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Effects of Laughter on Self-Report and Psychophysiological Measures of Stress

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EFFECTS OF LAUGHTER ON SELF-REPORTED AND PSYCHOPHYSIOLOGICAL MEASURES OF STRESS

by

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ABSTRACT

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The purpose of this study was to investigate the relationship between laughter and stress reduction. Past research indicates that humor is related to stress reduction, but little is known about the specific role of laughter. It was hypothesized that laughter would have a similar effect. Stress was elicited through a mental arithmetic task, which was followed by a viewing of either a laughter-inducing video or a control (nature) video. Stress levels were assessed with both self-report and psychophysiological measures, including heart rate and respiration rate. Data was analyzed using one-within and one-between repeated measures ANOVAs. It was found that there were no significant between-group differences in physiological measures of stress. In both conditions, heart rate significantly increased during the arithmetic task, and significantly decreased during the video. Self-reported ratings of stress were significantly higher after the arithmetic task than they were following the video. The laughter group reported significantly lower feelings of self-reported stress, however, the laughter group also had significantly lower baseline measures of self-reported stress. As such, it was concluded that there were no significant effects of laughter on stress reduction.

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Effects of Laughter on Self-reported and Psychophysiological Measures of Stress

Most people have heard the old adage, “Laughter is the best medicine.” For the most part, we all agree that laughter is a good thing, and that it makes us feel good. This notion has been scientifically supported, as laughter has been shown to have several health benefits. It is related to an increase in one’s pain threshold (Cogan, Cogan, Waltz, & McCue, 1987; Dunbar et al., 2012), a decrease in the presence of hormones related to arthritic joint pain (Ishigami et al., 2005), and can even reduce bronchial responsiveness to certain allergens in people with asthma (Kimata, 2004). Cross-generationally, people perceive laughter as healthful, and agree that “healthful” laughter is pleasant and related to positive emotion (Mahoney, Burroughs, & Lippman, 2002). While this has promising implications, the relationship between laughter and stress is unclear.

Laughter is an important part of development, and begins young; laughter first appears at 1-2 months of age (Sroufe & Wunsch, 1972). At 4-6 months, babies begin laughing in response to sensory stimulation, such as noises (e.g., lip popping) and touches (e.g., kissing their stomach). At this age, some babies also laugh in response to social stimulation, such as when someone is playing peek-a-boo. Once they are approaching 7-9 months of age, a much larger percentage of babies respond to laughter stimulation—especially social stimulation. Of course, laughter does not stop in childhood; it continues to occur and develop throughout adulthood. According to Kuiper and Martin (1998), on average, people laugh 17 times per day. Most of this laughter is spontaneous, and is not in response to other sources, such as media, recalled events, or jokes.

It is important to distinguish the differences between laughter and humor. While humor is subjective and often elicits laughter, laughter itself is more readily measured, as it is “a human vocal act and auditory signal" (Provine &Yong, 1991, p. 115). Laughter has certain stereotypical features, such as note structure and duration, as well as a decrescendo. It is largely expiratory—laughter almost always begins with a forceful expiration, and rarely begins with an inspiration (Llyod, 1938). Although humans use laughter as a form of communication, it is less complex than speech and language, and is more similar to animal calls (Provine & Yong, 1991). In fact, animals may even be able to exhibit similar behaviors. Charles Darwin (1872) reported that by tickling chimpanzees, he was able to elicit a "chuckle" similar to humans. Furthermore, in some cases, the corners of the chimpanzees' mouths pulled backward and their lower eyes became slightly wrinkled—much like what happens in humans.

Another important difference to establish is the one between humor and comedy. While both humor and comedy are both subjective and are closely linked to one another, they are not one in the same. For the purposes of this study, the best definition of humor is "that quality which appeals to a sense of the ludicrous or absurdly incongruous: a funny or amusing quality" (Merriam-Webster, n.d.). This can be compared to the definition of comedy, which is "professional entertainment consisting of jokes and sketches, intended to make an audience laugh" (Oxford, n.d.). In other words, comedy is the joke, humor is the aspect of the joke that makes it funny, and laughter is the result.

There are multiple techniques used to effectively elicit laughter. However, a potentially confounding factor is that the most of the methods used are also intentionally comedic. Some of these methods include comedic professional storytelling (Ishigami et al., 2005), comedic stage performances (Dunbar et al., 2012), and joke-telling (Overeem, Taal, Gezici, Lammers, & van Dijk, 2004). Researchers in this field consistently use videos to elicit laughter, which again, are often intentionally comedic. Despite the frequency of usage, there is no standard, validated video stimulus, and there is a great deal of variance among the video stimuli that are used. Examples of this include *Seinfeld's* "Soup Nazi" episode (Mahoney, Burroughs, & Hieatt, 2001), segments of *Candid Camera* and *Comic Relief* (White & Winzelberg, 1992), recordings from a stand-up comedian of the participants' choice (such as Ellen Degeneres or Jerry Seinfeld) or a favorite comedy program they brought (Sugawara, Tarumi, & Tanaka, 2010), clips from *Ghostbusters* and *The Pink Panther Strikes Again* (Devereux & Ginsburg, 2001), and even just a generically listed "comedy video" (Dunbar et al., 2012). Understanding comedy requires higher-order processing; one must be able to understand the humor of joke to laugh. As such, laughter in response to comedy is arguably less pure and less similar to the primitive, animal vocal calls to which Provine and Yong (1991) likened it.

Despite the trend toward use of comedy to induce laughter, research indicates that laughter itself may be laugh-inducing. In a study by Provine (1992), participants were exposed to prerecorded, or "canned," laughter from a laugh box. The experiment had 3 groups, each of which were exposed to 10 laugh box trials. For 2 of the 3 groups, the majority laughed in response to the laugh stimulus on the first trial (57% and 67% of subjects). Although not all laughed, the majority of subjects in all three groups smiled (98%, 94%, and 85%, of subjects, respectively). Not only does laughter matter, *who* is laughing matters, too. In a study that exposed participants to a stand-up comedy video, researchers found that when the video was accompanied by a laugh track, participants laughed significantly more than they did when there was no laugh track (Platow et al., 2005). Furthermore, participants laughed significantly more when they believed the people in the audience (i.e., those who they were hearing on the laugh track) were fellow students at their own university, as opposed to members of a political party with whom the university students did not identify. Specifically, they were four time more likely to laugh when they heard in-group laughter than in any other condition.

