The Impact of Self-Induced Laughter on Psychological Stress

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Key Words: ESRQ, humor, laughter, reading, stress, therapy

Abstract

American stress levels rose 39 percent in 2011 (APA, 2011). Research shows laughter produces endorphins that decrease health risks (e.g., MacDonald, 2008) but has primarily considered laughter produced by comic events (e.g., Ko & Youn, 2011). The current study examined the impact of self-induced laughter on psychological stress. Undergraduates (33 males and 27 females) were randomly paired and assigned to laugh or read aloud. Following, participants completed a stress inducing activity (adapted from Försvarsmakten, 2013). During this activity, participants listened to and recorded answers from a soundtrack, sorted cards, and paired information. After stress induction, participants completed the Emotional Stress Reaction Questionnaire (ESRQ; Larsson, 2010) followed by a relaxation exercise. ESRQs were sorted by laughter or reading group and scored. General linear modeling indicated no significant difference in psychological stress between laughter and reading conditions ($p = .980$). No significant difference in psychological stress was found between genders ($p = .767$). Generally, the findings indicate self-induced laughter prior to a stressful event does not decrease psychological stress.

Introduction

Societal norms suggest people should be successful at work, be responsive parents, have a certain appearance, and somehow still have time to preserve their own mental health. The pressure to be accepted in society could increase stress for anyone. The American Psychological Association (APA; 2011) assessed American stress and found it increased 44 percent between 2006 and 2011 and increased, specifically, 39 percent between 2010 and 2011. The APA conducted a cross-country stress survey designed for American adults that revealed an average stress level of 5.2 on a 10-point Likert scale. Reasons behind indicated stress levels are concerns about personal finances (75%), employment (70%), national finances (67%), relationships (58%), as well as personal and family health (53%) (APA, 2011). College undergraduates are especially concerned about the bleak prospective for future employment and their personal finances (Guo, Wang, Johnson, & Diaz, 2011).

Stress impacts the human physiological state. Viamontes and Nemeroff (2009) state the brain reacts to external stressors by sending signals to the rest of the body to prepare the person for action. This activation for preparedness produces an increase in heart rate and dilates blood vessels, thus increasing blood flow (Viamontes & Nemeroff, 2009). These increases in blood flow can increase risk of endothelial dysfunction, the forerunner to cardiovascular disease, if left untreated (Toda & Nakanishi-Toda, 2011). Toda and Nakanishi-Toda (2011) also claimed that adolescents exposed to long-term stress are prone to developing cardiovascular disease. Martin and Dobbin (1988) examined participants' saliva and measured secretory immunoglobulin A levels as an indicator of immune system efficiency. The findings show involvement in frequent stressful situations decreased secretory immunoglobulin A levels and, hence, reduced the efficiency of the immune system (Martin & Dobbin, 1988). The research indicates stress can increase serious health risks. Thus, education regarding effective stress reduction techniques is needed.

In the APA (2011) stress survey, 74 percent of American adults indicated they were actively trying to reduce stress by consuming more nutritious foods, increasing physical activity, decreasing body mass, and getting enough sleep. Unfortunately, no momentous results in stress reduction were noted and the other 26 percent of American adults stated they did not have enough time to participate in stress relieving activities. Losing weight, cooking healthier foods, sleeping longer, and spending time with friends are all time commitments; although these activities are encouraged, it can be difficult for people to motivate themselves when they already feel stress due to other obligations.

When physical attempts to relieve stress are ineffective (APA, 2011), a method incorporating psychological change may offer improvement. In an interview with a humor professional, Godfrey probed Goodman who stated a highly
cultivated sense of humor, applied in everyday life, could aid people in their effort to deal with potentially stressful situations (Godfrey, 2004). Laughter is the physiological response to a humorous event and is essential in the healing process of the psyche (Abrami, 2009).

Laughter has been an essential part of human mental health for most of our existence. Within the tribes of Alaskan Natives, laughter is viewed both as medicine and food for the soul (Cueva, Kuhney, Lanier, & Dignan, 2006). Laughter is said to purify the soul and fill the body with energy (Cueva et al., 2006). Humor is essential to human mental health (Paden-Levy, 2003) because laughter increases happiness through the discharge of endorphins that, in turn, increase immune system efficiency and decrease blood pressure (Abrami, 2009; Brassil, 2002; Cueva et al., 2006; Funk & Ferrell, 1995; Hoare, 2004; MacDonald, 2008). Cortisol, an active substance in the stress response, is found to be decreased through laughing (Sahakian & Frishman, 2007). Laughter, in turn, decreases blood pressure (Sahakian & Frishman, 2007). Together, these benefits help decrease both mental and physical symptoms of stress (Abrami, 2009) such as insomnia; weight gain; feelings of emptiness, misery, or resentment; and seclusion (APA, 2011).

