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Brainspotting reduces disturbance and increases Heart Rate Variability linked to distressing memories: A pilot study

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Abstract

Brainspotting (BSP) is a relatively new type of brain-body psychotherapeutic approach discovered and developed by David Grand (2003) that accesses the client's innate self-observing and self-healing capacities in the frame of a neurobiologically attuned clinical relationship. Despite it being increasingly growing in popularity among therapists, there is still a paucity of literature on its effectiveness. The aim of the study was to explore the efficacy of BSP in treating distressing (not necessarily traumatic) memories in a non-clinical sample of adults. A within-subjects design was employed for the Brainspotting effectiveness analysis, with two within-subjects factors (treatment, time). The treatment factor had two levels: Brainspotting, and a control condition (Body Scan Meditation). Both objective (Heart Rate Variability - HRV parameters) and subjective (self-report) measures were used in the study. Results showed that, after about 40 minutes of treatment, Brainspotting significantly reduced memory-related distress in comparison with Body Scan Meditation control condition (p = .028). Additionally, the participants had better HRV than before the treatment (all Time Domain parameters $p < .05$). Participants' Interoceptive Awareness dimensions and dispositional traits such as attachment style, temperament and character were also examined and discussed within the Brainspotting theoretical frame. These findings, more broadly, highlighted the key role of interoceptive awareness in the processing of distressing memories.

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1. Introduction

The current psychology defines memory as the capacity of encoding, storing, and retrieving information (Squire, 2009). Human autobiographical memory can consist of information stored both in episodic memories or experiences placed in time and space, and in semantic memory characterized by a conceptual, generic, and schematic knowledge of one's own life (Conway & Williams, 2008). Among the information stored in the personal history, there can be several distressful or traumatic memories. Distressing memories can consist of images, thoughts and feelings related to stressful events including extremely upsetting adverse life events such as non-life-threatening injuries, childhood humiliations, death of a pet, bullying, and loss of significant relationships (Shapiro, 2018). These memories are generally negatively emotionally charged. Traumatic memory is a particular kind of distressing memory emerging from a person's direct exposure to or witnessing of a traumatic event such as serious injury, threatened death or sexual violence (American Psychiatric Association, 2013). These traumatic events are risk factors for the development of several mental disorders, including Post Traumatic Stress Disorder (Bromet et al., 2018).

Brainspotting (BSP) is a brain-body psychotherapeutic approach used to support reprocessing of traumatic or distressful memories. Originating from an innovative modification of Eye Movement and Desensitization and Reprocessing (EMDR) protocol, called "Natural Flow EMDR" (Grand, 2001), David Grand discovered and started to develop BSP in 2003. Until now, over 13,000 therapists have been trained worldwide. However, despite the growing popularity of BSP, there is still a paucity of research reporting on the mechanisms and clinical efficacy of this treatment. Therefore, the purpose of this study was to investigate the effect of BSP on distressing, not-necessarily traumatic, memories in a sample of healthy adults.

The basic idea behind BSP is the motto «Where you look affects how you feel» (Grand, 2013, p. 3). Vision is a core sensory modality that the brain uses to orient humans in their environment (Chubb et al., 2013). Grand suggests that not only eye movements and positions have a high correlation with emotional experiences, but also the subcortical brain organizes itself around that eye position. For example, when you are exposed to a traumatic event, the eye position could be relevant to how you perceive the experience. The BSP therapist makes use of this natural tendency of humans to orient to what is salient in their environment to help clients find a presumed fixation point holding a trauma's unprocessed information in the brain. By focusing on eye position, you can connect to the traumatic experience and promote your self-healing ability to address and resolve trauma (Grand, 2013).

Similar to EMDR (Shapiro, 2018), BSP enables the client to access body and emotions to help dislodge the frozen material and to nudge along the brain and body's natural processing system. This type of processing is not typically achieved through traditional talk therapy. Indeed, while traditional talk therapy is conversational, BSP follows a bottom-up approach, which means that mindfulness is used to explore what is happening to the clients' emotions and body as the clients are exploring their problematic experience (Grand, 2013).

Corrigan and Grand (2013) proposed that the adaptive orientation to distressing information engages the orienting response in the midbrain tectum. This basic orientation response occurs unconsciously for survival and helps the human being pay attention to potentially dangerous environmental stimuli (Ogden et al., 2006). Adaptive orienting can become truncated at any point of sequence (arousal, stopping the current activity, sense of alertness, muscular adjustments, etc.) due to trauma (Corrigan & Grand, 2013; Corrigan et al., 2015). It is supposed that, when the brain cannot integrate all parts of the traumatic experience, residues of trauma are stored in its physiological "capsule" that holds traumatic experience in memory form (Grand, 2013).

BSP aims to create the environment for adaptive orientation to the trauma by finding the relevant eye position (called "brainspot") to the trauma. Brainspot is defined as a «stored oculomotor orientation to a traumatic experience which has failed to integrate» (Corrigan & Grand, 2013, p. 761). Holding the gaze on that brainspot, the client is then invited to observe the internal process, including body sensations, memories, emotions, and thoughts, with curiosity and without judgment (Grand, 2009).

This self-observation is called "focused mindfulness" and recruits the brain's medial prefrontal regions (Corrigan & Grand, 2013). It is supported by another core element of the BSP approach: the client/therapist "dual attunement", which is simultaneously the combined relational and neurobiological attunement that is similar to the model of Interpersonal Neurobiology (Siegel, 2010). In this way, the mindful and compassionate presence of the therapist supports the healing promoting brain pathways that are associated with feelings of safety, support, and connection. BSP mechanism of action on the right brain hemisphere, the limbic system, and the brain stem (midbrain) are only neurobiological hypotheses for now, that need future empirical research.

To the best of our knowledge, there have been only a few studies in the literature addressing BSP clinical application: a preliminary evidence on BSP efficacy in the treatment of Posttraumatic stress disorders (Hildebrand et al., 2014); a comparative study between BSP and EMDR on treating traumatized clients (Hildebrand et al., 2017); an unpublished clinical comparison study (EMDR, BSP, and Cognitive Behavioral Therapy) on the treatment of generalized anxiety disorder (Anderegg, 2015); two single case studies that focused on trauma (Masson et al., 2017) and on a persistent genital arousal disorder (Mattos et al., 2015).

Since these studies are based on self-report inventories, it could be important to integrate subjective measures with objective measurements like psychophysiological assessment. Indeed, BSP appears to promote coherence between the Sympathetic Nervous System (SNS) and the Parasympathetic Nervous System (PNS) activities (Grand, 2009). Moreover, it is argued that, through the therapist-client dual attunement and the processing of the brainspot, BSP can down-regulate the amygdala and facilitate PNS homeostasis (Scaer, 2005). These hypotheses could be tested through non-invasive measures such as Heart Rate Variability (HRV) parameters.

For example, in the field of Mindfulness Based Interventions (MBIs – Zhang et al., 2021) such as Mindfulness Based Stress Reduction (MBSR) protocol (Kabat-Zinn, 1994), research supports the utility of using HRV as a biomarker capable of demonstrating intervention effects (Christodoulou et al., 2020). The Body Scan Meditation (BSM) is a Focused Attention meditation (Lutz et al., 2008) that serves as a foundation for all MBIs. It involves focusing on bodily sensations, even unpleasant ones, gradually and sequentially moving one's own attention through each part of the body without judgement. A number of physiological changes occur during this practice, among which an increased Respiratory Sinus Arrhythmia (RSA) (Ditto et al., 2006). Normally, during inspiration the Heart Rate (HR) increases and during expiration it decreases. RSA is the naturally occurring variation in HR that occurs during the breathing cycle (Yasuma, & Hayano, 2004). RSA represents an index of cardiac vagal tone and therefore of HRV (Grossman, & Taylor, 2007; Porges, 1995).

