The Impact of a Gameful Breathing Training Visualization on Intrinsic Experiential Value, Perceived Effectiveness, and Engagement Intentions: Between-subject Online Experiment

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Abstract

Background: Slow-paced breathing has been shown to be positively associated with psychological and physiological health. In practice, however, there is little long-term engagement with breathing training, as shown by the usage statistics of breathing training apps. New research suggests that a gameful smartphone-delivered breathing training may address this challenge.

Objective: This study assesses the impact of breathing training, that is guided by a gameful visualization, on perceived experiential and instrumental values, and the intention to engage in such a training.

Methods: A between-subject online experiment with 170 participants was conducted and one-way MANOVA and t test analyses were used to test for any difference in intrinsic experiential value, perceived effectiveness, and the intention to engage in either a breathing training with a gameful or a nongameful guidance visualization. Moreover, prior experience in gaming and meditation practices were assessed as moderator variables for a preliminary analysis.

Results: The intrinsic experiential value for the gameful visualization was found to be significantly higher compared to the nongameful visualization ($P=.002$), while there was no difference in either perceived effectiveness ($P=.75$) or the intention to engage ($P=.55$). The preliminary analysis of the influence of meditation and gaming experience on the outcomes indicates that people with more meditation experience yielded higher intrinsic experiential values from using the gameful visualization than when using the nongameful visualization ($P=.01$). This analysis did not find any additional evidence of gaming time or meditation impacting the outcomes.

Conclusions: The gameful visualization was found to increase the intrinsic experiential value of the breathing training without decreasing the perceived effectiveness. However, there were no differences in intentions to engage in both breathing trainings. Gaming and meditation experiences seem to have no or only a small positive moderating effect on the relationship between the gameful visualization and the intrinsic experiential value. Future longitudinal field studies are required to assess the impact of gameful breathing training on actual behavior, that is, long-term engagement, and outcomes.

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Original Manuscript

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Background: Slow-paced breathing has been shown to be positively associated with psychological and physiological health. In practice, however, there is little long-term engagement with breathing training, as shown by the usage statistics of breathing training apps. New research suggests that a gameful smartphone-delivered breathing training may address this challenge.

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Conclusion: The gameful visualization was found to increase the intrinsic experiential value of the breathing training without decreasing the perceived effectiveness. However, there were no differences in intentions to engage in both breathing trainings. Gaming and meditation experiences seem to have no or only a small positive moderating effect on the relationship between the gameful visualization and the intrinsic experiential value. Future longitudinal field studies are required to assess the impact of gameful breathing training on actual behavior, that is, long-term engagement, and outcomes.

Keywords: breathing training; serious game; mobile health; mHealth; mobile phone; experiential value; instrumental value; online experiment

Introduction

Background

Slow-paced breathing training has been positively associated with psychological and physiological well-being. It has the potential to help ease the burden of mental illnesses [1] and chronic diseases [2], such as hypertension [3,4], type 2 diabetes [5], and chronic pain [6]. Slow-paced breathing has been shown to positively influence heart rate variability and cardiac vagal tone. The latter corresponds to the activity of the parasympathetic nervous system [7]. Therefore, often the main goal of slow-paced breathing training is to induce relaxation.

The use of smartphones and apps is increasing as they support users' daily activities [8,9]. Smartphone apps can support health and medical actions [9]. Moreover, persuasive technologies and digital interventions are showing promise in influencing personal and health behavior changes [10,11].

This increase in the usage of digital technologies and the positive effects of breathing training have led to the development of various applications that support breathing training [12-14]. Usually, such breathing training applications consist of an animation that guides users to breathe with 6 breaths per minute. Thereby, the users usually breathe with a specific breathing pattern, for example, 5 seconds inhalation and 5 seconds exhalation [15].

While adapting to such healthy behavior can help to prevent the onset of many diseases [16], behavior changes are challenging to sustain long-term [17]. It has been shown that breathing training apps have very low long-term adherence, even though the number of installations is high [18].

