include object-scene pairs rather than word pairs. This study further adapted the TNT task to be used online, which involved open-ended written responses that were then coded by two independent coders. This TNT procedure included three parts: training, instructed suppression or recall and a final recall test. Three psychometric questionnaires were then completed following the TNT procedure.

Participants

68 participants were recruited as part of an online recruitment strategy, through Facebook research group announcements and a convenience sample of mostly international and Swedish students at Lund University, Sweden. Requirements for participation were that

individuals were a minimum of 18 years old and did not have a diagnosed mental health condition. Following a data clean-up, seven participants were removed due to their responses to the TNT final test in which they wrote approximately one word rather than a description of some sort. This implied that either their understanding of the instructions was at fault or they did not take the time required to type out their remembered descriptions of the target scenes. The final participant pool comprised 61 predominantly female (62.3%, n=38) individuals mainly aged between 18 and 30.

Ethical approval was not necessary due to the use of non-emotional stimuli (valence ratings of between 4.21 and 8.22) and the absence of any aims to manipulate participants or change their mental state in any way. All participants gave explicit consent to taking part in the experiment and further analysis of their results. They were assured that all data is treated with confidentiality and anonymity, as well as being informed of their right to discontinue at any point, even after they submitted the results. They were given a unique code that they could send in so that the researcher was able to remove their data.

Materials

Programs. The experiment was conducted online via the Psytoolkit platform (Stoet, 2010, 2017). This enabled it to be distributed over the internet to a larger number of the specified population. Using this design, ecological validity is very high due to it happening in the real world and not in a lab environment. However, this comes at the cost of common issues with online experiments such as lack of attention, boredom with the length of the task and an uncontrolled experiment environment. SPSS 26 is used for analysis of the results (IBM Corp., 2019).

Borderline Symptom List (BSL-23). The BSL-23 is a self-rating instrument for assessment of borderline-typical symptomatology using a five-point Likert scale to assess

subjective severity of symptoms in the past week (0 = *not at all* to 4 = *very strong*). It provides a continuous measure of symptom severity for the whole range of BPD severity, from none to very high. It has been rated as efficient and convenient, displaying good psychometric properties with a Cronbach's alpha of 0.94-0.97 (Bohus, et al., 2009).

Thought Control Ability Questionnaire (TCAQ-20). The TCAQ has been used in similar experiments to assess a subjective view of memory control (Gallagher, Bentley, & Barlow, 2014; Küpper et al., 2014; Peterson et al., 2009), however the present study has paired it with the TNT paradigm. The two tests will produce a subjective and an objective measure of memory control. It was assessed as being unidimensional, reliable and valid, in its short, long and computerised versions with a Cronbach's alpha of around 0.90 (Feliu-Soler, et al., 2019). To compact the self-report questionnaire length, the short version will be used which is the TCAQ-20 (Williams, et al., 2010). It consists of 20 questions answered on a five-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*).

Emotion Regulation Skills Questionnaire (ERSQ). The ERSQ is a 27-item self-assessment questionnaire based on the adaptive coping with emotions model which conceptualises adaptive emotion regulation using vital skills required (Grant, Salsman, & Berking, 2018). It employs a five-point Likert-type scale (0 = *not at all* to 4 = *almost always*) for questions regarding emotion regulation skills used within the last week. The average score for the ERSQ is used in this study, higher scores indicate increased ability to deal with emotions and vice versa. The ERSQ scale was used due to strong evidence for its reliability and validity with a Cronbach's alpha of .90 (Grant, Salsman, & Berking, 2018).

Stimuli

Stimuli used in the TNT task are pictorial because memory intrusions tend to consist of flashes of images rather than verbal or written presentations (Holmes & Mathews, 2010).

30 object-scene pairs were created using Inkscape to fit within a 800x600 pixel size.

Neutrally valenced scenes were chosen and the object chosen was a representation of a critical object within the paired scene. The aim was that the object would trigger the memory of the scene in a similar way that is done in reality when everyday objects can trigger unwanted memories (Ehlers & Clark, 2000). The TNT method using images has been found to produce successful results and recall is more enhanced compared to that of verbal material (Holmes & Mathews, 2010; Küpper et al., 2014).