This may be related to laughter's deep roots in socialization. People are 30 times more likely to laugh when they are in a social situation than when they are alone and not consuming media (Provine & Fischer, 1989). Similarly, Devereux and Ginsburg (2001) found that when viewing a humorous video, participants laughed more when with a friend or stranger than when alone, despite the fact that there were no differences in participants' evaluations of the funniness of the videos. However, the role of laughter in socialization extends beyond that. In addition to mostly occurring in social situations, it occurs at specific times. It typically does not happen throughout speech or in the middle or a sentence; rather, it happens at the end of sentences as if it were punctuation (Provine, 1993). This is true for both the speaker and the listener.

One possible explanation for the social aspect of laughter may be social facilitation. The idea behind social facilitation is that people behave differently when they are around others than they do when they are alone (Zajonc, 1965). This can be further broken down into several categories, one of which is the audience effect, which assumes that people behave differently when they have spectators. Zajonc (1965) suggests that the presence of an audience facilitates performance, but inhibits learning. Furthermore, it is suggested that when the task is well-learned, the performance tends to be enhanced by an audience, whereas performance of poorly-learned tasks is hindered by an audience. Because laughter can be considered well-learned, one could argue that when people are around others (i.e., an audience) in a social situation, the increased laughter may be a result of social performance enhancement. A second category of social facilitation is the co-action effect (Zajonc, 1965). The idea behind this is that the behavior of one can influence the behavior of others. This is particularly evident in eating behaviors; when eating with others, animals tend to eat more than when they are alone. This concept could explain laughter as well. People may laugh more in social situations due to the co-action effect. Furthermore, social facilitation may require an active audience rather than just the presence of others (Cottrell, Wack, Sekerak, & Rittle, 1968). In other words, people may need to feel they are being watched for these effects to occur.

Smiles and laughter can be classified into two categories: Duchenne and non-Duchenne (Duchenne, 1862). From a physical standpoint, the two are categorized based on facial muscular involvement: Duchenne smiles require movement of the eye's orbicularis oculi muscle, whereas non-Duchenne smiles do not. From a psychological standpoint, Duchenne smiles are related to enjoyment, whereas non-Duchenne smiles are not (Duchenne, 1862; Ekman, Davidson, & Friesen, 1990a). As such, Duchenne laughter is natural and emotion-driven, whereas non-Duchenne laughter is forced and emotionless. As one may predict, these types of laughter have different implications. Keltner and Bonanno (1997) found that for bereaved participants, Duchenne laughter during an interview about the death of a spouse was correlated with decreased negative emotion and increased positive emotion, as well as a dissociation with distress. Conversely, non-Duchenne laughter was related to the awareness of one's own distress. This research implies that the authenticity of laughter plays a role in whether or not one experiences benefits.

Laughter, particularly mirthful laughter (i.e., Duchenne laughter), has several physiological benefits. The effects of laughter are first excitatory; it increases heart rate (HR) and circulation (Fry, 1992; Fry, 1994). This results in an increase in respiration rate, pulse, and alertness. Cessation of laughter is followed by a period of relaxation, or recovery; there is a decrease in HR, respiration rate (RR), and muscle activity. Lloyd (1938) notes that cessation of laughter is often followed by a period of apnea, wherein there is no inspiration or expiration. In addition to changes in HR and RR, mirthful laughter is accompanied by changes in blood pressure; during laughter, blood pressure significantly increases, and after laughing, blood pressure drops below baseline (Fry & Savin, 1988). This is further supported in a study by Sugawara et al. (2010). The researchers found that while watching a comedy video, participants experienced significant increases in HR for the first 20 (out of 30) minutes, as compared to a control group that watch a documentary and did not experience and increase in HR. The researchers also noted that participants did experience increased vascular function after viewing a comedy, although the effect was acute and diminished within 24 hours.

Humor appears to have many psychological benefits as well, which is evidenced by its prevalent use in patient-care fields. Medical clowns effectively use humor to make medical examinations less scary and stressful for children who have been sexually abused (Tener, Lev-Wiesel, Franco, & Ofir, 2010). A meta-analysis by Christie and Moore (2005) revealed that humor is consistently and effectively used in cancer treatments. Humor does not only help the patients—it helps the medical staff as well. In an analysis of nurses' diaries, it was found that using humor helped both patients and nurses cope with the unpleasant situations they were faced with at work (Astedt-Krki & Isola, 2001). This technique may be well justified; although the exact benefits of humor are unclear, a humorous coping style is correlated with better health (Carroll & Schmidt, 1992).

One possible explanation for this stems from the fact that researchers have been able to establish that there is a strong relationship between humor and stress reduction, which may be a key component in the relationship between humor and health. A meta-analysis identified 14 studies that found that humor reduces stress (Berk, 2001). For example, one of these studies found that people who report using humor as a coping mechanism approach stress in a problem-focused manner, tending to confront the issue, while also emotionally distancing themselves from it (Martin, Kuiper, Olinger, Dance, 1993). Since then, there has been even more evidence collected that supports this relationship. In a study of undergraduate social work students, Moran and Hughes (2006) found that using (i.e., producing) humor is correlated with low levels of stress.

A caveat one must consider is that this research relates to humor and stress, therefore it cannot be concluded that laughter reduces stress. Despite the strong relationship between humor and stress reduction, little is known about the specific relationship between laughter and stress reduction. Past studies do, however, indicate that there may be a relationship similar to that of humor and stress. In a study that assessed the relationship between stress, positive and negative affect, and daily laughter (i.e., self-reported laughing and not lab-induced laughter; Kuiper & Martin 1998). The researchers found that for people who had low levels of laughter, high levels of daily stress were associated with an increase in negative affect. However, for people who had high levels of laughter, higher levels of daily stress were not associated with an increase in negative affect. While this is pertinent, the majority of the reported laughter was "spontaneous," a categorization that makes it difficult to infer the cause of or type of laughter. In another study of laughter and stress reduction, White and Winzelberg (1992) found that laughter was not effective in reducing physiological measures of stress, whereas it was effective in reducing psychological levels of stress. It is important to note, though, that the laughter in this study was induced by intentionally comedic video clips (i.e., segments of *Candid Camera* and *Comic Relief*).

A particularly interesting genre of research involves the investigation of something called "laughter yoga," which offers some support for the efficacy of laughter alone having both physiological and psychological benefits (Yazdani, Esmaeilzadeh, Pahlavanzadeh, & Khaledi, 2014). Laughter yoga combines laughter with yogic breathing; the laughter typically begins as an artificial laugh (non-Duchenne) and quickly becomes authentic and natural (Duchenne). The laughter is not intended to be a result of something logical, but rather respiration-based (Farifteh, Mohammadi-Aria, Kiamanesh, & Mofid, 2014). It is believed that stress and negativity disturb respiration, which in turn disrupts the flow of vital energy into one's body. Laughter yoga is intended to combine the philosophy of yoga (specifically the pranayama respiration exercises) with laughter exercises.

