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Experiencing Presence in a Gaming Activity Improves Mood After a Negative Mood Induction

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ABSTRACT

Research suggests that immersion in computer games is beneficial for recovering from stress and improving mood. However, no study linked explicit measures of presence—individually experienced immersion—to mood enhancement. In the present experiment, immersion of a gaming activity was varied, and levels of presence and enjoyment were measured and connected to mood repair after a stress-induction. The participants (N = 77) played a game in virtual reality (VR; high immersion), on the desktop (medium immersion), or watched a recording of the game (low immersion). Positive emotions were enhanced in the high and medium, but not the low immersion condition. Presence was a significant predictor in the VR condition. Furthermore, an explanatory mediation analysis showed that enjoyment mediated the effect of presence on mood repair. These findings demonstrate positive effects of presence experiences in gaming. Strong presence in VR seems especially helpful for enhancing mood and building up positive emotional resources.

KEYWORDS

Computer Games, Enjoyment, Gaming, Immersion, Immersive Experiences, Mood Repair, Positive Emotions, Recovery, Virtual Reality

INTRODUCTION

In recent years, research about media use – especially *gaming* – has shifted its focus towards the investigation of positive effects (cf. Reinecke & Eden, 2016). A case in point is mood improvement. A number of authors suggest that interactive elements and high immersiveness of a computer game positively affect mood and may help to recover from work-related stress and strain (Bowman & Tamborini, 2012; 2015; Reinecke, Klatt, & Krämer, 2011; Rieger, Frischlich, Wulf, Bente, & Kneer, 2015). Interactivity and immersion are closely linked to *presence* – the feeling of *being there* in a mediated environment (Steuer, 1992; Witmer & Singer, 1998; Wissmath, Weibel, Schmutz, & Mast, 2011). Presence is often used synonymously with immersion (cf. McMahan, 2003). However, unlike interactivity and immersion, presence is a clearly defined term and is widely used in virtual reality

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(VR) and gaming research (cf. McMahan, 2003). As mentioned, it is believed that immersing oneself in the world of a computer game can have a positive effect on one's mood. Surprisingly, however, the role of presence has not yet been investigated in the context of mood repair and gaming. The present study aims to close this gap.

BACKGROUND

Presence has been described as mediated contents being experienced as real and one's self-awareness being immersed into another world (Draper, Kaber, & Usher, 1998). According to Lombard and Ditton (1997), presence is a perceptual illusion of non-mediation. Following a proposition by Slater and Wilbur (1997), the term presence is separated from immersion in more recent literature (Cummings & Bailenson, 2015; Hein, Mai, & Hußmann, 2018; Wu, Gomes, Fernandes, & Wang, 2018). Immersion is based on technical properties of the system and is objectively quantifiable. Presence, however, is the individual psychological response to the properties of the system (Norman, 2010; Wirth et al., 2007; Witmer & Singer, 1998). Empirical findings show that presence is indeed modulated by individual expectations and personality traits (Bucolo, 2004; Weibel, Wissmath, & Mast, 2010; 2011a; 2011b). This distinction will be used henceforth in this article by examining the influence of immersion (the characteristic of a computer game) as well as presence (the individual experience of immersion).

According to Reinecke (2009a; 2009b), the immersive experience (i.e. presence) is a key factor that accounts for the recovery experience of computer games. *Recovery* is a concept from organizational psychology and describes the renewal of depleted physical and psychological resources after phases of stress and strain (Sonnentag & Fritz, 2007; Sonnentag & Zijlstra, 2006). Sonnentag and Fritz (2007) proposed four central aspects of successful recovery: *Psychological detachment* (mental disengagement from work-related stress), *relaxation* (deactivation of arousal and increased positive affect), *mastery* (building up new internal resources through challenging experiences and learning opportunities), and *control* (increased self-efficacy and feelings of competence through experiencing personal control). The results of Reinecke (2009a; 2009b) suggest that presence goes along with psychological detachment, which contributes to the recovery experience of gaming activity. Additionally, entertaining media are an ideal way to stop negative cognitions and preventing episodes of rumination by letting their users immerse in the mediated environment. This is in line with Tamborini and Skalski (2006) who suggest that playing computer games requires the full attention of the player and strongly binds cognitive capacities to the screen, what in turn leads to a highly immersive experience. Games also often require taking over new roles (Bessière, Seay, & Kiesler, 2007) and experiencing fictional worlds (Yee, 2006). They provide opportunities to control the progress of events or characters (Klimmt & Hartmann, 2006) and to experience feelings of autonomy, challenge, and competition (Klimmt & Hartmann, 2006; Ryan, Rigby, & Przybylski, 2006). Thus, computer games contribute to all four aspects of successful recovery and are likely to enhance mood and support recovery form stress and strain (Collins & Cox, 2014; Reinecke, 2009a; 2009b; Reinecke et al., 2011).

