Abstract

Objective: Havening is a psychosensory therapeutic technique that purportedly harnesses the power of touch to stimulate oxytocin release and facilitate adaptive processing of distressing thoughts/memories. Whilst Havening is used in clinics worldwide, with anecdotal evidence, very few empirical studies exist to support its efficacy or mechanism of action. The current study is the first to investigate the effects of Havening touch on subjective distress, mood, brain function and wellbeing.

Methods: Participants (n=24) underwent a single session of Havening, in response to a self-reported distressing event. Mood and resting-state electroencephalography were assessed prior to, and immediately following, the session. Psychological health was assessed at baseline and two weeks follow-up via an online self-report questionnaire.

Results: There was a greater reduction in subjective units of distress during sessions that included Havening Touch (H+) than sessions that did not include Havening touch (H-). EEG results showed an increase in beta and reduction in gamma activity in H+. Both groups showed reduction in negative mood states immediately following the session and better psychological health at follow-up.

Conclusions: Findings suggest both touch and non-touch components of the intervention have therapeutic potential, and that Havening Touch may accelerate a reduction in distress during a single Havening session.

Key words: Havening, Touch, Trauma, EEG, Mood, Depression, Wellbeing

Public Significance: We present an investigation of an innovative psychological therapy known as Havening that incorporates nurturing touch in order to help people recover from traumatic experiences and improve wellbeing. In addition to asking people how they felt before and after the therapy, we also measured their brain activity. Moreover, psychological health was assessed at baseline and two weeks following the therapy. Findings suggest that Havening Touch is an important part of the intervention that facilitates reduction in feelings of distress and changes brain activity.

Introduction

The sensation of physical touch not only plays a significant role in social communication (Hertenstein et al., 2006; 2009), but development and maintenance of a healthy body and mind relies on regular nurturing touch (Cruciani et al., 2021; Jakubiak and Feeney, 2017; Field 2010). Non-human primates spend 10-20% of their waking hours grooming, which plays a central role in reconciling, sexual behaviour, food sharing, maintaining proximity and soothing during times of stress (Jablonski, 2021; Hertenstein et al., 2009; de Waal, 1989). Indeed, Harlow's early studies observed that infant primates prefer the comfort of touch over food itself, and that such touch plays a crucial role in psychological and physiological development (Jablonski, 2021). In adulthood too, nurturing touch is critical to psychological and physical health, promoting positive behaviours (Ellingsen et al., 2016) and healthy aging (Jakubiak & Feeney, 2017; Lee and Cichy, 2020). Warm, friendly touches of appreciation make others feel esteemed and valued, activating several physiological mechanisms that promote wellbeing (Jakubiak & Feeney, 2017), and ameliorate negative perceptions of loneliness (Heatley Tejada et al., 2020). Such benefits of nurturing touch have been harnessed by an innovative psychological intervention known as Havening; a psychosensory technique that integrates psychological techniques, such as positive self-affirmations with nurturing touch (Thandi et al., 2015; Cizmic et al., 2018 Hodgson et al., 2020). Havening uses the power of touch to cultivate healthy processing of traumatic events, distressing memories and/or disturbing thoughts. This therapeutic method was first developed by Dr Ron Ruden (see Ruden, 2018) and is currently practiced worldwide with anecdotally impressive outcomes. However, very little empirical evidence exits to support its efficacy (Thandi et al., 2015; Cizmic et al., 2018, Hodgson et al., 2020). Indeed, to our knowledge, the current study represents the first empirical support for the importance of nurturing touch in Havening for psychological well-being.

As well as cultivating self-esteem, and a sense of value and love (Jakubiak and Feeney, 2017), the criticality of nurturing touch for development was demonstrated by early studies showing that infants raised without touch had 30%-100% higher death rates (Balkwin, 1942; Bowlby, 1952). Furthermore, touch-deprived infants have impaired development of brain and body chemistry (Bales et al., 2018). In comparison, light massage in human infants results in 21-47% more weight gain (Elmoneim et al., 2020). Massage in the elderly also improves both physical and psychological wellbeing (Micillo et al., 2020). This likely reflects the importance of nurturing touch for the development and maintenance of several biological systems, particularly those involving hormones (e.g., oxytocin, cortisol), the immune response (e.g., inflammation) and brain chemistry (e.g., dopamine, serotonin and opiates; Kim et al., 2016; Jakubiak and Feeney, 2017; Jablonski, 2021; Ellingsen et al., 2016). Indeed, these systems interact to promote and maintain wellbeing. For more detailed evaluation, please see recent reviews (e.g. Carozza and Leong, 2021). However, key points will be currently presented.

Firstly, dopamine is released in response to social reward which includes nurturing touch (Cruciani et al., 2021; Ellingsen et al., 2016). As well as being the primary neurotransmitter for motivational and conditional learning systems, dopamine affects the immune system, protecting the brain and body from excessive inflammation (Xia et al., 2019). Following TRYCATS models of wellbeing (Anderson et al., 2014), inflammatory molecules disrupt the synthesis of serotonin and interfere with the resolution of stress-response (cortisol) networks, ultimately resulting in tissue damage and cell death throughout the body and brain. Central to the regulation of these systems is the hormone oxytocin.

Oxytocin is synthesised in the hypothalamus and is released into our bodies during social bonding and nurturing touch (Ellingsen et al., 2016; IsHak et al., 2011). It plays an important role in promoting wellbeing, especially following trauma. For example, oxytocin facilitates management of stress and promotes psychological growth following trauma and adaptive response to threat (Sharma et al., 2020). Moreover, activation or administration of oxytocin has been shown to lower baseline cortisol, but upregulates the acute response to stress (Ito et al., 2019). Oxytocin is also highly concentrated in limbic regions, like the amygdala, where it promotes more accurate discrimination of threats and facilitates adaptive behavioural responses (Olivera-Pasilio & Dabrowska, 2020). Whilst high oxytocin receptor concentrations in human limbic regions, has been questioned, administration of oxytocin (e.g., via nasal spray) alters reactivity of several limbic structures (Stevens et al., 2013). Oxytocin also promotes group cohesion and prosocial behaviour (Pepping et al., 2012), and is involved in regulation of the immune system (reducing chronic inflammation), thus protecting us from psychological and physical illness (Li et al., 2017; Russell et al., 2018; Jankowski et al., 2020). It is likely that the integration of touch in Havening harnesses the power of social reward (dopamine) and oxytocin (Ellingsen et al., 2016) to alter neurophysiology and cultivate a sense of well-being.