These benefits derived from mindfulness practice may be primarily due to the cultivation of Interoceptive Awareness (IA) resulting in the capacity to stay in a non-evaluating contact with body sensations (Farb et al., 2013; Mehling et al., 2012). Although IA can be considered a core component of MBIs, it is a distinct construct and, at the same time, it is tightly interwoven to the construct of dispositional mindfulness (Hanley et al., 2017). IA is defined as «the conscious perception of sensations from inside the body, such as heartbeat, respiration, satiety, and the autonomic nervous system sensations related to emotions, which create the sense of the physiological condition of the body» (Calì et al., 2015, p.1). At this point, one can hypothesize that IA may well be a fundamental component of mindfulness practice, but it could also be involved in the BSP processing phase of focused mindfulness.

1.1 Objectives of the study

The purpose of the current study was to make an empirical contribution to the research on BSP using both subjective (self-report questionnaires) and objective (psychophysiological indices) measures. The primary hypothesis regarded the therapeutic potential of the technique, specifically, if BSP is effective in reducing psychological pain related to distressing, but not necessarily traumatic, memories. In relation to this first hypothesis, the autonomic correlates of BSP intervention were also studied. Specifically, if the BSP technique can increase HRV in participants facing distressing memories.

The secondary hypothesis concerned which characteristics of the participant would favor or hinder the processing of the disturbing memories. Specifically, which dimensions of IA are related to a better processing of disturbing memories in the focused mindfulness phase, and which dimensions of the client's temperament and character, as well as attachment style, can affect the dual attunement and thus, the effectiveness of the technique.

Therefore, these hypotheses comparing BSP with an active control condition (BSM) were tested on a sample of healthy adults.

2. Materials and Methods

2.1 Participants

Participation in the study was voluntary, and potential participants were selected from available adult students attending a psychotherapy training course at the Institute of systemic psychotherapy of Udine (Italy). Students who met the criteria were offered the opportunity to participate. Criteria included not reporting diagnosis of mental and neurological disorder, medication or any other form of therapy, and no experience of BSP therapy and mindfulness meditation.

Of the 32 participants who completed the study, 4 participants were excluded from statistical analyses for not meeting HRV artifact threshold criteria. The remaining 28 participants' mean age was 34.19 years (SD = 6.65); 6 participants were male.

Informed consent for research assessment and procedure was obtained from all participants. The procedures were approved by the local Ethics of the University of Udine and were in accordance with the Helsinki Declaration guidelines.

The study was conducted by the clinician-researcher and author of this article, who has been trained in BSP in addition to holding a master's degree in MBIs, advanced diploma in psychotherapy teaching and clinical supervision.

2.2 Measures

Subjective Units of Disturbance (SUD) Scale. The SUD Scale, originally developed by (Wolpe, 1969), is a subjective disturbance scale ranging from 0 to 10. This self-report measure was used to assess the distress perceived by participants during the memory telling. Psychotherapy outcome research supports SUD scores (SUDs) as global measures of level of distress (Tanner, 2012) with good psychometric properties (Kim et al., 2008).

Multidimensional Assessment of Interoceptive Awareness (MAIA). The MAIA (Calì et al., 2015; Mehling et al., 2012) is a 32-item self-report questionnaire measuring multiple dimensions of Interoceptive Awareness ("Noticing", "Not-Distracting", "Not-Worrying", "Attention Regulation", "Emotional Awareness", "Self-Regulation", "Body Listening", and "Trusting"). The eight scales showed Cronbach's alpha coefficients ranging from .66 to .83.

Temperament and Character Inventory (TCI). The TCI (Cloninger et al., 1994; Delvecchio et al., 2016), is a self-report questionnaire composed of 125 true–false items that operationalizes Cloninger's personality model (Cloninger et al., 1993) organized into four Temperament scales (i.e., NS, "Novelty Seeking"; HA, "Harm Avoidance"; RD, "Reward Dependence"; Pe, "Persistence") and three Character scales (i.e., SD, "Self-Directedness"; Co, "Cooperativeness"; ST, "Self-Transcendence"). Internal consistency of the TCI was acceptable across different ages (i.e., $a \geq .70$).

Attachment Style Questionnaire (ASQ). The ASQ (Feeney et al., 1994; Fossati et al., 2003) is a 40 items self-report questionnaire designed to assess several dimensions of adult attachment ("Confidence", "Discomfort with Closeness", "Need for Approval", "Preoccupation with Relationships", and "Relationships as Secondary"). The five scales showed adequate internal consistency, with Cronbach's alpha coefficients ranging from .76 to .84.

Heart Rate (HR) and Heart Rate Variability (HRV). While HR counts the number of heartbeats per minute, HRV is based on the changes in time between successive heartbeats (also called Inter-Beat-Intervals or NN intervals). It can be considered a non-invasive and accurate measure of the Autonomic Nervous System (Laborde et al., 2017). Participants wore a soft textile strap with high quality electrodes designed for fitness that allowed them to move freely during the session. The HR monitor was connected to a compatible mobile app via Bluetooth. Research showed that measuring the HRV with a HR monitor chest strap can be comparable to HRV measured with an electrocardiogram (Gambassi et al., 2020; Plews et al., 2017).

The raw data were successively imported into Kubios HRV Standard 3.3.1 software that provided satisfactory tools for handling artefacts and analysing HRV data (Tarvainen et al., 2014). Participants having at least one measurement with a correction index of artefacts equal to or greater than 5% of the entire trace ($N = 4$) were discarded. The baseline measurement was set at 5 minutes, while the measurement of memories (5 minutes maximum time) depended on the length of the telling.

HRV analysis was performed considering Time-domain (i.e., SDNN, RMSSD, pNN50) and Frequency-domain (LF Power, and HF Power) variables. SDNN indicates Standard Deviation of Normal to Normal (or NN) intervals and reflects the combination of both sympathetic and parasympathetic influences. Root Mean Square of the Successive Differences (RMSSD) is considered the most relevant and accurate measure of Autonomic Nervous System activity (i.e., vagal tone) (Kleiger et al., 2005). While NN50 is the number of pairs of successive NN (R-R) intervals that differ by more than 50 ms, pNN50 is the percentage of NN50 divided by the total number of NN (R-R) intervals.

Despite the conventional minimum recording standard being 5 min (Malik et al., 1996), ultra-short term recording periods from 60 sec. can also be reliable measurements (Esco & Flatt, 2014; Munoz et al., 2015; Nussinovitch et al., 2011; Salahuddin et al., 2007).

The Low-Frequency (LF) component of the HRV spectrum (0.04–0.15 Hz) provides information on both sympathetic and parasympathetic activity and is generally recorded over a 2 min period (Shaffer et al., 2014). Even though several recordings were shorter than 2 minutes, this parameter was kept for the qualitative and overall HRV analysis. The High-Frequency (HF) power component (0.15–0.40 Hz) is considered as a marker of vagal modulation of cardiac activity and it is generally recorded over a 1 min period (Grossman & Taylor, 2007).

Since the measures were taken in different days with the risk of significant circadian variations in HR and HRV (Massin et al., 2000), the same time of the day was generally maintained. HRV during resting baselines and memory tasks was measured while sitting upright.

2.3 Procedure

For the purposes of this explorative study a within subject design was used to gather data. All participants were exposed randomly in sequence to both BSP treatment and BSM control condition. Each memory was assigned to one condition randomly.

This type of experimental design was adopted because it did not require a large pool of participants and is highly recommended for HRV experiments because it reduces errors associated with individual differences (e.g., age and gender, respiratory rates, caffeine and alcohol consumption, smoking, etc.) (Quintana & Heathers, 2014).

The experimental design followed a four-time points structure referred as: assessment (t0), pre-treatment (t1), treatment (t2), and post-treatment (t3).

Assessment (t0). Participants completed online questionnaires (MAIA, TCI, and ASQ) a few days before the first meeting with the clinician-researcher. During the first meeting participant was asked to recall and tell in sequence two distressing memories and, immediately after each of them, report the SUDs. The instructions given to participants were to freely tell the memory with no time limits. The clinician-researcher's task was to listen in silence. Only memories with high SUD scores (SUDs $\geq$ 6) were accepted.