The scenes were found using the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008) and adapted in the same way as the study by Küpper et al (2014). Using the IAPS valence rating from 1 (*very unpleasant*) to 9 (*very pleasant*) the chosen scenes had a mean of 6.1 using this scale. The objects were found through various different object databases available for psychological experiments (Naor-Raz, 2003; Brady, 2008; Konkle, 2010; Brodeur, 2014).

TNT Task and SIF Measure

The TNT task involved three stages. In the training phase, participants were asked to study all 30 object-scene pairs in two blocks of 15, each for eight seconds with an interstimulus interval (ISI) of 1s. They then practiced associating the object-scene pairs correctly using a small game whereby one object was presented and they had to choose the correct association out of three scenes within 4s. Feedback was given, “correct”, “incorrect” and “too slow” with a 750ms ISI. The same game was repeated but without feedback the second time and number of correct associations were recorded to ensure that the associations were learnt in the participant’s episodic, long-term memory.

The second TNT stage involved the instructed suppression or recall. Think objects were presented in the middle of the screen surrounded by a green border and no-think objects

were presented with a red border. Participants had four seconds to actively suppress or recall the associated scene and there was a ISI of between 1400 and 2600ms showing a fixation point. They started with a practice block with two filler objects, followed by a refresher of all 30 object-scene pairs (presented for 1.5s each with a 250ms ISI) and then three blocks of 16 test objects in a randomised order. Suppression instructions are important during this stage and there are two ways forgetting can be induced via memory control, distraction or direct intentional suppression (Anderson & Hanslmayr, 2014). Direct intentional suppression was the mechanism used for this test and it has been found to be more powerful than distraction as it generalises to other retrieval cues (Wang et al., 2015).

Lastly, during the final recall phase, participants were presented with the cue objects and asked to describe the associated scenes in a text box with as much detail as possible without a time limit. Details and accuracy of the descriptions were initially scored by two independent coders with a 90% agreement. Mismatched ratings were then discussed and consensus was made regarding what counted as an accurate detail and where an image could be identified by the description or not. The suppression induced forgetting (SIF) score was calculated as the number of no-think details identified subtracted from the number of baseline details identified. A negative SIF score indicated that memory control was present.

Procedure

Participants used an online link, either through email or Facebook and were directed to the Psytoolkit website where they started the full screen experiment which took between 30-60 minutes to complete. 30 object-scene pairs were included overall with six fillers, eight think pairs, eight baseline pairs and eight no-think pairs. Participants were randomly allocated into one of three groups in which the eight object-scene pairs in the categories previously mentioned were rotated, to ensure that the experimental effect was due to the manipulation

rather than the memorability of the specific picture. After the TNT task participants filled out three questionnaires: BSL-23, TCAQ-20 and ERSQ on the same online platform.

Results

Statistical analysis was performed using SPSS 26.0 statistical software (IBM Corp., 2019). Before testing the hypothesis, descriptive statistics were created to ensure that basic assumptions were met and the appropriate tests could be conducted. Next, several regression analyses were run to test the relationships between all variables: subclinical BPD symptom severity and thought control ability as well as emotion regulation skills and SIF score, additionally the relationship between SIF score and thought control and emotion regulation skills. Lastly, a mediation analysis using the intervening variable effect concept was run using the PROCESS v.3.5 macro in SPSS, which tested the hypothesis that emotion regulation skills is a mediating factor in the relationship between BPD symptoms and memory control.

Psychometric Scales

To ensure internal consistency and reliability, Cronbach's alpha was calculated for each of the scales (TCAQ-20 Cronbach's $\alpha = .94$; ERSQ Cronbach's $\alpha = .95$; BSL-23 Cronbach's $\alpha = .91$). A simple linear regression was calculated to predict emotion regulation skills based on subclinical BPD symptom severity. A statistically significant regression equation was found $F(1,59) = 16.09, p < .001$, with an R-squared of .214 (see Figure 1). Participants' predicted subclinical BPD symptom severity score is equal to $3.036 - .511$ (ERSQ score) when emotion regulation skill as measured by the ERSQ. Participants' subclinical BPD symptom score decreased .511 when emotion regulation skill score increased by 1.

