

Psychophysiological Responses to Laughter Yoga in Women: Two Studies on the Visual and Practice Effects of this New Physical Activity

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ABSTRACT

Laughter yoga is claimed to have similar psychological and physiological effects to exercising. The objectives of the two studies reported here were to examine the visual and practice effects of laughter yoga in women. Study 1 was performed with 13 young women (mean age = 21.92 ± SD = 1.66 years) who only experienced laughter yoga visually. Study 2 investigated 25 older women (mean age = 63.83 ± SD = 11.91 years) during an *in-situ* laughter yoga class. There was no relationship between the humor styles, expectancy, and the magnitude of change in psychological measures, neither in visual nor in the practice experience of laughter yoga. In Study 1, negative affect decreased while feeling states, heart rate, and respiration rate increased because of watching laughter yoga. In Study 2, feeling states, felt arousal, positive affect, and negative affect improved after the class. Even more intriguingly, heart rate also increased, and the basic metabolic rate during the class was comparable to that of light to moderate physical activity. As laughter yoga is characterized by positive psychological and cardiometabolic changes, it could represent a pleasurable, healthy, and secure form of recreation for all, but based on the current results, especially for older women.

Keywords: affect, exercise, humor, recreation, social.

INTRODUCTION

In 1976, Norman Cousins published his recovery in the prestigious *New England Journal of Medicine* exposing the potentially life-saving therapeutic effect of laughter on his ostensibly incurable illness (Cousins, 1976). About twenty years later, Madan Kataria, a medical doctor from Mumbai in India, developed breathing and gentle movement exercises performed in parallel with simulated (self-induced) laughter that later became known as ‘laughter yoga’ (Kataria, 2005). During its practice, participants laugh without any laughter triggers, such as jokes or comedy. Consequently, laughter yoga can be described as simulated laughter (Mora-Ripoll, 2011). It is performed in a group

setting in which people execute funny gestures that presumably add a laughing matter to the activity and, therefore, could fuel the self-initiated simulated laughter. Accordingly, both simulated and spontaneous laughter could be expected to be components of laughter yoga practice. It was postulated that the two have a similar effect on the organism (Kataria, 2005).

It has been known for a while that laughter is contagious. Empirical results confirm that laughter elicits laughter (Provine, 1992). In the context of laughter yoga, this cause-and-effect association reflects the transition from non-Duchenne context-driven and emotion-poor laughter to Duchenne

laughter, which is a form of automatic unforced laughter triggered by a stimulus and is emotion-laden (Gray et al., 2015). The Duchenne laughter lowers stress and increases positive emotions, such as positive affect (Keltner & Bonanno, 1997). Therefore, it appears that simulated laughter alone, with which laughter yoga practice is most often associated, is insufficient for generating positive psychological states. However, to the best of these authors' knowledge, to date, no research reports demonstrate that the mere visual experience of laughter yoga could be the source (or the object) of positive affectivity. Consequently, in Study 1 we examined this research question.

Numerous mental benefits of laughter yoga are reported in the literature (Nasr, 2013). A pilot investigation with two women and four men awaiting a heart and lung organ transplant provided tentative (because of the low sample size) evidence for laughter yoga's efficacy in improving mood measures and lowering chronic anxiety (Dolgoff-Kaspar et al., 2012). Further, laughter yoga might alleviate stress in cancer patients before chemotherapy (Farifteh et al., 2014). A study of healthy male nursing students showed that laughter yoga decreased anxiety and depression and improved health indices and social functioning (Yazdani et al., 2014). Two weekly laughter yoga sessions performed over four weeks (eight sessions) improved depressive symptoms compared with a control group in depressive patients. Still, the effects were no longer statistically significant three months after the intervention (Bressington et al., 2019). Summing the results of individual studies, a systematic literature review concluded that laughter yoga could improve mental health compared with other group-based interventions, however, more evidence is needed to establish its therapeutic effects (Bressington et al., 2018). A more recent review concluded that laughter yoga positively affects physical function and psychosocial outcomes in older adults (Alici & Donmez, 2020).

Indeed, the benefits of laughter yoga in aging individuals are frequently reported. For example, a study of 70 depressed older women showed that ten sessions of laughter yoga were at least as effective as a 10-session physical exercise program in lowering depression and raising life satisfaction (Shahidi et al., 2010). However, the reliability of the conclusions drawn from this research was later questioned, based on practical and theoretical issues (Proyer et al., 2011). Several years later, another study with elderly people living in residential aged

care homes revealed that laughter yoga induced positive changes in affect and happiness after a 30-minute session while also decreasing systolic blood pressure. These findings were replicated after several laughter yoga sessions (Ellis et al., 2017). Investigating older adults (mean age: 58.86 years), Weinberg and colleagues (2016) reported significant improvements in positive emotions, accompanied by lesser symptoms of anxiety and stress, after a single session of laughter yoga. Another work, consisting of pre/post-interventions of laughter yoga in primarily older adults (median ages in three studies: 57-78 years), reported positive changes in 10 measures of psychological well-being (Miles et al., 2016). A more recent study showed that laughter yoga could reduce depression and anxiety in older women (Armat et al., 2020).

