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The effect of laughter yoga on working memory: A pilot study

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Abstract

A growing body of evidence suggests that there is a link between laughter and memory. However, no research has been done to show a link between simulated laughter (laughter yoga) and the enhancement of working memory. Because laughter has numerous benefits, we examined whether simulated laughter can improve healthy adults' working memory (WM). A total of 30 participants (15 experimental and 15 control) were enrolled in this study. The research design was experimental and pretest-posttest with a control group. Participants in the laughter yoga intervention group had eight sessions twice a week for four weeks, whereas the control group received no intervention. We assessed all participants before and after laughter activity with the WM measures (Corsi Block Test and Digit Span). The laughter intervention programme focused on simulated laughter (laughter yoga) without relying on humour, jokes, or comedy. The results revealed a significant improvement in the memory of both visual and verbal WM performances in the experimental group after the intervention programme. In contrast, the study found no significant differences in the control group. Simulated laughter intervention is the easiest, practical, and cost-efficient method that seems to affect WM positively.

Keywords: *laughter, working memory, visual-spatial working memory, simulated laughter.*

1. Introduction

Laughter is a spontaneous psycho-physiological response to humour or any other favourable external or internal stimuli (Mora-Ripoll, 2013) that has remarkable physiological and psychological benefits (Yim, 2016; Yoshikawa et al., 2019). Simulated laughter is not the same as spontaneous laughter, which was used in this study. Spontaneous laughter is triggered by various (external) stimuli and positive emotion that is unrelated to one's own free will. Simulated laughter, on the other hand, is elicited at will (self-induced) for no specific reason (purposeful, unconditional), and thus unaffected by humour, fun, or other stimuli or positive emotions (Mora-Ripoll, 2011, 2013). Laughter yoga is a well-known form of simulated laughter that was used in this study to enhance working memory performance (Bressington et al., 2018).

Working memory (WM) is the ability to maintain and manipulate information (Baddeley & Hitch, 1974; Alloway & Copello, 2013) which is essential for language comprehension, reasoning, facilitates planning, solving problems, and learning. For academic success, working memory becomes a more powerful predictor than IQ (Alloway & Alloway, 2010). Thus, the improvement of working memory is essential. Alone with physiological and psychological enhancement, laughter may improve cognitive function, specifically memory (Mora-Ripoll, 2011). Thus, in this study, we assumed that laughter would improve working memory.

Several studies have explored the enhancing effect of humour on cognitive performance, in particular on memory. For example, Schmidt (1994) performed a series of experiments using various humorous sentences in incidental and intentional learning and tested memory with free and cued recall. The researcher found that humorous content has a memory benefit: humorous sentences enhance sentence memory. In another study, Carlson (2011) investigated the impact of humour on memory using humorous and inspirational materials (photographs, keywords, phrases). The researcher found participants recall humorous photographs, keywords, and phrases more than the inspirational group. Similarly, Badli and Dzulkifli (2013) investigated the impact of humour on memory recall by showing participants funny video clips with words. They found that humour improved memory recalls in both neutral and dysphoric moods. The above findings indicated that humorous materials such as a word, phrase, sentence, photograph, and video improve memory performance.

A large body of work showed that positive mood affects cognitive processes such as memory. For example, Esmaeili et al. (2011) investigated the impact of a positive emotional state (through a positive film) on undergraduate students' working memory. They used a self-report Working Memory Scale with two subscales: number-letter sequence and spatial span. They found that *positive emotion* dramatically improved working memory performance compared to the participants who watched a neutral movie. So, positively aroused films improve working memory. Later, Storbeck and Maswood (2015) identified how mood affects working memory using 5 minutes video clips (comedy, sad, neutral) and operation span tasks. They found that positive affect *(comedy)* increased verbal and spatial working memory capacity, whereas negative affect did not influence performance. Hence, the comedy clip induced positive emotion that improved verbal and spatial working memory. Furthermore, Palmiero et al. (2015) found that situational contexts that cause a particular mood (e.g., through using music) can influence visuospatial memory and navigational working memory in college students using the Corsi Block-Tapping Test and the Walking Corsi Test. In another similar study in 2016, Palmiero et al. found that only the positive emotion caused by music affected both visuospatial and navigational working memory. Then, music that elicited positive emotions was used to improve visuospatial and navigational working memory. Costanzi et al. (2019) investigated the impact of incidentally acquired emotional stimuli on visuospatial working memory on undergraduate students. They measured spatial working memory using object relocation tasks, and they used emotional pictures to induce emotion. They found that *emotions* enhance spatial memory performance when neutral and emotional stimuli compete for entry into the working memory system. So, emotional pictures enhance visuospatial working memory. All these findings revealed that positive mood produced by video clips (emotional, comedy), music, or picture enhances working memory (verbal, visuospatial, and navigational) performance.