Empirical investigations into the role of computer games in recovery are provided by three correlational online studies. In two studies by Reinecke (2009a; 2009b), levels of work-related fatigue and exposure to daily hassles were positively related to the use of games for recovery. Thus, participants who associated playing games with recovery played more extensively after stressful events. In addition, Collins and Cox (2014) found a relation between the amount of gaming activity and recovery from work-related stress.

In experimental studies, *interactivity* was manipulated by comparing active gaming with watching gameplay recordings and videos. There is no consensus about the definition of interactivity (cf. Smuts, 2009), but the respective authors focused on "active participation of the player" and having "control over the progress" of the game (Collins, Cox, Wilcock, & Sethu-Jones, 2019; Reinecke et al., 2011). As such, interactivity shares strong similarities with the immersion of games. In these experiments, interactivity has been shown to play a crucial role in recovery. Recovery in turn was shown to affect other measures such as cognitive performance (Reinecke et al., 2011) and enjoyment (Reinecke et al., 2011; Tamborini, Bowman, Eden, Grizzard, & Organ, 2010; Tamborini et al., 2011). In the study by Reinecke and colleagues (2011), a repetitive and tedious working task was used to induce a need for recovery. Participants were then assigned to one of four conditions that varied in interactivity (video game, recording of a video game, an animated video clip, and a control condition). The degree of interactivity of the condition positively affected the *involvement* in the game. Involvement was measured with the involvement subscale of the presence-questionnaire by Witmer and Singer (1998). Therefore, involvement is part of the presence experience as defined by Witmer and Singer. Involvement was positively associated with recovery, which in turn was positively associated with enjoyment. In a recent study, Collins et al. (2019) found that only a digital game condition could improve recovery as opposed to a mindfulness app and a non-media condition. Tamborini et al. (2010; 2011) showed that recovery through gaming was positively associated with enjoyment. Recovery in these studies was operationalized with need satisfaction (cf. Reinecke et al., 2011). Taken together, previous research on recovery from work-related stress has demonstrated that interactivity, and thus also likely immersion, supports recovery and that feelings of presence and enjoyment could serve as important individual enhancing factors for successful recovery. However, the different contributions of a game's immersion and the individual presence experience have not been worked out so far.

Instead of recovery from work-related stress, yet other studies used *mood repair* as a measure of the immediate effect of gaming on current mood. This approach is mainly inspired by mood management theory (Zillmann, 2000). Mood management assumes that individuals seek to avert negative mood and maximize positive mood by selecting appropriate media (Bryant & Zillmann, 1984; Knobloch & Zillmann, 2002; Mastro, Eastin, & Tamborini, 2002). Thus, mood repair is defined as the change in positive and negative mood after an intervention to regain an "optimal" state of mood (Bowman & Tamborini, 2012, p. 1339). In two studies by Bowman and Tamborini (2012; 2015), the task demand of a computer game was manipulated in order to influence mood repair (task demand is similar to the concept of interactivity, according to the authors). The results of both studies showed a curvilinear effect of task demand on mood repair, meaning that a medium level of task demand was evoking the strongest mood repair (Bowman & Tamborini, 2012; 2015). In a study by Rieger et al. (2015), high interactivity (i.e. gaming compared to watching a recording of the game and a control condition) was positively associated with mood repair. Positive emotions generally increased across conditions, whereas negative emotions only decreased in the highly interactive condition. The same result was previously obtained in a study by Chen and Raney (2009).