Although the accuracy of the theory that led to the development of laughter yoga is debatable, this approach has been scientifically tested on a variety of populations. In one study, nursing students participated in 8 one-hour laughter yoga sessions over the course of 4 weeks (Yazdani et al., 2014). After the intervention, as well as at a one-month follow-up, participants had significantly better general health than did those in the control condition, who did not receive the laughter yoga intervention. In a study of elderly participants, the researchers utilized laughter therapy, which is virtually the same as laughter yoga (Ko & Youn, 2011). The participants were led by a nurse in activities intended to make them laugh, such as dancing, singing, watching videos of laughter therapy, positive thinking training, and forced laughter. This treatment took place in the form of 4 one-hour sessions over the course of 4 weeks. It was found that after the intervention, participants experienced a significant decrease in depression and insomnia, as well as an increase in sleep quality. The control group experienced no improvements in any metric; however, it is important to note that the control group received no intervention. Because of this, it is difficult to pinpoint whether laughter (rather than another aspect of the group meetings) was what actually caused these improvements in patients. Laughter yoga has also been studied as a potential intervention for stress reduction in cancer patients (Farifteh et al., 2014). Based on self-report measures, it was found that 20-30 minutes of laughter yoga prior to chemotherapy was effective in significantly reducing patient stress.

Although most would likely agree that stress feels "bad," and that it is something that should be reduced, we do not always consider what it is and why we do not like it. It was first stated in the 1979 Surgeon General's report that severe stress is linked to serious illnesses such as cancer and heart disease. As such, low levels of emotional stress are an important part of a "healthy" lifestyle. To manage stress, though, it is important to define what it is. Most people tend to think of stress in fairly general and simplistic sense, much like the *Merriam-Webster* definition of "a state of mental tension and worry caused by problems in your life, work, etc.," and "something that causes strong feelings of worry or anxiety." This is further characterized, perhaps more scientifically, by Lazarus and Folkman (1984) as being something within one's environment that is taxing or exceeding one's resources, or something that is appraised as being a danger to one's well-being. These definitions are consistent with a one of psychological stress. While psychological stress is a key component in the general idea of "stress," it tends to be a more subjective measure, as it is often assessed through self-report. As such, another component, physiological stress, is also important to consider.

Physiological stress, which is arguably a more objective measure of stress, can be defined in a number of ways. Selye (1950) argues that, regardless of the stressor, one can expect to see certain physiological changes that are characteristic of stress, such as in an increase in blood pressure and a discharge of A.C.T.H. (adrenocorticotropic hormone). As is summarized by

Huang, Webb, Zarudos, and Acevedo (2013), physiological stress responses (particularly acute stress response) can also be seen through increases in HR.

One of the challenges of studying stress is evoking stress that one can measure. However, one reliable and valid task consistently used for this purpose is the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer., 1993). The TSST requires that participants perform a stressful task in front of an audience. This can include either giving a speech or doing the aforementioned mental arithmetic, or a combination of both. Not only does participation in the TSST significantly increase one's self-report ratings of perceived psychological stress, it also significantly elevates one's HR (Hellhammer & Schubert, 2012; Kirschbaum et al., 1993). The stress of mental arithmetic alone (i.e., the TSST without the speech component) has also been shown to significantly increase HR (Brown, Szabo, & Seraganian, 1988).

There are multiple ways to elicit emotions other than stress in participants. One effective method is use of film. While films of varying lengths have been used, research indicates that clips as short as 6 seconds are enough to initiate a response (Uhrig et al., 2016). In a similar respect, videos ranging from 29 seconds to 236 seconds have been found to successfully elicit 4 key emotions: amusement, sadness, anger, and disgust (Hewig et al., 2005). Another study provided further evidence for this, as it was shown that videos with an average length of 151 seconds were able to elicit those same emotions, with the addition of contentment, surprise, and fear (Gross & Levenson, 1995). As such, it can be expected that with acute exposure to a video, one can elicit a desired emotion.

The purpose of the present study was to evaluate the relationship between laughter and stress; namely, to investigate whether exposure to a laughter-inducing video can reduce lab-induced stress as compared to a nature control video. The present study aimed to assess potential benefits of laughter in the absence of a stimulus that is inherently comedic. The hypotheses were that (1) participants in the experimental condition would have lower HRs and RRs after exposure to a laughter video as compared to those in the control condition, and (2) participants in the experimental condition would report less stress following the laughter video as compared to those in the control condition.

Method

Participants

Participants included a total of 68 undergraduate students who were enrolled in psychology courses. Of the 68 participants, 8 were excluded from data analyses due to incomplete or inaccurate data. Therefore, a total of 60 participants, 30 per condition, were included in the analyses (10 males, 49 females, 1 preferred not to answer). Participants were 18-31 years old (*M* = 21.30, *SD* = 3.13). Participants were predominantly white (n = 39), followed by Hispanic/Latino(a) (n = 8), Asian (n = 7) and African American/Black (n = 4), other (n = 1), and multi-racial (n = 1).

Participants were recruited through the university's research sign-up system, SONA. Students received 1 hour of extra credit (1 point) in a course of their choosing in exchange for their participation in the study.

Materials and Measures

The present study required both self-report and physiological measures. All self-report measures were completed electronically via Qualtrics, and were distributed in 4 segments. The initial segment (Segment A) included demographic questions, followed by a series of scales, the first of which is the Perceived Stress Scale (PSS; Cohen & Williamson, 1988). The PSS is a 10-item questionnaire designed to assess a how stressful an individual perceives life situations to be.

The participant was asked to use a 5-point Likert-type scale ranging from 0 to 5 (with 0 being "never" and 5 being "very often") to rate how often they have felt or thought a certain way in the past month. The PSS was followed by the Ten-Item Personality Inventory (TIPI; Gosling, Rentfrow, & Swann, 2003). As the name suggests, the TIPI is a brief instrument used to assess a participant's "Big Five" personality traits. This measure utilizes a 7-point Likert-type scale ranging from 1 to 7 (with 1 being "disagree strongly" and 7 being "agree strongly"), with which participants were asked to rate the extent to which given personality characteristics were descriptive of themselves. The Daily Hassles Scale (DHS; Kanner, Coyne, Schaefer, & Lazarus, 1981) is a 117-item questionnaires that requires participants to rate the severity of hassle they have dealt with in the last month on a scale of 1 to 3 (with 1 being "somewhat severe" and 3 being "extremely severe").