A number of studies have examined whether laughter produces positive emotions. For example, Keltner and Bonanno (1997) found that people with a high frequency of Duchenne laughter (that involves the contraction of the muscles surrounding the eyes) had a higher level of enjoyment than those with a low frequency of Duchenne laughter. So, laughter that involved the contraction of muscles around the eyes produced enjoyment. Similarly, Bachorowski and Owren (2001) investigated the influence of laughter (presence and absence of voicing) in emotion. They found that only voiced laughs (laughs that engage the vocal chords and have a sing-song-like sound quality) determined the pleasantness and the degree of positive emotion instilled in others. So, laughter that involves vocal chords with a sound produced pleasantness. Likewise, Foley et al. (2002) used forced laughter on 17 college students in an experiment and found that 1 minute of forced laughter significantly increased their positive emotion, even though the participants were in a good mood before the experiment. Hence, 1 minute of forced laughter was able to produce positive emotion. Finally, Armony et al. (2007) investigated the influence of emotional expression on memory for vocalisation. They used emotional stimuli, such as 12 vocalisations of happiness (laughter) and enjoyment, as well as a memory recognition task. Armony et al. (2007) found that positive emotion enhances voice memory recognition performance. Then, laughter produced happiness, and this positive emotion increased voice memory. The above clearly indicated that laughter (Duchenne laughter, voiced laughter, and forced laughter) induces positive emotion (enjoyment, pleasantness) and this positive emotion influences memory. So, laughter influences memory.

Recently, a few researchers reported that laughter had an effect on the cardiovascular function. Law et al. (2018) tested the cardiovascular effects of spontaneous and simulated laughter. In different conditions, they showed a fake laughter/humour video/documentary to 72 participants. They discovered that laughing causes an increase in heart rate and a decrease in heart rate variability, similar to exercise's effects. This finding was more pronounced when simulated laughter was used. So, simulated laughter impacted cardiovascular activity in a way similar to exercise. Besides, Hötting et al. (2016) investigated the effects of a single bout of cardiovascular exercise on memory consolidation in young adults. They used vocabulary to test memory, where they discovered that participants in the high-intensity cardiovascular exercise group forgot less vocabulary than those in the relaxing group. Thus, simulated laughter impacts cardiovascular activity, and cardiovascular activity enhances memory.

So far, we have shown some of the contributions which are related to our current topic. There have been a number of studies that have investigated the effectiveness of laughter on cognitive functions. For example, Cueva et al. (2006) investigated how and in what respects laughter impacts learning from the learners' viewpoint. They demonstrated the importance and usefulness of laughter in assisting people in their learning process, as 94% of respondents thought that laughter was essential to support adult learning. So, the majority of learners believed that laughter aided adult learning. In support of this claim, in behavioural research, Bains et al. (2014) studied mirthful laughter and learning in three age-matched elderly groups (elderly, diabetic, and control). They used the Rey Auditory Verbal Learning Test to measure: (1) learning, (2) recall, and (3) visual recognition ability. They found that the elderly and diabetic elderly groups who produced mirthful laughter (by watching a humorous video), compared to the control group, showed more significant improvement in learning, recall, and visual recognition abilities in short-term memory function. So, mirthful laughter has an enhancing effect on short-term memory recall and visual recognition. In another study, Berk et al. (2016) unveiled how mirthful laughter enhances cognitive functions by investigating gamma-wave activity in the brain using EEG. They also used a video clip (10 minutes) to produce laughter during the EEG recording. The Gamma Band Activity of Cerebral Cortex regions (synchrony) of their findings revealed that mirthful laughter enhanced cognitive processing, memory, and recall. Thus, mirthful laughter activated the same region responsible for enhancing cognitive processing (memory and recall). Recently, Morishima et al. (2019) showed that laughter had a short-term impact on cancer patients' cognitive functioning, as measured through a self-report Quality of Health Questionnaire Core 30 version. They found that a 3-7-week laughter yoga intervention significantly improves cognitive functioning in cancer patients relative to baseline during the initial phase compared to the control group. So, simulated laughter (laughter yoga) enhances cognitive functions. These findings are backed with the learner's belief that laughter (mirthful, simulated) had a strong physiological basis for enhancing cognitive performance (learning, short-term memory, and visual recognition).