Pre-treatment (t1). After about a week, at the second meeting, participant short-term (5 minutes) at-rest HRV was recorded. Subsequently, the researcher explained the procedure (psychoeducation of the intervention foreseen in that session, i.e., BSP or BSM) and which of the assessment phase memories would be processed. Then, the participant was invited to recall and retell the memory as if it were the first time, not taking into account that the interlocutor already knew different aspects of that memory and trying not to repeat everything s/he said in the Assessment phase. During the memory telling HRV was recorded. Immediately after the memory telling participants reported the SUD score (i.e., On a scale of 0 – 10, where 0 is not disturbance/distress or neutral and 10 is the highest disturbance you can imagine, how disturbing does the memory feel to you now?).

Treatment (t2). The experimental condition was the "Inside Window" BSP (Grand, 2009). In this BSP technique clinician-researcher and participant cooperated to locate one brainspot through the participant's felt sense of the highest intensity of somatic activation. In Inside Window eye position was divided into two axes, X and Y. First, clinician-researcher and participant found the most activated (access) spot horizontally (left, center and right along the X axis), and from there they explored vertically (above, at or below eye level on the Y axis).

The BSP set-up was: (1) recall the disturbing memory, (2) check on activation, (3) level of activation perceived (0 to 10), (4) location of activation in the body, (5) find highest activation tracking horizontally at eye level (X axis), (6) then track above, at and below eye (Y axis) for the highest activation to locate brainspot, (7) focused mindfulness (processing phase), (8) go back to the beginning to assess change, (9) "squeeze the lemon" (if possible).

In the procedure called "squeeze the lemon" (Grand, 2009), the participant was guided, after a zero level of activation was attained, to go inside and do whatever was needed doing in order to achieve maximum reactivation level. If at any time this level was more than zero, the processing of the original brainspot continued following the same cycles until activation reached zero.

The participant wore stereophonic headphones with "Biolateral Sound". The audio was listened to throughout the processing phase and the headphones were removed when the clinician-researcher ended processing. The audio track consisted in slow and continuous bilateral stimulation with the sound of the sea waves. Volume was set at the lowest audible so as not to distract processing (Grand, 2009).

BSM was the active control condition chosen from MBSR protocol (Kabat-Zinn, 1990). Although it forms the core of the lying down practices of the MBSR, in this study BSM was practiced sitting on a chair and under the verbal guidance of the clinician-researcher, in the same setting condition of the BSP treatment. The participant was invited to close his/her eyes and to voluntarily shift his/her attention first to specific body parts (e.g., toes, back or head), then to the whole body; and to notice what happens (e.g., sensations such as pain or muscle tension) in the present moment without judging or reacting.

BSP intervention lasted on average 40.317 min. (SD = 3.426); BSM intervention fixed time was 40 min. The clinician-researcher respected the individual processing time by agreeing with the participant optimal time to stop.

Post-treatment (t3). At the end of the session, the participant was asked to recall and retell the memory again as if it was the first time. The new SUDs and HRV were measured.

After about a week, the participant was then invited to a similar session (t1-t2-t3) in order to process the second memory through the other treatment in the present study's focus.

2.4 Analysis

A within group research design was employed to analyze the data. Statistical analysis through SPSS Version 26.0 was carried out for within group mean comparisons. Changes in SUDs and in HRV values for each memory told pre- and post-treatment were analyzed with repeated measures ANOVAs. In these analyses, the within-group factors were Session ("Pre-treatment", "Post-treatment") and Intervention ("BSP", "BSM"). The analysis of these variables was also conducted using Paired-samples t-tests and Wilcoxon Signed-Ranks Test (for non-normal distribution data). Spearman's correlation analysis was performed to analyze the correlation between SUDs reduction and self-report questionnaires.

3. Results

3.1 SUDs analysis

Since for the SUDs at t0 the data were not normally distributed, non-parametric analysis was used to check if there could be a significant variation in the SUDs between assessment and pre-treatment for both conditions.

Table 1. Descriptive Statistics

N = 28		BSP					BSM				
		Min	*Max*	*M*	*SE*	*SD*	*Min*	*Max*	*M*	*SE*	*SD*
SUD Scale	Pre	3.000	10.000	6.946	0.307	1.624	3.500	10.000	7.268	0.268	1.417
	Post	0.000	7.000	2.411	0.414	2.190	0.000	8.000	4.232	0.455	2.409
Time	Pre	1.050	5.000	2.721	0.251	1.330	1.070	5.000	3.031	0.243	1.286
	Post	1.050	5.000	2.318	0.231	1.220	1.030	5.000	2.631	0.259	1.368
Mean HR	Pre	55.000	106.000	80.821	2.723	14.409	57.000	108.000	82.107	2.309	12.218
(bpm)	Post	52.000	95.000	75.536	2.265	11.983	57.000	102.000	77.429	2.138	11.315
SDNN	Pre	8.900	81.800	47.439	3.579	18.940	21.200	88.700	46.204	2.670	14.127
(ms)	Post	11.100	96.600	50.350	3.466	18.341	19.600	76.800	49.875	2.926	15.481
RMSSD	Pre	7.700	80.000	34.257	3.591	19.001	11.400	61.700	30.286	2.388	12.635
(ms)	Post	9.700	82.800	37.846	3.747	19.829	13.900	69.400	33.921	2.774	14.681
pNN50	Pre	0.000	48.980	13.368	2.721	14.398	0.000	38.820	10.676	1.797	9.510
(%)	Post	0.000	55.170	15.649	2.925	15.477	0.000	43.520	13.771	2.253	11.921
LF Power	Pre	3.460	8.770	7.102	0.210	1.111	5.510	8.820	7.367	0.121	0.641
(log)	Post	3.300	8.470	7.246	0.189	1.002	5.700	8.650	7.458	0.131	0.694
HF Power	Pre	2.960	7.450	5.608	0.221	1.167	3.530	6.840	5.511	0.177	0.938
(log)	Post	2.440	7.870	5.797	0.242	1.279	3.150	7.400	5.644	0.202	1.070

Note: BSP = Brainspotting, BSM = Body Scan Meditation; SUD = Subjective Units of Disturbance; HR = Heart Rate, SDNN = Standard Deviation of Normal-to-Normal R-R, RMSSD = Root Mean Square of the Successive Differences, pNN50 = percentage of NN50 divided by the total number of NN intervals, LF = Low-Frequency, HF = High-Frequency.

A Wilcoxon Signed-Ranks Test indicated that pre-test scores were not significantly different from assessment scores for both conditions (BSP $Z = -1.629$, $p = .103$; BSM $Z = -1.144$, $p = .253$). Furthermore, a paired-samples t-test was conducted to compare the SUDs at t1 in BSP and BSM conditions. There was not a significant difference in the scores for BSP ($M = 6.946$, $SD = 1.623$) and BSM ($M = 7.268$, $SD = 1.417$) conditions; $t(27) = -1.000$, $p = .326$. Thus, the starting point of the SUDs for memories treatment was the same for both conditions (i.e., BSP and BSP).

Prior to conducting the ANOVA, the assumption of normality was evaluated and determined to be satisfied as the two-time (t1 and t3) SUDs distributions were associated with skew and kurtosis less than |2.0| and |9.0|, respectively (Schmider et al., 2010).

Furthermore, the assumption of homogeneity of variances was tested and satisfied based on Levene's F test, (pre-treatment $F(1, 54) = .970$, $p = .329$; post-treatment $F(1, 54) = .028$, $p = .867$).