The DHS (Kanner et al., 1981) was followed by a modified version the International Positive and Negative Affect Schedule Short Form (I-PANAS-SF; Thompson, 2007). This 10-item metric is designed to assess individuals' trait affect. Typically, participants are asked to use a 5-point Likert-type scale ranging from 1 (very slightly or not at all) to 5 (extremely) to rate the extent to which they generally experience a given emotion. For the purposes of this study and to obtain a rating of in-the-moment emotion, participants were asked to rate the extent to which they *currently* felt a given emotion. Finally, participants were asked to provide a rating of the extent to which they currently felt stressed, using the same 5-point Likert-type scale used in the I-PANAS-SF.

In addition to the initial survey, each participant completed three abridged versions of the survey throughout the course of the study. Segments B and D included the I-PANAS_SF and stress rating from Segment A. Segment C included the I-PANAS-SF and current stress rating as it was presented in Segment B and D, as well as a 16-item emotion self-report inventory to assess the emotion evoked by the film (Gross & Levenson, 1995). This measurement allowed participants to rate the extent to which they felt each listed emotion during the film using a Likert-type scale ranging from 0 (did not even feel the slightest bit of emotion) to 8 (the most he or she has felt in his or her entire life).

To collect physiological data, the participant wore a strain gauge and electrodes, both of which were attached to an MP36 Biopac system. The strain gauge was placed around the chest and used to collect respiration data. The electrodes were placed on the wrists and ankles in a lead III configuration for ECG signal detection. This configuration was selected to accommodate right-handedness, as participants were required to complete surveys while wearing the electrodes. By placing the electrode on the left wrist, the potential for noise from use of the right hand was reduced. Data was collected at 1,000 Hz to allow report of HR, respiratory sinus arrhythmia (RSA), or heart-rate variability (HRV), and respiration rate and amplitude.

Procedure

Participants signed for the 60-minute lab study online through the SONA system. Upon arrival to the lab, participants completed the initial survey (Survey A; 15 minutes). After the survey was completed, a research assistant placed the strain gauge around the participant's chest and attached the electrodes and lead cables in a lead III configuration. Once the Biopac equipment was in place, the participant was asked to sit still while a 5-minute baseline measure was recorded. After the baseline measure was finished, the research assistant came back into the room and began filming the experiment with a digital camera on a tripod, which was visible to the participant. Next, the participant was instructed to participate in a stress task administered by the research assistant, namely the arithmetic portion of the Trier Social Stress Test (TSST;

Kirschbaum et al., 1993). During this task, participants were asked to serially subtract 13 from 1,022. Each time the participant made an error, the research assistant intervened by saying, "Stop, 1022," and the participant was required to restart the task from the beginning. At minutes 1 and 3 within this segment, the participant was told to go faster, regardless of the speed at which he or she was performing the mental arithmetic task.

Upon the completion of the TSST, the participant completed Segment B of the survey to assess his or her reaction to the stress task, as well as his or her emotional state. Following the survey, the participant viewed one of two videos (each approximately 2 minutes in length), which was based on random assignment. Participants in Condition A, the control condition, viewed a nature video (arctic scenes; see Appendix A), whereas participants in Condition B, the experimental condition, viewed a video intended to make them laugh (a video of a baby laughing hysterically at his dad ripping paper; see Appendix B). During this portion of the experiment, the research assistant sat in an adjacent room behind a two-way mirror to watch the participant. The research assistant marked on the Biopac output when the participant laughed. Short laughs (i.e., a single "ha" or other brief expression of laughter) was characterized by a single mark and counted as one second of laughter. Longer laughter was characterized by marking and labeling the beginning (B) and end (E) of the laughter sequence.

After the video ended, the video camera was turned off and the participant completed the third segment of the survey (Segment C). This was followed by a request to sit still once more while a second 5-minute baseline was recorded. Finally, the participant completed the fourth segment of the survey, and was debriefed about the purpose of the study. An overview of the procedure can be seen in Figure 1.

Results

Physiological Measure

Heart Rate. A one-between (condition), one-within (phase) analysis of variance (ANOVA) was used to examine mean HR across four main phases: during the first baseline (Base 1), during the mental arithmetic task (TSST), while watching the video (Video), and during the second baseline (Base 2) and condition. Mauchly's test of sphericity was violated, and so the Greenhouse-Geisser correction was used. The interaction between group and phase was not significant, $F(1.59, 92.04) = .50$, $p = .57$. There were, however, significant differences between the 4 phases, $F(1.59, 92.04) = 27.95$, $p < .001$. More specifically, HR was significantly higher during TSST ($M = 85.56$ beats per minute; BPM) than during Base 1 ($M = 77.34$ BPM), $F(1, 58) = 79.95$ $p < .001$. Likewise, HR was significantly higher during TSST than during Video ($M = 72.60$ BPM), $F(1, 58) = 44.44$, $p < .001$. As can be seen in Figure 2, there were no significant differences between Video and Base 2 ($M = 76.36$ BPM), $F(1, 58) = 3.00$, $p = .09$. These data suggest that the Trier Social Stress Test (Kirschbaum et al., 1993) was successful in inducing physiological stress. Furthermore, there were no significant differences in mean HR between the control and laughter groups, $F(1, 58) = 0.10$, $p = .76$, suggesting there was no main effect of group.

Respiration Rate. A one-between and one-within repeated measures ANOVA was run to examine mean RR across 3 main phases: during baseline 1 (Base 1), while watching the video (Video), and during baseline 2 (Base 2). RR from the TSST phase was excluded from these analyses due to the oral component of this task; because participants had to speak, RR during this phase was an unreliable measure. Sphericity was violated and the Greenhouse-Geisser correction was used. The ANOVA indicated that there was no significant interaction between phase and group, $F(1.22, 70.96) = 0.41$, $p = .67$. There were no significant differences in RR across the 3 phases, $F(1.22, 70.96) = 1.59$, $p = .21$. Furthermore, there were no significant differences in RR between groups, $F(1, 58) = 0.02$, $p = .88$.

Self-Report Measures

Between-group comparisons of self-report measures were done in two ways. First, groups were compared based on condition, i.e. control (n = 30) vs laughter (n=30). For a second between-group measure, participants in the laughter condition were further categorized into two groups: those in the laughter group who laughed (Laughers; n = 15), and those in the laughter group who did not laugh (Non-laughers; n = 15). This allowed for the comparison of Laughers, Non-laughers, and controls. Of the Laughers, total time spent laughing ranged from 1 second to 16 seconds ($M = 3.67$ seconds).