All these data led to the realisation that humorous materials (such as words, phrases, sentences, photographs, or videos) improve memory performance. Next, it follows that laughter (Duchenne/voiced/forced) improves positive emotion (enjoyment/pleasantness), whereas positive emotion (induced by video clips, music, or pictures) improves working memory (verbal/visuospatial/navigational) performance. Finally, laughter, either mirthful or simulated, directly enhances cognitive performance, such as learning, short-term memory, and visual recognition. However, no research has so far indicated that simulated laughter (laughter yoga) improves working memory. Therefore, the current study aims to examine the effect of laughter yoga on the WM of healthy adult participants. The outcomes of this research, as a pilot study, have a potential to inform larger investigations by establishing a foundation for understanding how simulated laughter affects working memory. Based on earlier research, we formed the following hypotheses:

H_1: Simulated laughter would result in significantly greater improvement in visual WM test compared to the control group.
H_2: Simulated laughter would result in a more significant improvement in verbal WM test compared to the control group.

2. Methods

2.1 Participants

A total of 30 (m = 10, f = 20) participants were included in this study. We recruited 5 males for the experimental group and 5 males for the control group from 10 males. Similarly, from 20 females, 10 were assigned to the experimental group and 10 to the control group. Their average age was 20.57 (SD = 1.25), and they had normal vision with no uncontrolled medical conditions, such as hypertension, chronic coughs, acute low back pain, and consumption of any antipsychotic drugs. They also had no history of any surgery in the past three months. Participants were randomly assigned either to the experimental group (n = 15) or the control (non-intervention) group (n = 15).

2.2 Materials

The computerised version of the Corsi Block Test and Digit Span test were used in this investigation. Mueller and Piper (2014) developed these instruments, which began with a demonstration trial to familiarise participants with the procedure. The demonstration trial was identical to the test trials.

2.2.1 Corsi Block Test

The Corsi Block Test (CBT) measures visual-spatial working memory. It assesses the ability to recall a series of screen locations. Participants saw nine blue squares on the screen during each CBT trial. The squares were lit up one by one in order. The participants were asked to recall the series. When it was finished, the participants' task was to click on each square in the given order. The sequence began with two squares and increased by one after another as participants correctly completed the minimum one of the two sequences.

2.2.2 Digit Span

Digit Span is a test of verbal working memory. It also assesses numerical processing ability and short-term memory. On each trial, participants were shown a series of digits one by one on the screen and asked to type the list of digits exactly in the order in which they saw them. It began with a list of three items, and each length was made up of three different lists. When participants correctly recalled two out of three lists, they were given access to the extended list length. For this test, the correlation between the test and the retest was moderate (r=.63) (Piper et al., 2015).

2.2.3 Simulated laughter

The experimental group was subjected to 30 minutes of simulated laughter. The study was carried out in a group setting, and we followed the standard structure of a laughter yoga session, which includes the repetition of three key components: clap, breathe, and laugh. After a brief explanation of the laughter activity, the participants practised simulated laughter (beaming all over their faces) for the first 10 minutes: laughing with eye contact, clapping hands parallel to each other so that their palms and fingers were thoroughly clapped, and chanting "ho, ho, ha-ha-ha". The 'breathe' phase followed, in which participants focused on relaxing and regulating their breathing. During the 15-minute 'laugh' phase, the researcher guided participants through the activities designed to simulate laughter. We used the following exercises to make people laugh: greeting laughter (salam and handshake laughter);

lion laughter; telephone laughter; airport and flight laughter; hot soup laughter; bill laughter; and no money laughter. Although the duration of the laughter exercises and the time spent in each phase vary from session to session, the 'laugh, clap, breath' structure remains consistent across all sessions. The final 5 minutes were spent on body relaxation and deep breathing.

2.3. Procedure

This study primarily enlisted the participation of 50 undergraduate students. However, only 30 people met the inclusion criteria and were therefore included in this study. Healthy vision, no uncontrolled medical conditions (e.g., hypertension, chronic coughs, acute low back pain, and antipsychotic drug use), and no history of surgery in the previous three months were all inclusion criteria. The participants were then randomly assigned to one of two groups: experimental or control (non-intervention). After completing consent forms and a demographic information form, participants were asked to attend one of their weekly sessions. The study's purpose was explained to them, and their anonymity was ensured. The measurements were taken the day before the first laughter session and the day after the last session. The participants went through a quick practice session prior to the measurements. The experimental group received simulated laughter (laughter yoga) training twice a week for four weeks, whereas the control group remained passive, that is, they received no intervention. Each session lasted 30 minutes and was delivered in a total of eight sessions.

3. Results

To examine the potential effects of the simulated laughter programme, we used Paired Samples *t*-test. Participants who participated in the simulated laughter activity obtained higher scores on the CBT from pre to post than controls. The experimental group's t-test results show a significant improvement in visual WM for the post-test (M = 5.43, SD = 0.59) over pre-test (M = 4.83, SD = 0.56) measure t (14) = -4.05, $p < .01$. The size of the effect was determined to be significant. The control group, on the other hand, showed no significant difference for the post-test (M=5.40, SD=.73) over pre-test (M=4.93, SD=.90;) measure t (14) = -1.74, $p > .05$.