One approach to address the issue of low long-term adherence might be to approach intrinsic motivation through gamification [19]. Gamification adds game elements to nongame tasks to make them more engaging and enjoyable. This approach is motivated by the notion that playing a game is generally considered an enjoyable experience [20]. Therefore, the combination of technology to influence human behavior [21] and gamification in the healthcare context [22] offers promise for the benefit of people, especially when it comes to health behavior change and long-term usage.

It is thus, not surprising that experiential values, such as fulfillment, enjoyment, meaningfulness, or playfulness, have received growing recognition in recent years [23,24]. Liu et al [25] introduced the term meaningful engagement as the main goal of gamification. It constitutes the experiential and the instrumental values of a gamified system. In terms of breathing training, the instrumental value is the effectiveness of the training in inducing the desired effects, such as relaxation. Meaningful engagement can be the deciding factor for the continued use of a system [26]. However, it must be ensured that an increase in experiential values does not reduce the effects regarding relaxation [25]. For example, a previous study [19] collected recordings of breathing rates and heart rate variability derived measures, to ensure that gameful breathing training does not impair the effectiveness of breathing training. While the study found that gameful breathing training is as effective as normal breathing training, it did not investigate whether there was an experiential gain in gameful breathing training. Chittaro et al [12] researched the effectiveness of different nongame breathing training guidance based on visualizations and audio. The authors found that some types of guidance are more effective than others. However, they did not investigate gameful visualizations and did also not report the experiential values of these different visualizations. Furthermore, whether participants would have the intention to engage in such breathing training in their everyday life, guided by these different visualizations, remains unknown.

Objectives

In this study, we compare gameful and standard slow-paced breathing training visualizations regarding the intrinsic dimension of the experiential value. This perceived intrinsic value serves as a concept to evaluate the effectiveness of the visual components of the gameful design. As a basis for

the gameful breathing training served Breeze, which was first introduced by Shih et al [27]. Additionally, perceived effectiveness was measured to ensure that the gameful design elements do not weaken the instrumental aspect of the task. Furthermore, intention to engage was measured, that is, the intention to perform the breathing training on a regular basis. Intention to engage was used as a surrogate to study potential long-term engagement.

Moreover, the study investigated the impact of gaming time and meditation experience of participants on the main outcome, namely the intrinsic dimension of the experiential value. However, the analysis was not powered for this latter analysis.

This resulted in the following objectives:

1. To assess the intrinsic dimension of breathing training guided by gameful and nongameful visualizations.
2. To assess the perceived effectiveness of breathing training guided by gameful and nongameful visualizations.
3. To assess the intention to engage in breathing training guided by gameful and nongameful visualizations as preliminary forecast of long-term engagement.
4. To preliminarily assess the influence of gaming time and meditation experience on the intrinsic value, perceived effectiveness, and intention to engage.

Methods

Study Design

The study compared Breeze (Error: Reference source not found), a gameful breathing training visualization, to a standard breathing training visualization, hereafter referred to as Circle (Error: Reference source not found). The standard breathing training visualization was adapted from previous studies, [15,19,27]. The videos that were used to instruct and guide the participants before and during breathing training can be found in Multimedia Appendences 1-4. Both breathing training visualizations guide the user to breathe with six breathing cycles per minute. We employed a 4-3-3 (inhalation-exhalation-pause) pattern in both visualizations. It is a slight variation from the 4-2-4 breathing pattern from Russel et al [15]. The increase of the exhalation phase was motivated by feedback from testers that felt that the exhalation phase was too short.

The anonymized study was conducted from June 2020 to July 2020 and followed a between-subject design amid the independent variable visualization versions, Breeze or Circle. The study was reviewed and approved by the ethics committee of ETH Zurich (ID: 2020-N-82).

Main Outcomes

The intrinsic dimension of the experiential value induced by Breeze and Circle formed the major outcome of the study. The intrinsic dimension consists of the subdimensions aesthetics and playfulness. To measure intrinsic experiential value, referred to as intrinsic value in this study, we adapted items from the validated value landscape suggested by Mathwick et al [28] that have also been used in the mobile gaming context [29]. However, solely the intrinsic value was included, as the extrinsic values, consumer return on investment (CROI), and service excellence are made for goods on the market, consequently, no price and no sales process are in place for Breeze or Circle, nor do they include a service component.