In an interview with Abrami (2009), Sultanoff explained how humor and laughter are related by stating humor includes, "wit, mirth, and laughter" (p. 9) where laughter is the physiological component and, hence, an important part of humor. Humor, and the subsequent laughter, is often used to relieve stress (Abrami, 2009). The act of laughing creates a mental free space by allowing the person to release interpersonal, intrapersonal, and psychological worries otherwise overwhelming their cognitive abilities (Abrami, 2009). When a person’s mental state is relaxed, more complex cognitions (e.g., problem solving) become possible (Dziegielewski, Jacinto, Laudadio, & Legg-Rodriguez, 2004). Research indicates the presence of laughter increases health and aids in managing stress. Sing-a-longs (Houston et al., 1998), humorous human interaction (Ko & Youn, 2011), and joke telling (Trice & Price-Greathouse, 1986) are used to induce laughter. Dziegielewski et al. (2004) stated that further research on humor and laughter would be beneficial to clinicians and society.

Experts in the field of laughter therapy, Smith and Segal (2012), stated that the optimal way to incorporate laughter in everyday life is to develop the ability to laugh in situations when one usually would not (Smith & Segal, 2012). Laughing together, with others and for no particular reason, helps people view the world from a child’s perspective where issues are temporary and easily overcome (Smith & Segal, 2012). Certified laughter therapist, Junkins (1999), stated that laugh therapy’s most important goal is to teach people how to laugh without restraint. Laughing helps us discharge suppressed tension and can open windows to other emotions (e.g., frustration and sadness) (Junkins, n.d.).

Humor producing laughter is also believed to be a positive component in therapeutic relationships due to the multiplied advantage produced when laughter is shared with another person (Abrami, 2009). Ko and Youn (2011) conducted a study that aligns with the view of positive affect derived from interactive laughter therapy. Adults over the age of 65 participated in four, one-hour group laughter therapy sessions for the duration of one month. The laughter therapy consisted of self- and interaction-induced laughter where participants clapped their hands while laughing, engaged in laughter meditation, and sang and danced while laughing. Staff at the convalescent home where the study took place assessed outcomes by observing behavior. The findings showed that laughter therapy can reduce symptoms of depression and insomnia and increase self-esteem. The study by Ko and Youn (2011) expanded on previous research by Houston, McKee, Carroll, and Marsh, (1998) who investigated laughter’s effect on negative emotions such as anxiety and depression in the elderly population. Houston et al. (1998) concluded that participating in a sing-a-long could increase well-being in this population. Ko and Youn (2011) speculated whether the benefits of laughter could be an effect of the human interaction required in many laughter settings and also argued that laughter in therapeutic settings is practical because the procedure is affordable and convenient.

Through laughter therapy interventions (e.g., sing-a-longs, laughter meditation, etc.), several studies (Houston et al., 1998; Ko & Youn, 2011) indicated increases in laughter were correlated with decreases in depressive symptoms, decreases in sleep difficulties, and corresponding increases in sleep quality. Utilizing humor as a method for stress relief does not eliminate the stressful situation, but the laughter can alter perception and coping strategies through an increased awareness and acceptance of responsibility (Jacobs, 2009).

Laughter evoked by comic elements is the most prominent intervention examined in previous research, however, Kuiper and Martin (1998) argued that the source of laughter is unimportant when considering laughter’s effect on stress. Given the results of pre-existing research and Kuiper and Martin’s argument, the purpose of the current study was to examine the impact of self-induced laughter on psychological stress to determine whether or not self-
induced laughter had a similar impact on stress as comically-induced laughter and to investigate whether or not self-induced laughter could act as a buffer and minimize stress when this laughter occurred immediately previous to the stressful event. In the current study, the presence or absence of self-induced laughter, prior to a stressful activity, was assessed with regard to self-reported stress with the hypothesis that the presence of self-induced laughter would reduce the amount of self-reported psychological stress.