Ten-Item Personality Inventory. A one-way ANOVA was used to examine between-group differences in self-reported personality traits. It was found that those in the laughter group rated themselves as significantly more open to experiences ($M = 6.07$, $SD = 0.74$) than those in the control group ($M = 5.33$, $SD = 1.21$), $F(1, 58) = 7.99$, $p = .006$. To further examine this relationship, a one-way ANOVA was run to examine differences between those in the control, Laughers, and Non-laughers. It was found that there were significant differences in ratings of openness to new experiences, $F(2, 57) = 4.23$, p = .02. Follow-up tests using the Tukey procedure indicated that there were no significant differences between Laughers ($M = 5.93$, $SD = 0.70$) and Non-laughers ($M = 6.20$, $SD = 0.78$), $p = .75$, nor were there significant differences between those who Laughed and the control group ($M = 5.33$, $SD = 1.21$). There were, however, significant differences between Non-laughers and the control, in that Non-laughers rated themselves as significantly more open to new experiences, $p = .02$.

There were no other significant between-group differences in self-reported personality traits.

Perceived Stress Scale. A one-way ANOVA on total PSS (Cohen & Williamson, 1988) score indicated that the control group (M = 18.83, SD = 6.30) had significantly higher PSS scores than the experimental group (M = 14.45, SD = 5.91), F (1, 56) = 7.46, p = .008. A one-way ANOVA was also used to examine differences is PSS score between Laughers, Non-laughers, and control groups. It was found that there were significant differences between the three groups, F(2, 55) = 4.15, p = .02. Follow-up tests were completed using the Tukey procedure. As was the case for the TIPI, there were only significant differences in PSS total score between the control group (M = 18.83, SD = 6.30) and Non-laughers (M = 13.36, SD = 5.93), in that Non-laughers had lower PSS scores, p = .02.

Daily Hassles. A one-way ANOVA revealed differences between control and laughter groups in total scores from the DHS (Kanner et al., 1981), in that those in the control group (M = 73.62, SD = 43.01) had significantly higher DHS scores than those in the laughter group (M = 48.60, SD = 28.66), F(1, 57) = 6.96, p = .01.

A one-way ANOVA also revealed significant differences in DHS score between the control, Laughers, and Non-laughers, F(2, 56) = 4.37, p = .02. Follow-up tests were completed using the Tukey procedure. These tests indicated that there were no significant differences in DHS total score between the Laughers (M = 57.20, SD = 29.84) and Non-laughers (M = 40.00, SD = 23.54), nor were there significant differences in DHS total score between Laughers and the control (M = 73.62, SD = 43.01). However, Non-Laughers had significantly lower DHS total scores than those in the control, p = .01.

Self-reported Stress. A one-between and one-within repeated measures ANOVA was run to evaluate the differences in self-reported stress ratings across 4 phases: during the initial survey (Base 1), after the arithmetic task (TSST), after watching the video (Video) and after the second baseline (Base 2). Using a Greenhouse-Geisser correction, as is shown in Figure 3, it was found that there were significant differences in self-reported stress between the 4 phases, $F(2.33, 132.69) = 33.09$, $p < .001$. Contrasts indicated that stress ratings were significantly lower at Video ($M = 1.90$) than at TSST ($M = 2.91$), $F(1, 57) = 53.73$, $p < .001$. In addition, there were significant differences in stress rating between groups, in that those in the laughter condition ($M = 2.06$) reported lower stress than those in the control condition ($M = 2.63$), $F(1, 57) = 6.19$, $p = .02$. However, there was no significant interaction between group and phase, $F(2.33, 132.69) = 0.43$, $p = .69$. (See Table 1.)

Due to the unexpected between-group differences in baseline stress, other stress-related variables were examined. As such, the one-between, one-within repeated measures ANOVA was once again used to examine the differences in self-reported ratings of stress across the 4 phases, this time using baseline DHS score as a covariate. Using a Greenhouse-Geisser correction, it was found that after controlling for DHS total score, there was no significant interaction, $F(2.29, 126.19) = 0.21$, $p = .84$. There were significant differences between the 4 phases, $F(2.29, 126.19) = 3.70$, $p = .02$. Contrasts indicated that there were significant differences between TSST and Video ratings of stress, $F(1, 55) = 8.35$, $p = .006$. However, after controlling for DHS score, there were no longer significant differences between groups, $F(1, 55) = 2.84$, $p = .10$. (See Figure 4.)

A one-between and one-within repeated measures ANOVA was used to assess differences in stress rating across the 4 time points between Laughers, Non-laughers, and controls. Mauchly's Test of Sphericity was violated, therefore, the Greenhouse-Geisser correction was used. There was no significant interaction between phase and group, $F(4.68, 131.11) = 0.95$, $p = .45$. It was found that there were significant differences between phases, $F(2.34, 131.11) = 28.67$, $p < .001$. Contrasts indicated that stress was significantly lower at Video than at TSST, $F(1, 56) = 48.83$, $p < .001$. There were also significant between-group differences, $F(2, 56) = 3.40$, $p = .04$. Post-hoc tests using the Tukey adjustment indicated that Laughers reported significantly lower stress than controls, $p = .04$ (Table 2, Figure 5).

Laughers, Non-Laughers, and the control group were again examined using a repeated measures ANOVA, this time using DHS score as a covariate. As was the case in prior analyses, after controlling for DHS score and using a Greenhouse-Geisser correction, there was no significant interaction between phase and group, $F(4.61, 124.56) = 0.56$, $p = .76$. There were significant differences between phases, $F(2.31, 124.56) = 3.92$, $p = .02$. Contrasts indicated that Video stress was significantly lower than TSST stress, $F(1, 54) = 9.10$, $p = .004$. However, after controlling for DHS, there were no longer significant between-group differences, $F(2, 54) = 2.41$, $p =.10$ (Figure 6).

16-item Emotion Inventory. A one-way ANOVA was used to examine between-group differences in self-reported ratings of happiness from the 16-item emotion inventory (Gross & Levenson, 1995). Those who watched the laughter video ($M = 5.20$, $SD = 2.27$) reported that they had experienced significantly more happiness while watching the video than those who watched the control video ($M = 3.79$, $SD = 2.11$), $F(1, 57) = 6.08$, $p = .02$. There were no significant differences between groups in self-reported ratings of any other emotions from Gross' and Levenson's (1995) emotion inventory. There were no significant differences in happiness ratings between Laughers, Non-laughers, and the control group.