Liu et al [25] suggested that meaningful engagement consist of experiential values and instrumental values. An earlier study [19] had collected recordings of breathing rates and heart rate variability-derived measures, to ensure that the instrumental values are maintained when using Breeze. Therefore, this study focused mainly on the second category: the experiential value to evaluate experiential outcomes.

Besides the experiential value, the instrumental value consisting of perceived effectiveness (including perceived relaxation) suggested by Chittaro et al [12] was investigated to ensure that the desired effects are achieved. Moreover, intention to use was included, in this study referred to as intention to engage, which was adopted from Shih et al [27] to ensure comparability to this earlier study.

Consequently, the following main hypotheses were tested using pairwise independent *t* tests:

- H1.** There is a difference in intrinsic experiential value between the conditions.
- H2.** There is no difference in perceived effectiveness between the conditions.
- H3.** There is a difference in intention to engage between the conditions.

To gain more insight, the study also investigated the effects of the visualizations on the

subdimensions aesthetics and playfulness of the intrinsic experiential value. There, a MANOVA with subsequent univariate tests was used to evaluate the following hypotheses:

H4.1 There is a difference in the aesthetics subdimension of intrinsic experiential value between the conditions.

H4.2 There is a difference in the playfulness subdimension of intrinsic experiential value between the conditions.

Explorative outcome

Additionally, an exploratory analysis was carried out regarding the differences in reported intrinsic experiential values, perceived effectiveness, and intention to engage between participants with different levels of experience in gaming and meditation. On the one hand, affluent gaming experiences are suspected to diminish the effectiveness of gamification [30]. On the other hand, mindfulness meditation was suggested to promote health and performance [31,32]. Both these conjectures could influence the experiential outcome.

To investigate whether gaming time or meditation experience has an impact on the experiential value, instrumental value, or the engagement, the effects on the intrinsic value, perceived effectiveness, and intention to engage were investigated. This was done using pairwise independent t-tests on subgroups in both conditions. For the analysis of gaming experience, the subgroups were gamers and non-gamers, and for meditation experience, meditation experts and non-experts.

Questionnaire

The questionnaire was structured for both conditions (Circle and Breeze) as follows:

- 1) Demographic questions
- 2) Instruction video with questions regarding intrinsic value, perceived effectiveness and intention to engage.

The demographic questionnaire asked participants about, amongst other things, their age and gender, and their experience with relaxation and meditation techniques (Multimedia Appendix 5).

To measure the participants' intrinsic value, perceived effectiveness, and intention to engage, a questionnaire with the items listed in **Table 1** was employed. Each item was rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Items I-IV were averaged to assess the intrinsic value, which consists of playfulness (items I-II) and aesthetics (items III-IV), items V-XI were averaged to assess the perceived effectiveness of both conditions.

The items used in the questionnaire were based on existing questionnaires, items and keywords [12,28,33].

Table 1. The table indicates the scale item wordings of each construct, namely intrinsic value, perceived effectiveness and intention to engage. Cronbach α of each construct and both conditions Circle and Breeze are described to measure the internal consistency.

Construct	Scale item wording	Cronbach α	
		Circle	Breeze
Intrinsic value		0.72	0.62
	I. Doing the breathing training makes me feel I am in another world.		
	II. I enjoy doing this breathing training.		
	III. I like the way the breathing training looks.		

Perceived effectiveness	IV.	I think the breathing training is very entertaining.	0.78	0.72
	V.	The breathing training facilitates relaxation.		
	VI.	The breathing training is pleasant to use.		
	VII.	It is easy to follow the breathing training instructions.		
	VIII.	The breathing training effectively teaches how to breath.		
	IV.	The breathing training is effective in reducing stress.		
Intention to engage	X.	The breathing training is effective in increasing attention to breath.	N/A ^a	N/A ^a
	XI.	I would perform this breathing training in my everyday life to better manage stressful situations.		