Even though immersive experiences were postulated to affect mood and recovery and related concepts such as involvement, interactivity, or task demand were empirically investigated, there is a lack of studies that differentiate between immersion and presence. Particularly, there is a lack of studies that specifically link subjective immersion in the sense of *presence* (being there in a mediated environment; Steuer, 1992) with mood repair or recovery after playing video games. Presence is of great importance in VR research as a VR display completely surrounds the user with another world as opposed to a desktop display that provides a discontinuity between the screen and the user in front of the screen (Slater & Wilbur, 1997) According to Steuer (1992), presence is the underlying concept of VR. Thus, it is important to include VR conditions in the study of stress recovery and mood repair in order to understand the impact of presence. However, surprisingly, no study so far has manipulated presence with a VR gaming condition.

A few studies have assessed presence in the context of relaxation tasks in a nature setting specifically designed to induce stress recovery or *restoration* (e.g. de Kort, Meijnders, Sponselee, & IJsselsteijn, 2006; Sponselee, de Kort, & Meijnders, 2004). Restoration was defined as renewing resources, enhancing the ability to focus one's attention, reducing stress, and promoting positive affect (cf. de Kort et al., 2006). These studies show a beneficial effect of presence on reducing stress and enhancing mood. It would be of high interest to study presence also in the context of computer games as it is an important concept in the gaming community and has been shown to be one of the driving factors for playing computer games (Yee, Ducheneaut, & Nelson, 2012). Jennett et al. (2008, p. 644) even describe it as being "key to a good gaming experience". As Reinecke (2009a; 2009b) pointed out, immersive experiences in games (i.e. presence) are also crucial for the recovery experience. However, empirical findings for this claim are sparse and none of the reported studies explicitly measured presence. Thus, in the present experiment, an explicit measure of presence was used and it was linked to mood repair following a phase of computer gaming. To induce increased variability in presence and to look at differences between the immersion of conditions, the mode of presentation of the gaming activity was manipulated, including a VR condition. This study is the first to include a VR condition in the context of gaming and mood improvement. Again, the available literature is mainly based on research on VR therapy and stress reduction in relaxing virtual environments (VEs). Although, results of these studies show a clear effect of presence in VEs on stress reduction and mood enhancement, it is not clear whether computer games would elicit the same effect (e.g. Annerstedt et al., 2013; Freeman, Lessiter, Keogh, Bond, & Chapman, 2004; Liszio, Graf, & Masuch, 2018; Valtchanov & Ellard, 2010; Villani & Riva, 2012; Villani, Riva, & Riva, 2007; Villani, Luchetta, Preziosa, & Riva, 2009; for an overview see Villani, Cipresso, Gaggioli, & Riva, 2016).

Thus, the aims of the present study were 1) to link presence with mood repair following a gaming experience, 2) to differentiate between the effect of individual experienced presence and the effect of immersion as a property of the system, and 3) to add a VR gaming condition. For this purpose, 77 participants underwent a stress-induction to create a need for mood repair. Afterwards, they were assigned to one of three immersion conditions in which they either played a computer game in VR using a Head-mounted display (HMD), played the same game on a desktop computer, or – in a control condition – watched a recording of the same game. To assess mood repair after the respective experience, mood ratings before gaming (after the stress-induction, respectively) and after gaming were assessed and both measures were compared. The individual level of presence was assessed with a questionnaire. A measure of enjoyment was also included since enjoyment was shown to be related to recovery or need satisfaction and involvement (Reinecke et al., 2011; Tamborini et al., 2010; 2011). Additionally, Wirth et al. (2007) proposed that presence acts as a booster of media effects such as enjoyment. Thus, relationships between enjoyment, individual presence and mood repair were explored.

In accordance with the literature review above, the authors stated the following hypotheses:

Hypothesis One: The higher the immersion of the gaming activity, the stronger the effect of mood repair.
Hypothesis Two: The higher the level of individual presence, the stronger the effect of mood repair.
Hypothesis Three: Enjoyment is positively related to (a) mood repair and (b) presence.

Insights into these issues could help us to better understand the potential of computer games as a means for mood repair and the role of presence.

METHOD

Participants

77 participants (24 male and 53 female) took part in the experiment. Five participants were excluded because they guessed the hypotheses (see Procedure for details). The average age was 23.1 years (*SD* = 5.7 years). Participants received either course credit or a little token of appreciation (chocolate bar) for their participation and were debriefed after the experiment. The study was approved by the ethics committee of the Human Sciences Faculty of the University of Bern and participants were treated according to the declaration of Helsinki (World Medical Association, 1991).