Therefore, the acute positive psychological changes associated with laughter yoga were already reported in the literature. However, it is unknown whether personal humor styles and expectancy associated with laughter, which represent two core components of laughter yoga, influence the reported findings. Humor styles are important since people use adaptive and maladaptive humor styles that could influence psychological experiences (Kuiper & Harris, 2009). The adaptive styles of humor are 'affiliative' and 'self-enhancing' and the maladaptive styles are the 'aggressive' and 'self-defeating' (Martin et al., 2003). Expectancies associated with self-selected and perceived-as-positive events can dramatically influence the outcome measures (Kirsch, 1999; Szabo & Kocsis, 2016). Therefore, examining the relationship between the humor styles, expectancies, and psychological responses, in the context of laughter yoga's positive effects appears to be well justified.

One delimitation of the works reported here was the examination of women only that was set for two reasons; one is that laughter yoga classes are primarily (approximately 4:1 ratio) attended by women (Miles et al., 2016; Weinberg et al., 2016), but more importantly, the other reason was that *women respond differently to funny and/or humorous situations* than men (Azim et al., 2005; Kohn et al., 2011), which could be one reason why more women than men participate in laughter yoga. Another delimitation - that could also be an advantage - was the performance of the study in the attendees' usual laughter yoga class (Study 2), which was implemented to enable us to conduct *in-situ* research in the participants' habitual social and physical environment to increase the external validity of the results.

We formulated and tested the following three hypotheses in two studies. Study 1: In the non-practitioners of laughter yoga, the mere watching of practice will generate positive psychological effects and possibly even physiological changes attributable to emotional responses or laughter. Study 1 and Study 2: There will be a positive relationship between the humor styles, expectancy, and the magnitude of psychological changes in response to laughter yoga's visual and actual experience. Study 2: Practicing laughter yoga will generate positive psychological changes and will require energy expenditure above the basal metabolic rate rendering it a gentle form of exercise for aging women.

STUDY 1

The Effects of Watching a Laughter Yoga Session

METHODS

Participants

To avoid the general problem of self-selection in psychology research, which could affect the outcome of this type of research, a third-year undergraduate class studying sports science was delivered a practical session in a mental hygiene subject as part of the teaching curriculum in which the effects of watching laughter yoga were studied. While the experiment was a class exercise, those wishing to abstain from being tested were free to do so but had to attend as observers to fulfill the learning objectives. Ethical clearance for the current study was obtained from the Research Ethics Committee of the Faculty of Education and Psychology at ELTE Eötvös Loránd University in Budapest, Hungary. Thirteen female students signed an informed consent form by which they agreed to participate. Their mean (M) age was $21.92 \pm SD = 1.66$, $Mdn = 22$ years; M height $167.90 \pm SD = 8.18$ cm, and M weight $57.10 \pm SD = 5.32$ kg. All participants were white European and had a similar social and economic background.

Materials

Questionnaires. The Positive and Negative Affect Schedule (PANAS - Watson et al., 1988) was used for measuring affect before and following watching the laughter yoga. In the current work, we used the 10-item psychometrically validated (Thompson, 2007) version of the PANAS, which

consists of five positive adjectives (e.g., active) and another five negative items (e.g., nervous). The ten adjectives were rated on a 5-point Likert scale ranging from 1 (*very slightly or not at all*) to 5 (*very much*). An aggregate score was obtained for both positive and negative items by summing up the ratings of the respective items. The PANAS was presented with excellent psychometric properties (Thompson, 2007; Watson et al., 1988). In the current study, we used the validated Hungarian version of the PANAS (Gyollai et al., 2011). The internal reliabilities of this version range between (Cronbach's alpha) .73 and .79 for the positive affect subscale and from .65 to .67 for the negative affect subscale (Gyollai et al., 2011).

Momentary well-being was assessed with the single-item Feeling Scale (FS; Hardy & Rejeski, 1989) using an 11-point Likert scale, ranging from -5 (feeling *very bad*) to +5 (feeling *very good*). Momentary well-being was conceptualized as 'core affect' based on Russell's (2003) work. Core affect can be described as one's conscious general psychophysiological feeling state available as a basic non-reflective feeling, such as feeling good or bad, feeling tired, or energetic (Russell, 2003). Perceived arousal was assessed with the single-item Felt Arousal Scale (FAS; Svebak & Murgatroyd, 1985) using a 6-point Likert scale ranging from 1 (*low arousal*) to 6 (*high arousal*). Expectation about the effects of laughter was assessed prior to the intervention with a single item 6-point Likert scale ranging from 1 (*very negative*) to 6 (*very positive*). A similar scale, ranging from 1 (*not at all*) to 6 (*totally*), was employed after the intervention to estimate the subjectively perceived effect of the laughter yoga video.