^aN/A: Not applicable, as intention to use only consists out of one item.

Sample Size

Prior to the study, a power analysis was conducted to determine the required sample size. To be able to also draw conclusions about the two subdimensions of intrinsic value (playfulness and aesthetics) a MANOVA with two groups and two response variables was chosen as the basis of the power analysis. The parameters for the power analysis were a significance level (α err. Prob.) of 0.05, effect size of 0.0625, and a power ($1-\beta$ err. prob.) of 0.8. This suggested a sample size of $n=158$. The participant sample size exceeded this determined sample size due to the inclusion of a safety margin. Thus, the study aimed to recruit 170 participants.

Participants

The study was conducted in two phases. First, a pilot study with 8 participants (8 females) was carried out to eliminate ambiguities and verify the technical setup. Second, the main study was carried out with 170 participants (85 females). The participants were recruited from the web-based prolific.co platform [34].

Participants were eligible for the study, if they were at least 18 years old, were not pregnant, not taking any medication to treat symptoms of depression, anxiety or low-mood, and were not suffering from any respiratory diseases, such as asthma or chronic obstructive pulmonary disease. To match the selection and exclusion criteria the participants were filtered by the platform. Moreover, participants were expected to take approximately 15 minutes for the questionnaire. After completing the experiment, the participants received a compensation worth 2.09 pounds sterling.

Procedure

Participants were greeted through an explanatory introduction text informing them that they would conduct a breathing exercise and subsequently answer some assessing questions. After accepting the terms and conditions, participants were asked to answer a set of demographic questions. The participants were then randomly assigned to the Circle or the Breeze condition. Subsequently, they were shown an instruction video (Figure 1), accompanied by a tutorial. Next, they were asked to

confirm that the breathing training will be taken seriously, to convey a binding character. Then, the participants were asked to follow the guided breathing instructions for 6 minutes delivered through a video of Circle or Breeze, respectively. During this time, the participants were unable to rewind or fast-forward the video. Also, the survey could not be continued before the full 6 minutes of the video had elapsed. Upon completion, the participants were asked about the perceived effects of the breathing training and how they perceived the visualization. Finally, they were led to the final debriefing view, where the purpose of this study was explained to them (for the full questionnaire/tutorial see Multimedia Appendix 5).

Figure 1. Exercise instruction: Person on the left showing the exercise with enlarged smartphone screen of Breeze on the right. Participants in the Circle condition were shown a similar instruction video with Circle.

Results

All analyses were performed in R studio (Version 1.2.5042) and R version 4.0.0. For constructs that consisted of multiple items, the average of the items was calculated to arrive at a single score for each construct. All measures met assumptions of normality and no transformations were made.

Participants Demography

The study was attempted by 180 participants of which 10 did not complete the experiment, either because they abandoned the experiment or exceeded the time limit of the prolific.co platform [34]. The platform automatically replaced these failed attempts, resulting in 170 participants completing the experiment. Of these participants 14 participants were excluded from subsequent analysis due to requiring more than 10 minutes for the breathing training. This threshold was set to account for participants who likely did not take the training seriously, as they stayed on the training page for a long time after the 6 minutes of training. This resulted in a sample size of N=156. The participants' mean age was 27 ± 8.47 years. Additional data on participant demographics are depicted in Error: Reference source not found.

Table 2. The table outlines the demographics and mean responses of the study participants.