Design

A mix of group comparisons and correlational analyses was used. On the one hand, groups were used to investigate influences on mood ratings in terms of immersion. On the other hand, the relationship between mood ratings and individual presence scores of participants across conditions was explored. Participants were randomly assigned to one of three groups: *VR*, *desktop*, and *video* condition. The conditions varied in the level of immersion, with the *VR* condition having the highest immersion and the *video* condition having the lowest immersion. Using a meta-analysis, Cummings and Bailenson (2015) demonstrated that the level of immersive quality of a system leads to higher experienced presence, which especially applies to the level of user tracking and the use of stereoscopic visuals. Thus, the *VR* condition should evoke the highest presence levels. Additionally, two studies have shown that actively playing a game evoked more presence than watching a pre-recorded playing session (Kätsyri, Hari, Ravaja, & Nummenmaa, 2013; Wong, Rigby, & Brumby, 2017). Nevertheless, watching pre-recorded video games can still lead to feelings of presence (Collins et al., 2019; Wong et al., 2017), which means that all conditions should lead to at least some degree of presence and that the average level of presence should vary between conditions.

The *VR* and *desktop* conditions involved playing the game *Star Conflict*, with ($n = 31$) and without the addition of an HMD ($n = 29$). The *video* condition required participants to watch a recording of the same game ($n = 17$). See Material below for more information. Different subsample sizes were obtained because the *video* condition was later added as a control condition. However, unequal group size is not a requirement for simple group comparisons (i.e. non-factorial designs; cf. Miliken & Johnson, 1984). The possible loss of statistical power implies a conservative testing of the hypotheses. For correlational analyses, data points were weighted according to the size of the group (cf. Meinck & Rodriguez, 2013) or included the condition as a factorial variable.

The measured variables were feelings of *presence* while playing, ratings of momentary mood (*positive* and *negative*), and *enjoyment*. Before being randomly assigned to a condition, participants had to undergo a stress-induction procedure. Differences between mood ratings before and after the procedure served as a check whether the stress-induction worked as expected. In order to assess *mood repair*, differences in positive and negative mood ratings between after the gaming activity and after the stress-induction were computed. Mood repair was defined as a change of mood ratings in the desired direction (positive values indicating an increase in positive mood and a decrease in negative mood). A summary of the experimental design is shown in Figure 1.

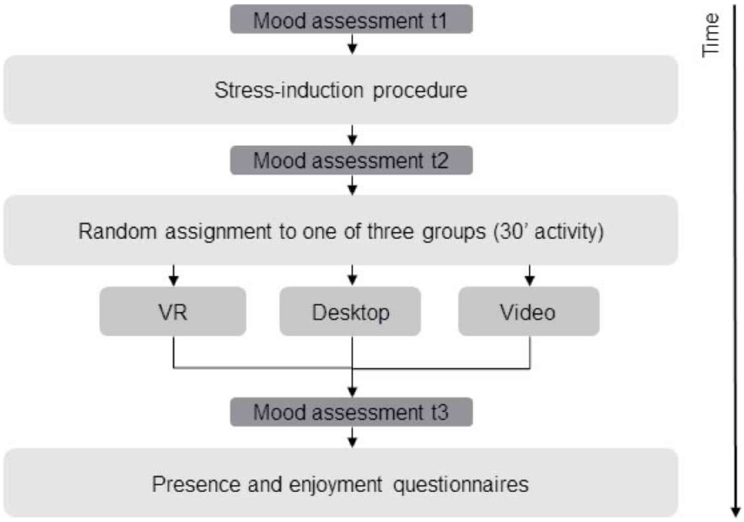
Material

Stimulus Material

The game *Star Conflict* was used (Star Gem Inc., 2015). Star Conflict is a "fast-paced, third person space shooter, allowing players to sit at the helm of a starship and take part in high-octane skirmishes for control of ancient alien artefacts" (Star Conflict Wiki, 2015). The game involves elements of strategy and action. Five subjects that were tested in a pilot test prior to the actual experiment described the game as non-violent and fun to play. Whereas the original game is a multiplayer online game, in this study only the initial tutorials of the game were used, where participants learned to control the ship and how to take over an enemy base. The authors chose the game because full technical support for playing in VR was given and it was freely available. Furthermore, the game is described as highly immersive by players in online forums (Oculus VR, 2015). Additionally, the genre of the game is suitable for detecting effects on mood enhancement: Collins and Cox (2014) showed that first person shooters and action games were most highly correlated with recovery experiences, whereas the recovery potential of sports games turned out to be lower.