Discussion

The purpose of the present study was to examine the effects of laughter on stress reduction. It was hypothesized that participants in the laughter condition would experience lower HR and RR after watching the video. There was a significant main effect of phase for HR, in that TSST HR was significantly higher than Base 1 and Video HR. However, there were no significant changes in RR across phases. Furthermore, it was found that there were no significant differences in HR or RR between groups. It was also hypothesized that participants in the laughter condition would report less stress than the control group following the video. Results indicated that self-reported stress was significantly lower following the Video than it was following the TSST, and that there were significant between-group differences. While the laughter group did report significantly lower stress than the control group, there was not a significant phase by group interaction, indicating that these participants came into the experiment with lower stress. After controlling for DHS scores, there were no longer significant differences in self-reported stress between groups. Analyses comparing the control group, Laughers, and Non-laughers indicated similar results. Laughers reported significantly lower stress than the control group, but there was no significant phase by group interaction. After controlling for DHS scores, there were no longer significant between-group differences.

One possible explanation for the lack of differences is the small amount of laughter that occurred in the laughter condition. Of the participants in the laughter condition, only half laughed, and those who did laugh typically did so very little. This may be a result of the missing component of social facilitation. Participants watched the videos alone to decrease the probability that any confounding factors, such as being in a social situation, could influence stress recovery. The presence of an audience can facilitate performance, as well as increase co-action (Zajonc, 1965). Because there was no audience and therefore nothing to help facilitate laughter, participants may not have laughed as much as they would have if an audience had been present (whether that be another participant or a confederate). Participants' lack of laughter was one of the biggest limitations of this study. Because social facilitation may play a key role in laughter, in future research, it would be beneficial to include a condition in which participants were paired with another participant or a confederate.

In addition to the lack of audience, the stimulus may not have been powerful enough to induce large amounts of laughter. Provine's (1992) research using canned laughter as a stimulus indicated that laughter itself was a laugh-inducing stimulus. Therefore, it was predicted that the laughter of the baby and father in the present stimulus would induce laughter. However, it may not be that laughter induces laughter, as Provine's (1992) research suggested. Although people did laugh in response to the canned laughter, the 1992 study was also done in large groups. Instead of the primary cause of laughter being contagion from the laugh tracks, it may be the audience was more important in facilitating laughter. Additionally, Platow et al. (2005) found that people laughed more when they heard a laugh track that they believed to be in-group members' laughs. It may be that the undergraduate students who participated in the study did not consider parents and children to be a part of their *ingroup,* and as a result, may have laughed less.

This study was further limited in that the minimal number of stimuli were presented. Since there was only one control video and one laughter video, the results may indicate a direct effect of those specific videos, rather than an effect of the condition. It may be that there is a relationship between laughter and stress reduction that was not detected in the present study due to the insufficient number of stimuli. Future research should include an increased number of stimuli in each condition to account for any effects of the video itself. It may also be beneficial to allow for participants to select stimuli that they find most humorous to increase the probability that they laugh.

Finally, the length of this study was very brief. The video duration was only 2 minutes. Although past research indicates that video clips lasting only a few seconds are enough to elicit emotion (Uhrig et al., 2016), the same may not be true for laughter. Not only may participants need longer exposure to stimuli to induce laughter, they may need to spend more time laughing to experience benefits. This study was also brief in that participants were only followed for 5 minutes following the presentation of the stimuli. There may have been delayed effects of the stimuli that were not accounted for in this design. Future research should examine longer term effects of laughter.