The Havening touch involves application of gentle touch, particularly to the face, tops of the arms and palms of the hands. In the case of Event Havening, which is one of several modalities of Havening, this is undertaken following activation of a distressing event (e.g., traumatic memory, disturbing thought), often through bringing-to-mind associated sensory information. Theoretically, this activates amygdaloid representation of the event which, when accompanied by Havening touch (oxytocin/dopamine release), facilitates adaptive processing of the event. As the amygdala is centrally involved in processing social and affective touch (Gordan et al., 2013;

Gothard et al., 2021), Ruden has proposed a neurological model by which Havening touch alters amygdala functioning (Ruden, 2018; Spampanato et al., 2011). This is in line with current understanding of the role of oxytocin in the amygdala (Sobota et al., 2015). For example, oxytocin in the central amygdala may attenuate fear and stress responses (Knobloch et al., 2012).

Ruden has also proposed an electrophysiological manifestation of Havening touch in brain activity – specifically, delta waves (Ruden, 2018), which are slow frequency (0-4 Hz) oscillations (Knyazev, 2012, Harmony, 2013) that can be measured from the scalp using electroencephalography (EEG). Whilst the functional significance of delta activity during wakefulness is not well understood, it likely differs from that during sleep and is not unitary (Harmony, 2013). According to Ruden, mechanisms reflected by delta activity inhibit amygdala activity during recollection of a traumatic or stressful event. Whilst there is currently little to no empirical evidence supporting this notion, it is in line with Harmony (2013) who propose that delta activity, in particular that produced by the medial frontal cortex, reflects active inhibition of mechanisms not required for completion of specific tasks, such as the inhibition of sensory or affective networks during the completion of cold executive function tasks. On-the-other hand, Knyazev (2012) proposed that, in part, delta reflects activation of basic homeostatic and primal motivational processes, such as touch. Thus, Havening may well activate inhibitory mechanisms reflected in delta activity.

Whilst delta activity might be a reasonable contender, other EEG bands might reflect alternative underpinning mechanisms. For example, the functional coupling of delta and beta activity is seen in anxiogenic states (Harmony, 2013; Knyazev, 2012). Moreover, alterations in alpha activity (8-12Hz) in response to touch and in relation to oxytocin have been proposed to reflect shifts in

attention and perception (Portnova et al., 2020). Kraus et al., (2020) have reported that the effects of being touched on frontal EEG depend on whether the person touched is a stranger or a loved one, with lower theta (4-8Hz) seen when holding hands with a loved one. Lower right frontal theta is proposed to reflect anxiolytic mechanisms (Shadli et al., 2021). Kraus et al., (2020) also suggest that gamma power (>30Hz) was highest when touched by a stranger compared to when alone or with a partner, possibly reflecting the aversive power of unwanted touch (Ellingsen et al., 2016). Evidence from animal studies has shown that application of oxytocin to the amygdala during threat response alters amygdaloid electrophysiology, reducing gamma activity (Sobota et al., 2015).

To our knowledge only three peer-reviewed, published empirical studies exist of Havening. Thandi et al., (2015) showed that a single Havening session resulted in an improvement (at two months follow-up) in depression, anxiety and impact of psychological problems on work and social functioning. However, their design did not use any control condition. Cizmic et al. (2018) found no support for Havening in reducing pain or narcotic consumption following joint arthroplasty. Most recently, Hodgson et al., (2020) examined the impact of a single Havening session on individuals with Type D personality characteristics and reported a reduction in Type D scale scores and biomarkers of stress (blood pressure, heart rate, salivary cortisol) compared to a waiting list control group.

The current study investigates the nurturing touch component of the Havening technique. Specifically, it directly compares Event Havening methods with Havening touch to a similar protocol without the Havening Touch component on 1) change in the emotional response to a distressing event; 2) change in mood and resting-state EEG activity immediately following a

single intervention session with (H+) and without (H-) Havening touch; and 3) change in psychological health two weeks following a single session with and without Havening touch. We hypothesised that compared to H-, H+ would be associated with a greater reduction in distress during Havening and an improvement in mood following the session, paralleled by reduced gamma and increased delta activity. Given their role in wellbeing as described above, other frequency bands were also explored, including alpha, beta and theta. For example, one might expect a shift from theta to higher frequency (alpha, beta) activity with an improvement in mood (Shadli et al., 2021). Greater improvement in psychological health would be seen 2 weeks following H+ compared to H-.

Methods

Procedures for this project were approved by Nottingham Trent University Ethic Committee and all participants provided written informed consent prior to data collection.

Participants

Participants (n=24, 21 female/3 male, n=21 white, age range 18-47 years mean=25.21, SD=7.81) were recruited from students and staff of the university. Inclusion criteria included aged ≥18 years, right-handed (due to brain function arm of this project), having reported a moderately distressing thought or event (scoring between 5 and 8 on a 0 (not at all distressed) – 10 (extremely distressed) point scale of subjective units of distress, Baseline SUD) that had persisted for at least 1 month. Individuals with any formally diagnosed neurological disorder or AXIS 1 psychiatric disorder were excluded. Based on the primary outcome measure, assessed across 5 timepoints (with at least .5 correlation between measures) in 2 conditions, n=24 is estimated to have 85% power to detect medium effect size of .25 at 5% alpha threshold. Due to the drop out

between baseline and two-week follow-up, further recruitment was planned. However, this was not possible due to COVID-19 associated lockdown.