Finally, humor styles were measured with the Humor Styles Questionnaire (HSQ - Martin et al., 2003), which determines the strength of four humor styles: affiliative, self-enhancing, self-defeating, and aggressive. The items are rated on a 7-point agreement-disagreement Likert scale ranging from 1 (*disagree completely*) to 7 (*agree completely*). Examples of items are: '*I laugh and joke a lot with my friends*' (affiliative humor); '*If I am feeling depressed, I can usually cheer myself up with humor*' (self-enhancing humor); '*I let people laugh at me or make fun at my expense more than I should*' (self-defeating humor), and '*If I don't like someone, I often use humor or teasing to put them down*' (aggressive humor). Reliabilities reported for the scales were: affiliative .80, self-enhancing

.81, self-defeating .80, and aggressive .77. We used the psychometrically validated 22-item Hungarian version of this scale (Boda-Ujlaky et al., 2017). The internal consistency (Cronbach's alpha) of the four subscales ranges from acceptable .72 to good .85.

Physiological data. The instrument used was the Firstbeat TeamBelt from FirstBeat SPORTS Team Pack (manufactured by Firstbeat Technologies Ltd., Jyväskylä, Finland). The unit comprises a chest belt attached to the ribcage under the musculus pectoralis major; it contains two built-in electrodes and a wireless unit that transmits real-time data to a receiver connected to a computer. Data transferred to the computer are analyzed with special software (Firstbeat Sports; v4.5.0.2.). Apart from heart rate and several other cardiac measures, the software also estimates the respiration rate based on detecting the respiratory sinus arrhythmia. Finally, energy expenditure is calculated from pre-inputted anthropometric data and the recorded heart rate and respiratory rate data.

Procedure

After signing the consent form, the Firstbeat TeamBelts were placed on the participants, followed by an initial verification of proper recording. Three participants did not consent to wear the heart rate monitors, so physiological data were obtained from 10 participants. Subsequently, a five-minute quiet rest was followed by the presentation and completion of all questionnaires, which were then collected by one of the experimenters. At this point, the participants laid back and watched a video entitled '*Laughter Yoga 40 Foundation Exercises*' (Rivest 2014-2015) which lasted for about 25 minutes. Immediately after watching the video, apart from the expectancy and Humor Styles Questionnaires that were completed only once, participants completed the FS, FAS, and the PANAS again and the Likert scale on which they indicated the perceived effect of video watching. Subsequently, the questionnaires were collected, and the heart rate monitors were removed. Participants' questions related to the study were answered, and then they were debriefed with the information that the results of the research will be shared as part of the course material with all, not only participating students.

RESULTS

Due to the low sample size, nonparametric tests were used (Pett, 2015) even at the expense of statistical power. First, the effects of watching

laughter yoga were determined by comparing the before and after-video data with Wilcoxon matched-pairs signed-ranks tests. Results revealed that pre-intervention scores differed statistically significantly from post-intervention scores in four out of six dependent measures. The detailed results are presented in Table 1.

One-sample Wilcoxon signed-ranks tests were used to test whether expectancy and perceived effect of the treatment were greater than the two scales' median value (3.5). The results of both tests yielded statistically significant results; the observed median was higher than the hypothesized median ($Mdn = 5.00$, $Z = 3.24$, $p = .001$, effect size [r] = 0.90, and $Mdn = 5.00$, $Z = 3.24$, $p = .001$, $r = 0.90$, respectively). Subsequently, difference, or delta (Δ), scores were calculated for all dependent measures by subtracting the pre-intervention scores from the post-intervention values. One-sample Wilcoxon signed-rank tests also confirmed that the change or delta (Δ) scores were statistically significantly different from zero for negative affect ($p < .027$) as well as for feeling states ($p < .011$), but not for positive affect and subjectively perceived arousal. Using Spearman ranks correlation, these '*change scores*' were then correlated with expectancy about the effects of laughter, perceived effect of the laughter yoga video, and humor style to determine if there was a relationship between them. The results of the correlations indicated that the Δ scores were not associated with expectancy about the effects of laughter or humor styles, but statistically significant positive correlations emerged between the perceived effect of the laughter yoga video and the magnitude of changes in the reported feeling states ($\rho = .59$, $p = .035$), and positive affect ($\rho = .56$, $p = .045$). The correlation between the expectancy about the effects of laughter that was measured before the intervention and the perceived effect of the video watching, measured after the treatment, was also statistically significant ($\rho = .59$, $p = .033$).