Another simple linear regression was calculated to predict thought control ability based on subclinical BPD symptom severity. A statistically significant regression analysis was found $F(1,59) = 49.206, p < .001$, with an R-squared of .455 (see Figure 2). Participants' predicted subclinical BPD symptom severity score is equal to $72.914 - 22.165$ (TCAQ score) when thought control ability is measured by the TCAQ-20. Participants' subclinical BPD symptom severity score decreased by 22.165 when thought control ability score increased by 1. Together these indicate that the higher the subclinical BPD symptoms a participant had, the lower their self-assessed thought control ability and emotion regulation skills.

Figure 1

Relationship between Borderline Symptom Severity and Emotion Regulation Skills

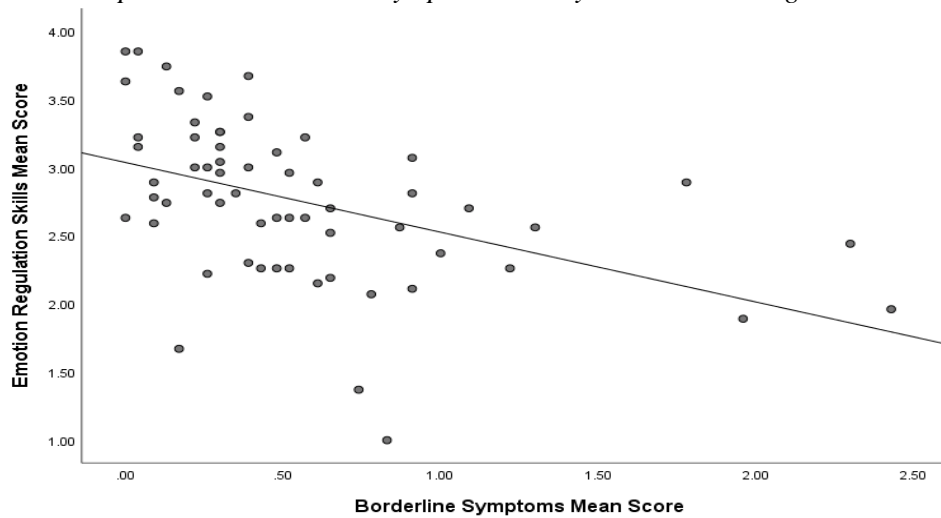
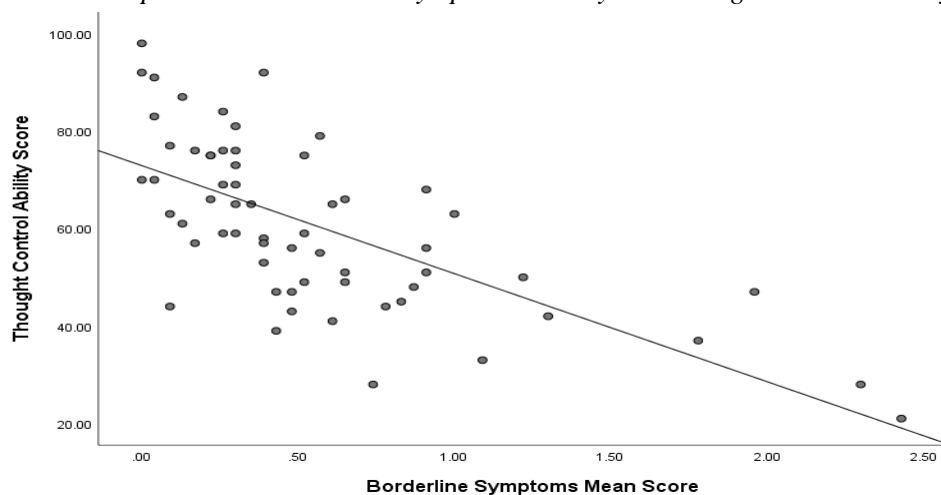