**Method**

The current study assessed the impact of the presence or absence of laughter on individual stress levels. After providing informed consent, participants completed either a self-induced laughter session or a neutral (i.e., non-emotion evoking) reading session. After this session, participants completed a stress inducing activity followed by a questionnaire designed to facilitate independent assessment of psychological stress.

**Participants**

A convenience sample of 60 undergraduate students (33 males and 27 females) completed the current study. Participants received course credit for their participation. Using an independent groups design, participants were assigned to one of two groups: the laughter group or the reading group. Participants in each group were paired with a randomly assigned person from the same group.

**Procedure**

Randomly assigned pairs in the laughter group were instructed to sit, facing each other with their knees touching, looking into each other's eyes, while laughing, for the timed duration of 5 minutes. As a part of the instructional phase, the concept of self-induced laughter was defined for participants as simply laughing aloud for no particular reason.

Randomly assigned pairs in the reading group were instructed to take turns reading a factual text, *The Birth of the Earth* by Hugh Thomas (Thomas, 1996), aloud for a duration of 5 min. The text was deliberately selected due to the lack of emotional and physical arousal it would, likely, produce in participants. Reading group participants completed the activity in pairs to control for effects produced by interaction.

After the 5 minute laughter or reading session, participants were unpaired and each participant took part in a 15 minute individually executed, stress inducing activity. The stress audio recording played while participants were asked to simultaneously sort one deck of cards by suit, one deck of cards by number, match 74 countries with their corresponding capitals, and record instructions provided via the stress audio recording in the stress packet (see Appendix A). Participants were informed the activity must be completed within a time constraint but were not informed how much time they were given. Participants were also informed they were competing against one another for the highest score. The 15 minute time limit was imposed to assure unattainable completion of activity components.

To evaluate participant stress levels after completion of the stress inducing activity, all participants completed the Emotional Stress Reaction Questionnaire (ESRQ; Larsson, 2010; see Appendix B). Larsson's (2010) ESRQ was designed to estimate stress in less than 60 seconds and does so by posing 14 questions, each requesting a rating on a 4-point Likert-scale. After ESRQ completion, participants took part in a 10 minute relaxation session including deep breathing meditation. The relaxation session was based on mindfulness-based stress reduction (Praissman, 2008) and was included to ensure participant well-being after completion of the study. During the first minute of relaxing music (Okanokumo, 2013), participants were instructed to focus on their breathing. The remaining time was dedicated to focusing their breathing on specific body parts for 1 minute each (in this order: feet, legs, back, shoulders, arms, hands, brain, and heart).

**Materials**

The stress audio recording, created for the purpose of this study, was played for the duration of the stress inducing activity. The recording included multiple, overlapping, background sounds (e.g., air horns, marching soldiers, alarms, etc.) retrieved from YouTube.com (see Appendix C for detailed summary). The background sounds were constantly interrupted with vocally recorded and task relevant instructions requiring participants to write specific information into their test packet. The stress audio recording was projected through JBL Creature 2.1 speakers and was set to play, once, from beginning to end via Windows Movie Maker on a Dell Studio 15 personal computer.
To take part in the study, each participant was provided

One Test Packet consisting of

- One section of neighbor information: 12 segments of a fictional story concerning neighborhood life
- One section of numbers: 5 sets of 5 single digit numbers
- One section of phone book inventory: 10 names to locate using their phone numbers in a phone book
- One world knowledge packet: 74 world countries and their respective capitals to pair

One standard Yellow Pages phone book (AT & T, 2013)

Two decks of Bee® Club Special brand playing cards. Each deck consisted of 52 cards, jokers removed, in the colors black and red.

Results and Discussion

It was predicted participants who laughed for 5 minutes prior to a stress inducing activity would report lower levels of immediate stress than participants who did not laugh before the activity. As the stress inducing activity was an induction activity (i.e., not an outcome measure), the corresponding stress packet was not scored. The ESRQs, the outcome measure, were sorted by laughter or reading group and scored. The 14 ESRQ items were categorized into four groups (Larsson & Larsson-Wilde, 2012): irrelevant (indifferent), benign-positive (relaxed, pleased, glad), challenge (alert, focused, concentrated, energetic) and threat, harm, or loss (uncertain, concerned, disappointed, heated, mad, angry). The raw scores from the positive emotion categories (benign-positive and challenge) and the negative emotion categories (threat, harm, or loss and irrelevant) were added to each other, respectively. Then, the sum of the negative emotion categories was subtracted from the sum of the positive emotion categories to compute the ESRQ appraisal index. The ESRQ appraisal index ranged from -21 to +21 where a score of -21 indicated, "maximum dominance of negative emotions" and a score of +21 indicated, "maximum dominance of positive emotions" (p. 32).