The difference between minimal and maximal heart rates during the watching of the laughter was $Mdn = 12.50$, $M = 13.30 \pm SD = 5.84$, while corresponding values for the range of respiration rates were $Mdn = 7.00$, $M = 7.04 \pm SD = 2.39$. Statistically significant differences between minimal and maximal values during laughter yoga watching in both measures were substantiated by the Wilcoxon matched-pairs signed-ranks tests (refer to Table 1). Despite these differences, heart rates were primarily in the resting zone while watching the laughter yoga (Figure 1).

Table 1. The Wilcoxon matched-pairs signed-ranks tests compared pre- and post-laughter video-watching psychological measures and minimal and maximal heart rate and respiration rate during the video watching (Study 1)

Measures Pre- Post		N	Mean Rank	Sum of Ranks	Z	p*	Effect size (r)
Positive affect	Negative Ranks	4	5.00	20.00	-1.167	0.292	NS
	Positive Ranks	7	6.57	46.00			
	Ties	2					
Negative Affect	Negative Ranks	6	3.50	21.00	2.207	0.031	0.43
	Positive Ranks	0	0.00	0.00			
	Ties	7					
Feeling State	Negative Ranks	0	0.00	0.00	-2.558	0.008	0.50
	Positive Ranks	8	4.50	36.00			
	Ties	5					
Felt Arousal	Negative Ranks	2	5.25	10.50	-1.461	0.195	NS
	Positive Ranks	7	4.93	34.50			
	Ties	4					
Heart Rate	Negative Ranks	0	0.00	0.00	-2.805	.002	0.55
	Positive Ranks	10	5.50	55.00			
	Ties	0					
Respiration Rate	Negative Ranks	0	0.00	0.00	-2.803	.002	0.55
	Positive Ranks	10	5.50	55.00			
	Ties	0					

Note: * using the 'Exact test' due to small sample size; NS = Not Significant

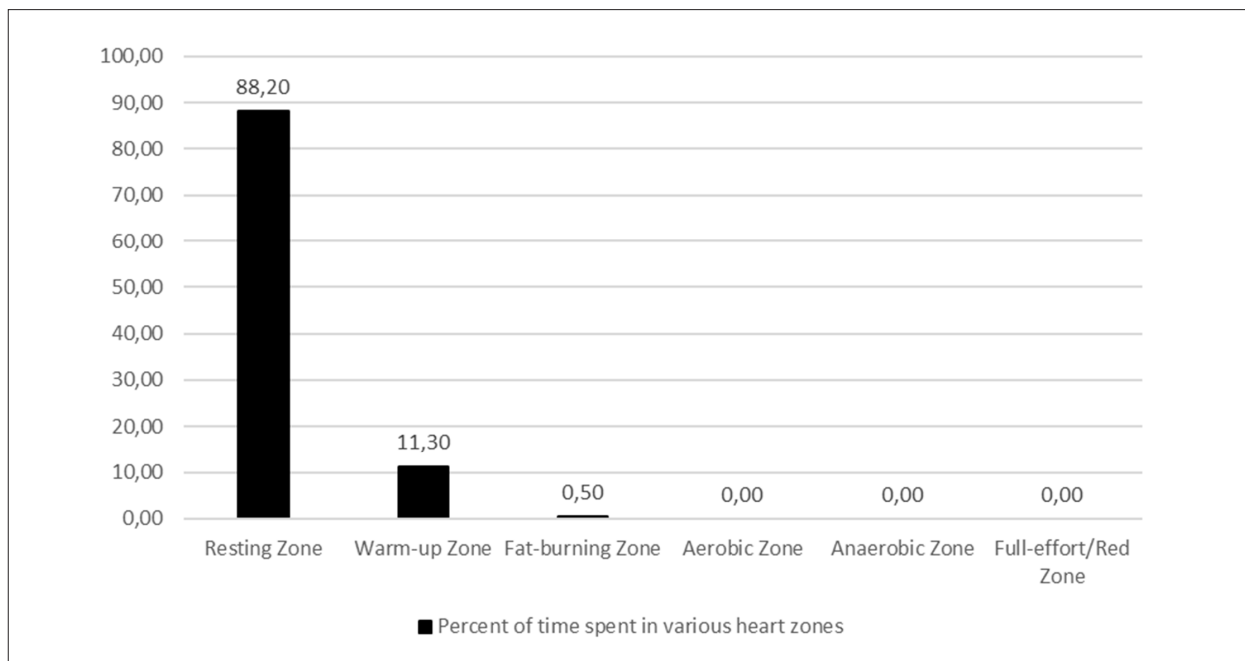


Figure 1. The average percent of time spent in different heart rate zones, based on age-adjusted maximal heart rates, during laughter video watching (n = 10) in Study 1