Design and general procedure

Participants completed an online questionnaire that i) recorded online informed consent and demographic information (e.g., age, sex); ii) asked participants to rate the "Event" (0-10 baseline SUD); and iii) assessed self-reported psychological health using psychometric instruments. Participants who were eligible to participate were invited to a single face-to-face Havening session including brain function (electroencephalography, EEG) assessment that took place at the university. Participants were pseudo-randomised into one of two intervention groups: with Havening touch (H+) or without Havening touch (H-). MS created a randomisation list based on random number generation in Excel, which allocated participants at the time of booking randomly to either H+ or H-, stratified by practitioner (male practitioner TB, female practitioner JF), with the view to achieving equal numbers in all groups. Due to 'no shows' on the assessment day, ultimately H- had fewer participants.

Assessments of mood and EEG (resting state) were made immediately prior to and following (approximately 5 minutes wait) the Havening (or non-touch) session. EEG was also continuously recorded and SUDs for the event were assessed at 5 time points (T1, T2, T3, T4, T5) throughout the Havening session. Two weeks following the session, participants were invited to complete psychometric measures a second time. A subgroup (n=16) was invited to a qualitative interview about the Havening experience. Findings from qualitative arms of the study and EEG assessment during the session are not presented in the current manuscript.

The Event

Online, participants were asked to consider an event or thought that had persistently been causing them distress over at least a month prior to the study. They were asked to provide a SUD rating (i.e. how distressed they felt about the event, Baseline SUD on 0 -10 scale), to name the event in an open text box and state what emotions they felt about the event. Examples of events included broken friendship, addiction of a family member, crushed by a crowd at a large festival, death of friend, family member, or close pet, car crash, near death experience, work-place/education stress, resignation, injury or hospital operation, pregnancy, being physically or emotionally attacked, betrayal, serious illness of family member, heated argument with stranger. Examples of emotions felt about the event included sad, anxious, guilty, annoyed, petrified, emotionally distressed, upset, betrayed, angry.

Measures

Positive and negative affect scale (PANAS)

Prior to (Pre) and immediately following (Post) the Havening session, participants rated how they felt at that moment by considering 20 PANAS (Watson et al., 1988) adjectives (10 positive e.g., , e.g., cheerful, active, 10 negative e.g., sad, afraid) on a 1 (not at all like me) to 5 (extremely like me) point scale. Scores ranged from 10-50 for each scale (positive, negative).

Psychological Health

Participants completed several psychometric instruments to assess psychological health. Assessments of psychological health typically ask about behaviour over a previous time period (e.g., two weeks). Thus, these assessments were performed at baseline (BL, prior to the Havening

session and follow-up (FU, 2 weeks following the appointment), but not immediately following the intervention.

1. The short 21 item Depression Anxiety Stress Scale (DASS-21; Lovibond & Lovibond, 1995) is designed to measure depression, anxiety, and stress. The scale is divided into three sub-scales with good internal consistency (Antony et al., 1998): Depression (7 items, α=.94), Anxiety (7 items, α=.87) and Stress (7 items, α=.91). Participants are asked to use a 4-point severity/frequency scale (0=never to 3=almost always) to rate the extent that they have experienced each state over the past 2 weeks. Range of scores for each subscale are 0 (no depression, anxiety, stress) to 42[1] (severe depression, anxiety, stress). A total DASS score (sum of depression, anxiety and stress) was calculated.
2. The dysfunctional attitudes scale (short forms, DAS-SF1, DAS-SF2; Beevers et al., 2007) assesses beliefs associated with vulnerability to depression. DAS-SF1 (α=.84) and DAS-SF2 (α=.83) are parallel forms, each with 9 items rated on a 1 to 4-point scale. It has good concurrent validity with other depression scales and is sensitive to change with several interventions for depression (e.g., cognitive behavioural therapy; Cristea et al., 2015). In the current study, a mean score was generated based on scores from both forms that had a possible range of 9 (less functional)-36 (more functional).
3. Wellbeing was measured using the Warwick-Edinburgh Mental Well-being Scale (WEMWBS; Tennant et al., 2007), which has 14 items rated on a 1-5 point scale. Higher scores (ranging 14-70) are indicative of better wellbeing. Internal consistency is high (α=.89-92) and test-retest reliability in a student sample has been recorded at .83.

[1] Multiple by 2 to get equivalent full DASS score

WEMWBS is responsive to several interventions across various groups (Maheswaran et al., 2012)

4. The Subjective Vitality Scale (SVS; Ryan and Frederick, 1997) was used to assess thriving, such as a state of feeling alive, alert and having energy available to the self. Vitality is considered an aspect of eudaimonic well-being (Ryan & Deci, 2001). The current study used the 7 item self-report state scale rated on a 1 (not at all true) to 7 (very true) Likert scale. High scores indicate high subjective vitality. Internal consistency has been recorded between .84-.87.

Intervention Procedure

Prior to attending the intervention session, to reduce confounding, participants were asked to ensure that they arrived for the session after having a 'normal' night's sleep, to refrain from excessive alcohol consumption for the previous 24 hours. Upon arrival, participants were given a hard copy of the information sheet, and invited to ask any questions about the study before completing a hard copy of the consent form. Participants were then fitted with an EEG cap and pre-session resting state EEG data was collected which required participants to sit quietly for 4 minutes (2 minutes with eye closed EC, 2 minutes with eyes open EO). In total, EEG cap fitting and data collection took about 30-40 minutes. In addition, participants completed the PANAS to give pre-mood state. Next, the participant was introduced to an accredited Havening practitioner (either TB or JF). The EEG researcher left the room and remained blind to which Havening protocol was administered thereafter. The participants remained blind to whether they were in the 'active' condition until final debrief. Apart from the practitioners and one of the researchers (MS, who conducted a follow-up qualitative interview), all other researchers were

bind to condition throughout data collection and EEG signal processing. AS became unblinded to conduct statistical analysis.