Similarly, individuals in the simulated laughter activity had higher scores in the digit span test from pre to post than controls. The results also showed a substantial improvement in verbal WM for the post-test (M= 7.60, SD= 1.59) compared to the pre-test (M= 6.33, SD= 1.54), t(14)= -3.02, $p < .01$. The size of the effect was determined to be significant. The control group, on the other hand, demonstrated no significant difference in verbal WM for the post-test (M = 6.93, SD = 1.53) over pre-test (M = 6.87, SD = 1.77) measures t(14) = -0.16, $p > .05$.

Table 1. Pre-test and post-test measures of Corsi Block Test (CBT) and Digit Span test score for the experimental and control groups.

Variable	Group	Pre-intervention	Post-intervention	*t*	Effect

		M (SD)	M (SD)		size (d)
CBT	Experimental	4.83 (0.56)	5.43 (0.59)	-4.05*	-1.04
	Control	4.93 (0.90)	5.40(0.73)	-1.74	
Digit Span	Experimental	6.33 (1.54)	7.60 (1.59)	-3.02*	-.81
	Control	6.87 (1.77)	6.93(1.53)	-.16	

*p < .01

4. Discussion

The purpose of this study was to examine the effectiveness of simulated laughter intervention on both visual and verbal WM in healthy adults. The broader goal was to advance our understanding of the potential benefits of laughter practise among adults. We expected that simulated laughter would significantly improve visual WM and verbal WM compared to the control group. To our knowledge, this is the first study that identifies the incremental effect of simulated laughter on working memory.

In our first hypothesis, we expected that simulated laughter would significantly improve visual WM. Our results revealed a significant increase in visual WM for participants in the laughter group, whereas those in the control group did not reveal significant changes. These findings supported our first hypothesis and suggested that simulated laughter effectively improves visual working memory. This outcome is consistent with the findings of Bains et al. (2014) who showed that mirthful laughter increases visual recognition but did not show an effect on visual working memory. The possible explanation of our findings is compatible with the results of Foley et al. (2002) and Palmiero et al. (2015) that simulated laughter increases positive emotion. Positive emotion plays a role in enhancing visuospatial working memory.

In our second hypothesis, we anticipated that simulated laughter would improve verbal WM significantly. When compared to the control group, participants in the laughter group showed a significant increase in verbal WM. As a result, our second hypothesis was also supported by our findings, indicating that simulated laughter can successfully increase verbal WM. Our finding is in line with the findings of Berk et al. (2016) who showed that mirthful laughter increases memory. The reason behind this increment of verbal memory may be emotion. We know that voice laughter or simulated laughter produces positive emotion (Foley et al., 2002), and this positive emotion (Armony et al., 2007) may lead to increased verbal working memory in our study.

Both findings of this study were consistent with Morishima et al. (2019) who found that simulated laughter (i.e., laughter yoga) enhances cognitive performance. WM is one of the components of cognitive processing according to the information processing model. Moreover, our findings also are explained by the information processing theory, according to which, when we selectively attend to certain information, it is kept in our working memory and processed for later use. This process may be the cause of the increase in working memory. Another possible explanation for our findings is that simulated laughter (laughter yoga) increases cardiovascular activity, causing a rise in heart rate and a decrease in heart rate variability (Law et al., 2018), and this cardiovascular activity improves memory (Hötting et al., 2016). In this way, laughter yoga may help to improve working memory.

5. Conclusion

We may train our bodies and minds to laugh at will. In this preliminary study, eight weeks of simulated laughter (laughter yoga) successfully boosted participants' visual and verbal working memory. According to these findings, young individuals can benefit from merely laughing in their daily lives. More precisely, laughter yoga may aid tertiary-level students who are performing poorly due to poor working memory. Furthermore, laughter yoga could be a novel and simple method for working memory training. It makes no difference if our laughter is artificial or genuine; laughing helps us improve our visual and verbal working memory.

5.1. Limitations and future directions

There were a few limitations in this preliminary study. First of all, the small number of participants at the outset is one of our limitations. In the future, a larger number of participants may be included to replicate and strengthen the findings. Secondly, one of the drawbacks was that we used a passive control group rather than an active control group in this experiment. Next, the fact that we did not include a follow-up condition was another limitation. In the future, a follow-up study could be considered to investigate how long the positive effect of simulated laughter on WM lasts. Finally, the participants were all young adults in their twenties. In the future, one could investigate the laughter yoga effect on WM considering different age groups (i.e., children and senior citizens).

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