Note: Resting zone = under 50% of the maximal heart rate (MHR); warm-up zone = 50-60% MHR; fat-burning zone = 60-70% MHR; aerobic zone = 70%-80%; MHR; anaerobic zone = 80-90%; full effort/red zone = > 90% MHR

Using the Mifflin-St Jeor icon Equation for women (Mifflin et al., 1990), we calculated the Basal Metabolic Rate (BMR) for each individual and adjusted it at three levels: 1) sedentary (little or no exercise), 2) light physical activity (exercise 1 to 3 days a week), and 3) moderate physical activity (exercise 3 to 5 times a week). We then compared the energy cost (Kcal/min) of watching the laughter yoga ($M = 1.78 \pm SD = 0.74$, $Mdn = 1.53$, Physical Activity Ratio (PAR) = 1.71-1.22) with the three levels of BMR (sedentary $M = 1.13 \pm SD = 0.08$, $Mdn = 1.11$; light $M = 1.29 \pm SD = 0.10$, $Mdn = 1.27$; moderate $M = 1.45 \pm SD = 0.11$, $Mdn = 1.43$). The Wilcoxon matched-pairs exact signed ranked tests showed that energy expended while watching the laughter video was statistically significantly greater than the BMR for sedentary ($Z = 2.70$, $p = .007$, $r = 0.60$) and for the lightly active ($Z = 2.41$, $p = .017$, $r = 0.54$), but not for moderately active levels ($Z = 1.48$, $p > .05$).

DISCUSSION

The results of Study 1 suggest that the mere watching of laughter yoga yields positive psychological changes while also triggering a notable cardiorespiratory reaction. Therefore, the results of Study 1 confirm our research hypothesis that the mere watching of laughter yoga on a video induces positive psychological changes manifested via decreased negative affect and improved core affect or feeling state. The visual experience of laughter yoga appears to be a source of positive emotion stemming from the observed activity's joyful, happy, and funny characteristics and possibly a vicarious social experience. These positive emotional changes were accompanied by physiological changes as manifested through the statistically significant differences between minimal and maximal heart and respiration rates. Since the video-watching occurred in a comfortable sitting position, these physiological changes could only be associated with the emotional reaction to the video and/or smile-laughter. Due to the lack of similar earlier research, these findings cannot be contrasted with past research results.

Unexpectedly, statistically significant energy expenditure was noted during the watching of the laughter yoga video at sedentary and low, but not at moderate activity levels, the latter representing 3 to 5 regular weekly exercise sessions. While we did not assess physical activity patterns, the

participants being sport science students having several practical sports sessions each week, likely qualified for at least moderate activity BMR level at which no significant difference occurred between the energy cost of the video watching and the BMR. Nevertheless, for individuals with BMRs at lower activity levels, there would be a significant difference in energy cost, confirming the results of Buchowski and colleagues (2006) concerning the energy cost of laughter.

Given that the psychological effects of *observing* laughter yoga have not been studied to date, the current results are difficult, or rather impossible, to compare with findings from earlier research. However, despite the relatively small sample size, which is nevertheless greater than the sample studied in another published and often cited work (Dolgoff-Kaspar et al., 2012), it can be argued that the visual experience of laughter yoga practice is a source of positive affect that supports the conjecture that laughter yoga practice is not merely based on simulated non-Duchenne laughter, but perhaps more on emotion-triggered Duchenne laughter. Based on these findings, we suggest that simulated laughter might ignite spontaneous and natural laughter during laughter yoga classes. These results are largely independent of the Study 2 presented in the next section, but they may help in the interpretation of the findings from that study.

STUDY 2

The Effects of Practicing Laughter Yoga in Older Women

Study 2 was performed *in-situ* during a regularly scheduled laughter yoga session in a private yoga club. In this study, we investigated the psychological effects of laughter yoga in a real-life situation and also examined physiological effects and the energy cost associated with the activity in aging women.

METHODS

Participants

Participants attending a laughter yoga class in Budapest were asked to take part in the study. Twenty-five women consented to participate. Apart from two women, one aged 35 and the other 40, and two who did not wish to provide their age but appeared to be in the older adults age range, all participants were aged over 52. Participants' mean

(*M*) age was $63.83 \pm SD = 11.91$, *Mdn* = 66 years; *M* height $163.94 \pm SD = 7.58$ cm, and *M* weight $66.50 \pm SD = 11.45$ kg. Ethical clearance for the work was obtained from the Research Ethics Committee of the Faculty of Education and Psychology at ELTE Eötvös Loránd University in Budapest. Questionnaire data could only be gathered from 21 participants since two did not see well enough to complete the scales, and two of them only provided partial answers that were insufficient for the statistical analyses. Heart rate and respiration rate data were obtained from 16 participants because the others did not wish to wear the heart rate monitor belt during the laughter yoga class.

Materials

The questionnaires and the instruments were fully identical to those used in Study 1.