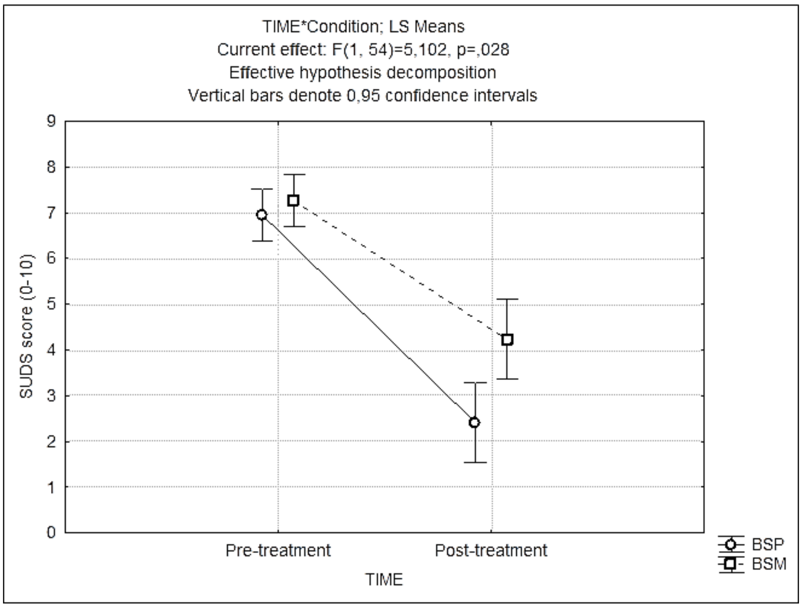
A repeated measures ANOVA with between-subjects factor was conducted to compare the effect of BSP and BSM techniques on SUDs in a single session of treatment.

There was a main effect of time (pre/post treatment) on SUDs ($F(1, 54) = 129.979$, $p < .001$, $\eta^2_p = .706$) and also a significant effect of condition on SUDs ($F(1, 54) = 7.086$, $p = .010$, $\eta^2_p = .116$). Consistently with the primary hypothesis, there was a significant time by condition interaction, $F(1, 54) = 5.102$, $p = .028$, $\eta^2_p = .086$ (see Figure 1).

Planned comparisons using paired sample t-test revealed that participants in the BSP condition reduced significantly more SUDs after the treatment $t(27) = 9.335$, $p < .001$, $d = 1.764$; there was also a significant difference pre-post treatment in the BSM condition $t(27) = 6.705$, $p < .001$, $d = 1.267$.

Results showed that, after only about 40 minutes of treatment, BSP significantly reduced memory-related SUDs compared with BSM control condition.

Figure 1. Subjective Units of Distress Scale (SUDS) ratings pre- and post-treatment for both conditions (BSP and BSM).



Note: SUDS = Subjective Units of Distress Scale; BSP = Brainspotting; BSM = Body Scan Meditation.

The experimental design structured in four time points allowed to measure the change between baseline and pre-treatment at t1 (reactivity during the memory task), to measure the change between pre- and post-treatment (t3-t1), and to compare the change between baseline-pre-treatment difference and baseline-post-treatment difference (recovery from treatment/residual reactivity during the memory task).

Following the same criteria of SUDs analysis, changes in HR and HRV parameters for each memory told from pre- to post-treatment were analyzed with two groups of repeated measures ANOVAs and Wilcoxon Signed-Ranks Tests. In these ANOVAs, the within-group factors were Session ("Pre-treatment" and "Post-treatment") and Treatment ("BSP" and "BSM"). In the first group t1 and t3 referred to HR/HRV pre- and post-treatment values, while in the second group they referred to the difference in percentage between the HR/HRV baseline and the pre-treatment, and the difference in percentage between baseline and the post-treatment, respectively.

HR/HRV Data analysis 1

There was a main effect of Session ($F(1, 54) = 73.029$, $p < .001$, $\eta^2_p = .575$) with HR mean decreasing. There was not a significant Session by Condition interaction ($F(1, 54) = .271$, $p = .605$, $\eta^2_p = .005$). A paired-samples t-test was conducted to compare HR mean before and after each condition. There was a significant difference in the scores for pre- (BSP: M = 80,821, SD = 14,409; BSM: M = 82,107, SD = 12,218) and post-treatment (BSP: M = 75,536, SD = 11,983; BSM: M = 77,429, SD = 11,315) sessions both in BSP and BSM conditions, $t(27) = 5.502$, $p < .001$, $d = 1.040$, $t(27) = 7.080$, $p < .001$, $d = 1.338$, respectively.

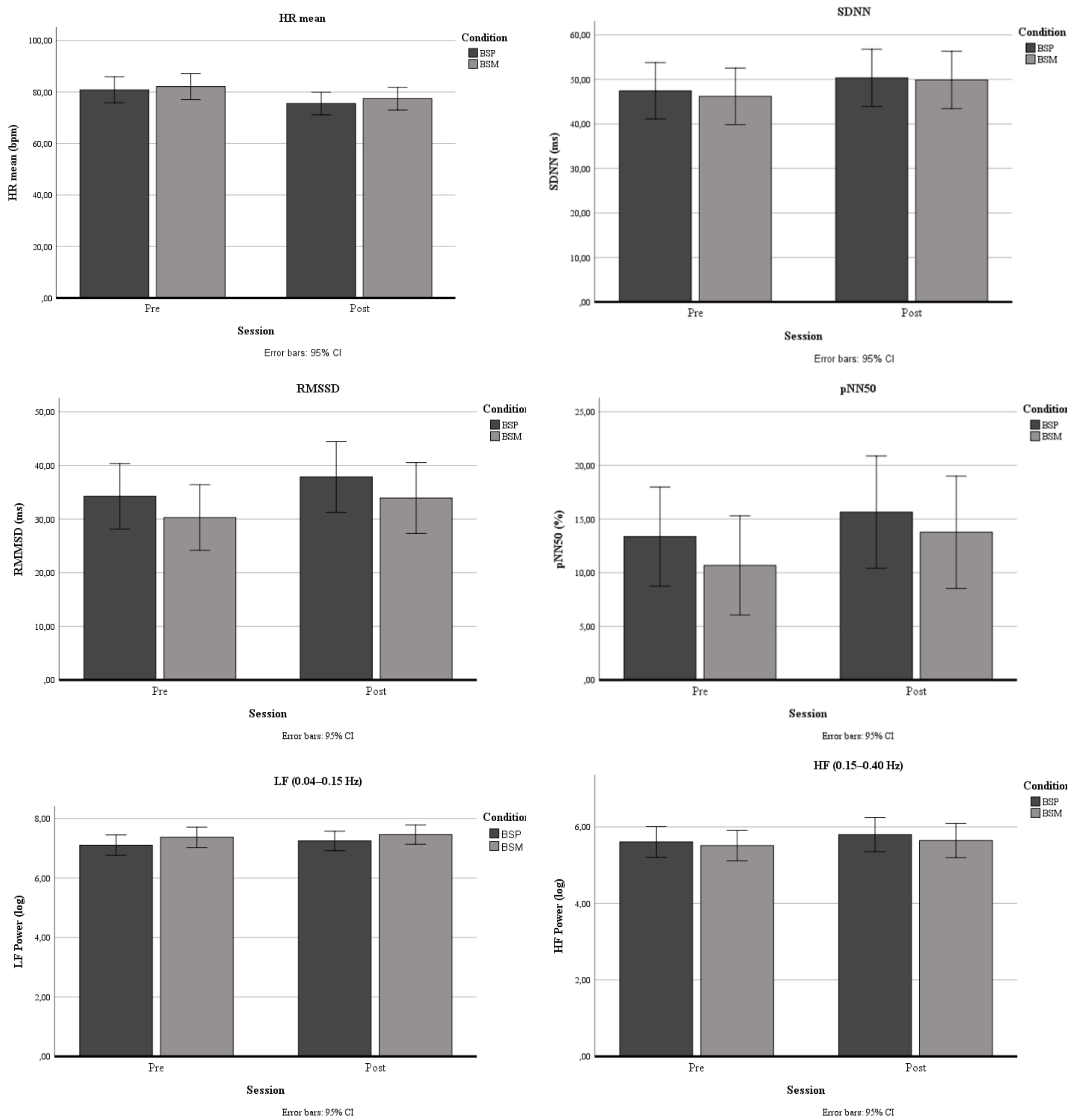
There was a main effect of Session ($F(1, 54) = 8.142$, $p = .006$, $\eta^2_p = .131$) with SDNN parameter increasing. A paired-samples t-test revealed that the significant difference in scores for pre- (M = 46.204, SD = 14,127) and post-treatment (M = 49,875, SD = 15,481) sessions happened only in the BSM condition, $t(27) = -2.441$, $p = .021$, $d = -0.461$.