In both the H+ and H- interventions, the protocol comprised the following components and was administered by an experienced Havening therapist. Participants were asked to:

1. Close their eyes for 15 seconds and think about the distressing event/memory that they had identified in the Baseline measures
2. provide a SUD score in relation to the distressing event/memory
3. name animals beginning with specific letters
4. think about photos of happy images
5. hum Old MacDonald (a childhood song)
6. imagine being in a beautiful landscape and to count their steps as they walk
7. imagine watching a tennis match and to count the strokes
8. say the months of the year in backwards order from December to January

Delivery of components 1-8 was defined as a 'cycle'. Typically, the duration of each component varied from 20-140 seconds with an average duration of 40-60 seconds. An intervention session typically included four cycles (4*8 components). SUDs were recorded at step 2 in the cycle and at the end of the session. During H+ condition only, the therapist incorporated Havening touch during components 3-8 of the cycle. For this, the practitioner administered a gentle sweeping touch to either the participant's face (as if washing the face), upper arms and shoulders (as if hugging), or palms (as if washing hands). Every intervention session (following four cycles) was brought to a close by the participant and practitioner vocalising a number of positive affirmations (e.g. I am hopeful, I am ready for the future).

EEG

Data collection

EEG data was available for n=23 participants only. Data from one participant was not usable due a technical failure resulting in substantial artefact. EEG activity was recorded using an active-electrode, 64-channel Active-Two acquisition system (BioSemi, Amsterdam, Netherlands), sampled at 2048 Hz, digitised at 24-bits. Data were collected using ActiView V 6.05 (National Instruments, TX, USA). All EEG signals were average referenced on-line.

Signal processing

Signal processing was performed using Curry 7.12 software (including several bug fixes) for each of eyes open and eyes closed conditions. Following baseline correction, data were filtered at 1-80Hz. PCA was used to model and reduce ocular artefacts. Two second back-to-back epochs were created, and automatic detection of residual artefacts was performed based on voltage amplitude across all electrodes. Initially a ±70µV threshold was used that was optimised on an individual basis allowing for maximum artefact-free data for each participant. Those epochs containing residual artefact were removed from analysis. Spectral power for delta (1-4Hz), theta (4-8Hz), alpha (8-12Hz), beta (12-20Hz) and low gamma (20-50Hz) were calculated for each 2 second epoch and then an average including all artefact-free epochs was generated. To simplify analysis only a subset of electrodes were used in the current study. These included lateral frontal (F3, F7, F4, F8), lateral central (C3, T7, C4, T8), lateral parietal (P3, P7, P4, P8), medial anterior (F1, F2, FC1, FC2), medial central (C1, C2, CP1, CP2) and medial posterior (P1, P2, PO3, PO4) sites.

Planned statistical analysis

1. Primary outcome (Subjective Units of Distress): Mixed Methods Analysis of Variance ANOVA was used to test for *Time point* (T1, T2, T3, T4, T5), *Condition* (H+, H-) and *Time point* * *Condition* effects on SUD scores. BL SUD was entered as a covariate.
2. Secondary Outcome (Positive and Negative Mood): A similar analysis was performed on i) PANAS positive scores and ii) PANAS negative scores, with 2 levels for Time point (pre, post)
3. Tertiary Outcomes (EEG): A similar analysis was performed on each EEG band (delta, theta, alpha, beta, gamma) with 2 levels for *Time* point (pre, post). Electrode positions were treated as 2x2 within subject variables, *Hemisphere* (left, right) and *Site* (e.g., F3/F4, F7/F8). As such, separate analyses were performed for lateral frontal, lateral central, lateral parietal, medial anterior, medial central and medial posterior scalp regions.
4. Follow-up (Psychological Health): A similar analysis was performed on total scores for DASS, DAS-SF, WEM and SVS with 2 levels for *Time* point (Baseline, Follow-up). Greenhouse-Geisser correction was implemented if Sphericity could not be assumed.

Post-Hoc, lower order ANOVA were used to follow up any interaction effects

Results

Table 1 shows demographics and baseline SUD for H+ and H- groups, and comparison statistics for these variables. H+ and H- did not significantly differ at baseline on demographics. Whilst baseline SUD was slightly higher in H+ than H-, this difference did not reach significance (p=.19)

Table 2 shows means and standard deviations for PANAS (positive, negative) before (Pre) and after (Post) the session and psychological health measures at baseline and follow-up. Figure 1. shows SUDs (mean, standard error) as a function of *Condition* and *Time* point throughout the session. Figure 2. shows power as a function of frequency. Time series represents an average

across Left Lateral Frontal (F3, F7), Lateral Frontal (F3, F4, F7, F8) and Medial Central (C1, C2, CP1, CP2) sites.

[please place table 1 and 2 about here]

Immediate Effect

Subjective units of distress (SUD)

There were significant *Time* [F(2.06, 53.48)=38.21, p<.001, Partial Eta Squared=.60] and *Time* * *Condition* [F(2.06, 53.48)=3.81, p=.027, Partial Eta Squared =.13] effects (figure 1). Post-hoc analysis showed significant effects of *Time* for H+ [F(2.34, 28.04)=4.43, p=.017, Partial Eta Squared=.27], but not H- F(1.88, 15.02)=.36, p=.69, Partial Eta Squared=.04]. Univariate analysis at each time point showed significant effects of *Condition* for T2 [F(1, 21)=5.09, p=.035, Partial Eta Squared=.20], T3 [F(1, 21)=7.52, p=.012, Partial Eta Squared=.26], T4 [F(1, 21)=5.41, p=.030, Partial Eta Squared=.21] and T5 [F(1, 21)=4.44, p=.047, Partial Eta Squared=.17], with lower scores for H+ than H- in each case. However, there was no effect of *Condition* for T1 [F(1, 21)=.65, p=.43, Partial Eta Squared=.03].