Procedure

The laughter yoga class was informed about the purpose and requirements of the study. Those who agreed to participate signed the informed consent form and subsequently completed the questionnaires comprised of the PANAS, FS, FAS, HSQ, and expectancy about the effects of laughter. Prior to the start of the class, the Firstbeat TeamBelts were placed on the participants who agreed to wear them, and proper continuous recording was verified. Subsequently, the yoga instructor started the class which comprised the elements from ‘*Laughter Yoga 40 Foundation Exercises*’ (Rivest 2014-2015). Upon termination of the class, participants removed the heart rate monitor belts and completed the PANAS, FS, FAS, and then indicated on the single-item Likert scale the subjectively perceived the effect of the laughter yoga activity. When all was done, the experimenters collected the questionnaires, answered questions related to the study, and thanked the women for participating in the research.

RESULTS

To test the psychological changes attributable to the laughter yoga class, a repeated-measures multivariate analysis of variance (MANOVA) was employed. This test yielded a statistically significant multivariate time main effect (Pillai’s Trace = .830, $F_{4, 17} = 20.71$, $p < .001$, effect size: partial Eta squared [$p\eta^2$] = .830, $1 - \beta = 1.00$). The univariate results revealed that all four psychological measures changed statistically significantly from before- to after-laughter yoga class. The detailed results are presented in Table 2. The sample size ($n = 21$) was sufficient for these parametric tests on psychological data as determined *post-hoc* with the G*Power (v. 3) software (Faul et al., 2007), which indicated that, based on the obtained results, there was sufficient statistical power ($1 - \beta = 1.00$) as based on: one group, two repeated measures, $p\eta^2 = .830$, $\alpha = .05$, $r = .64$ (minimal calculated r between repeated measures).

One-sample Wilcoxon signed-ranks tests were used to determine whether expectancy and perceived effect of the laughter yoga was greater than the Likert scale’s median value (= 3.5). The results of both tests yielded statistically significant results. The calculated median was higher than the hypothesized median (*Mdn* = 6.0, $Z = 4.03$, $p < .001$, $r = 0.88$) for expectancy, and *Mdn* = 6.0, $Z = 4.17$, $p < .001$, effect size $r = 0.91$ for the perceived effect of the laughter yoga). Next, to inspect whether there was a link between expectancy, perceived effect, four humor styles, and the four dependent measures, change scores were calculated by subtracting the pre-laughter yoga class scores from the post-yoga class scores. One-sample Wilcoxon signed-rank tests confirmed that the change or delta scores were different from zero for all four psychological measures ($p < .001$). These change scores were correlated with expectancy

Table 2. Means \pm standard deviations and the results of the univariate repeated measures analysis of variance determining the differences in psychological measures pre- and post-laughter yoga session (Study 2)

Measures	Pre-	Post-	<i>F</i>	<i>df</i>	<i>p</i>	^a η_p^2	^b (1- β)
Positive affect	16.71 \pm 3.76	20.67 \pm 3.93	31.102	1, 20	< .001	.609	1.000
Negative affect	8.05 \pm 2.85	6.52 \pm 2.23	9.827	1, 20	= .005	.329	.846
Feeling state	2.38 \pm 1.66	4.00 \pm 1.73	27.524	1, 20	< .001	.586	.999
Felt arousal	3.38 \pm 1.12	4.1 \pm 1.10	24.381	1, 20	< .001	.762	1.000

Note: ^a Effect size: partial Eta squared (η_p^2); ^b Observed power calculated at $\alpha = .05$.