For the desktop and the video condition, a commonly available gaming notebook with a 15.6-inch LED screen was used (resolution: 1920 x 1080 pixels). In the VR condition, participants played with

Figure 1. Graphical representation of the procedure



the Oculus Rift DK 2 (Oculus VR, 2014). Both active playing groups used an Xbox 360 controller (Microsoft Corporation, 2005) as input device.

Stress-Induction

Two stress-induction procedures suggested by Bauer, Pripfl, Lamm, Prainsack and Taylor (2003) and McLaughlin, Lefaivre and Cummings (2009) were combined. The resulting procedure comprised an anagram task and a number series task, each consisting of five items. Participants had to find solutions within a given time period of ten minutes. All items were unsolvable or almost unsolvable, except for one item in each task, which was included for plausibility. Participants were motivated to perform well by putting a chocolate bar in front of them. They were informed that they would receive the bar depending on the score in the test. They were told that most participants usually achieved the required score (cf. Henna, Zilberman, Gentil, & Gorenstein, 2008). After returning the response sheet, participants were told that they did not score high enough for receiving the chocolate bar.

Measurement Instruments

Mood Repair

Momentary mood was assessed using the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Mood repair was then computed as the difference between the post-game mood ratings and the pre-game mood ratings (t3 – t2). The authors refer to decreases in negative mood as *mood repair in negative emotions* and to increases in positive mood as *mood repair in positive emotions*. The PANAS is one of the most used measures to assess current mood and emotions (Watson & Vaidya, 2003). Previous studies suggest that it is a useful measure to assess sudden changes in mood (e.g. Russell & Newton, 2008). Participants in the present study gave ratings on an analog scale (measured in cm with a range of 0 to 13 cm) for ten positive and ten negative adjectives (e.g. *alert* or *determined* as positive and *upset* and *ashamed* as negative adjectives). In the present study, the reliability of the scales was Cronbach's $\alpha = .86$ for positive and Cronbach's $\alpha = .84$ for negative emotions.

Presence

Feelings of presence were obtained by the Pictorial Presence SAM questionnaire (Weibel, Schmutz, Pahud, & Wissmath, 2015). The SAM questionnaire – which was inspired by the widely used Self-Assessment Manikin to measure emotion (Lang, 1980) – was recently developed to assess presence intuitively and unambiguously. It has been shown to be a valid and sensitive measure for assessing spatial presence (Weibel et al., 2015). For six items representing the sensation of presence, participants choose one of five graphical representations that best matches their sensations. In the present study, the SAM questionnaire showed a sufficient reliability with Cronbach's $\alpha = .67$.

Enjoyment

In line with various other studies (Green, Brock, & Kaufman, 2004; Knobloch & Zillmann, 2002; Weibel et al., 2011; Weibel, Wissmath, & Stricker, 2011c) enjoyment was measured with one single item: "On a scale from one to ten, how much fun have you had?" (1 = *no fun at all*; 10 = *a lot of fun*).

Procedure

In order to assure the feasibility of the procedure, participants were told that the study served the purpose to relate their ability to solve a rule-based cognitive task with their ratings of presence in a gaming task. Furthermore, they were told that the ratings of current emotions would serve as a control variable.

The procedure of the experiment is summarized in Figure 1. First, participants filled out the PANAS. Then they were introduced to the anagram and the number series task. They had ten minutes to complete the tasks. After explaining the results of the test, participants filled out the PANAS again in order to test whether the stress-induction was successful. Next, participants were randomly assigned to one of the three experimental conditions. First, the handling of the controller was explained. Furthermore, in the *VR* condition, they were instructed on how to use the HMD and were told to immediately report any feelings of nausea. Participants were asked to freely play the game or watch the recording. The duration of this phase was 30 minutes in each condition. Afterwards, participants filled out the PANAS a third time in order to test whether playing the computer game led to mood repair. Finally, participants filled out the presence scale and answered the enjoyment question, followed by a demographic questionnaire. The authors carefully interviewed each participant after the experiment to make sure not to include participants who guessed the hypotheses. Only five participants reported that they drew a link between the gaming task and the mood questionnaires and were therefore excluded. Upon completion of the experiment, the participants were debriefed.