[Please place figure 1 about here]

PANAS

No effect of *Time* or *Condition* on PANAS positive scores were noted. However, there was a significant effect of *Time* on PANAS negative scores [F(1, 21)=9.16, p=.006, Partial Eta Squared=.34] with lower Post than Pre scores. There was no significant *Time* * *Condition* effect for either positive or negative PANAS scores.

EEG

Table 3. presents a summary of key EEG findings involving *Time* and *Time*Condition* interactions

[Please place table three and figure 2 about here]

Delta and Theta

Eyes Closed

There was a significant effect of *Condition* for medial [F(1, 21)=4.24, p=.05, Partial Eta Squared=.17] and lateral [F(1, 21)=4.94, p=.04, Partial Eta Squared=.19] frontal delta (H+>H-). There was a significant *Time*Hemisphere*Condition* interaction for lateral frontal delta [F(1, 21)=6.20, p=.02, Partial Eta Squared=.23] and theta [F(1, 21)=5.77, p=.026, Partial Eta Squared=.22]. For lateral frontal delta there was a significant *Time* * *Condition* interaction in the left hemisphere [F(1, 21)=7.08, p=.015, Partial Eta Squared=.25], which was due to a significant effect of *Time* in H+ [F(1, 12)=8.92, p=.011, Partial Eta Squared=.43], but not in H- (p=.51). In H+, Pre (F3 mean=92.36, sd=49.00; F7 mean= 114.18, sd=74.97) was higher than Post (F3 mean=78.50, sd=43.72; F7 mean= 94.85, sd 57.90). Lateral central sites showed a similar pattern, however the *Time* * *Hemisphere* * *Condition* interaction was not significant [F(1, 21)=3.22, p=.087, Partial Eta Squared=.13]. Nevertheless, there was a significant 4-way interaction [F(1, 12)=5.42, p=.030, Partial Eta Squared=.21]. In the left hemisphere, pre delta was higher in H+ (C3 mean=43.09, sd=21.96; T7 mean=97.48, sd=61.71) compared to H- (C3 mean=26.27, sd=19.01; T7 mean=50.59, sd=19.57) [F(1, 21)=5.94, p=.024, Partial Eta Squared=.22]. However, no difference was seen in the right hemisphere (p=.26) nor at Post assessment (p=.19). In

comparison, medial central delta showed a slight increase in H+ (Pre mean and decrease in H- with *Time*, however the *Time* * *Condition* interaction was not significant (p=.095).

Eyes open

There was a significant effect of *Condition* for delta at lateral frontal [F(1, 21)=6.23, p=.021, Partial Eta Squared=.23], lateral parietal [F(1, 21)=5.11, p=.034, Partial Eta Squared=.20] and medial frontal [F(1, 21)=6.70, p=.017, Partial Eta Squared=.24] sites; and for theta at medial frontal sites [F(1, 21)=6.24, p=.021, Partial Eta Squared=.23]. Also, at lateral parietal sites, there was a significant *Condition* * *Site* interaction [F(1, 21)=5.11, p=.034, Partial Eta Squared=.20], due to a significant effect of *Site* (P7/P8 > P3/P4) in H+ [F(1, 21)=14.25, p=.003, Partial Eta Squared=.30] that did not reach significance in H- (p=.08). At medial central sites, the pattern was for an increase in delta in H+ and a decrease in H-, however, the *Time* * *Condition* interaction did not reach threshold for significance [F(1, 21)=1.96, p=.18, Partial Eta Squared=.09].

There was a significant *Time* * *Hemisphere* * *Site* interaction for lateral frontal theta [F(1, 21)=4.50, p=.046, Partial Eta Squared=.18]. Lower order ANOVA suggested this was due to a significant effect of *Hemisphere* (F7 > F8) sites at Post assessment [F(1, 21)=8.95, p=.007, Partial Eta Squared=.30; H+ Post F7 Mean=13.29, sd=9.33; Post F8 Mean=11.38, sd=6.98; H- Post F7 Mean=7.28, sd=2.82; Post F8 Mean=5.92, sd=2.01] that was not seen at Pre assessment or for F3/F4 sites.

Alpha

Eyes-Closed

The *Time* * *Condition* interaction for medial central alpha fell short of reaching threshold for significance [F(1, 21)=3.33, p=.08, Partial Eta Squared=.14], as did the main effect of *Condition* at lateral central [F(1, 21)=2.98, p=.099, Partial Eta Squared=.12] and lateral frontal [F(1, 21)=3.43, p=.08, Partial Eta Squared=.14] sites. There was a significant 4-way interaction for medial posterior alpha [F(1, 21)=4.2, p=.05, Partial Eta Squared=.17], that was not followed up.

Eyes open

There was a significant *Site* * *Condition* interaction [F(1, 21)=6.70, p=.017, Partial Eta Squared=.24] at medial central sites due to a significant effect of *Site* in H+ [F(1, 12)=12.10, p=.017, Partial Eta Squared=.50], but not H- (p=.43).

Beta

Eyes-Closed

There was a significant effect of *Condition* for lateral frontal beta [F(1, 21)=6.69, p=.017, Partial Eta Squared=.24], with higher power in H+ (Pre F3 Mean=3.44, sd=2.39; Pre F7 Mean=3.0, sd=1.32; Pre F4 Mean=2.80, sd=1.64; Pre F8 Mean=2.48, sd=1.12; Post F3 Mean=3.54, sd=3.17; Pre F7 Mean=2.85, sd=1,77; Pre F4 Mean=3.07, sd=2.16; Pre F8 Mean=2.92, sd=1.77) than H- (Pre F3 Mean=1.45, sd=.84; Pre F7 Mean=1.44, sd=.49; Pre F4 Mean=1.63, sd=.88; Pre F8 Mean=1.39, sd=.52; Post F3 Mean=1.63, sd=1.12; Pre F7 Mean=1.48, sd=.45; Pre F4 Mean=1.84, sd=1.43; Pre F8 Mean=1.34, sd=.42). There was a significant *Time* * *Condition* interaction for medial central beta [F(1, 21)=5.69, p=.027, Partial Eta Squared=.21] and a *Time* * *Condition* * *Hemisphere* interaction for lateral central beta [F(1, 21)=8.96, p=.007, Partial Eta Squared=.21]. Lower order ANOVA showed a significant effect of *Time* at medial central sites in H+ [F(1, 21)=5.11, p=.043, Partial Eta Squared=.30; Pre < Post; Pre CP1 Mean=1.47, sd=.95; Pre C1