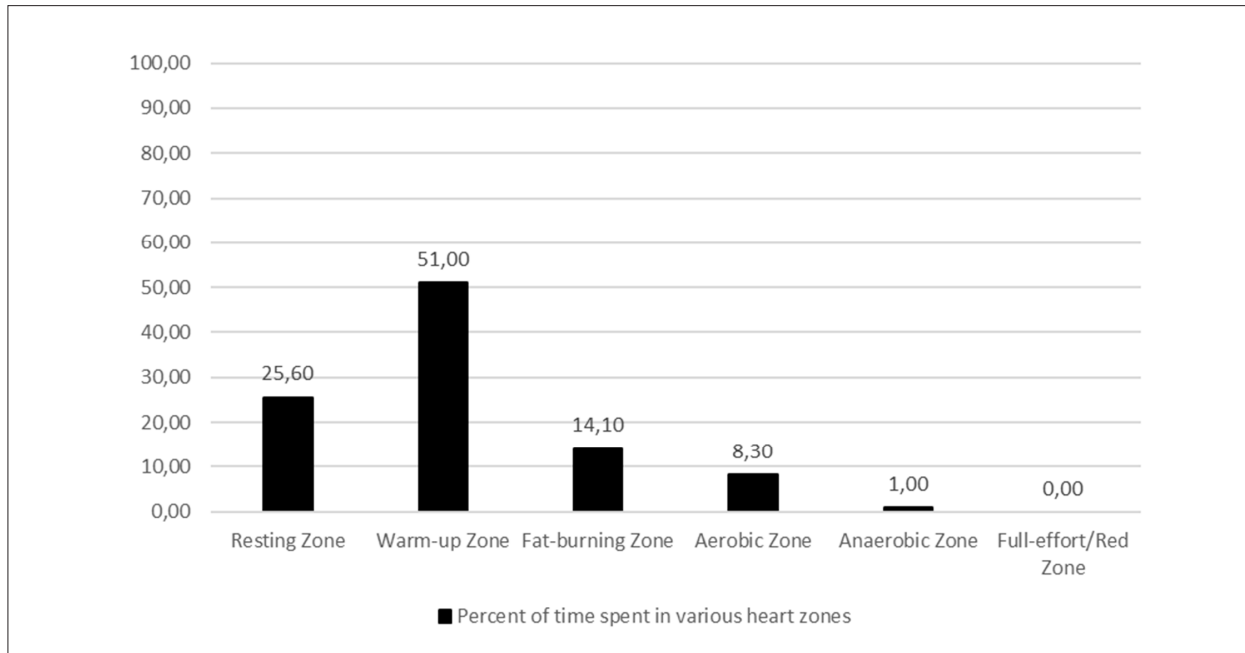


Figure 2. Average percent of time spent in different heart rate zones, based on age-adjusted maximal heart rates, during laughter yoga practice (n = 16) in Study 2

Note: Resting zone = under 50% of the maximal heart rate (MHR); warm-up zone = 50-60% MHR; fat-burning zone = 60-70% MHR; aerobic zone = 70%-80% MHR; anaerobic zone = 80-90%; full effort/red zone = > 90% MHR.

about the effects of laughter, the perceived effect of the laughter yoga, and the four humor styles scores using the nonparametric Spearman ranks correlation. The results of the correlations revealed that the change scores were not associated with expectancy about the effects of laughter or any of the humor styles. Still, a statistically significant positive correlation emerged between perceived effect of the laughter yoga and the amount of change in the reported positive affect ($\rho = .53, p = .013$). Finally, the correlation between the expectancy about the effects of laughter measured before the laughter yoga session and the perceived effect of the completed activity measured after the laughter yoga was also statistically significant ($\rho = .65, p = .001$).

To examine the difference between the lowest and highest heart rate and respiration rate during the laughter yoga class, due to smaller sample size (n = 16), Wilcoxon matched-pairs signed-ranks tests were used. The results revealed that the difference between minimal and maximal values was equally statistically significant for both variables (M rank = 8.50, sum of ranks = 136.00, no negative ranks, positive ranks = 16.00, $Z = -3.52, p < .001, r = 0.62$). Heart rates during laughter yoga activity were primarily in the warm-up zone (51%) as based on the age-adjusted maximal heart rates. Still, in more

than 20% of the class time participants' heart rates were in the fat-burning and aerobic training zones (Figure 2).

Using again the Mifflin-St Jeor Equation for women (Mifflin et al., 1990), BMRs were calculated for each individual and adjusted at three activity levels as done in Study 1. Then the energy expended (Kcal/min) during the practice of the laughter yoga ($M = 2.02 \pm SD = 0.54, Mdn = 1.91, PAR = 1.98-1.53$) was compared with the BMR at three activity levels (sedentary $M = 1.02 \pm SD = 0.12, Mdn = 1.04$; light $M = 1.17 \pm SD = 0.14, Mdn = 1.20$; moderate $M = 1.32 \pm SD = 0.15, Mdn = 1.35$). The Wilcoxon matched-pairs exact signed ranked tests revealed that the energy expended during laughter yoga was statistically significantly greater than the BMR for sedentary, light, and moderate activity levels (vs. sedentary: $Z = 3.52, p < .001, r = 0.62$; vs. lightly active: $Z = 3.52, p < .001, r = 0.62$; vs. moderately active lifestyles: $Z = 3.41, p = .001, r = 0.60$, respectively).

DISCUSSION

Study 2 confirmed that a single session of laughter yoga has a positive psychological effect as manifested through increased core affect or general feeling state, increased positive affect, and decreased

negative affect. The subjectively reported increased arousal suggests an invigoration experience related to laughter yoga. These findings agree with the reports on the psychological benefits of laughter yoga (Ellis et al., 2017; Weinberg et al., 2016). Furthermore, they expand the previous reports by revealing that the changes are independent of humor styles. This finding emerged in two studies after both watching and practicing laughter yoga. While the moderating role of humor styles between laughter yoga and psychological measures was not examined to date in other studies, similar findings were reported in the context of the relationship between humor styles and well-being (Ruch & Heintz, 2014).