There was a main effect of Session ($F(1, 54) = 15.512$, $p < .001$, $\eta^2_p = .223$) with RMSSD increasing. There was not a significant Session by Condition interaction ($F(1, 54) = .001$, $p = .980$, $\eta^2_p = .000$). A paired-samples t-test was conducted to compare RMSSD before and after each condition. There was a significant difference in the scores for pre- (BSP: M = 34.257, SD = 19.001; BSM: M = 30.286, SD = 14.681) and post-treatment (BSP: M = 37.846, SD = 19.829; BSM: M = 33.921, SD = 14.681) sessions both in BSP and BSM conditions, $t(27) = -2.418$, $p = .023$, $d = -.457$, $t(27) = -3.374$, $p = .002$, $d = -.638$, respectively.

A Wilcoxon Signed-Ranks Test indicated that both post-treatment pNN50 scores were statistically significantly higher than pre-treatment scores for each condition (BSP $Z = -2.273$, $p = .023$; BSM $Z = -2.778$. $p = .005$). The same test showed also that there was not a statistically significant difference between pre- and post-treatment in the Frequency Domain (i.e., LF Power and HF Power parameters, all $p > .05$).

For a comparison chart of pre- and post-treatment HR/HRV parameters, see Figure 2.

Figure 2. Comparison bar charts of pre- and post-treatment HR/HRV parameters.



Note: HR = Heart Rate, SDNN = Standard Deviation of Normal-to-Normal R-R intervals, RMSSD = Root Mean Square of the Successive Differences, pNN50 = percentage of the number of pairs of successive NN intervals that differ by more than 50 ms, LF = Low Frequencies, HF = High Frequencies; BSP = Brainspotting, BSM = Body Scan Meditation.

HR/HRV Data analysis 2

The analysis of pre- and post- changes in terms of percentage difference compared to the baseline confirmed the previous analysis. No significance interaction was found between Session and Treatment (all p > .05). Paired-samples t-tests showed a significant decrease in scores for HR mean for pre- (BSP: *M* = 5.710, *SD* = 8.265; BSM: *M* = 6.152, *SD* = 6.691) and post-treatment (BSP: *M* = -0.871, *SD* = 7.785; BSM: *M* = 0.215, *SD* = 6.956) sessions both in BSP and BSM conditions ($t(27) = 5.619$, $p < .001$, $d = 1.062$, $t(27) = 6.970$, $p < .001$, $d = 1.317$, respectively), a significant increase in scores for SDNN for pre- (BSP: *M* = 13,833, *SD* = 28,648; BSM: *M* = 7,773, *SD* = 26,566) and post-treatment (BSP: *M* = 23,443, *SD* = 32,882; BSM: *M* = 15,730, *SD* = 28,486) sessions both in BSP and BSM conditions ($t(27) = -2.294$, $p = .030$, $d = -0.434$, $t(27) = -2,204$, $p = .036$, $d = -0.417$, respectively), and no statistically significant difference between pre- and post-treatment in the Frequency Domain (i.e., LF Power and HF Power parameters, all $p > .05$). A Wilcoxon Signed-Ranks Test indicated that both post-treatment RMSSD scores were statistically significantly higher than pre-treatment scores for each condition (BSP and BSM $Z = -2.550$, $p = .011$).

In summary, results showed that after BSP (and BSM), when participant recalled and retold the distressing memories, there was a significant reduction in HR mean and a significant increase in SDNN, RMSSD and pNN50 parameters. No significant difference was found in HRV Frequency Domain.

Correlations

Finally, Spearman's correlation analysis was performed to analyze the correlation between the efficacy in the reduction of SUDs (i.e., the difference in percentage between pre- and post-treatment) reduction and self-report measures of attachment (ASQ), temperament/character (TCI) and interoceptive awareness (MAIA).

Table 2. Self-report questionnaires used in the study (N = 28).

Questionnaire	Scale	Min	Max	M	SE	SD
ASQ (raw scores)	Confidence	22.000	42.000	33.286	0.954	5.047
	Discomfort with Closeness	17.000	44.000	35.714	1.135	6.005
	Relationships as Secondar	7.000	22.000	13.393	0.748	3.957

	Need for Approval	12.000	28.000	19.429	0.915	4.841
	Preoccupation with Relationships	14.000	36.000	25.357	1.226	6.488
MAIA (raw scores)	Noticing	1.750	4.750	3.500	0.149	0.788
	Not-Distracting	1.000	2.670	1.727	0.105	0.553
	Not-Worring	1.000	4.330	2.904	0.143	0.758
	Attention Regulation	1.570	4.140	3.113	0.115	0.611
	Emotional Awareness	1.000	5.000	3.436	0.167	0.883
	Self-Regulation	1.250	4.500	3.152	0.154	0.815
	Body Listening	1.000	5.000	2.916	0.167	0.883
	Trusting	1.670	5.000	3.630	0.185	0.979
TCI (T-statistic)	Novelty Seeking (NS)	33.680	68.620	52.452	1.762	9.322
	Harm Avoidance (HA)	31.340	66.560	46.691	1.550	8.200
	Reward Dependence (RD)	32.330	68.660	51.615	1.837	9.721
	Persistence (PS)	30.960	63.990	48.095	1.879	9.944
	Self-Directedness (SD)	33.410	62.790	56.118	1.465	7.750
	Cooperativeness (CO)	38.640	64.960	56.423	1.235	6.533
	Self-Transcendence (ST)	33.540	81.420	49.190	2.427	12.844

Note: ASQ = Attachment Style Questionnaire, MAIA = Multidimensional Assessment of Interoceptive Awareness, TCI = Temperament and Character Inventory.

The results of the Spearman's Rho test showed a significant negative linear relationship between BSP-SUDs efficacy and TCI-Co subscale ($r_s(28) = -.472$, $p = .011$), MAIA "Noticing" ($r_s(28) = -.405$, $p = .032$) and "Emotional Awareness" ($r_s(28) = -.438$, $p = .020$) dimensions. Results of the Spearman correlation indicated also a significant positive association between BSP-SUDs efficacy and ASQ "Discomfort with Closeness" ($r_s(28) = .425$, $p = .024$), and "Relationships as Secondary" ($r_s(28) = .446$, $p = .017$) scales.

Regarding instead the BSM, a significant negative correlation was found between BSM-SUDs efficacy and ASQ "Confidence" ($r_s(28) = -.382$, $p = .045$) scale, MAIA "Emotional Awareness" ($r_s(28) = -.383$, $p = .044$), "Body Listening" ($r_s(28) = -.437$, $p = .020$), and "Trusting" ($r_s(28) = -.376$, $p = .049$) dimensions.

Table 3. Spearman correlation coefficient (N = 28).

Questionnaire	Scale	BSP Post-Pre SUDs (%)		BSM Post-Pre SUDs (%)	
		rho	*p*	*rho*	*p*
ASQ	Confidence	-0.310	0.109	-.382*	0.045
	Discomfort with Closeness	.425*	0.024	0.033	0.869
	Relationships as Secondary	.446*	0.017	0.080	0.687
	Need for Approval	-0.106	0.593	0.031	0.876
	Preoccupation with Relationships	0.178	0.365	0.063	0.749
MAIA	Noticing	-.405*	0.032	-0.242	0.215
	Not-Distracting	0.295	0.127	0.125	0.528
	Not-Worring	0.072	0.716	0.122	0.535
	Attention Regulation	0.192	0.327	0.026	0.894
	Emotional Awareness	-.438*	0.020	-.383*	0.044
	Self-Regulation	-0.207	0.289	-0.307	0.112
	Body Listening	-0.329	0.087	-.437*	0.020
	Trusting	-0.314	0.104	-.376*	0.049
TCI	Novelty Seeking (NS)	-0.251	0.198	-0.070	0.723
	Harm Avoidance (HA)	0.365	0.056	0.270	0.165
	Reward Dependence (RD)	-0.364	0.057	-0.173	0.379
	Persistence (PS)	0.082	0.677	0.029	0.884
	Self-Directedness (SD)	-0.083	0.675	-0.075	0.704
	Cooperativeness (CO)	-.472*	0.011	-0.216	0.269
	Self-Transcendence (ST)	-0.312	0.106	-0.333	0.083

Note: BSP = Brainspotting. BSM = Body Scan Meditation; SUDs = Subjective Unit of Disturbance scores; ASQ = Attachment Style Questionnaire, MAIA = Multidimensional Assessment of Interoceptive Awareness, TCI = Temperament and Character Inventory.