Mean=1.65, sd=.1.17; Pre CP2 Mean=1.57, sd=1.07; Pre C2 Mean=1.68, sd=1.15; Post CP1 Mean=1.64, sd=1.20; C1 Mean=1.86, sd=1.41; CP2 Mean=1.91, sd=1.48; C2 Mean=1.85, sd=1.38] and a significant Post assessment effect of *Condition* at the left central site (C3 electrode) [F(1, 21)=4.17, p=.05, Partial Eta Squared=.17; H+ C3 Mean=2.01, sd=1.39 > H- C3 Mean=1.07, sd=.50].

Eyes-open

There was a significant effect of *Condition* (H+>H-) for lateral parietal beta [F(1, 21)=4.41, p=.05, Partial Eta Squared=.17]. H+ (Pre P3 Mean=1.71, sd=1.42; Pre P7 Mean=2.19, sd=1.19; Pre P4 Mean=1.65, sd=1.21; Pre P8 Mean=2.50, sd=1.46; Post P3 Mean=1.71, sd=1.30; Post P7 Mean=2.41, sd=1.33; P4 Mean=1.66, sd=1.11; P8 Mean 2.52, sd=1.48); H- (Pre P3 Mean=.88, sd=.51; Pre P7 Mean=1.21, sd=.53; Pre P4 Mean=1.11, sd=.96; Pre P8 Mean=1.54, sd=1.07; Post P3 Mean=.87, sd=.44; Post P7 Mean=1.23, sd=.47; P4 Mean=.99, sd=.67; P8 Mean 1.37, sd=.78).

Gamma

Eyes-Closed

There was a significant *Time* * *Condition* interaction for lateral frontal gamma [F(1, 21)=4.21, p=.05, Partial Eta Squared=.17]. This was due to a significant Pre assessment effect of *Condition* [F(1, 21)=4.8, p=.04, Partial Eta Squared=.19; H+>H-] that was not seen at Post assessment [F(1, 21)=.71, p=.41, Partial Eta Squared=.03]. Pre assessment H+ (F3 Mean=.90, sd=1.19; F7 Mean=1.13, sd=.99; F4 Mean=.56, sd=.61; F8 Mean=.81, sd=.81) was greater that H- (F3 Mean=.27, sd=.13; F7 Mean=.40, sd=.15; F4 Mean=.39, sd=.28; F8 Mean=.40, sd=.23) Also, the effect of *Time* in the H+ group approached, but fell short of, significance threshold [F(1, 12)=3.88, p=.07, Partial Eta Squared=.24] and was not significant in H- (p=.35).

There was a significant *Time* * *Condition* * *Hemisphere* interaction for lateral central gamma [F(1, 21)=8.20, p=.009, Partial Eta Squared=.28] and a four-way interaction at these sites [F(1, 21)=9.27, p=.006, Partial Eta Squared=.31]. These appeared to be due in part to a significant effect of *Condition* at C3 at Pre assessment [F(1, 21)=5.84, p=.025, Partial Eta Squared=.22], but not at Post assessment (p=.44). Lower order ANOVAs showed no significant effect of *Time* at any *Site* or in either *Condition*.

Eyes-open

There was a *Time* * *Hemisphere* * *Site* [F(1, 21)=4.54, p=.045, Partial Eta Squared=.18] for lateral parietal gamma. However, no significant effect of *Time* was seen at any *Site* or *Hemisphere.*

Summary of key EEG results

There were several differences between H+ and H- irrespective of *Time.* Frontal (F7>F8) EO theta asymmetry increased with *Time* irrespective of *Condition.* The H+ group had reduced left lateral frontal delta, extending to left lateral central and increased medial central beta during EC.

Psychometrics 2 weeks follow-up

Only n=16 (n=10 H+) participants completed the follow-up assessments. One of the H+ participants did not complete SVS. Thus, dropout represents approximately 33% of the sample, which although high, is not uncommon in longitudinal studies, particularly if (as was the current study) participation is not incentivised.

There was a significant effect of *Time* for DASS-21 [F(1, 14)=8.35, p=.012, Partial Eta Squared=.17], Wellbeing [F(1, 14)=5.10, p=.040, Partial Eta Squared=.27] and SVS [F(1, 14)=5.22, p=.040, Partial Eta Squared=.29], but no significant *Time* Condition* interactions.

Whilst there were no significant main or interaction effects of *Time* (p=.24) or Time * *Condition* (p=.19) for DAS-SF, the pattern was for an improvement in the H+ group [F(1, 9)=4.12, p=.073, Partial Eta Squared=.31], but not the H- group [F(1, 5)=008, p=.93, Partial Eta Squared=.002].

Discussion

The current study is the fourth empirical study of the psychosensory therapeutic technique known as Havening, and the first to investigate nurturing touch in the context of Havening. Findings suggest a greater reduction in subjective units of distress relating to the event during the session that contained Havening Touch (H+) than the session that did not contain Havening touch (H-). Furthermore, in the entire group (i.e., irrespective of touch), PANAS negative affect was lower immediately after (compared to just before) the session. Likewise, the longer-term (2 weeks) effect on psychological health did not significantly differ between conditions. A general improvement was seen for 1) Depression, anxiety and stress (DASS-21 total), 2) Wellbeing and 3) Subjective Vitality (SVS). Whilst no significant main or interaction effects were seen for dysfunctional attitudes, the pattern was for an improvement in H+, but not H- conditions. H+ was associated with site-specific increase in beta, decrease in gamma power and decrease in delta following the intervention.

