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Do Hugs and Their Constituent Components Reduce Self-Reported Anxiety, Stress, and Negative Affect?

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ABSTRACT. Past research has suggested that touch and pressure can have antidepressant and anxiolytic properties. The present investigation hypothesized that brief interventions of hugging and its constituent components (pressure and the presence of a friend) during a stressful situation would reduce anxiety, social anxiety, stress, and negative affect while increasing social support, relative to control condition. Undergraduate participants (n = 155) completed the Trier Social Stress Test while either receiving hugs from a friend (hug), having a friend nearby (friend), wearing a weighted pressure vest (vest), or having nothing added (control). There was no significant effect of condition on state measures of anxiety ($\eta_p^2 = .01$, $p = .79$), social anxiety ($\eta_p^2 = .01$, $p = .70$), stress ($\eta_p^2 = .02$, $p = .58$), negative affect ($\eta_p^2 = .01$, $p = .77$), or social support ($\eta_p^2 = .03$, $p = .22$). These findings suggest that brief interventions with hugs, weighted pressure vests, or the presence of a friend are not effective at increasing social support nor at reducing anxiety, social anxiety, stress, or negative affect. Alternative explanations for these results are discussed.

Keywords: hugging, weighted vests, anxiety, touch, pressure

Open Data badge earned for transparent research practices. Data available at https://osf.io/g9z8k/

Touch and, more broadly, pressure, have long been held to have medicinal properties, even though scientific research has only recently begun to put these beliefs to the test (Classen, 2012). *Touch* is defined here as "the tactile stimulation of one person by another," whereas *pressure* is defined as tactile stimulation induced by any person or object (Mulaik et al., 1991, p. 308). Touch in particular has been underresearched, with no formal evaluation of its benefits for a variety of common psychological maladies, despite systematic reviews largely lauding its wide-ranging benefits across a variety of mediums (e.g., Field, 2010; Jakubiak & Feeney, 2017).

Massage, for instance, has been found to reduce anxiety and cortisol levels (e.g., Field, 2010; Field et al., 1992). Massage and other forms of touch also improve sleep and decrease the production of substance P, a chemical associated with pain production, in addition to increasing the release of oxytocin, serotonin, and dopamine in the brain (e.g., Field, 2010; Stock & Uvnäs-Moberg, 1988). Oxytocin, serotonin, and dopamine increases have been linked to reductions in anxiety, stress, and depression (for a review, see Field, 2010; Field et al., 1992). According to the polyvagal theory, these neurochemical changes are likely due to vagus nerve stimulation from skin pressure (e.g., Field, 2010; Gamse, Lembeck, & Cuello, 1979; Porges, 2001; Stock & Uvnäs-Moberg, 1988). These neurochemical changes may explain why touch decreases anxiety in cardiac patients (Weiss, 1990), as well as existential anxiety after a death reminder (Koole, Tjew A Sin, & Schneider, 2014).

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Touch is also often used as a demonstration of affection, and some forms of affection (though not always physical affection) have been associated with reduced cortisol levels and stress (e.g., Floyd et al., 2007; Floyd & Riforgiate, 2008). Touch and other forms of tactile stimulation have also been implemented in sensorimotor therapy, which is used to help traumatized individuals reconnect with their bodies and modulate their own arousal (e.g., Ogden & Minton, 2000; for an overview, see Van der Kolk, 2015). However, it is important to note that touch is not always beneficial—a wrist touch on highly socially anxious people was demonstrated to increase anxiety (Wilhelm, Kochar, Roth, & Gross, 2001). Overall, this growing body of research indicates that touch can (across a wide range of modalities) improve a diverse set of variables related to mental health.

The range of possible responses to touch, from reducing stress to increasing anxiety, suggests that these responses are, to some degree, dependent on context and individual perception (Field, 2010; Wilhelm et al., 2001). This is one of the many reasons why a well-researched stress test such as the Trier Social Stress Test (TSST) was selected for participants to undergo; that way the context of the interventions would be constant across conditions. Both reviews and original research have found that touch in close adult relationships increases oxytocin levels, and when that touch is paired with a positive interpretation of the touch, it leads to lowered stress and could cause cognitive changes that increase both relational and psychological well-being (e.g., Holt-Lunstad, Birmingham, & Light, 2008; for a systematic review, see Jakubiak & Feeney, 2017). Touch also stimulates the vagus nerve, which activates the pregenual anterior cingulate cortex (related to rewarding pleasant stimulations) even more strongly than pressure, suggesting that interpreting skin pressure as touch may enhance any neurochemical benefits (Jakubiak & Feeney, 2017; Lindgren et al., 2012).