While expectancy- the Hawthorne-effects often contaminate the within-participants designs, in the current study we could not find significant correlation between the change in subjective measures and expectancy associated with laughter. Still, the Hawthorne effect may not be ruled out in Study 2, because the presence of the experimenters modified the habitual context of the laughter yoga class to which the participants were accustomed.

We noted a positive correlation between participants' expectancies and the perceived effect of different laughter yoga interventions in two studies. In repeated measures designs, there is often a dissociation between objectively measured and subjectively perceived effects (Babulka et al., 2017; Köteles & Babulka, 2014; Schwarz & Büchel, 2015). Expectancies usually have a greater impact on perceived effects than on the objective effects; in fact, they did not predict objective changes in many earlier studies (Babulka et al., 2017; Köteles & Babulka, 2014; Schwarz & Büchel, 2015; Szabo et al., 2017a; Szabo et al., 2017b). In other words, *a priori* expectancies often bias perception in a self-fulfilling direction, but in our case, only the perceived effect was correlated with positive affect and feeling state.

Concerning the energy cost of laughter yoga, we did the calculation separately for sedentary people and lightly and moderately active people by using corrected BMRs. This categorization is essential because if direct measurement is not possible, the level of activity of a person can only be estimated. For the primarily older women in Study 2, even those who could have been moderately active (physical exercise 3-5 times per week), laughter yoga energy expenditure was statistically significantly higher than the BMR. However, despite this difference,

the energy cost of laughter yoga is relatively low in these women. Indeed, it appears to be somewhat less than the energy cost of walking, but slightly more than the energy cost of cooking based on a compilation of the energy cost of various physical activities (Vaz et al., 2005). However, when contrasting to the cost of physical activities in healthy older women, the values calculated in the current study fall between standing activities and cycling (Visser et al., 1995). Study 2 indicates that while laughter yoga increases heart rate, during its practice, older women spend less than 10% in the aerobic and anaerobic zone, which does not qualify for sufficient physical activity for health as recommend by the American College of Sports Medicine and the American Heart Association (Nelson et al., 2007). Nevertheless, laughter yoga may pose a physical challenge above BMR for aging women with a limited range of movement. These results suggest that laughter yoga is a gentle exercise that, in addition to providing low-grade physical activity, has substantial psychological benefits too. These benefits can be connected to the joyful and/or funny aspects of the social situation that were demonstrated in Study 1, in addition to the actual and perceived increase in the level of arousal and energy expenditure.

Practical Implications

First, the current results are consistent with research on humorous videos triggering positive affect (Szabo, 2003). Watching others laughing in a group for no reason and observing the contagious effect of laughter could create positive affective feelings and motivation to try out the activity. The practice of laughter yoga qualifies for mild to moderate exercise and. Accordingly, in addition to its psychological benefits, laughter yoga is a compensatory physical activity for those with a limited range of movement because of illness or older age. Therefore, laughter yoga is an excellent psychological, physical, and social activity for a large segment of the aging women population. Studying its psychophysiological effects in men appears to be warranted based on the current findings.

Strengths and Limitations

Despite its small sample size, Study 1 has two strengths: 1) it was performed with a non-volunteer sample, thus attraction toward the intervention could be ruled out, and 2) it is the first study to indicate

that laughter yoga is a situation that elicits the Duchenne laughter capable of improving emotions just by watching it. Study 2, while it was performed with a convenience sample, was an *in-situ* research in the participants' natural environment where they usually go for the laughter yoga practice. These studies have greater external validity than laboratory interventions. Further, to the best of these authors' knowledge, this is the first study ever to demonstrate that the energy expenditure associated with laughter yoga qualifies this activity for gentle, low to moderate, physical activity.

The present study is not without limitations. Study 1 had small sample size that forced the authors to use non-parametric data analyses at the expense of statistical power, but any significant result disclosed with such a small sample can be expected to yield more robust results with a larger sample. In Study 2 the powerful (large) effect sizes compensated for the low sample size as demonstrated by a *posteriori* power analyses. Still, this post-factum test is rather chance-based. A priori sample size calculation is warranted even if that is difficult or sometimes impossible with *in-situ* real-life investigations.

CONCLUSIONS

The studies reported here reveal that in passive observers, the mere visual experience of laughter yoga generates positive psychological responses and measurable changes in heart rate and respiratory rate. There is no relationship between the humor styles, expectancy, and the magnitude of change in psychological measures, neither in visual nor in practice of laughter yoga. Both visual and actual experience of laughter yoga appear to be associated with energy cost above the BMR. However, in aging women, the energy cost of laughter yoga is insufficient for qualifying it as a form of physical activity that was recommended for health. Nevertheless, it is a form of recreation that qualifies for low to moderate physical activity that yields immediate psychological benefits, independent of humor styles and expectancy effects.

Conflict of interest

The authors have no conflict of interest to declare.

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