Findings for SUDs are in line with the role of nurturing touch (Jakubiak and Feeney, 2017) and oxytocin (Olivera-Pasilio & Dabrowska, 2020) in wellbeing and an adaptive processing of

traumatic events. They indicate the superiority of Havening Touch over the session without touch in ameliorating distress. Such evidence is important in supporting this novel psychosensory intervention, which is growing in use due to anecdotal reports, but has received little empirical support. Further studies will need to confirm and extend the current findings in larger, diverse groups and seek to better understand underpinning physiological processes.

A further limitation of the current study is that we did not stratify based on baseline SUD, which was slightly higher in H+. Future studies will incorporate such stratification into randomisation procedures. Work is also needed to better understand the mechanism underpinning the response to Havening, including biochemical outcomes such as hormones, inflammatory markers and indicators of the hedonic response to affectionate touch (Cruciani et al., 2021; Ellingsen et al., 2016). Finally, most research on the beneficial effects of affectionate touch has been in adult populations (Cruciani et al., 2021). Future work on Havening that investigates efficacy and mechanisms in younger groups, particularly those emerging from traumatic environments, is warranted and would potentially be highly impactful.

Concordant with current findings for psychological health, Thandi et al (2015) reported a reduction in depression and anxiety following a single Havening session. However, no control condition was used in that study. In the current study, H+ and H- showed little difference in affecting mood or wellbeing, which improved irrespective of condition (main effect of *Time*). Thus, superiority of H+ (relative to H-) in improving longer-term psychological health remains unclear and would benefit from studies that compare 1) Havening versus a true placebo condition and 2) Havening versus a gold standard psychological therapy for treatment of distress/trauma.

Further studies should also investigate the role of the distractor tasks. On-the-one hand, improvement in some measures in the H-condition may reflect demand characteristic. However, some of the "Distractors" used in the current protocol may also have carried therapeutic value, such as priming positive affect (e.g., thinking about happy images humming childhood songs, imagining beautiful landscapes). Thus, comparison to a more neutral placebo condition is warranted. Moreover, because pairing touch with the priming of positive emotions enhances the beneficial effects (e.g., hedonic content, oxytocin release; Ellingsen et al., 2016), the presence of "Distractors" with positive valence may indeed be enhancing the beneficial effects of Havening touch. Thus, rather than being neutral distractors, the tasks may represent a critical therapeutic element in Havening protocols

Whilst there were promising findings for Dysfunctional Attitudes, the small sample size in the follow-up assessment (due to drop out) resulted in insufficient power to determine the significance of the *Time * Condition* interaction. Unfortunately, data collection of further participants was not possible due to disruption by the 2020/1 COVID pandemic. Nevertheless, partial Eta squared values suggest large effect sizes, even in cases where p-values did not cross the threshold for significance. Thus, further work in a larger cohort is warranted.

Regarding EEG, several differences between H+ and H- at baseline confound identification of change in measures with time, and small sample size limits interpretation of p values. Nevertheless, estimates of effects size were relatively large in several cases, suggesting, as for the psychometrics, that further investigation in a larger cohort is warranted.

Higher frontal delta activity, for example, was seen in H+ compared to H-. Contrary to our hypotheses, delta activity at left lateral frontal sites was reduced following the session in H+, but not H-, with a similar pattern at left lateral central sites. In comparison, medial central sites showed a pattern for the anticipated delta activity increase in H+ relative to H- over *Time*, but effects did not reach threshold for significance. Thus, we are unable to support the proposal that Havening Touch increases delta waves, at least following the session. Whether delta activity increases during Havening will require further investigation.

Whilst this is the first study to suggest an effect of Havening touch on gamma activity, findings should be considered with caution, not only because of the borderline significance level, but also because H+ and H- groups differed at baseline, with higher power in H+ than H-. Thus, we cannot rule out that gamma reduction in H+ may simply reflect a return to mean. Further studies are clearly needed with a larger cohort matched for baseline gamma activity. If further supported, this would be in line with animal studies showing a reduction in amygdaloid gamma activity following oxytocin administration (Sobota et al., 2015) and could represent a mechanism of action for Havening Touch. However, future studies would need to test this hypothesis.

Although not expected, Havening with touch (H+) resulted in an increase in medial central beta activity following the session. It is unclear how this should be interpreted. However, it may reflect midcingulate cortex function, which is implicated in implicit processing of fear and cognitive interpretation of emotions, in particular pain in self and others (e.g., empathy; Vogt 2016). Centroparietal beta was also seen to increase following spontaneous self-touch to the face in people performing a stressful memory task (Grunwald et al., 2014). Such behaviour may reflect an instinctive response to stimulate oxytocin release and facilitate processing difficult emotions.

In summary, we have shown the superiority of H+, relative to H-, in reducing subjective distress to an event, but not in ameliorating general negative mood or longer-term outcomes. Findings from EEG remain inconclusive. Whilst current results are promising, further work in larger cohorts is needed to determine the underpinning mechanisms involved in Havening with more certainty.

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Tables and figures

Table 1. Demographics and distress (Mean (SD))

	H+ (n=14)	H- (n=10)	Comparison statistic
Age	24.8 (8.1)	25.8 (7.7)	t(22)= -.307, p=.76
Sex (women: men)	13:1	8: 2	Chi Sqr p=.35
Ethnicity (white: other)	12:2	9: 1	Chi Sqr p=.75
Baseline SUD	6.89 (1.04)	6.3 (1.06)	t(22)=1.37, p=.19

SUD=Subjective Units of Distress

Table 2 Means and standard deviations for Mood and Psychological Health as a function of Condition and Time

	H+		H-	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
	Pre (n=14)	Post (n=10)	Pre (n=10)	Post (n=6)
PANAS +	30.15 (9.10)	30.46 (11.24)	32 (6.62)	34 (6.96)
PANAS -	14.23 (5.46)	11.46 (2.44)	13.5 (2.72)	11.3 (1.06)
	Baseline	Follow-up	Baseline	Follow-up
DASS	16.36 (9.27)	12.2 (11.21)	14.5 (9.23)	6.17 (4.62)
DAS	24.39 (3.94)	26.35 (5.07)	28.05 (5.58)	27.92 (1.88)
Wellbeing	47.21 (9.15)	49.9 (9.92)	53.5 (5.76)	56.67 (4.72)
SVS	4.09 (1.19)	4.45 (1.61)	3.96 (1.00)	4.9 (1.13)

* Pre and Post refer to PANAS measures; Baseline (BL) and 2-weeks Follow-up (FU) refer to other measures.