These benefits, although most pronounced in response to touch, have their roots in pressure. Pressure has been described as "relaxing" and "calming" ever since Temple Grandin described her "Squeeze Machine," now termed the "Hug Machine" (Edelson, Edelson, Kerr, & Grandin, 1999; Grandin, 1992, pp. 63, 67). There have been several designs of this machine, but usually the individual using the machine lies on their stomach in it and pulls a lever that tightens cushioned pads and boards all around the user's body (Edelson et al., 1999; Grandin, 1992). Grandin stated that her Hug Machine "calm[ed] down [her] anxiety" (Grandin, 1992, p. 66). However, this has only ever been investigated in a single study evaluating 12 children diagnosed with autism, which found that the Hug Machine significantly reduced tension and marginally reduced anxiety (Edelson et al., 1999). It is worth noting that this study consisted of a small sample of children and focused entirely on nonnormative populations. One other study evaluated the effects of a similar contraption on college students, and although Krauss (1987) found no clear effect on state anxiety, subjective relaxation did increase. These conflicting results may be due to the unusual contraptions employed by Krauss and Grandin, the small samples used in each study, or the different qualities of the samples.

The vast majority of the research, from Grandin onward, has been aimed at identifying the sensory benefits of pressure (particularly with small, nonnormative samples of children), despite inconsistent and rarely significant results (Losinski, Sanders, & Wiseman, 2016; Stephenson & Carter, 2009). The mixed results for pressure as an effective remedy for autism and other sensory disorders (as well as the promising preliminary results highlighting pressure's anxiolytic properties) suggest that this focus on utilizing pressure to improve sensory and behavioral issues may be misguided. Sensory and behavioral improvements may be caused by nothing more than a reduction in anxiety, as there is some evidence that anxiety is related to sensory overresponsivity (Green & Ben-Sasson, 2010; Mazurek et al., 2013). Pressure might also disproportionately benefit individuals diagnosed with autism because their elevated anxiety (compared to a normative population) may be reduced by the pressure (White, Oswald, Ollendick, & Scahill, 2009). Previous researchers might have been measuring uninformative variables in their attempts to ascertain why pressure—particularly *weighted pressure vests*—seemed to help some children diagnosed with autism.

Research on weighted pressure vests has suffered from the same issues as research on pressure as a whole, with the majority of studies on the vests only addressing behavioral or sensory issues in autism, attention deficit disorders, or pervasive development disorder (e.g., Kane, Luiselli, Dearborn, & Young, 2004; Lin, Lee, Chang, & Hong, 2014). Weighted pressure vests are defined

here as adjustable vests that can be tightened and are filled with small metal or sand-filled weights that in total weigh anywhere from 1 to 10 pounds. Most of these studies were focused on children and relied on very small sample sizes (e.g., Fertel-Daly, Bedell, & Hinojosa, 2001; Losinski, Cook, Hirsch, & Sanders, 2017). Systematic reviews have revealed that weighted pressure vests are not effective at treating autism, among other disabilities (e.g., Stephenson & Carter, 2009). Very little literature exists on the effect of weighted pressure vests on anxiety despite the vests being the focus of a substantial amount of research on nonnormative populations and animals. To date, this potential effect has been most clearly described in a handful of studies on dogs where it has been effective at reducing dogs' fear of thunder (Cottam, Dodman, & Ha, 2013; Fish, Foster, Gruen, Sherman, & Dorman, 2017; King, Buffington, Smith, & Grandin, 2014).

Weighted blankets, or blankets that have been filled with metal weights or a heavy material such as sand and often weigh 12 pounds or more, have more clear results than the weighted pressure vests (e.g., Champagne, Mullen, Dickson, & Krishnamurty, 2015). However, many of the studies have the same issues: small sample sizes, samples that only include children, and samples that consist only of nonnormative individuals (i.e., individuals diagnosed with autism, individuals with insomnia, or patients in a psychiatric inpatient facility; e.g., Champagne et al., 2015; Gee, Peterson, Buck, & Lloyd, 2016; Gringras et al., 2014). Although the results have been mixed, there is some agreement that weighted blankets reduce anxiety, at least in some specific populations and contexts such as inpatients at a psychiatric facility and individuals undergoing dental care (e.g., Chen, Yang, Chi, & Chen, 2013; Novak, Scanlan, McCaul, MacDonald, & Clarke, 2012). Weighted vests were chosen over weighted blankets for this study primarily due to the need for participants to be sitting up for the TSST; it is likely that a weighted blanket would have fallen off if not actively held in place for the duration. The potential anxiolytic effects of other types of pressure have yet to be confirmed empirically.

