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A comparison of the cardiovascular effects of simulated and spontaneous laughter

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ABSTRACT

Objectives: Laughter has long been regarded as beneficial for health, but the mechanisms are not clearly understood. The current study aimed to compare the acute cardiovascular effects of spontaneous and simulated laughter.

Design: A mixed factorial experiment was performed to examine changes in cardiovascular variables in response to experimental tasks across conditions.

Interventions: A sample of 72 participants were randomised to one of three 6 min interventions. Participants in the simulated laughter condition were asked to generate fake laughter, the spontaneous laughter condition viewed a humorous video, and the control condition watched a non-humorous documentary. This was followed by a laboratory stress task.

Main outcomes measures: Heart rate and heart rate variability (as indexed by rMSSD) were monitored continuously throughout the experiment using ECG.

Results: The simulated laughter condition had a significantly higher heart rate ($p < .001$, $\eta_p^2 = .26$) and lower rMSSD ($p < .001$, $\eta_p^2 = .13$) during the laughter task compared to the other two conditions. Follow-up hierarchical regressions indicated that the difference in heart rate was due to the fact that the simulated condition produced more laughter. The difference in rMSSD, however, was unique to the simulated condition even when controlling for the amount of laughter. The simulated laughter condition had a significantly lower mean HR during the stress task but this was not significant after controlling amount of laughter produced.

Conclusions: Laughter leads to increased heart rate and reduced heart rate variability, which is similar to the effects of exercise. This finding is more pronounced in simulated laughter.

1. Introduction

In popular culture, laughter is perceived as being beneficial for one's health, and some research supports this. Different forms of laughter have been found to improve mood,[1] reduce depression,[2] improve immune function,[3] decrease pain,[4] and reduce stress hormone concentrations.[5,6] However, other studies have shown that laughter may be detrimental to people with particular health conditions in the short-term, including asthmatics.[7] and those with chronic obstructive pulmonary disease[8]

Research has focussed on two main types of laughter; simulated and spontaneous laughter.[9] Spontaneous laughter, commonly referred to as 'real' laughter, is triggered by external humorous stimuli, and occurs in the presence of positive emotions. Spontaneous laughter is unique as it elicits involuntary contractions of the orbicularis oculi muscles in the eye socket, a phenomena known as the Duchenne Smile.[10] In contrast, simulated laughter is triggered by oneself at will and therefore is not elicited by humorous stimuli or positive emotions.[9] This form of laughter is commonly known as 'fake' or voluntary laughter and involves laughing on command. Simulated laughter can be performed by any individual using controlled vocal sounds (e.g. ha, he, ho) and is gaining popularity as a form of therapy.[11] For example, the Laughing Qigong Programme uses a combination of simulated laughter and qigong techniques as a standardised therapy which has been shown to improve mood and decrease stress markers.[12]

It has been theorised that laughter is beneficial because it is a form of aerobic exercise. Like exercise, laughter is stimulating: it increases heart rate and blood pressure, enhances immune functioning and exercises skeletal muscle.[13] Laughter activates internal oblique muscles to similar levels as crunches and back lifting exercises.[14] Laughter also consistently causes changes in respiration levels similar to exercise: lung volume decreases, respiration rate increases, and compression is

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applied to the airways.[15] The parallels drawn between laughter and exercise demonstrate a possibility that the health effects of laughter are merely due to exercise effects, rather than from anything unique to laughter. Therefore, the act of laughter itself is the critical component, even in the absence of humour.[9] This mechanism implies there is little need to distinguish between spontaneous and simulated laughter as both should produce the same physiological effects on the body.

A related theory is the Motion Creates Emotion Theory. Dr. Kataria, the founder of laughter yoga, argues that both simulated and spontaneous laughter can lead to the same physiological and psychological health benefits.[16] This theory states that while the human mind can tell the difference between simulated and spontaneous laughter, the human body cannot.[10] However, simulated and spontaneous laughter have never been compared within the same study.

An important indicator of how well the body responds to a stimulus, and in particular exercise, is heart rate (HR) and heart rate variability (HRV). HRV is the normal rhythmic variations in consecutive heart beats that index the cardiovascular system's ability to meet demands.[17] HRV represents both the sympathetic and parasympathetic effects on the heart. Stress or exercise triggers parasympathetic withdrawal and subsequently sympathetic activation. This leads to increased HR and decreased HRV as the underlying dynamic switches from inhibitory to excitatory dominance to allow the system to meet the challenge at hand.