Table 3. Summary of key findings by EEG band(s)

Delta • Reduction in Delta (eyes closed, Pre>Post) in H+, but not H- • H+ had higher Pre delta than H- in the left hemisphere Beta • Increase medial central beta (eyes closed, Pre<Post) in H+ (but not H-) • Higher eyes-closed left central (C3) Beta in H+ compared to H- following the session (Post) Gamma • H+ had higher Gamma (eyes closed) than H- at pre assessment, but not at Post assessment

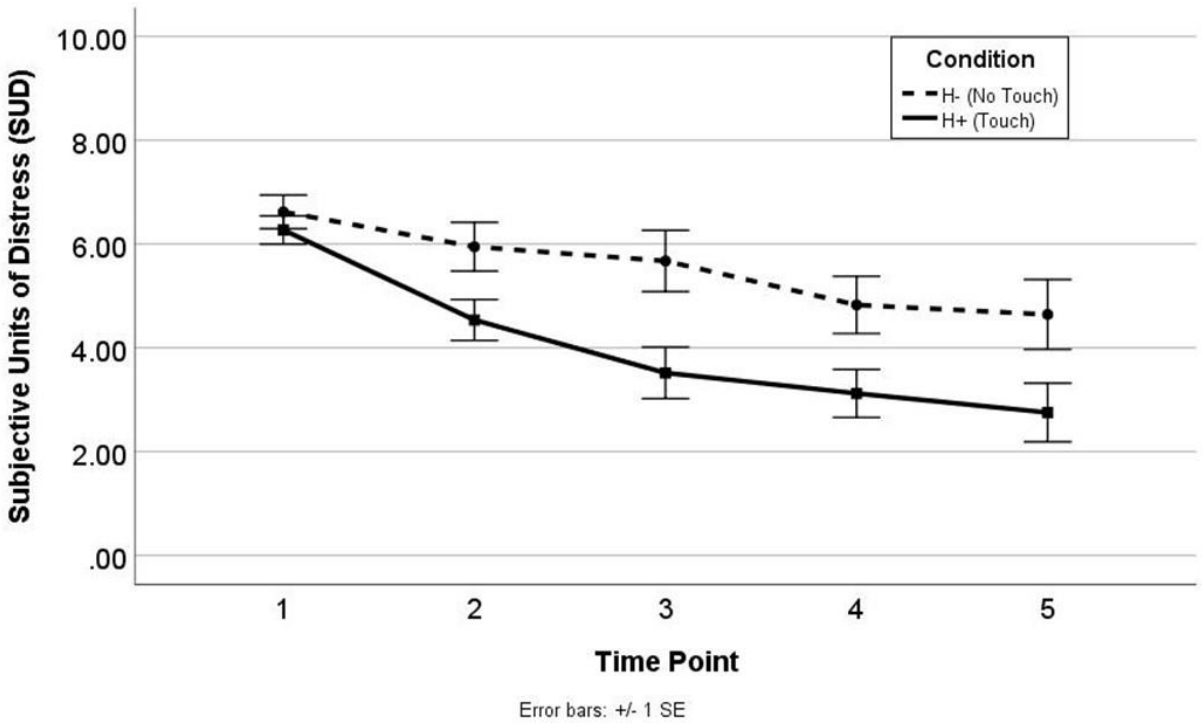

Figure 1. Subjective units of distress as a function of Time and Condition (co-variate=baseline SUD; Error Bars=+/- 1 SE)

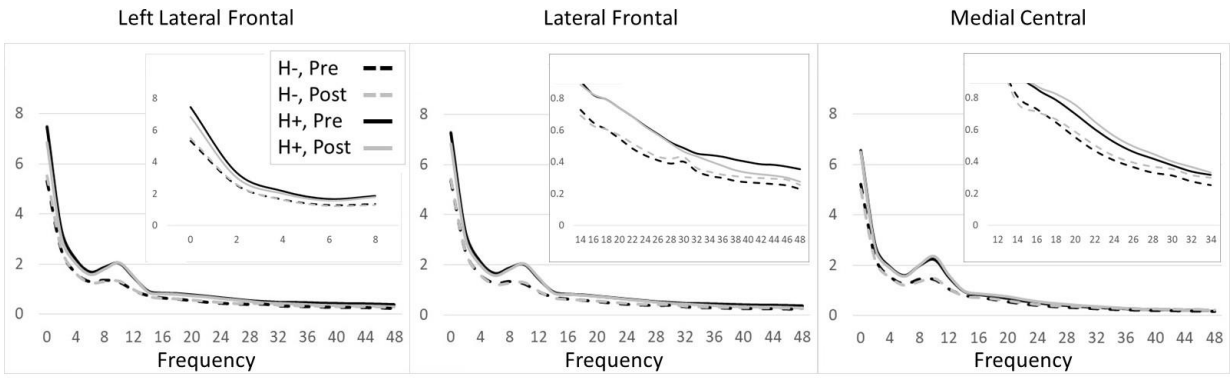

Figure 2. Mean power (eyes closed) from averaged Left Lateral Frontal, Lateral Frontal and Medial Central sites as a function of frequency and condition. Insets show close ups of delta, gamma and beta ranges, representing key findings in these bands.