To sum up, correlation analysis showed that the low scores obtained in ASQ "Discomfort with Closeness" and "Relationships as Secondary" scales, and the higher scores in MAIA "Noticing" and "Emotional Awareness" scales were associated to greater effectiveness of BSP in reducing SUDs. On the other hand, the effectiveness of BSM was associated to higher scores in ASQ "Confidence" scale and MAIA "Emotional Awareness", "Body Listening" and "Trusting" scales.

4. Discussion

The aim of the study was to explore the efficacy of BSP in treating distressing, not necessarily traumatic, memories in a non-clinical sample of adults. Specifically, participants were exposed to BSP Inside Window technique (Grand, 2009) in a single 40-min session for the reprocessing of a personal distressing memory. Each participant was also exposed to an active control condition (BSM). Both objective (HRV) and subjective (SUDs) measures were used in the study. And in addition, a correlation analysis was performed on the participants' possible dispositional traits that could have influenced the effectiveness of the treatment.

Although, in normal clinical settings, a session of BSP may generally last from 1.5 to 2 hours, in the current study only about 40 minutes of treatment were enough to significantly reduce SUDs by an average of 64%. Moreover, 8 of 28 participants completed all the steps of the technique, including the “squeeze the lemon” procedure (Grand, 2009). These outcomes, that are significantly better than BSM, suggest that BSP could have a high therapeutic potential applicable not only in psychotraumatology, but also in the treatment of several disorders as previous studies have already shown (Anderegg, 2015; Mattos et al., 2015).

However, it should be noted that BSM was also effective in reducing perceived disturbance by an average of 43%. This outcome supports the idea that the BSM may have its own intrinsic value as an independent clinical resource (Dreeben et al., 2013). Indeed, it seems that having greater confidence in oneself and in others (ASQ "Confidence"), experiencing one’s body as safe and trustworthy (MAIA "Trusting"), awareness of the connection between body sensations and emotional states (MAIA “Emotional Awareness”), and capacity to active listening to the body for insight (MAIA “Body Listening”) could be associated to the BSM therapeutic potential. Indeed, the ASQ “Confidence” scale reflects a secure attachment style characterized by being able to rely and depend on others in a balanced way and an efficient interactive regulation and autoregulation of internal emotional states (Schore, 1994). Furthermore, research showed that this secure adult orientation is linked to adaptive coping in facing threatening stimuli, such as distressing memories, to increased self-regulation, and could be related to mindfulness and IA in dealing with stress (Bornemann et al., 2015; Fischer et al., 2017; Gibson, 2019; Stevenson et al., 2017).

In the present study, improved vagal modulation recorded after BSM (significant HR decreasing and HRV indices increasing) may be associated with a state of calm and relaxation that influenced the subjective memory-related disturbance. However, research indicated that BSM works more through neural mechanisms of sensory-awareness (including the insula and the pregenual anterior cingulate) than through the relaxation-response (Sevinc et al., 2018). Indeed, several participants reported insights or different perspectives on the event after the BSM, without having thought about the memory during the meditation practice.

Coming back to the core topic of the present study, the primary hypothesis on the BSP efficacy was supported as well as by SUDs also by psychophysiological measures. Indeed, after the treatment participants showed significant indices of lower arousal activation (decreasing of HR mean) and improved HRV Time Domain parameters. The decrease in hyper-arousal associated with an increase in general variability (SDNN) and in vagal tone (RMSSD, pNN50) could be an index of parasympathetic dominance and enhanced efficiency of physiological regulation systems (Laborde et al., 2017). These results seem to be the first evidence in support on the assumption that BSP helps down-regulate the amygdala and promote coherence between SNS and PNS activity (Grand, 2009; Scaer, 2005). The psychophysiological effects of BSP are comparable to those of BSM and this similarity could be studied further in future research. Instead, identifying which component of the Inside Window BSP technique (e.g., brainspot, Biolateral Sound stimulation, etc.) may have been most relevant to the processing goes beyond this study and would perhaps require a more reductionist laboratory approach.

Regarding the secondary hypothesis, on which characteristics of the participant would favor or hinder the processing of the disturbing memories, correlation analysis showed that awareness of uncomfortable, comfortable, and neutral body sensations (MAIA "Noticing") and awareness of the connection between body sensations and emotional states (MAIA "Emotional Awareness") were associated with the processing (focused mindfulness). The more the participant was able to notice body sensations and was aware of their connection with emotions, the more s/he processed the distressing memory. There is a large body of literature showing IA benefits on emotional regulation (Füstös et al., 2013; Pinna & Edwards, 2020; Price & Hooven, 2018). The key role of sensory (physical and emotional) awareness in reducing distress, and improving emotional regulation found in the present study results suits well a definition of BSP as an attuned treatment approach for effective brain-body healing in therapy (Baumann, 2020).

However, it should be borne in mind that study participants were medical doctors and psychologists, who may have developed expertise in observing their own emotional states related with bodily sensations. Therefore, it would be useful to extend the research to healthy non-therapist subjects and to clinical populations.

Correlation analysis also showed that the more the participants had a personal trait of being agreeable in relationships with other people (TCI Co), and the fewer features of avoidant/dismissing attachment (ASQ "Discomfort with closeness" and "Relationships as secondary" scales), the more effective was BSP in reducing SUDs (for the relationship between TCI-Co trait and ASQ secure attachment style see Martinotti et al., 2008). These findings fit well with the central role attributed to the therapeutic relationship in BSP (Grand, 2013). Therefore, the dual attunement could require not only a mindful therapist, but also a client who can feel comfortable in a close relationship, be willing to bring out disturbing material in the presence of another person, and show a collaborative attitude in engaging with the therapist.

In summary, as enthusiastically observed by thousands of therapists in nearly 20 years of clinical practice, the present study showed the early empirical evidence supporting the BSP high therapeutic potential in processing painful experiences. However, this study was just exploratory and had several limitations that need to be considered.

First, the sample consisted of a few subjects, mainly women psychologists. This particular sample allowed to conduct a study focused on the technique in a single treatment session but did not allow to extend results to the general population, and even less so to the clinical population. Furthermore, the experimental design lacked one or more follow-up sessions to study the results maintenance in the medium/long term.

Regarding the psychophysiological measures, results must be considered very cautiously due to the limited number of participants, the high individual variability in the HRV parameters, the limits of technical instruments (e.g., the absence of direct measures of respiration, chest belts create more artefacts than electrodes due to friction against the skin) and recordings being short. However, it is also true that HRV results could be easily underestimated (Laborde et al., 2017).

In future research it would be interesting to measure also HRV trend during BSP in both patient and therapist. Furthermore, in the field of BSP research, directions could be important not only to understand and validate this therapeutic tool, but also to deeply study the complex eye/brain interactive mechanisms.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any potential conflict of interest.