Variable	Overall
n	156
Visualization (%)	
Breeze	79 (50.6)
Circle	77 (49.4)
Sex (%)	
Women	77 (49.4)
Men	79 (50.6)
Age (SD)	27.00 (8.47)
Gaming time (%)	
Never	27 (17.3)
1-3 hours	52 (33.3)
4-6 hours	28 (17.9)
7-9 hours	22 (14.1)
10-12 hours	10 (6.4)
13+ hours	17 (10.9)
Meditation experience (%)	
Strongly Disagree	34 (21.8)
Disagree	53 (34.0)
Neither Agree nor Disagree	38 (24.4)
Agree	29 (18.6)
Strongly Agree	2 (1.3)
Breathing experience (%)	
Strongly Disagree	34 (21.8)
Disagree	53 (34.0)
Neither Agree nor Disagree	38 (24.4)
Agree	29 (18.6)
Strongly Agree	2 (1.3)
Intrinsic value (SD)	

	3.30 (0.68)
Perceived effectiveness (SD)	
	4.07 (0.54)
Intention to engage (SD)	
	3.48 (1.04)

Intrinsic Value, Perceived Effectiveness, and Intention to Engage

The questionnaire responses regarding intrinsic value and perceived effectiveness were evaluated by an exploratory factor analysis [12,35], as intention to engage only consisted of one item. For the analyzed data sets and conditions, the Kaiser-Meyer-Olkin (KMO) was greater than 0.6, and Bartlett's Test of Sphericity was significant (Table 3). Therefore, factor analysis could be conducted [12,36].

Table 3. KMO and *P* values of Bartlett's Test of Sphericity observed on questionnaire data.

	KMO		Bartlett's Test of Sphericity	
	Circle	Breeze	<i>P</i> value	
			Circle	Breeze
Intrinsic value				
	0.71	0.60	<.001	<.001
Perceived effectiveness				
	0.79	0.73	<.001	<.001
Intention to engage				
	N/A ^a	N/A ^a	N/A ^a	N/A ^a

^aN/A: Not applicable, as intention to engage only consists out of one item.

A pairwise independent *t* test was used to investigate the effects of conditions on intrinsic value, perceived effectiveness, and intention to engage. To reduce type I errors a conservative alpha level of .025 was used [37].

The comparison revealed a significant difference between Breeze and Circle for intrinsic value ($P < .01$), with a positive effect of Breeze (Figure 2). However, among perceived effectiveness and intention to engage there was no significant difference (Table 4). The analysis yields a medium effect size (Cohen's *d*) for intrinsic value, and a small effect size for perceived effectiveness and intention to engage [38,39] (Table 4).

Figure 2. Boxplots, representing intrinsic value, perceived effectiveness and intention to engage median of both conditions (Circle and Breeze). Error bars indicate standard error of the median.

Table 4. Items of intrinsic value, perceived effectiveness and intention to engage were averaged of both condition (Circle and Breeze) to form a reliable scale. Standard deviation of the mean for each condition are given and *t* values, and *P* values, Cohen's *d* together with its 95% confidence interval is given.

	Circle	Breeze	<i>t</i> test		
	Mean (SD)	Mean (SD)	<i>t</i> (<i>df</i>)	<i>P</i> value	Cohen's <i>d</i> (CI 95%)
Intrinsic value	3.12 (0.73)	3.47 (0.58)	-3.34 (145)	.001	0.54 (0.21 to 0.86)
Perceived effectiveness	4.04 (0.57)	4.09 (0.50)	-0.67 (150)	.50	0.11 (-0.21 to 0.42)
Intention to engage	3.42 (1.08)	3.54 (1.01)	-0.77 (153)	.44	0.12 (-0.19 to 0.44)

Differences in Subdimensions Playfulness and Aesthetics

Multivariate analysis of variance (MANOVA) was performed to investigate the condition difference of the subdimensions of intrinsic values (playfulness and aesthetics). To reduce the risk of type I error a conservative alpha level was applied, as suggested by Cohen [37,40] and Chittaro et al [12].

Thus, a Bonferroni corrected conservative alpha level of .0125 was used, which was assessed by dividing the anticipated alpha level of .05 for the MANOVA by 4, which is the number of dependent variables included in the MANOVA.

The one-way MANOVA showed statistically significant difference between the two conditions on the combined dependent variables aesthetics and playfulness (Wilks' $\lambda = 0.915$, $F_{(2, 153)} = 7.083$, $P = .001$, $\eta_p^2 = 0.085$).