One common, perhaps ubiquitous form of both pressure and touch is hugging (e.g. Fromme et al., 1989). Hugging has also been overlooked in the literature. One of the few hugging studies found that the number of daily perceived hugs correlated positively with increased social support, which then buffered stress and improved resistance to infection (Cohen, Janicki-Deverts, Turner, & Doyle, 2015). This finding supports the hypothesis that hugging can reduce stress while increasing social support. Also, the frequency of hugs has been associated with lower blood pressure and higher oxytocin, suggesting that hugs have a wide array of positive benefits that are all linked to vagal stimulation (Light, Grewen, & Amico, 2005; Porges, 2001; Stock & Uvnäs-Moberg, 1988). However, most of the experimental studies on hugging actually assessed *warm contact*, which consists of positive social and physical interaction with a partner (usually a romantic partner) that often culminates in a 20-second hug. Such "warm contact" appears to increase oxytocin and self-reported happiness while reducing alpha amylase and blood pressure (Grewen, Girdler, Amico, & Light, 2005; Holt-Lunstad, Birmingham, & Light, 2008; Matsunaga et al., 2011). No study has analyzed whether hugging alone can reduce psychopathological symptomology, and the effects of hugging on anxiety has yet to be the subject of published research.

It is also unclear whether any benefits that might arise from hugging are due to the touch and pressure involved in the act, or if they are due simply to the presence of a supportive friend, as the presence of a friend alone can reduce some measures of stress such as *cardiovascular reactivity*, which is "the response of physiological parameters, often blood pressure or heart rate, to a laboratory stressor" (e.g., Christenfeld et al., 1997, p. 388; Grewen, Girdler, Amico, & Light, 2005). Cardiovascular reactivity is related to vagal stimulation, just like touch and pressure, implying that similar or connected processes may be at the root of these benefits (e.g., Huang, Webb, Zourdos, & Acevedo, 2013).

In sum, pressure, touch, and the presence of a friend all show promise as symptom reduction strategies for anxiety, stress, and depression (e.g., Cohen et al., 2015; Field, 2010). However, much of the work on touch and pressure has substantial limitations, often featuring populations that are not generalizable or measuring inconsistent variables of interest. Anxiety, stress, and depression are all exceedingly common, both as various disorders and as subthreshold nuisances; these issues incur profound amounts of pain, suffering, economic costs, and death every year (DuPont et al., 1996; Kessler et al., 2005). New strategies for managing these disorders and the corresponding suffering these maladies cause could have wide-ranging benefits.

Present Investigation

In light of past research demonstrating that warm interpersonal contact, physical pressure, and the presence of friends produce positive outcomes, we tentatively expected hugs, weighted pressure vests, and friends to mitigate anxiety, stress, and depression to some degree. More specifically, we hypothesized that brief interventions of hugging and its two primary components, pressure (wearing a weighted pressure vest), and social presence (being in the presence of a friend) throughout a stressful situation would reduce state anxiety, state social anxiety, state stress, and state negative affect while increasing state social support. Negative affect was included as an exploratory variable of interest despite the weaker evidence supporting its relationship to touch and pressure due to its close relationship to anxiety and stress. Participants completed the TSST (Kirschbaum, Pirke, & Hellhammer, 1993), which consisted of a speech task and a math task performed in front of a camera monitored live by a judge, in order to determine if any of the experimental conditions had a protective effect on participants' otherwise elevated stress and anxiety levels. Elevating stress and anxiety also made the corresponding variables more easily measurable and any differences more easily detectable.

Hugging, and its two primary components, pressure and social presence, were examined as strategies for reducing anxiety, stress, and negative affect for the first time in this study. These strategies could potentially be used as affordable supplements to common treatments such as cognitive-behavioral therapy or medication.

Method

Participants

One hundred fifty-five (110 women, 43 men, 2 other; age: $M = 19.55$ years, $SD = 1.24$) undergraduates from Franklin & Marshall College participated in return for either partial course credit or $5 from January to May 2018. After institutional review board approval from the Franklin & Marshall College IRB was obtained, participants signed up for the study online either through Sona (www.sona-systems.com) or via a publicly available Google Sheets spreadsheet. Participants were recruited from an introductory psychology class, via word-of-mouth (including paid recruiters who received $3 per pair of participants), Facebook posts to a subset of college class pages, and emails to a randomized sample of 400 students.