Average participant stress levels in each group were compared through general linear modeling. No significant difference in immediate psychological stress was found between self-induced laughter or neutral reading conditions ($p = .980$). Figure 1 (see Appendix D) displays the pattern of results between conditions where the self-induced laughter group showed an average of a 3.65 ESRQ appraisal index and the neutral reading group showed an average 3.50 ESRQ appraisal index.

Although it was reasonable to predict the methods employed in the current study would produce lower stress levels in the laughter condition, based on the observed data, we failed to reject the null hypothesis. These findings indicate self-induced laughter immediately prior to a stressful event is not effective as a buffer for psychological stress. The results from the current study do not align with previous research where several studies (Houston et al., 1998; Ko & Youn, 2011) indicated laughter had a positive influence on physiological and mental health.

A post hoc analysis was conducted to explore differences in reported stress levels between males and females, but no significant difference was found between genders ($p = .767$). Figure 2 (see Appendix E) shows the relative similarity of ESRQ means where the average for males was a 4.29 ESRQ appraisal index and the average for females was a 2.78 ESRQ appraisal index. These findings indicate no statistical difference between male and female response to self-induced laughter occurring before a stressful event.

The current study investigated self-induced laughter's effect on psychological stress as a preventative measure. Because no significant difference was found, perhaps self-induced laughter is not useful as a buffer against stress but might be effective after a stressful event. It is recommended future research employ self-induced laughter after a stress-inducing activity, rather than before, to further investigate whether self-induced laughter could be effective as an intervention.

Experimental realism as related to the duration of each experimental phase should also be considered. Everyday stress is maintained over a longer period of time (Toda & Nakanishi-Toda, 2011) compared to the 15 minute duration of the intensely stress inducing activity. Fifteen consecutive minutes of intense challenge may not be the norm, hence, the relatively short period of self-induced laughter might not have been sufficient to act as a buffer against psychological stress. Self-induced laughter might be less powerful than laughter induced by comic events and, therefore, should be employed for a longer duration to have an impact.
Although the current study showed no benefit of self-induced laughter as related to psychological stress, laughter therapists (e.g., Junkins) claim self-induced laughter aids in psychological care. It is possible laughter, as a therapy, requires a therapeutic setting where the client, or therapist, has chosen this method. A clinical setting, or a modified experimental setting created to produce a genuine situation with experimental realism, would be more suitable to test laughter's impact on stress. In the current study, experimental sessions were conducted in classrooms with multiple (6-20) participants present at a time, while laughter therapy is, generally, conducted in pairs. Modifying the experimental methodology to be more sensitive for use in therapeutic practice may produce different results.

Laughter remains important, and prior research supports its utility for physiological and mental health. Accordingly, the results of this study should not discourage use of this method for relieving stress. Therapists who support laughter therapy should also not be dissuaded as research may reveal the hypothesized impact of self-induced laughter on psychological stress. Further research is necessary to investigate the practical impact of self-induced laughter on psychological stress.

References


Okanokumo. (2013, January 30). 10 minute ambient music “deep relaxing” [Web log post]. Retrieved from http://www.youtube.com/watch?v=UdoqN4FTx-s&list=PLW7qWuSwNFyLq4BgR9c0ZiajOE5JuxSao&index=8


**Acknowledgement**

A special acknowledgement to Steve Ellsworth for statistical consultation concerning appropriate statistical measures.

**Appendix A**

**Test Packet**

**Instructions:** Please answer the questions with information presented in the Stress Audio Recording. Your score will be recorded and used to evaluate your ability to multitask.