Subsequent univariate tests (with Bonferroni correction) yielded a significant difference for the aesthetics dimension ($P < .001$) between conditions, with Breeze yielding a higher value. For playfulness the difference was also higher for the Breeze condition. The difference, however, was not significant ($P = .041$).

Table 5. Subsequent univariate tests for the MANOVA on the condition differences for the subdimensions aesthetics and playfulness of the intrinsic value.

	Circle	Breeze	<i>F</i> test	
	Mean (SD)	Mean (SD)	<i>F</i> (df)	<i>P</i> value
Aesthetics				
	3.20 (0.80)	3.64 (0.67)	14.20 (154)	<.001
Playfulness				
	3.05 (0.82)	3.30 (0.74)	4.25 (154)	.041

Influence of Gaming Time and Meditation Experience

Furthermore, an explorative analysis of the influence of gaming time and meditation experience on the intrinsic value, perceived effectiveness, and intention to engage was conducted. The median of gaming time (>3 h/week) was used to assign participants into gamers (>3 h/week) and non-gamers (≤ 3 h/week). Furthermore, participants were classified as meditation experts if they responded with agree or strongly agree of being experienced in meditation. The mean intrinsic value for gamers was slightly higher in both conditions, yet not significantly, with 3.18 ± 0.65 compared to 3.06 ± 0.80 (non-gamers) for Circle ($P = .50$) and 3.51 ± 0.60 compared to 3.44 ± 0.56 (non-gamers) for Breeze ($P = .60$). For perceived effectiveness there was no difference between gamers and non-gamers for Circle with 4.06 ± 0.61 and 4.01 ± 0.54 ($P = .77$) and Breeze with 4.09 ± 0.58 and 4.10 ± 0.42 ($P = .87$). For intention to engage there was no significant difference between gamers and non-gamers for Circle with 3.47 ± 1.01 and 3.36 ± 1.16 ($P = .64$) and Breeze with 3.62 ± 1.07 and 3.48 ± 0.96 ($P = .52$). The Circle condition had similar mean intrinsic values of 3.13 ± 0.71 for meditation experts and 3.13 ± 0.74 for non-meditation experts ($P = .98$), and the Breeze condition mean intrinsic value significantly decreased ($P = .03$) from experts to non-experts with 3.78 ± 0.52 to 3.41 ± 0.57 . For perceived effectiveness there was no significant difference. Circle had a mean of 4.17 ± 0.46 (meditation experts) compared to 4.01 ± 0.59 (non-meditation experts) ($P = .21$), and Breeze 4.11 ± 0.76 (meditation experts) compared to 4.09 ± 0.44 (non-meditation experts) ($P = .94$). Intention to engage, showed a slight decrease for meditation experts with 3.64 ± 1.01 for Circle and 3.79 ± 0.89 for Breeze to non-meditation expert with 3.37 ± 1.10 for Circle and 3.49 ± 1.03 for Breeze. However, for both, Circle ($P = .37$) and Breeze ($P = .29$), the differences were not significant. Additionally, there seemed to be no moderator effect of gaming time (>3 h/week) or meditation expert (agree and strongly agree) on the relationship of intrinsic value, perceived effectiveness and intention to engage to condition

(Multimedia Appendix 6).

Discussion

Intrinsic Experiential Value and Intention to engage feedback

The intrinsic value for the Breeze visualization was found to be higher compared to the standard breathing training visualization Circle. Therefore, the gameful visualization was well received by the respondents and successfully found to raise the intrinsic value. The analysis of the subdimensions of intrinsic value, aesthetics and playfulness, showed that both subdimensions scored higher for Breeze. The dimension playfulness, however, did not increase significantly. It could be argued that this may be due to the fact that the video-delivered gameful breathing training visualization did not incorporate an interactive component. It is plausible that an interactive component of Breeze (eg, stronger acceleration of the boat when exhaling at the right time) might further elevate both subdimensions and thus, the intrinsic dimension of the experiential value as a whole. However, a stronger influence on playfulness than on aesthetics would be expected, since the aesthetics dimension is less strongly linked to interactive aspects. Nevertheless, further research is needed to confirm this.