References

1. Anderegg, J. (2015). *Effective treatments for generalized anxiety disorder*. Unpublished. https://brainspotting.com/about-bsp/research-and-case-studies/
2. American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596
3. Baumann, M. (2020). *Brainspotting with Children and Adolescents: An attuned treatment approach for effective brain-body healing*. www.brainspotting-kids.com
4. Bornemann, B., Herbert, B. M., Mehling, W. E., & Singer, T. (2015). Differential changes in self-reported aspects of interoceptive awareness through 3 months of contemplative training. *Frontiers in psychology, 5*, 1504. https://doi.org/10.3389/fpsyg.2014.01504
5. Bromet, E., Karam, E., Koenen, K., & Stein, D. (Eds.). (2018). *Trauma and Posttraumatic Stress Disorder: Global Perspectives from the WHO World Mental Health Surveys*. Cambridge: Cambridge University Press. https://doi.org/10.1017/9781107445130
6. Calì, G., Ambrosini, E., Picconi, L., Mehling, W. E., & Committeri, G. (2015). Investigating the relationship between interoceptive accuracy, interoceptive awareness, and emotional susceptibility. *Frontiers in Psychology, 6*. https://doi.org/10.3389/fpsyg.2015.01202
7. Christodoulou, G., Salami, N., & Black, D. S. (2020). The utility of Heart Rate Variability in Mindfulness research. *Mindfulness, 11*(3), 554–570. https://doi.org/10.1007/s12671-019-01296-3
8. Chubb, C., Dosher, B. A., Lu, Z.-L., & Shiffrin, R. M. (Eds.). (2013). *Human information processing: Vision, memory, and attention*. American Psychological Association. https://doi.org/10.1037/14135-000
9. Cloninger, C R, Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. *Archives of General Psychiatry, 50*(12), 975–990. https://doi.org/10.1001/archpsyc.1993.01820240059008
10. Cloninger, C., Robert, Przybeck, T. R., Svrakic, D. M., & Wetzel, R. D. (1994). *The Temperament and Character Inventory (TCI): A guide to its development and use*. Center for Psychobiology of Personality, Washington University St. Louis, MO.
11. Conway, M.A., & Williams, H.L., (2008). *Autobiographical memory*. In John H. Byrne et al., Learning and Memory: A Comprehensive Reference. Oxford: Elsevier Ltd. pp. 893-909.
12. Corrigan, F., & Grand, D. (2013). Brainspotting: Recruiting the midbrain for accessing and healing sensorimotor memories of traumatic activation. *Medical Hypotheses, 80*(6), 759–766. https://doi.org/https://doi.org/10.1016/j.mehy.2013.03.005
13. Corrigan, F. M., Grand, D., & Raju, R. (2015). Brainspotting: Sustained attention, spinothalamic tracts, thalamocortical processing, and the healing of adaptive orientation truncated by traumatic experience. *Medical Hypotheses, 84*(4), 384–394. https://doi.org/https://doi.org/10.1016/j.mehy.2015.01.028
14. Delvecchio, G., Garzitto, M., Fagnani, C., Fornasari, L., Stazi, M. A., Picardi, A., Ciappolino, V., Fabbro, F., Altamura, A. C., & Brambilla, P. (2016). Normative data and effects of age and gender on temperament and character dimensions across the lifespan in an Italian population: A cross-sectional validation study. *Journal of Affective Disorders, 204*, 83–91. https://doi.org/https://doi.org/10.1016/j.jad.2016.06.014

15. Ditto, B., Eclache, M., & Goldman, N. (2006). Short-term autonomic and cardiovascular effects of mindfulness body scan meditation. *Annals of Behavioral Medicine, 32*(3), 227–234. https://doi.org/10.1207/s15324796abm3203_9

16. Dreeben, S. J., Mamberg, M. H., & Salmon, P. (2013). The MBSR Body Scan in Clinical Practice. *Mindfulness, 4*(4), 394–401. https://doi.org/10.1007/s12671-013-0212-z

17. Esco, M. R., & Flatt, A. A. (2014). Ultra-short-term heart rate variability indexes at rest and post-exercise in athletes: Evaluating the agreement with accepted recommendations. *Journal of Sports Science & Medicine, 13*(3), 535–541.

18. Farb, N. A. S., Segal, Z. V, & Anderson, A. K. (2013). Mindfulness meditation training alters cortical representations of interoceptive attention. *Social Cognitive and Affective Neuroscience, 8*(1), 15–26. https://doi.org/10.1093/scan/nss066

19. Feeney, J. A., Noller, P., & Hanrahan, M. (1994). Assessing adult attachment. In M. B. Sperling & W. H. Berman (Eds.), *Attachment in adults: Clinical and developmental perspectives* (pp. 128–152). Guilford Press.

20. Fischer, D., Messner, M., & Pollatos, O. (2017). Improvement of Interoceptive Processes after an 8-Week Body Scan Intervention. *Frontiers in human neuroscience, 11*, 452. https://doi.org/10.3389/fnhum.2017.00452

21. Fossati, A., Feeney, J. A., Donati, D., Donini, M., Novella, L., Bagnato, M., Acquarini, E., & Maffei, C. (2003). On the dimensionality of the Attachment Style Questionnaire in Italian clinical and nonclinical participants. *Journal of Social and Personal Relationships, 20*(1), 55–79. https://doi.org/10.1177/02654075030201003

22. Füstös, J., Gramann, K., Herbert, B. M., & Pollatos, O. (2013). On the embodiment of emotion regulation: interoceptive awareness facilitates reappraisal. *Social cognitive and affective neuroscience, 8*(8), 911–917. https://doi.org/10.1093/scan/nss089

23. Gambassi, B. B., Neves, V. R., Brito, E. Z. A., da Silva Fernandes, D. S., Sá, C. A., da Rocha Nogueira, R. M., de Jesus Furtado Almeida, F., de Araújo Cavalcanti, P. A., Gomes Gonçalves E Silva, D. C., Neto, D. S., de Souza Mesquita, F. O., Novais, T. M. G., de Souza, V. de F. M., Oliveira, A. C. C., Leite, R. D., & Schwingel, P. A. (2020). A validation study of a smartphone application for heart rate variability assessment in asymptomatic adults. *American Journal of Cardiovascular Disease, 10*(3), 219–229.

24. Gibson, J. (2019). Mindfulness, interoception, and the body: A contemporary perspective. *Frontiers in Psychology, 10*, 2012. https://doi.org/10.3389/fpsyg.2019.02012

25. Grand, D. (2009). *Brainspotting Phase One training manual.* Unpublished.

26. Grand, D. (2001). *Emotional healing at warp speed: The power of EMDR.* Harmony Books.

27. Grand, D. (2013). *Brainspotting: The revolutionary new therapy for rapid and effective change.* Sounds True.

28. Grossman, P., & Taylor, E. W. (2007). Toward understanding respiratory sinus arrhythmia: Relations to cardiac vagal tone, evolution and biobehavioral functions. *Biological Psychology, 74*(2), 263–285. https://doi.org/10.1016/j.biopsycho.2005.11.014

29. Hanley, A. W., Mehling, W. E., & Garland, E. L. (2017). Holding the body in mind: Interoceptive awareness, dispositional mindfulness and psychological well-being. *Journal of Psychosomatic Research, 99*, 13–20. https://doi.org/https://doi.org/10.1016/j.jpsychores.2017.05.014