Prior to arrival at the lab, participants signed up for the study, entitled "Social Behavior and Emotions" in order to minimize demand characteristics. It was made clear to all participants in the description of the study that they needed to sign up with a friend. This was necessary to ensure that all conditions had equivalent groups of participants; otherwise the conditions that do not require a friend to come along (control and vest) would have more participants who cannot bring a friend, while the friend-bringing conditions (hug and friend) would have more participants who can bring a friend, thus creating inequivalent groups with differing characteristics. However, it would also be problematic for all participants to bring a friend, as the Friend condition is specifically trying to measure the effect of the presence of a friend, and this variable would be very difficult to differentiate if all participants brought a friend. It would also make it impossible to ascertain if any benefits in the vest condition were from the weighted pressure vest alone if a friend was also present. As such, after signing up, participants were randomly assigned without replacement to a condition based on when they signed up and their assumed gender, and were then either emailed a reminder to bring a friend to the study (hug or friend conditions) or an update informing them to come alone (control or vest conditions).

Measures

We first assessed general anxiety, social anxiety, depression, stress, and social support at the trait level to determine whether they moderated the impact of condition on our outcomes of interest. Immediately after participants completed the TSST, we assessed the same variables at the state level as our outcomes of interest. All state measures were modified from their original forms to reference the TSST.

Demographic information. All participants provided their gender and their age in addition to completing the following scales.

Generalized Anxiety Disorder Scale (GAD-7). We measured trait anxiety using the GAD-7, a 7-item self-report scale developed by Spitzer, Kroenke, Williams, and Löwe (2006). The GAD-7 measured trait anxiety on a 4-point Likert-type scale ranging from 0 (*not at all*) to 3 (*nearly every day*) and included items such as "Feeling nervous, anxious, or on edge." This scale demonstrated adequate validity and reliability ($\alpha = .92$) when taken by adults in a clinical setting (Spitzer et al., 2006). The scale was internally reliable using a student sample in the current study, $\alpha = .88$.

Social Interaction Anxiety Scale (SIAS-6) and Social Phobia Scale (SPS-6). We measured trait social anxiety by combining the 6-item SIAS-6 and the 6-item SPS-6 scales, both developed by Peters, Sunderland, Andrews, Rapee, and Mattick (2012), into one self-report scale. The SIAS-6 and SPS-6 measured trait social anxiety on a 5-point Likert-type scale ranging from 0 (*not at all characteristic or true of me*) to 4 (*extremely characteristic or true of me*) and included items such as "I can feel conspicuous standing in a line." The individual scales demonstrated adequate validity and reliability (αs > .90) in clinical samples (Peters et al., 2012), and the composite scale demonstrated adequate internal reliability in the present study, α = .84

Patient Health Questionnaire (PHQ-2). We measured trait depression using the PHQ-2, a two-item self-report scale developed by Löwe, Kroenke, and Gräfe (2005). The PHQ-2 measured trait depression on a 4-point Likert-type scale ranging from 0 (*not at all*) to 3 (*nearly every day*) and included items such as "Little interest or pleasure in doing things." The scale demonstrated adequate validity and reliability (α = .83) in a sample of medical outpatients (Löwe et al., 2005). The scale demonstrated adequate internal reliability in the present study using the Spearman-Brown coefficient (α = .73) despite the limitations of two-item scales (Eisinga, Te Grotenhuis, & Pelzer, 2013).

Perceived Stress Scale (PSS). We measured trait stress using the PSS, a 10-item self-report scale developed by Cohen, Kamarck, and Mermelstein (1983). The PSS measured trait stress on a 5-point Likert-type scale ranging from 0 (*never*) to 4 (*very often*) and included items such as "In the last month, how often have you been upset because of something that happened unexpectedly?" This scale has been found to be internally reliable in clinical and student populations, α = .84 to .86, as well as in the present study, α = .84 (Cohen et al., 1983).

Multidimensional Scale of Perceived Social Support (MSPSS). We measured trait social support using the MSPSS, a 12-item self-report scale developed by Zimet, Dahlem, Zimet, and Farley (1988). The MSPSS measured trait social support on a 7-point Likert-type scale ranging from 1 (*very strongly disagree*) to 7 (*very strongly agree*) and included items such as "There is a special person who is around when I am in need." This scale has been reliable in student samples (α = .84 to .92; Zimet et al., 1988). It was also internally reliable in the present study, α = .87.