Figure 2

Relationship between Borderline Symptom Severity and Thought Control Ability

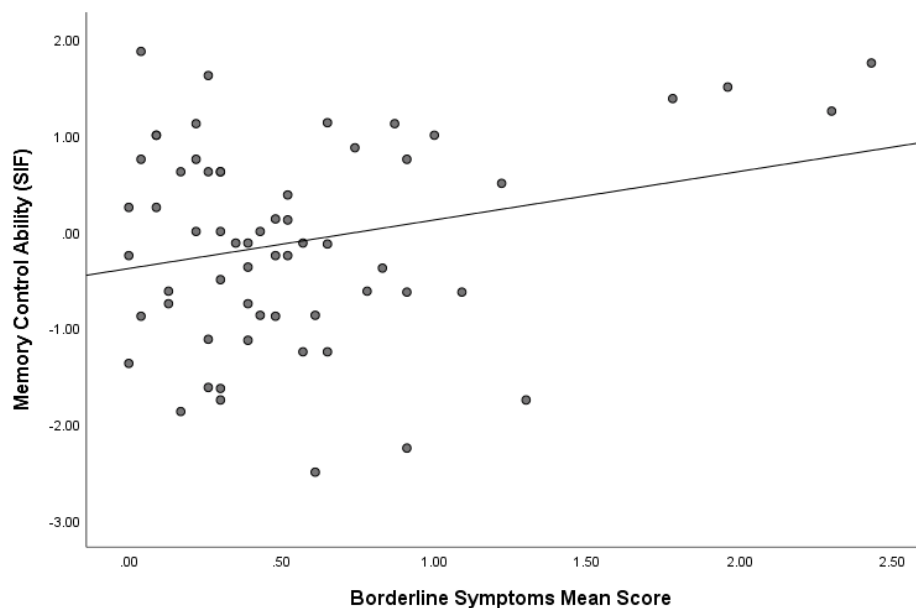


Memory Control Analysis

To see if memory control predicted subclinical BPD symptoms, a linear regression analysis was conducted which was found to be statistically significant $F(1,59) = 4.020, p < .05$, with an R-squared of .064 (see Figure 3). Participants' predicted subclinical BPD symptom severity score is equal to $.564 + .126$ (SIF score) when memory control is measured by the SIF score. Participants' subclinical BPD symptom severity score increased by .126 when SIF score increased by 1. Taking into account that a positive SIF score indicates reduced memory control this suggests that those with higher subclinical BPD symptoms tended to have poorer memory control than those with lower to no subclinical BPD symptoms. To test the relationship between emotion regulation skills and memory control, another simple regression analysis was conducted and did not identify a statistically significant relationship $F(1,59) = .015, p = .904$.