30. Hildebrand, A., Grand, D., & Stemmler, M. (2014). A preliminary study of the efficacy of Brainspotting – A new therapy for the treatment of posttraumatic stress disorder. *Journal for Psychotraumatology, Psychotherapy Science and Psychological Medicine, 13*(1), 84–92.
31. Hildebrand, A., Grand, D., & Stemmler, M. (2017). Brainspotting - the efficacy of a new therapy approach for the treatment of posttraumatic stress disorder in comparison to Eye Movement Desensitization and Reprocessing. *Mediterranean Journal of Clinical Psychology, 5*(1), 1–17. https://doi.org/10.6092/2282-1619/2017.5.1376
32. Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain and illness*. Dell Publishing.
33. Kabat-Zinn, J. (1994). *Wherever you go, there you are: Mindfulness meditation in everyday life* (1st ed.). Hyperion.
34. Kim, D., Bae, H., & Park, Y. C. (2008). Validity of the subjective units of disturbance scale in EMDR. *Journal of EMDR Practice and Research, 2*(1), 57–62. https://doi.org/10.1891/1933-3196.2.1.57
35. Kleiger, R. E., Stein, P. K., & Bigger, J. T. J. (2005). Heart rate variability: Measurement and clinical utility. *Annals of Noninvasive Electrocardiology: The Official Journal of the International Society for Holter and Noninvasive Electrocardiology, Inc, 10*(1), 88–101. https://doi.org/10.1111/j.1542-474X.2005.10101.x
36. Laborde, S., Mosley, E., & Thayer, J. F. (2017). Heart Rate Variability and cardiac vagal tone in psychophysiological research – Recommendations for experiment planning, data analysis, and data reporting. *Frontiers in Psychology, 8*, 213. https://doi.org/10.3389/fpsyg.2017.00213
37. Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences, 12*(4), 163–169. https://doi.org/10.1016/j.tics.2008.01.005
38. Malik, M., Bigger, J. T., Camm, A. J., Kleiger, R. E., Malliani, A., Moss, A. J., & Schwartz, P. J. (1996). Heart rate variability: Standards of measurement, physiological interpretation, and clinical use. *European Heart Journal, 17*(3), 354–381. https://doi.org/10.1093/oxfordjournals.eurheartj.a014868
39. Martinotti, G., Mandelli, L., Di Nicola, M., Serretti, A., Fossati, A., Borroni, S., Cloninger, C. R., & Janiri, L. (2008). Psychometric characteristic of the Italian version of the Temperament and Character Inventory--revised, personality, psychopathology, and attachment styles. *Comprehensive psychiatry, 49*(5), 514–522. https://doi.org/10.1016/j.comppsych.2007.11.002
40. Massin, M. M., Maeyns, K., Withofs, N., Ravet, F., & Gérard, P. (2000). Circadian rhythm of heart rate and heart rate variability. *Archives of Disease in Childhood, 83*(2), 179–182. https://doi.org/10.1136/adc.83.2.179
41. Masson, J., Bernoussi, A., & Moukouta, C. S. (2017). Brainspotting therapy: About a Bataclan victim. *Global Journal of Health Science, 9*(7), 103. https://doi.org/10.5539/gjhs.v9n7p103
42. Mattos, P. F., José, F. P., & Marcelo, M. (2015). Persistent Genital Arousal Disorder as a dissociative trauma related condition treated with Brainspotting – A successful case report. *International Journal of School and Cognitive Psychology, 1*(1), 1–4. https://doi.org/10.4172/2469-9837.S1-002
43. Mehling, W. E., Price, C., Daubenmier, J. J., Acree, M., Bartmess, E., & Stewart, A. (2012). The Multidimensional Assessment of Interoceptive Awareness (MAIA). *PLoS ONE, 7*(11), e48230. https://doi.org/10.1371/journal.pone.0048230

44. Munoz, M. L., van Roon, A., Riese, H., Thio, C., Oostenbroek, E., Westrik, I., de Geus, E. J. C., Gansevoort, R., Lefrandt, J., Nolte, I. M., & Snieder, H. (2015). Validity of (ultra-)short recordings for Heart Rate Variability measurements. *PloS One, 10*(9), e0138921–e0138921. https://doi.org/10.1371/journal.pone.0138921
45. Nussinovitch, U., Elishkevitz, K. P., Katz, K., Nussinovitch, M., Segev, S., Volovitz, B., & Nussinovitch, N. (2011). Reliability of Ultra-Short ECG Indices for Heart Rate Variability. *Annals of Noninvasive Electrocardiology: The Official Journal of the International Society for Holter and Noninvasive Electrocardiology, Inc, 16*(2), 117–122. https://doi.org/10.1111/j.1542-474X.2011.00417.x
46. Ogden, P., Minton, K., & Pain, C. (2006). *Trauma and the body: A sensorimotor approach to psychotherapy*. WW Norton & Company.
47. Pinna, T., & Edwards, D. J. (2020). A systematic review of associations between interoception, vagal tone, and emotional regulation: Potential applications for mental health, wellbeing, psychological flexibility, and chronic conditions. *Frontiers in psychology, 11*, 1792. https://doi.org/10.3389/fpsyg.2020.01792
48. Plews, D. J., Scott, B., Altini, M., Wood, M., Kilding, A. E., & Laursen, P. B. (2017). Comparison of Heart-Rate-Variability recording with smartphone photoplethysmography, Polar H7 chest strap, and electrocardiography. *International Journal of Sports Physiology and Performance, 12*(10), 1324–1328. https://doi.org/10.1123/ijspp.2016-0668
49. Porges S. W. (1995). Cardiac vagal tone: a physiological index of stress. *Neuroscience and biobehavioral reviews, 19*(2), 225–233. https://doi.org/10.1016/0149-7634(94)00066-a
50. Price, C. J., & Hooven, C. (2018). Interoceptive awareness skills for emotion regulation: Theory and approach of mindful awareness in body-oriented therapy (MABT). *Frontiers in Psychology, 9*, Article 798. https://doi.org/10.3389/fpsyg.2018.00798
51. Quintana, D. S., & Heathers, J. A. J. (2014). Considerations in the assessment of heart rate variability in biobehavioral research. *Frontiers in Psychology, 5*, 805. https://doi.org/10.3389/fpsyg.2014.00805
52. Salahuddin, L., Cho, J., Jeong, M. G., & Kim, D. (2007). Ultra short term analysis of heart rate variability for monitoring mental stress in mobile settings. *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference, 2007*, 4656–4659. https://doi.org/10.1109/IEMBS.2007.4353378
53. Scaer, R. (2005). *What Is Brainspotting? – Brainspotting*. Brainspotting Trainings, LLC. https://brainspotting.com/about-bsp/what-is-brainspotting/
54. Schmider, E., Ziegler, M., Danay, E., Beyer, L., & Bühner, M. (2010). Is it really robust? Reinvestigating the robustness of ANOVA against violations of the normal distribution assumption. *Methodology: European Journal of Research Methods for the Behavioral and Social Sciences, 6*(4), 147–151. https://doi.org/10.1027/1614-2241/a000016
55. Schore, A. N. (1994). *Affect regulation and the origin of the self: The neurobiology of emotional development*. Erlbaum.

56. Sevinc, G., Hölzel, B. K., Hashmi, J., Greenberg, J., McCallister, A., Treadway, M., Schneider, M. L., Dusek, J. A., Carmody, J., & Lazar, S. W. (2018). Common and dissociable neural activity after mindfulness-based stress reduction and relaxation response programs. *Psychosomatic Medicine, 80*(5), 439–451. https://doi.org/10.1097/PSY.0000000000000590
57. Shaffer, F., McCraty, R., & Zerr, C. L. (2014). A healthy heart is not a metronome: An integrative review of the heart's anatomy and heart rate variability. *Frontiers in Psychology, 5*, 1040. https://doi.org/10.3389/fpsyg.2014.01040
58. Shapiro, F. (2018). *Eye Movement Desensitization and Reprocessing (EMDR) therapy. Basic principles, protocols, and procedures* (3rd Ed.). Guilford Press.
59. Siegel, D. J. (2010). *The mindful therapist: A new approach to cultivating your own neural integration from the inside out.* CMI/Premier Education Solutions.
60. Squire, L. R. (2009). Memory and brain systems: 1969–2009. *The Journal of Neuroscience, 29*(41), 12711–12716. https://doi.org/10.1523/JNEUROSCI.3575-09.2009
61. Stevenson, J. C., Emerson, L.-M., & Millings, A. (2017). The relationship between adult attachment orientation and mindfulness: A systematic review and meta-analysis. *Mindfulness, 8*(6), 1438–1455. https://doi.org/10.1007/s12671-017-0733-y
62. Tanner, B. A. (2012). Validity of global physical and emotional SUDS. *Applied Psychophysiology and Biofeedback, 37*(1), 31–34. https://doi.org/10.1007/s10484-011-9174-x
63. Tarvainen, M. P., Niskanen, J.-P., Lipponen, J. A., Ranta-Aho, P. O., & Karjalainen, P. A. (2014). Kubios HRV--heart rate variability analysis software. *Computer Methods and Programs in Biomedicine, 113*(1), 210–220. https://doi.org/10.1016/j.cmpb.2013.07.024
64. Wolpe, J. (1969). *The practice of behavior therapy*. Pergamon.
65. Yasuma, F., & Hayano, J. (2004). Respiratory sinus arrhythmia: Why does the heartbeat synchronize with respiratory rhythm? *Chest, 125*(2), 683–690. https://doi.org/https://doi.org/10.1378/chest.125.2.683
66. Zhang, D., Lee, E., Mak, E., Ho, C. Y., & Wong, S. (2021). Mindfulness-based interventions: An overall review. *British medical bulletin, 138*(1), 41–57. https://doi.org/10.1093/bmb/ldab005

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