**Neighborhood information**

- How many students are there in Mary's class?
  _______________________________________________________

- Where did Harold go for vacation?
  _______________________________________________________

- What was the date of Daniels’ deadline?
  _______________________________________________________

- How many cows were there at the farm?
  _______________________________________________________

- What pattern was banner above the window in the farmhouse?
  _______________________________________________________

- Where did Susan go camping?
  _______________________________________________________

- What is the color of the house across from Greg's?
  _______________________________________________________ 

- How many cats does Greg have?
  _______________________________________________________ 

- What color is Lisa's car?
  _______________________________________________________ 

- Where did Bob forget his daughter?
  _______________________________________________________ 

- Who, except for her husband, loves Susan?
  _______________________________________________________ 

- What color is the farmer's tractor?
  _______________________________________________________ 

**Numbers**

- _____    _____    _____    _____    _____
- _____    _____    _____    _____    _____
- _____    _____    _____    _____    _____
- _____    _____    _____    _____    _____
- _____    _____    _____    _____    _____
Phonebook Inventory

- Name: ________________________________
  Phone Number: __________________________
- Name: ________________________________
  Phone Number: __________________________
- Name: ________________________________
  Phone Number: __________________________
- Name: ________________________________
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- Name: ________________________________
  Phone Number: __________________________
- Name: ________________________________
  Phone Number: __________________________
- Name: ________________________________
  Phone Number: __________________________

World Knowledge Packet

*Instructions*: Pair the countries with the correct capital by writing the number of the country in the provided space in front of the capital.

1. Afghanistan ___ Nairobi
2. Algeria ___ Lisbon
3. Andorra ___ Washington D.C.
4. Argentina ___ Athens
5. Australia ___ Nassau
6. Austria ___ Canberra
7. The Bahamas ___ Brasilia
8. Barbados ___ Manila
9. Belarus ___ Kuwait City
10. Belgium ___ Luxembourg
11. Botswana — Baghdad
12. Brazil — London
13. Bulgaria — Gaborone
14. Canada — Vienna
15. Chile — Vatican City
16. China — Riyadh
17. Colombia — Brussels
18. Costa Rica — Budapest
19. Croatia — Kuala Lumpur
20. Czech Republic — Santiago
21. Denmark — Tunis
22. Dominican Republic — San Jose
23. Ecuador — Buenos Aires
24. Egypt — Cairo
25. Ethiopia — Bratislava
26. Germany — Tokyo
27. Ghana — Abuja
28. Greece — Panama City
29. Guatemala — Kingston
30. Guinea-Bissau — Minsk
31. Hungary — Reykjavik
32. Iceland — Quito
33. India — Pyongyang
34. Iran — Kampala
35. Iraq — Bogota
<table>
<thead>
<tr>
<th></th>
<th>Country</th>
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<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>Ireland</td>
<td></td>
<td>Kabul</td>
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<tr>
<td>37</td>
<td>Italy</td>
<td></td>
<td>Monaco</td>
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<tr>
<td>38</td>
<td>Jamaica</td>
<td></td>
<td>Ottawa</td>
</tr>
<tr>
<td>39</td>
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<td></td>
<td>Bridgetown</td>
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<td>Kenya</td>
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<td>Hanoi</td>
</tr>
<tr>
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<td>North Korea</td>
<td></td>
<td>Santo Domingo</td>
</tr>
<tr>
<td>42</td>
<td>South Korea</td>
<td></td>
<td>Moscow</td>
</tr>
<tr>
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<td></td>
<td>Andorra la Vella</td>
</tr>
<tr>
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<td>Madrid</td>
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<tr>
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<td></td>
<td>Algiers</td>
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<tr>
<td>46</td>
<td>Luxembourg</td>
<td></td>
<td>Tripoli</td>
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<td>Malaysia</td>
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<td>Bissau</td>
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<td>48</td>
<td>Malta</td>
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<td>Rabat</td>
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<td>49</td>
<td>Mexico</td>
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<td>Copenhagen</td>
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<td>Singapore</td>
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<td></td>
<td>Zagreb</td>
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<td>Bangkok</td>
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<td></td>
<td>Seoul</td>
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<td>57</td>
<td>Philippines</td>
<td></td>
<td>Windhoek</td>
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<tr>
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<td>Poland</td>
<td></td>
<td>Rome</td>
</tr>
<tr>
<td>59</td>
<td>Portugal</td>
<td></td>
<td>Accra</td>
</tr>
<tr>
<td>60</td>
<td>Russia</td>
<td></td>
<td>Tehran</td>
</tr>
</tbody>
</table>
61. Saudi Arabia  ___ Mexico City
62. Singapore  ___ Addis Ababa
63. Slovakia  ___ Beijing
64. Spain  ___ New Delhi
65. Sudan  ___ Lima
66. Taiwan  ___ Guatemala City
67. Thailand  ___ Sofia
68. Tunisia  ___ Taipei
69. Uganda  ___ Caracas
70. United Kingdom  ___ Dublin
71. United States of America  ___ Berlin
72. Vatican City  ___ Riga
73. Venezuela  ___ Khartoum
74. Vietnam  ___ Warsaw

Appendix B

Emotional Stress Reaction Questionnaire

Instructions: Below is a list of words describing different emotions. Beside each word are four response choices. Circle the choice which best describes how you feel right now.