The effects of laughter on the cardiovascular system have been investigated in only a few studies to date. Laughter produced by watching a humorous video increased sympathetic nervous system arousal as indexed by increased galvanic skin resistance, increased heart rate (HR) and decreased finger temperature.[18] Similarly, watching a humorous video produced a significant increase in HR and blood pressure, compared to watching a control video.[19] These studies demonstrate that laughter can produce changes in cardiovascular function.

To test the theory that both simulated and spontaneous laughter are forms of exercise that can stimulate the cardiovascular system similarly, this study aimed to compare the acute cardiovascular effects of simulated and spontaneous laughter. The study also compared the ability of these two types of laughter to buffer the cardiovascular stress response to a laboratory stress task. Lastly, the study investigated whether the effects observed were correlated with the amount of laughter produced. This final aim was included as past research on laughter has failed to actually correlate laughter with health outcomes.

It was hypothesised that simulated and spontaneous laughter would have similar cardiovascular effects (increased HR and decreased HRV) during the laughter task, and these cardiovascular responses would be significantly larger than the control condition. It was expected that the simulated and spontaneous laughter conditions would exhibit similar cardiovascular responses to the stress task but smaller cardiovascular responses (decreased HR and increased HRV) compared to the control condition. It was further hypothesised that the amount of laughter produced during the laughter task would predict the cardiovascular outcomes above and beyond the effect of condition and adding condition as a predictor would not significantly increase the amount of variance explained.

2. Method

2.1. Design

A 7 (task) × 3 (condition) mixed factorial experiment was performed to examine the acute changes in cardiovascular variables overtime in response to experimental tasks across conditions (spontaneous laughter vs. simulated laughter vs. control).

2.2. Sample

A sample of 72 adults (48 female, 24 male; average age 24.15 years, SE = 1.00) was recruited from advertisements to the general public and University students. Inclusion criteria were those aged 18–64 who could give informed consent. The exclusion criteria included: people with cardiovascular conditions, those taking regular medication which may affect the cardiovascular system, women who were pregnant, those with asthma and those with clinical depression or anxiety. Participants were randomised to one of the three conditions prior to the experimental setting on a 1:1:1 basis. The experimenter was not blinded to condition allocation.

Ethics Approval was granted by the University of Auckland Human Participants' Ethics Committee, and participant written informed consent was obtained.

2.3. Cardiovascular measures

The primary outcome was cardiovascular functioning as measured by heart rate (HR, bpm) and heart rate variability (HRV). HR and HRV were continually measured throughout the experiment using a standard 3-lead ECG attached to the participants chest. Data was collected using Mindware Bio lab 3.02 software with a 1000 Hz sampling rate and was analysed using Kubios HRV version 2.2 software. Root Mean Square of the Successive Differences (rMSSD) was used as an index of vagally-mediated HRV, which was calculated by analysing the intervals between the R-Spikes during each time period. rMSSD reflects the parasympathetic activity on the heart, as opposed to an overall measure of HRV.

2.4. Laughter intensity and frequency scale (LIFS)

The amount of laughter produced by each participant was observationally coded to check whether the changes in the cardiovascular variables were correlated with the actual occurrence of laughter as this has been a limitation in past laughter research. A systematic coding schedule was designed, the Laughter Intensity and Frequency Scale (LIFS), adapted from Bennett's[20] Humour Response Scale, with more clearly operationalised definitions of laughter[21] Each participant was rated by the lead researcher on two separate scales for intensity (0 = no laughter to 3 = nearly continuous laughter) and frequency (0 = no laughter to 3 = belly laughter) at the end of each one minute period. Scores for each minute were totalled for each scale to get an overall intensity and frequency scale out of 18. These scores for each scale were then combined to give an overall score for the six minutes ranging from 0 to 36. The full scale is provided in the Appendix A.

2.5. Procedure

All participants were asked to avoid exercise, alcohol, tobacco and caffeine the 24 h before the experiment and to refrain from eating and drinking two hours prior. Participants were seated in front of a computer which prompted the experimental tasks. The procedure is shown in Fig. 1. During the resting periods, participants were asked to sit as still as possible and not to move, talk or close their eyes, in order to measure resting cardiovascular activity.

During the intervention period, participants were asked to perform a task, specific to their allocated condition which lasted six minutes. The participant's responses to the task were video-recorded for later analysis. Those in the simulated laughter condition were instructed to generate as much simulated laughter as they could for six minutes. Participants in the spontaneous laughter condition viewed a six minute stand-up comedy routine on video. Lastly, participants in the control condition viewed a six minute documentary on Paua farming which was deemed by the researcher to be interesting, yet emotionally neutral.

After their assigned intervention, participants were exposed to a shortened version of the Trier Social Stress Test (TSST).[22] Participants were given three minutes to prepare and three minutes to present a speech to convince the experimenter to give them their dream job.