Figure 3

Relationship between Borderline Symptom Severity and SIF Memory Control

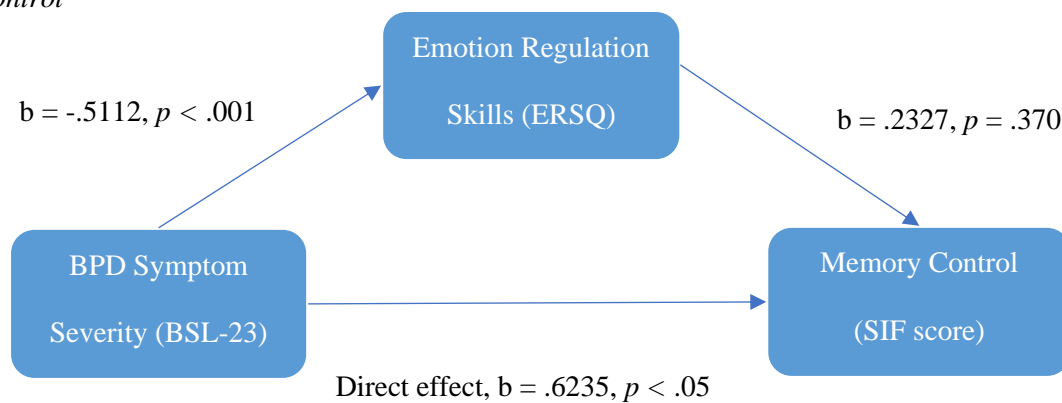


Mediation Analysis

The direct effect of BSL-23 score on SIF score is positive and statistically significant ($b = .2635, p < .05$) indicating that those with higher subclinical BPD symptom severity are more likely to have lower memory control (the lower the SIF score the better the memory control). The direct effect of BSL-23 score on ERSQ score is negative and significant ($b = -.5112, p < .001$) indicating that people with higher subclinical BPD symptom severity are more likely to have lower emotion regulation skills than those with lower subclinical BPD symptom severity. The direct effect of ERSQ score on SIF score is positive and non-significant ($b = .2327, p = .370$). The indirect effect is tested using non-parametric bootstrapping and the indirect effect (IE = $-.1190$) is not statistically significant: 95%CI = ($-.4203, .2041$) (see Figure 4).

Figure 4

Mediation Model between Borderline Symptom Severity, Emotion Regulation Skills and Memory Control



Discussion

This study is the first to assess the role of emotion regulation skills on the relationship between subclinical borderline personality disorder symptoms and memory control. The results suggest that those with higher subclinical BPD symptom severity have a reduced memory control ability, as well as reduced emotion regulation skills. Nevertheless, the predicted mediating effect of emotion regulation skills on the relationship between BPD symptoms and memory control was not found. Therefore the first hypothesis is held but the second hypothesis is not supported. However, the finding that memory control is affected even within subclinical BPD is a crucial to BPD research, providing further evidence that diagnosis-specific research is not conclusive in discovering the underlying mechanisms of BPD and similar disorders (Wright, et al., 2013).

The findings are in line with previous research on subclinical BPD symptoms and emotion dysregulation which found that they are highly correlated (Glenn & Klonsky, 2009; Salsman & Linehan, 2012). Previous research also shows that those with BPD have trouble with their self-assessed thought control ability (Peterson R. D., Klein, Donnelly, & Renk, 2009). The current results add to these findings by providing evidence that difficulties with emotion regulation and thought control ability extend beyond the diagnosis threshold and affect individuals with subclinical BPD symptoms. Specific research using the TNT paradigm as a measure memory control is scant when it comes to the topic of BPD even though it is just as pertinent as other disorders involving intrusive memories. The current research supports the results from the only study on BPD using the TNT paradigm, suggesting that people with BPD have difficulties with memory control (Sala, et al., 2009). Results from the present study, however, suggest that this problem is also present in subclinical BPD populations when looking at BPD symptoms as dimensional rather than clear-cut categorical divisions. There has been a strong push in the field of personality disorders towards viewing

them as dimensional rather than categorical (Hopwood, et al., 2018). This is supported by research which demonstrates problems such as low reliability and heterogeneity within personality disorder diagnoses (Widiger & Samuel, 2005).

The current results are, however, not directly comparable to previous literature due to the nature of measurement used in this study. The adapted TNT experiment was novel in that it was distributed online rather than in a lab environment. This had advantages including reaching a larger population and allowing individuals to do the experiment in their own time and environment, increasing the ecological validity of the study. Having scene-object pairings rather than word pairings also increases the ecological validity because it more closely resembles the process of intrusive memories based on seeing an object you associate with a scene. Ecological validity was, however reduced by the lack of emotional stimuli used within the TNT experiment and this was due to ethical constraints; although pictures and objects are used, intrusive memories are not usually evoked by neutral stimuli (Bowen, Kark, & Kensinger, 2018). Nevertheless, this study also had disadvantages which were that some participants might not have taken the time necessary to complete the experiment with their full attention which would have reduced the quality of their written response in the final TNT stage. Instead of verbally recalling a scene, participants wrote their descriptions and these were then rated for number of details recalled correctly. This method worked insofar as a marked difference in SIF scores was identified depending on BPD symptom severity, even though the relationship was rather weak.

The weak relationship found between BPD symptom severity and memory control could be caused by the first attempt at running the TNT online. It was successfully implemented in this study, however would need further testing to increase the robustness of it as a measure of memory control. Another possibility is the neutral valence of stimuli used. Evidence is contradictory surrounding whether memory control difficulties worsen with

negatively valenced emotional stimuli compared to neutral stimuli (Gagnepain, Hulbert, & Anderson, 2017). However, the possibility still stands that the weak effect found may have been larger if more emotional stimuli was used. The memory control test may have been just strong enough to be related to BPD symptom severity but not to emotion regulation.