Spielberger State-Trait Anxiety Inventory (STAI). We measured state anxiety using the short-form STAI, a 6-item self-report scale developed by Marteau and Bekker (1992). The STAI measured state anxiety on a 4-point Likert-type scale ranging from 1 (*not at all*) to 4 (*very much*) and included items such as "I feel calm." This scale has been found to be internally reliable in a combined sample including students and pregnant women, α = .82, as well as in the present study, α = .81 (Marteau & Bekker, 1992).

State Social Anxiety Questionnaire (SSAQ). We measured state social anxiety using the SSAQ, a 6-item self-report scale developed by Kashdan and Steger (2006). The SSAQ measured state social anxiety on a 5-point Likert-type scale ranging from 1 (*not at all*) to 5 (*extremely*) and included items such as "I worried about what the judges thought of me." This scale originally had seven items, but one item ("I found it hard to interact with people") was removed due to most participants not interacting with anyone but the experimenter. This scale has been found to be internally reliable with a student sample, α = .91, as well as in the present study, α = .93 (Kashdan & Steger, 2006).

State Stress Scale. We measured state stress using the State Stress Scale, a single-item self-report scale based on the work of Park, Armeli, and Tennen (2004). The State Stress Scale consists of a single item, "How stressed did you feel *during* the speech and math tasks you just completed?", with responses on a 5-point Likert-type scale ranging from 1 (*not at all*) to 5 (*extremely*).

Positive Affect and Negative Affect Schedule (PANAS). We measured state negative affect using the 10-item negative affect subset of the PANAS, a self-report scale developed by Watson, Clark, and Tellegen (1988). The PANAS measured state negative affect on a 5-point Likert-type scale ranging from 1 (*not at all*) to 5 (*extremely*) and including items such as "distressed." This scale has been found to be internally reliable in student samples, α = .84 to .90, as well as in the present study, α = .89 (Watson et al., 1988).

State Social Support Scale. We measured state social support using the State Social Support Scale, a single-item self-report scale based on the MSPSS (Zimet et al., 1988). It consisted of the item "To what extent did you feel emotionally supported *during* the speech and math tasks you just completed?" The state social support measure was evaluated on a 5-point Likert-type scale ranging from 1 (*not at all*) to 5 (*extremely*).

Procedure

The following procedure is depicted in Figure 1. Participants were greeted by a male experimenter in a white lab coat. All participants were then asked to read and sign an informed consent form.

Control condition. After completing the consent process, participants in the control condition were then led into the lab room and asked to complete the trait measures on the computer using Qualtrics (www.qualtrics.com). Four participants completed the trait measures online, less than one week before arriving for the lab session. After completing the trait measures, the participants informed the experimenter that they were done, and the experimenter took them back to the waiting area where they had arrived and instructed the participants to wait for 1 minute. This was the participants' first 1-minute break. After the break, the experimenter led the participants back to the lab room. The experimenter then informed them that they would be giving a 5-minute speech to the camera in the lab room about why they would be a good candidate for their ideal job. The experimenter also informed participants that the camera was monitored live by three judges, including the experimenter; in actuality it was only monitored by the experimenter. Participants then began the TSST, which consisted of a 3-minute preparation period, a 5-minute speech task, and a 5-minute math task (Kirschbaum, 2015). Participants were first given 3 minutes to prepare for their speech task before performing the 5-minute speech. During the speech task, if the participants stopped speaking for an extended period of time, the experimenter would tell the participants via intercom to continue, as there was still time remaining. After the speech was completed, the second 1-minute break took place, with participants remaining in the lab room. Then, participants were instructed to serially subtract 17 from 2023 (one of the more difficult math tasks proposed for the TSST) for another 5 minutes and were told to restart if they made a mistake (Kudielka, Hellhammer, Kirschbaum, Harmon-Jones, & Winkielman, 2007). Afterward, the experimenter informed the participants that they now had a third and final 1-minute break; the participants again remained in the lab room. After the break, the participants completed the state measures on the computer using Qualtrics (www.qualtrics.com).

Vest condition. The procedure for the vest condition was nearly identical to the above procedure for the control condition, except during the first 1-minute break the experimenter helped participants put on the weighted pressure vest. Four weighted pressure vests (Hyper Wear Inc., Austin, TX) weighing 10 pounds each were used, one in each of the four commonly available sizes (small, medium, large, and extra-large). Each participant selected the size that best fit. Participants in the vest condition wore the vest throughout the experiment until the final 1-minute break, when the experimenter helped participants remove the vest.