Figure 1.
Procedure

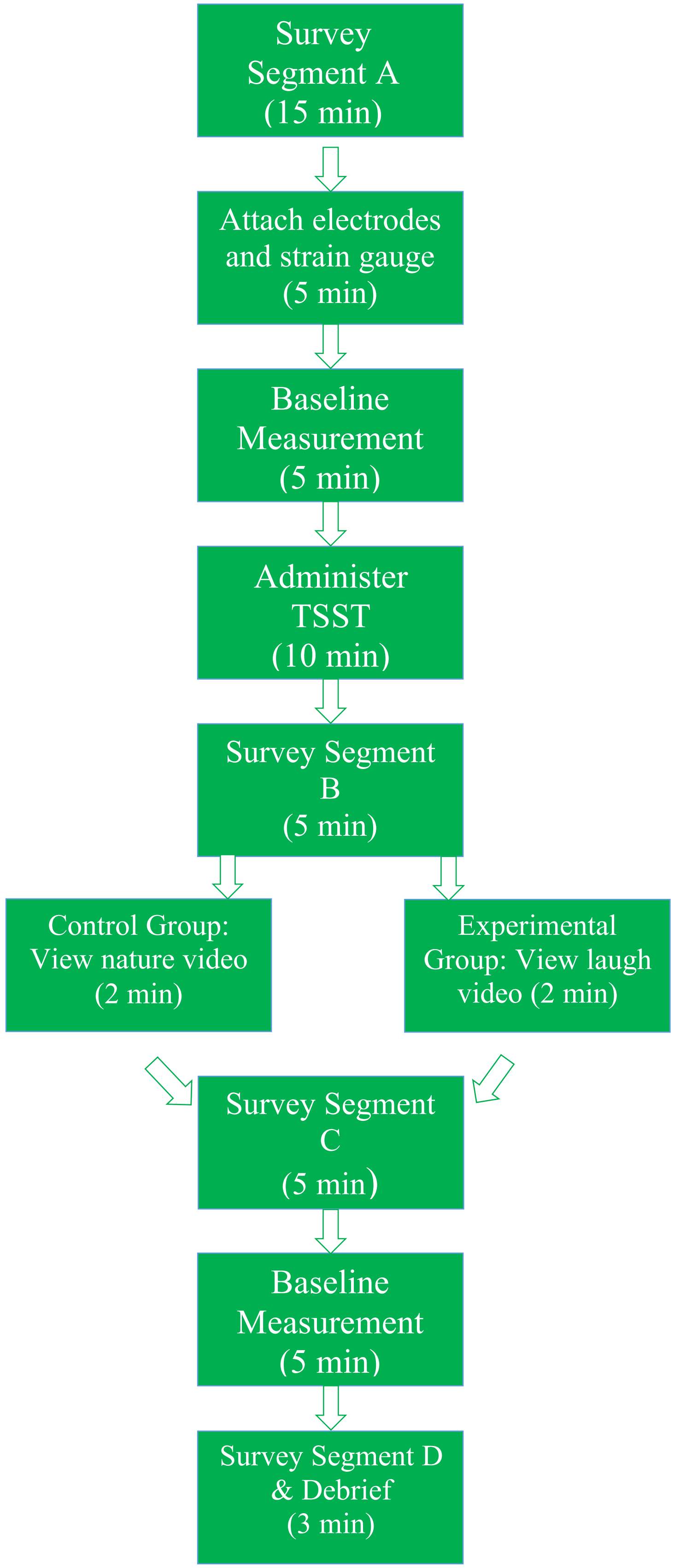

Figure 2

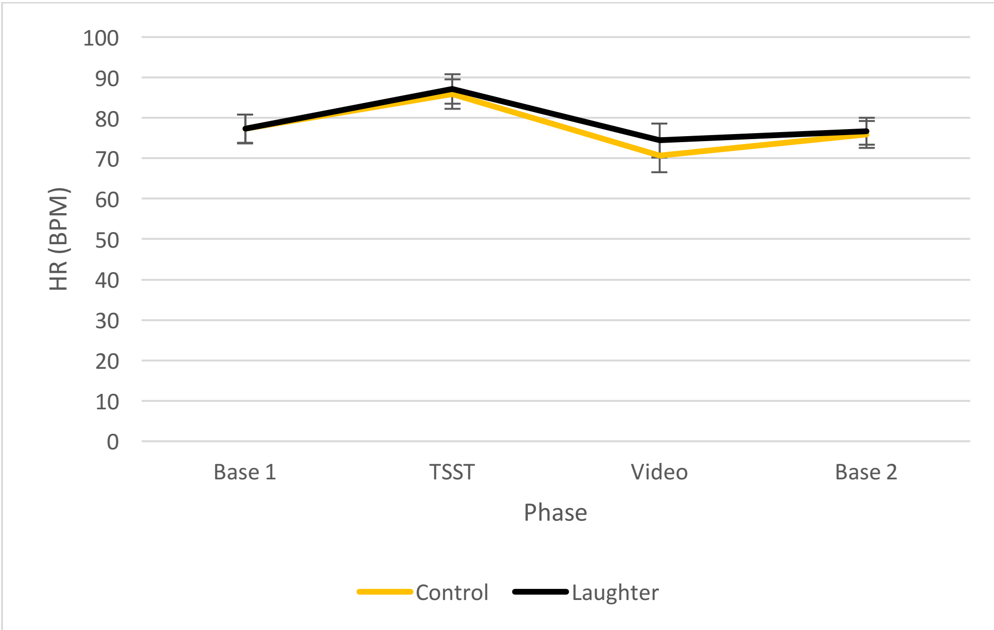

Figure 2. Mean HR. HR during TSST was significantly higher than HR during Base 1 and Video. No significant interaction or significant between-group differences were found. Bars at each data point represent standard error.

Figure 3

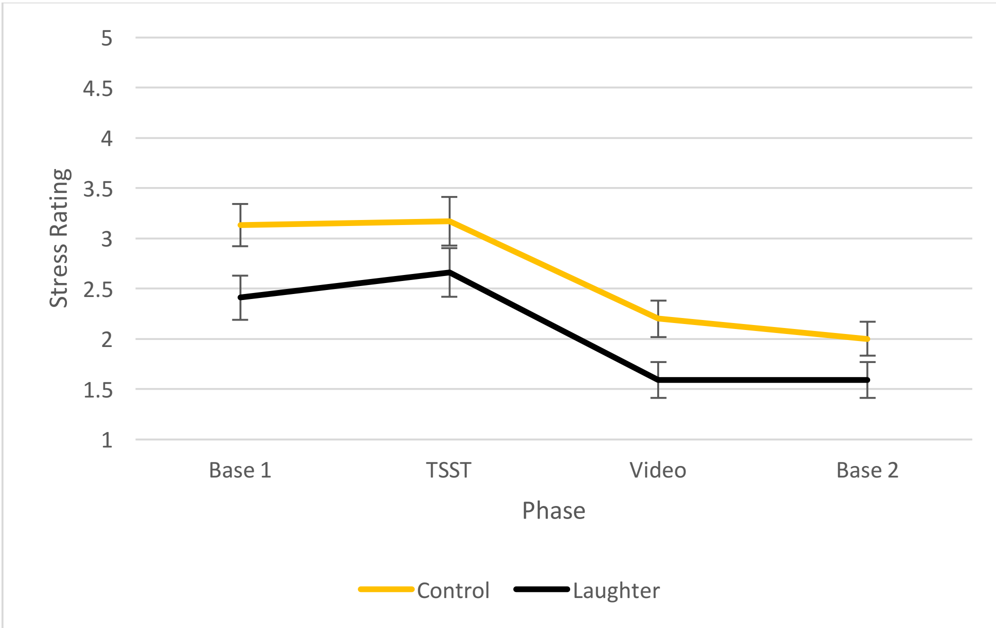

Figure 3. Mean Self-Reported Stress Rating: I. Stress rating was significantly higher following TSST than stress rating following video. Laughter group reported significantly lower stress than control group. No significant phase by group interaction was found. Bars at each data point represent standard error.

Figure 4

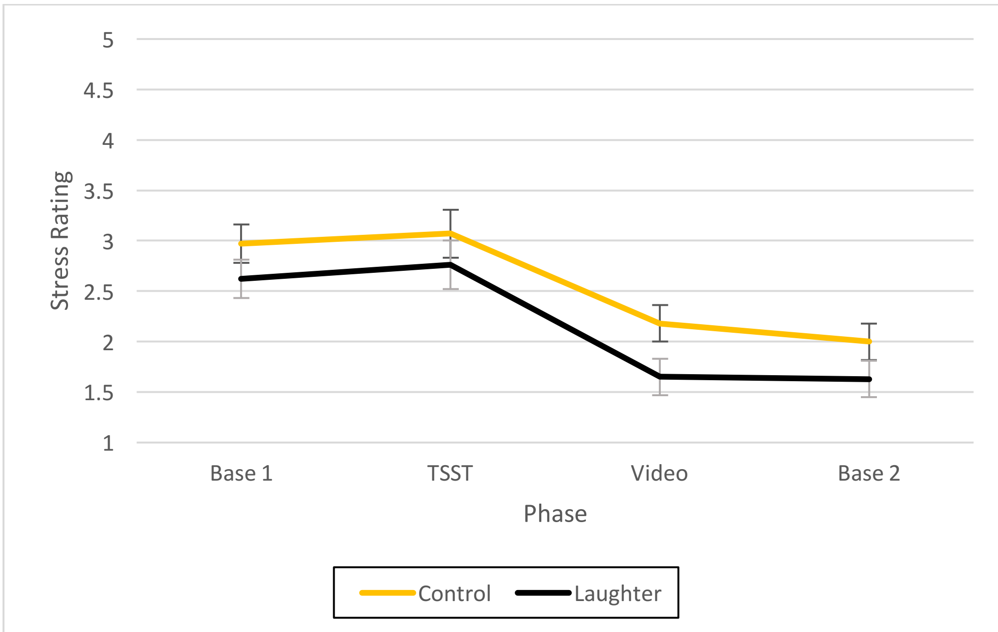

Figure 4. Mean Self-Reported Stress After Controlling for DHS Score: I. Stress rating was significantly higher following TSST than stress rating following video No significant interaction or significant between-group differences were found. Bars at each data point represent standard error.