Considering that emotion regulation skills and BPD symptom severity are highly related and there is evidence in other research supporting a hypothetical relationship between memory control and emotion regulation skills, the insignificant results should be interpreted with care (Engen & Anderson, 2018; Korfine & Hooley, 2000; Sala, et al., 2009).

Due to there being a lack of relationship between subclinical BPD symptom severity and emotion regulation skills, the second hypothesis is not supported. Further research using a more developed version of an online TNT experiment using emotional stimuli should be done to investigate this connection. It is likely that emotion regulation skills may only come in to play when the content to be forgotten is emotionally stimulating. The theoretical link between memory control and emotion regulation skills is very strong especially considering that it is a defining feature of BPD symptomatology, therefore it is surprising that the relationship was not significant. Further evidence for this relationship comes from research that shows that individuals with symptoms of BPD tend to adopt suppressive emotion regulation strategies (Chapman, Rosenthal, Dixon-Gordon, Turner, & Kuppens, 2017). Chapman et al. (2017) suggest that this memory suppression can be adaptive, at least in the short term, if it is used properly. This implies that despite trying to suppress information or memories they are unable to do so successfully (demonstrated by their difficulty with memory control), which leads to rebound effects and thereby adverse outcomes such as self-harm and substance misuse.

The present study benefited from strong ecological validity with regard to the materials used, however due to constraints the effect of emotional content on memory control

was not measured which would have increased ecological validity even further (Lewkowicz, 2001). Using a convenience sample reduced the external validity slightly, however in terms of the participants recruited, a large range of individuals participated increasing generalisability of the results. As a non-clinical population was used the results are not as generalisable to those with BPD diagnoses. Nevertheless, the present population provides a wide variability of combinations of BPD symptoms present in individuals without a diagnosis, which allows for a larger number of people to benefit from the results (Salsman & Linehan, 2012). Internal validity was high due to the counterbalancing used in the experiment where the forget/remember items were rotated in each condition. During the rating of number of details remembered, the use of two independent researchers blindly rating responses also increased internal validity (Juni, Altman, & Egger, 2001). The sample size was large enough to ensure statistical validity in part, however the results should be interpreted with care due to the weak relationship identified (Pek & Hoyle, 2016; Staines, 2008).

Using the results from this study the field of memory control has its first TNT paradigm comparing emotion regulation and memory control investigating those with a range of subclinical BPD symptoms. Future research should include emotional stimuli within the paradigm and further investigate the idea that memory control could be improved as a skill and potentially use short-term treatments to improve emotion regulation skills in those with a range of BPD symptom severity. Hulbert and Anderson (2018) provide evidence suggesting that those who have practiced memory control throughout their lives are better at it than those who have not done so (Hulbert & Anderson, 2018). Along with the current research findings, this suggests that skills in memory control could be improved thereby potentially reducing BPD symptom severity and possibly improving emotion regulation skills.

Conclusion

The present study looked into the negative linear relationship between memory control and a range of subclinical BPD symptoms, which was found to be statistically significant in participants largely based in Lund, Sweden. Emotion regulation skills was also measured and found not to be a mediator of the negative relationship between memory control and subclinical BPD symptom severity. Key findings include that those with higher subclinical BPD symptom severity have significantly more problems with memory control than those with lower symptomatology. This provides evidence towards the idea that diagnosis-specific research is not as useful with regards to personality disorders, which are being pushed more towards a dimensional approach of analysis. The use of an online TNT experiment produced significant, albeit weak, results in this study, which suggests that it is possible to transfer the experiment to an online version but further testing is necessary to identify how well it measures the construct of memory control. Further research can build upon these findings and identify whether memory control is a skill one can learn and whether interventions in this can help alleviate symptoms of BPD even in subclinical populations. The benefits of finding an easily accessible, short-term intervention based on memory control training can help individuals waiting for more long-term treatments and also those who are at risk of developing more severe symptoms.

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