Hug condition. If the participant was in the hug condition, then the procedure was also similar to that of the control condition but with a few major changes. One such change is that, at the beginning of the study, the participant and friend were told that, during the study, they would not be

FIGURE 1

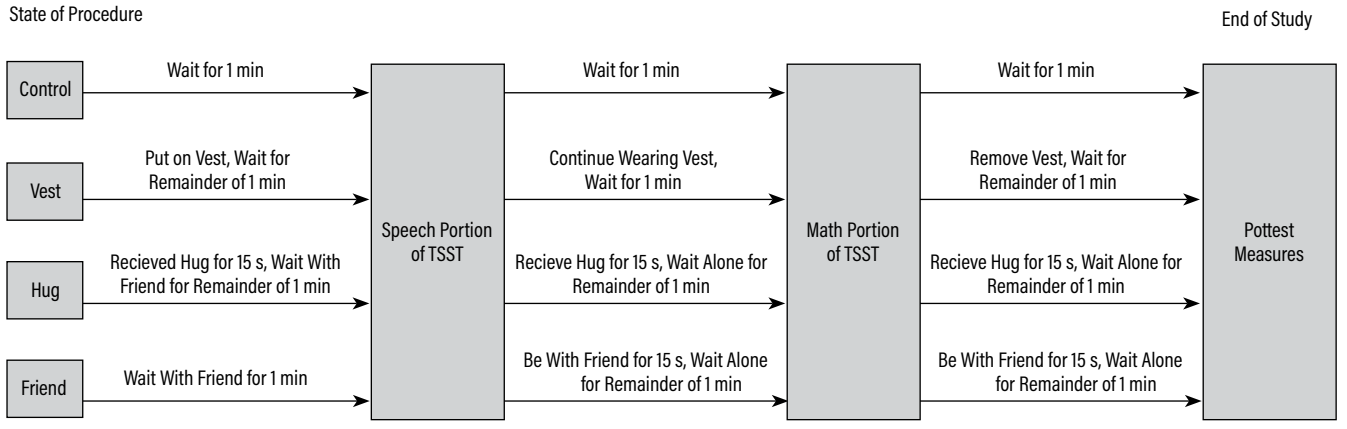

Figure 1. A flow chart demonstrating the procedural differences between the four conditions in the present study. TSST = Trier Social Stress Test.

allowed to talk to or touch each other without permission from the experimenter. This was to ensure that communication and touch that was not a part of the protocol—both of which could generate social support or reduce stress and anxiety—were relatively constant across participants and conditions. They were also informed that the participant would be doing tasks in the lab room while the friend primarily remained in the waiting area. The procedure was then identical to the control condition until the first 1-minute break, when the participant and friend were instructed to hug each other, using both hands and arms for 15 seconds. Then, both the participant and the friend waited together for the rest of the break. The procedure was then identical to the control condition until the second break, when the friend was asked to follow the experimenter to the lab room and hug their friend in the same way as before for 15 seconds. After the hug was over, the experimenter asked the friend to return to the waiting area. The participant and friend then waited out the rest of the second break alone. The procedure was then identical to the control condition until the third and final break, when the same 15-second hug was repeated once more before the friend was asked to return to the waiting area.

Friend condition. The friend condition was nearly identical to the hug condition. However, instead of receiving a hug during the first break, the participant and friend just waited together for 1 minute in the waiting area. The gender of the friend in both the hug and the friend conditions was not recorded, although the experimenter anecdotally observed that the majority of participants brought a same-sex friend. During the two other minute-long breaks, the friend entered the second room and stood near the participant for the same 15-second interval that the hug took place in the hug condition, but the friend did not touch or talk to them before being asked to leave after 15 seconds.

All participants finished the protocol by completing the state measures.

Results

All of the scales were reduced by reverse-scoring appropriate items and averaging the scores. Fifteen participants were dropped from analyses for a variety of reasons such as failing to follow protocol ($n = 3$), knowing revealing information about the study beforehand ($n = 1$), experimenter error with vest removal ($n = 2$), or the participant being an acquaintance or friend of the experimenter ($n = 9$).[1] In preliminary analyses involving gender, the one participant with nonbinary gender was also excluded, but this participant was included for analyses that did not involve gender.