Figure 5

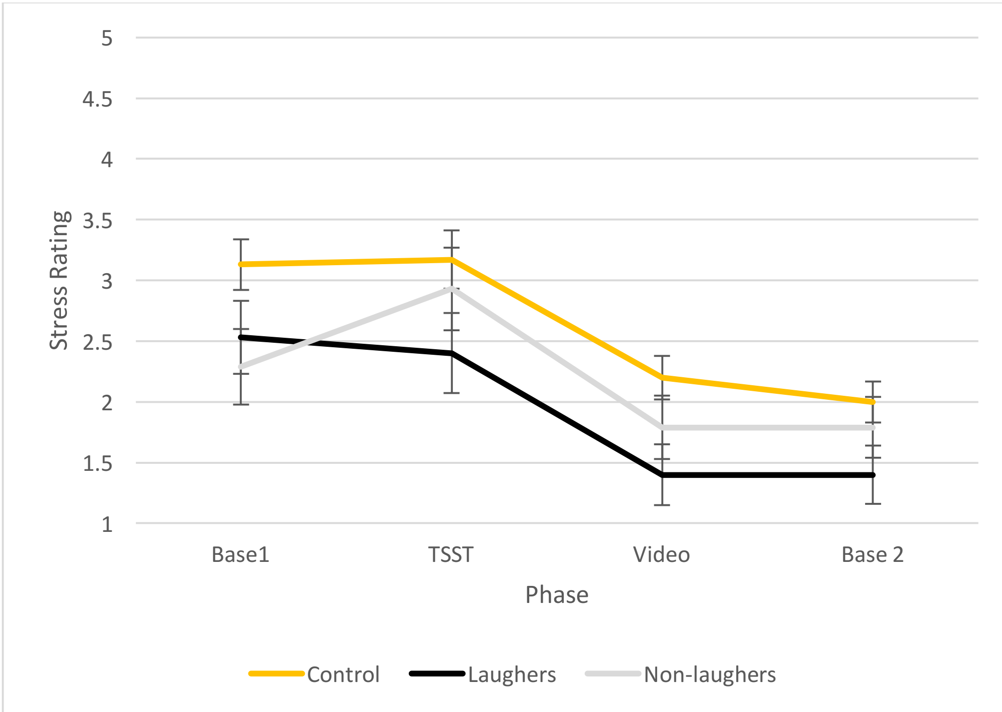

Figure 5. Mean Self-Reported Stress: II. Stress rating following TSST was significantly higher than stress rating following Video. Significant between-group differences were found. The Tukey procedure indicated Laughers reported significantly lower stress than the control. No significant interaction was found. Bars at each data point represent standard error.

Figure 6

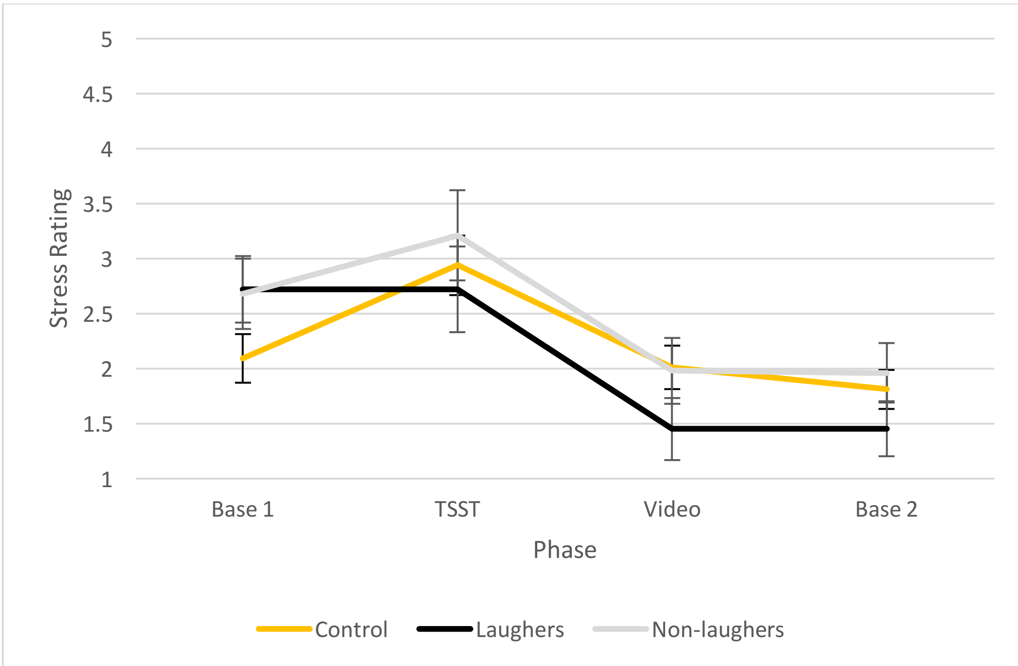

Figure 6. Mean Self-Reported Stress After Controlling for DHS Score: II. Stress rating was significantly higher following TSST than stress rating following Video. No significant interaction or significant between-group differences were found. Bars at each data point represent standard error.

Table 1

Mean Self-Reported Stress: Control and Laughter

Phase	Control	*SE*	Laughter	*SE*
Base1	3.13	0.2	2.41	0.22
TSST	3.17	0.24	2.66	0.24
Video	2.2	0.18	1.59	0.18
Base 2	2	0.18	1.59	0.18

Note: Table represents mean stress ratings and standard errors (*SE*). Scale ranged from 1-5.

Table 2

Mean Self-Reported Stress: Control, Laughers, and Non-Laughers

Phase	Control	*SE*	Laughers	*SE*	Non-laughers	*SE*
Base1	2.97	0.2	2.59	0.26	2.64	0.28
TSST	3.05	0.24	2.44	0.33	3.14	0.35
Video	2.17	0.18	1.42	0.25	1.92	0.27
Base 2	1.98	0.18	1.42	0.24	1.88	0.26

Note: Table represents mean stress ratings and standard errors (*SE*). Scale ranged from 1-5.

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Appendix A: Control Video
https://www.youtube.com/watch?v=iVyeWM0Ebus

Appendix B: Laughter Video
https://www.youtube.com/watch?v=RP4abiHdQpc