In addition to higher scores in intrinsic value and its subdimensions, it was hypothesized that the Breeze condition would be associated with a higher intention to engage. This would have been an additional confirmation that the use of a gameful visualization in breathing training would potentially be beneficial for long-term engagement. However, the hypothesis could not be confirmed as no difference in intention to engage was observed between the two conditions. Nevertheless, these results are comparable to the results of a previous study [27], in which a small number of participants engaged in both, gameful and nongameful breathing training. That study also found only non-significantly increased values for intention to engage for gameful breathing training.

Consequently, it can be concluded that while a gameful visualization component results in a higher intrinsic value, it appears not to significantly increase the behavioral intention to engage with breathing training. At this time, it still remains unclear whether a gameful visualization component could help improve long-term engagement.

Perceived Effectiveness

The participants reported a clearly positive perceived effectiveness of the training. Furthermore, no significant differences were found regarding perceived effectiveness among the Breeze and Circle condition. Thus, the gameful visualization of Breeze had no impairing impact on the instrumental value of the breathing training, which is crucial as gamification should not reduce the instrumental value even if the experiential value increased [19,25]. These results are in line with our hypotheses and confirm results from previous work where the influences of gameful and nongameful breathing training on the physiological outcomes were investigated [27].

Gaming and meditation

No influence of gaming time per week ($\leq 3h$ or $> 3h$) was observed among conditions, as implied by the lack of significant differences in mean intrinsic value, perceived effectiveness, and intention to engage. Also, no effect was found for meditation experience on the relation to perceived effectiveness and intention to engage in both conditions. However, a significant difference ($P=.03$) between meditation experts and non-experts was found for intrinsic value in the Breeze condition. Hence, the gameful visualization was better received by meditation experts, but for the Circle condition no differences were found between the meditation subgroups. Nevertheless, the moderators of both, gaming time and meditation, had no influence on the relationship between the conditions regarding intrinsic value, perceived effectiveness, or intention to engage.

Limitations

This study was conducted with the users' feedback via video, and, therefore, did not contain biofeedback, as previous studies employing Breeze did [19,27]. Biofeedback is essential to provide individuals with real-time feedback information, so that they can adjust their behavior by modifying their physiological functions. As Cugelman suggested [41], biofeedback is a core ingredient with clear linkage to those proven behavior change strategies. Therefore, it is a crucial part of gameful breathing training, and thus, the inclusion of biofeedback should be further investigated.

Likewise, the evaluation of this study was solely based on perceived indicators and not on physiological measurements. Nevertheless, it can be argued that the online format allowed the exercise to take place in a more realistic setting, as participants were conducting the training in their daily lives rather than in an experimental setting.

The intrinsic dimension of experiential value, composed of playfulness and aesthetics, was chosen as the main outcome, because of the overlapping context of the appeal of the design and the emotions induced by the application [28]. However, questionnaire items were selected and slightly adapted to fit with this study. While the reliability analyses yielded scores in the acceptable reliability range [42] the score for intrinsic value in the Breeze condition was on the lower end of the acceptable range. Thus, the results regarding intrinsic value yielded acceptable reliability but should still be regarded with caution. To ensure comparability, perceived effectiveness and intention to engage were used in the same way as in previous studies [12,27]. Moreover, the factor analysis ensured the validity of the items of intrinsic value and perceived effectiveness. No factor analysis was conducted for intention to engage, as it only consisted of one item.

One main goal of Breeze is to enhance long-term usage [19]. While this study was able to show an increase in experiential value for gameful breathing training, a long-term study is necessary to allow to conclude whether this increase has a positive effect on long-term usage.

The subgroup analysis of gaming time per week and meditation experts was a secondary data analysis, and consequently not powered. Thus, further investigations will be necessary to confirm that gaming time and meditation experience do not have a large impact on the intrinsic value, perceived effectiveness, or intention to engage and whether Breeze is better received by meditation experts. However, this analysis provides a first insight and preliminary results of gaming time and meditation experience influence on the studied dimensions.