First, a two-way Multivariate Analysis of Variance with gender and condition was run on all trait variables (anxiety, social anxiety, depression, stress, and social support) in order to verify that random assignment was successful. There were no significant main or interaction effects. To confirm that there were no effects for any individual variables, additional two-way Analyses of Variance (ANOVAs) with gender and condition were run on each of the trait variables. There were no significant effects involving condition.

A series of one-way ANOVAs were then run to examine whether significant differences in our outcome variables emerged as a function of condition. Inconsistent with our hypotheses, these analyses revealed no significant differences between conditions in participants' state anxiety, $F(3, 136) = 0.36$, $p = .79$, $\eta_p^2 = .01$, state social anxiety, $F(3, 136) = 0.48$, $p = .69$, $\eta_p^2 = .01$, state stress, $F(3, 135) = 0.66$, $p = .58$, $\eta_p^2 = .02$, state negative affect, $F(3, 136) = 0.37$, $p = .77$, $\eta_p^2 = .01$, or state social support, $F(3, 136) = 1.48$, $p = .22$, $\eta_p^2 = .03$.

Descriptive statistics for state variables across conditions (and the whole sample) are viewable in Table 1. No other state or trait measures or analyses had any results of note.[2]

TABLE 1

Mean State Variable Scores Across Conditions

Variable	Control ($n = 37$)	Hug ($n = 36$)	Vest ($n = 34$)	Friend ($n = 33$)	Full Sample ($n = 140$)
Anxiety	2.68(0.58)	2.69(0.73)	2.72(0.56)	2.83(0.75)	2.73(0.65)
Social Anxiety	2.60(1.20)	2.72(1.32)	2.49(1.03)	2.81(1.24)	2.65(1.20)
Stress[a]	2.97(1.14)	3.17(1.08)	3.09(1.11)	3.34(1.13)	3.14(1.11)
Negative Affect	2.13(0.77)	2.20(0.86)	2.14(0.73)	2.32(0.98)	2.20(0.83)
Social Support	1.49(0.08)	1.92(1.08)	1.74(0.93)	1.58(0.90)	1.68(0.94)

Note. Standard deviations are provided in parentheses.
[a]One participant in the friend condition did not complete this scale and was not included in analyses involving state stress. This participant was included in all other analyses.

[1]Additional analyses using all 155 participants yielded results which were largely the same as those presented here. These additional tests are available upon request to the first author.
[2]Exploratory ANOVAs were also run with gender and each of the state and trait measures (anxiety, social anxiety, stress, depression, and social support). No significant effects involving condition were found. These analyses are also available upon request to the first author.

Discussion

Contrary to predictions, our brief interventions utilizing hugs, weighted vests, and the presence of a friend were all ineffective at reducing state anxiety, state social anxiety, state stress, and state negative affect during a stressful situation, relative to a control condition. All interventions also failed to significantly increase state social support, relative to a control condition. Overall, these results do not appear, at least at first glance, to align with previous research suggesting that all of these conditions can produce fast-acting beneficial effects, such as rapid anxiolytic and supportive responses to massage and warm contact, respectively (Field, 2010; Light et al., 2005). However, further examination suggests that these results may nonetheless make sense when interpreted through an established theoretical framework.

There are a number of possible explanations for our null results. The most likely of these explanations is that there are very little to no actual benefits conferred from being hugged, wearing a weighted pressure vest, or being in the presence of a friend. However, this explanation is not aligned with the limited amount of previous research suggesting that similar brief interventions have at least some measurable benefits (Field, 2010; Light et al., 2005; Novak et al., 2012). The research indicating the importance of context and interpretation is also inconsistent with this explanation (Jakubiak & Feeney, 2017).

Another possible explanation for our results is that the beneficial effects of touch, pressure, and the presence of a friend are heavily moderated by the perception or interpretation of the touch, pressure, or presence of a friend (Jakubiak & Feeney, 2017). This idea is robustly supported in a number of studies on touch and pressure, which suggest that many of its benefits are due to the release of oxytocin via vagal stimulation (Field, 2010; Jakubiak & Feeney, 2017). Oxytocin has been clearly linked to perceived social support, as well as dopaminergic and serotoninergic pathways, which could be why massage has antidepressant and anxiolytic properties (Baskerville & Douglas, 2010; Field, 2010; Marazziti et al., 2012). If oxytocin is indeed at the root of all of the benefits related to touch, pressure, and social support, then it would make sense that these benefits would only present themselves in positive contexts because oxytocin is a context-dependent hormone (e.g., Jakubiak & Feeney, 2017). As summarized in Jakubiak and Feeney's model of affective touch (2017), most of the benefits of oxytocin are not realized unless they are paired with a positive interpretation of the oxytocin-releasing stimulus—and no such positive interpretation was provided during this study.