Respond as follows:
- The word does not correspond to how I feel right now
- The word partly corresponds to how I feel right now
- The word fairly well corresponds to how I feel right now
- The word completely corresponds to how I feel right now

Respond with the ranking that first comes to your mind.

1. Indifferent  1 2 3 4  8. Energetic  1 2 3 4
2. Relaxed  1 2 3 4  9. Concerned  1 2 3 4
3. Pleased  1 2 3 4  10. Uncertain  1 2 3 4
4. Glad 1 2 3 4 11. Disappointed 1 2 3 4
5. Alert 1 2 3 4 12. Heated 1 2 3 4
6. Focused 1 2 3 4 13. Mad 1 2 3 4
7. Concentrated 1 2 3 4 14. Angry 1 2 3 4

Note: Adapted from Emotional Stress Reaction Questionnaire (Larsson, 2010)

**Appendix C**

Table 1.

*Stress Audio Recording Stimuli*

<table>
<thead>
<tr>
<th>Sound Title</th>
<th>Creator</th>
<th>Retrieved from</th>
</tr>
</thead>
<tbody>
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<td>Air horns</td>
<td>Jojikiba</td>
<td><a href="http://www.youtube.com/watch?v=XDvuAYySJJ0">http://www.youtube.com/watch?v=XDvuAYySJJ0</a></td>
</tr>
<tr>
<td>Thunder and lightning</td>
<td>Edvin25</td>
<td><a href="http://www.youtube.com/watch?v=6_39wbG1J_I">http://www.youtube.com/watch?v=6_39wbG1J_I</a></td>
</tr>
<tr>
<td>Marching soldiers</td>
<td>CMIUC100</td>
<td><a href="http://www.youtube.com/watch?v=U9xSFHo8Rv1">http://www.youtube.com/watch?v=U9xSFHo8Rv1</a></td>
</tr>
<tr>
<td>Ticking clock - slow</td>
<td>Jojikiba</td>
<td><a href="http://www.youtube.com/watch?v=cokwoi5GPQ">http://www.youtube.com/watch?v=cokwoi5GPQ</a></td>
</tr>
<tr>
<td>Ticking clock - fast</td>
<td>Jojikiba</td>
<td><a href="http://www.youtube.com/watch?v=i72Dgsuy3yc">http://www.youtube.com/watch?v=i72Dgsuy3yc</a></td>
</tr>
<tr>
<td>Beeping alarm clocks</td>
<td>Thesoundfxguru</td>
<td><a href="http://www.youtube.com/watch?v=NHg8jTH7Bqk">http://www.youtube.com/watch?v=NHg8jTH7Bqk</a></td>
</tr>
<tr>
<td>Explosions</td>
<td>EffectsLibrary</td>
<td><a href="http://www.youtube.com/watch?v=ANE5AeOIFm4">http://www.youtube.com/watch?v=ANE5AeOIFm4</a></td>
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<td>Ringing home phones</td>
<td>CMIUC100</td>
<td><a href="http://www.youtube.com/watch?v=ShpgEY1UJoK">http://www.youtube.com/watch?v=ShpgEY1UJoK</a></td>
</tr>
<tr>
<td>Nails on a chalkboard</td>
<td>LightItUp Studios</td>
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<tr>
<td>Emergency vehicle sirens</td>
<td>Joeyboy680</td>
<td><a href="http://www.youtube.com/watch?v=8hXQMJjjuNe0">http://www.youtube.com/watch?v=8hXQMJjjuNe0</a></td>
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*Note.* A 15 min compilation of these audio stimuli was created for use with the stress audio recording. Background sounds were interrupted by vocal recordings providing instructions to participants.

**Appendix D**
Appendix D

Figure 1. Comparison of average stress scores between the laughter and reading group.

Appendix E

Figure 2. Comparison of average stress scores between male and female participants.