Finally, gamification may influence people with different backgrounds in different ways. Thus, cultural and social influences might affect the way gamification is best realized regarding breathing training [43]. This study did not take these potential influences into account since Breeze is not designed with a specific target group in mind and the participant recruitment process did not include any cultural or social parameters.

Future work

As this study was conducted as an online experiment, consisting of one session, the conclusions regarding long-term engagement are limited. Because of this, plans exist to test Breeze in future in a longitudinal field prototype with various patient populations, including healthy, vulnerable, and sick individuals that require breathing training for different purposes. Future studies might focus on students exhibiting exam stress or depression, and cancer and hypertension patients that suffer from distress.

Moreover, a study that includes biofeedback will be crucial to assess whether this technique has an advantageous effect on gamification, and consequently on behavior change [41].

Additionally, a collection of physiological data measurements next to the perceived indicators will be beneficial to evaluate the instrumental value of the breathing training. Other concepts, which could be integrated in further research are flow, user engagement, usability, or technology acceptance.

Conclusion

In this study, we evaluated the difference between a gameful and a nongameful breathing training guidance-visualization. Variables measured were intrinsic value representing experiential value, perceived effectiveness representing instrumental value, and intention to engage representing long-term engagement. The results yielded a positive effect by showing that the experiential value of Breeze was higher than the experiential value of Circle, without decreasing the instrumental value and the engagement. Subgroup analyses indicated no impact of gaming time (≤ 3 h and > 3 h per week) and meditation (experts and non-expert) on intrinsic value, perceived effectiveness or intention to engage. The only difference identified was that the gameful visualization was better perceived by meditation experts than by non-experts.

The outcomes showed that the intrinsic dimensions of the experiential value of a breathing training can be increased by employing gameful instead of nongameful visualizations without impairing the perceived effectiveness of the training.

Abbreviations

CROI: Consumer Return on Investment

MANOVA: Multivariate analyses of variance

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Conflict of Interest

YL, SK, VB, OK, EF, and TK are affiliated with the Centre for Digital Health Interventions, a joint initiative of the Department of Management, Technology, and Economics at ETH Zurich and the Institute of Technology Management at the University of St. Gallen, which is funded in part by the Swiss health insurer CSS. EF and TK are also the cofounders of Pathmate Technologies, a university spin-off company that creates and delivers digital clinical pathways. Pathmate Technologies is not involved in the study app described in this paper.

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Supplementary Files

Figures

Breeze, the developed gameful breathing training visualization.

Circle, the standard breathing training visualization.

Exercise instruction: Person on the left showing the exercise with enlarged smartphone screen of Breeze on the right. Participants in the Circle condition were shown a similar instruction video with Circle.

Boxplots, representing intrinsic value, perceived effectiveness and intention to engage median of both conditions (Circle and Breeze). Error bars indicate standard error of the median.

Multimedia Appendixes

Instruction video shown to the participants assigned to the Breeze condition.

URL: <http://asset.jmir.pub/assets/d9e6767f3038c5ef2cd2c3f5a318da72.mp4>

Instruction video shown to the participants assigned to the Circle condition.

URL: <http://asset.jmir.pub/assets/b0802614f252382b0b5d3f7d0dd6a75f.mp4>

Training video (6 minutes) shown to the participants assigned to the Breeze condition.

URL: <http://asset.jmir.pub/assets/d60b886a418a11705372619272219184.mp4>

Training video (6 minutes) shown to the participants assigned to the Circle condition.

URL: <http://asset.jmir.pub/assets/ad77fd42472dce3f50e84b4bfc99f436.mp4>

Employed questionnaire.

URL: <http://asset.jmir.pub/assets/7a881b86a9a7bf238ac0817ec2f1196d.docx>

Influence of gaming time and meditation experience on the investigated outcomes.

URL: <http://asset.jmir.pub/assets/144532517d5dda816b5560fd1a876449.docx>

TOC/Feature image for homepages

Person conducting breathing training using the developed gameful guidance visualization.