Negative contexts and interpretations may also be why previous research on weighted pressure vests was so mixed and largely unclear; children and nonnormative populations may be more likely to interpret new situations and sensations negatively (Fertel-Daly et al., 2001; Losinski et al., 2017). It is also possible that these interventions are effective, but only when implemented for long periods of time (e.g., wearing the vest for a longer period of time), or when used repeatedly (e.g., wearing the vest for several short intervals a day for several weeks). Long-term intervention strategies (e.g., massaging a participant daily for several weeks) have been used effectively in previous research (for a systematic review, see Field, 2010). This explanation, however, conflicts with several other studies that demonstrate relatively rapid changes in oxytocin and its accordant benefits (e.g., Jakubiak & Feeney, 2017; Light et al., 2005).

The presence of a friend condition might have also failed to reach significance as it only measured the effect of the presence of a friend when behavior between friends was restricted (i.e., they were not allowed to touch or talk to one another). It is possible that some benefits could have been gained if social behavior had not been restricted. Another likely explanation for the null effect is that oxytocin was released in the presence of a friend, but that it was moderated heavily by the confusing context and possibly negative interpretation of a psychological experiment (Jakubiak & Feeney, 2017).

Of all possible explanations, this study appears to align most closely with Jakubiak and Feeney's aforementioned model of affectionate touch (2017). Our findings were consistent with that model and suggest that the effects from the basic actions of wearing a weighted vest, being hugged by a friend, or being in the presence of a friend have very little psychological value when they are not interpreted positively.

Limitations

The study, however, is not without limitations. We were unable to recruit sufficient numbers of participants to achieve the desired power of .80. Assuming a medium effect size, our study had .73 power, according to a G*Power analysis. This study also had a surprisingly young sample (even for college students), with a mean age of 19.55 years

(*SD* = 1.24). Given the limited age range and that all participants attended the same undergraduate institution, it is possible that this sample was not representative of college students.

The gender of the friend in both the hug and friend condition was also not accounted for, and it is likely that the gender of the friend is a significant moderator because the gender of both the hugger and individual receiving the hug has a major role in touch behaviors and touch responses during a hug (Stier & Hall, 1984). This may be due to concerns about the possibility of intimacy, as well as social norms (Stier & Hall, 1984).

The study might also have lacked ecological validity; that is, the forced, clinical nature of the experiment might have made a lab-based hug irreconcilable with a real, genuine hug borne from prosocial impulses (Sbordone, 1996). This may well be the case, and, if it is indeed what occurred, serves to further support the model of affectionate touch, in that the context and interpretation of the hug is what makes a hug genuine and beneficial, as opposed to the action itself (Jakubiak & Feeney, 2017).

Demand characteristics might also have contributed to the results (Nichols & Maner, 2008). It is thoroughly possible that participants believed that the hug (or any of the other conditions) was meant to be beneficial (or perhaps harmful) and therefore were biased to report more positive (or negative) results. However, this seems somewhat unlikely given the null results across all conditions, and no indications of negative bias from participants, but it is a potential factor that should be considered.

Future Research

Future research should focus on how context, meaning, and interpretation impact both social interactions and tactile stimulation. It would be interesting to see what the benefits of a naturally occurring hug in a positive context are, without the artificial and often negative sentiment of a directed hug. And although research on naturally occurring hugs is needed, future studies should also examine directed hugs because their effects are both more easily measurable and more easily administrable as an adjunct to therapy. Further studies examining the context of touch and pressure, particularly in the form of hugs, should be performed, in an effort to truly understand the benefits that may be gained. Additional work is needed to see if these null results were real and replicable, or if they were spurious.

Conclusion

In sum, brief interventions with hugs, weighted pressure vests, or the presence of a friend did not reduce anxiety, stress, or negative affect. They also did not significantly increase social support. As such, it appears that these brief interventions are not viable as strategies for reducing anxiety, stress, or negative affect. However, given previous research, it is possible that the effects of hugs, weighted pressure vests, and the presence of a friend were attenuated by the lack of positive context or interpretation during the stress test. Further research on the medicinal properties of touch and pressure must be done, focusing in particular on how context and interpretation moderate the effects of oxytocin released in response to tactile stimulation.

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