RESULTS

Strategy of Analyses

Two different approaches were used to test the hypotheses: In an experimental approach, the three experimental conditions were compared in terms of positive and negative mood repair, presence, and enjoyment, using one-way analyses of variance (ANOVAs) or Kruskal-Wallis tests. In a correlational approach, measures of association between individual levels of presence, enjoyment, and mood repair were calculated. Group-size-weighted bivariate correlations with Pearson coefficients were used. Additionally, a moderated regression model was calculated to differentiate the effect of individual presence on mood repair from the group-level effect of presence. This is important because of the hierarchical structure of the data: Individual presence and mood repair are nested in the three conditions and, thus, the overall level of presence and mood repair could vary between groups (contextual effect). Therefore, analyzing the effect of presence only on the individual level would potentially result in a *Simpson's paradox* (cf. Ameringer, Serlin, & Ward, 2009). An exploratory mediated regression model to test whether enjoyment serves as a mediator variable between presence and mood repair

Table 1. Descriptive statistics for variables across all conditions

Variable	*min*	*max*	*M*	*SD*
Enjoyment	1	10	5.70	2.75
Pictorial Presence SAM	1.00	5.00	3.40	0.85
Mood repair in positive emotions	-2.21	7.46	0.80	1.84
Mood repair in negative emotions	-1.18	9.10	1.27	1.61
Enjoyment	1	10	5.70	2.75
Pictorial Presence SAM	1.00	5.00	3.40	0.85

Notes: N = 76 for Pictorial Presence SAM and 77 for all other variables

is also reported. Since mood repair in positive and negative emotions were both left skewed, a log-transformation with an added constant on both variables was performed. This way normally distributed residuals for the correlational analyses were obtained.

Descriptive Statistics

A summary of descriptive statistics for the whole sample is presented in Table 1. All but six participants had never used an HMD before. Additionally, the average time participants spend playing computer games in a week was 66 minutes ($SD = 164$ minutes).

Manipulation Checks

To examine the stress-induction procedure, differences in the PANAS ratings before and after the stress-induction (t2 – t1) were analyzed. As expected, the mean value for positive emotions after the stress-induction ($M = 6.41$, $SD = 2.37$) was lower than the baseline mean value assessed before the stress-induction ($M = 7.42$, $SD = 1.85$). This indicates that the stress-induction for positive emotions was successful, $t(76) = -6.81$, $p < .001$, $d = -0.78$. Similarly, ratings for negative emotions were higher after the stress-induction ($M = 2.70$, $SD = 2.08$) than before the stress-induction ($M = 1.57$, $SD = 1.33$), $z = 2652$, $p < .001$, $d = 0.67$ (a Wilcoxon signed-rank test was used because residuals were not normally distributed).

A one-way Kruskal-Wallis test was used to assess differences in presence scores between conditions for the SAM questionnaire because residuals were not normally distributed. This served as a check whether the manipulation of designated immersion worked as intended. The test revealed a significant effect, $\chi^2(2) = 19.0$, $p < .001$, $\varepsilon^2 = 0.25$. Post hoc comparisons (Dwass-Steel-Critchlow-Fligner) showed that presence scores were lower in the *video* condition compared to the *desktop* and *VR* conditions (both $p < .01$). Descriptively, there was a linear trend, which suggests that the higher the intended immersion of the condition, the more presence was reported by participants. This is in accordance with expectations. Presence scores for each condition are shown in Figure 2.

A one-way ANOVA revealed also a significant difference between conditions in enjoyment, $F(2, 74) = 12.2$, $p < .001$, $\eta_p^2 = 0.25$. Post-hoc comparisons (Tukey) indicated that the *video* condition involved lower enjoyment compared to the other conditions (both $p < .001$). Enjoyment scores for each condition are shown in Figure 3.

Testing the Hypotheses

Hypothesis One: The higher the immersion of the gaming activity, the stronger the effect of mood repair.

Figure 2. Mean presence SAM scores for each condition. Error bars represent standard errors. Significance codes: ** p < .01, *** p < .001.

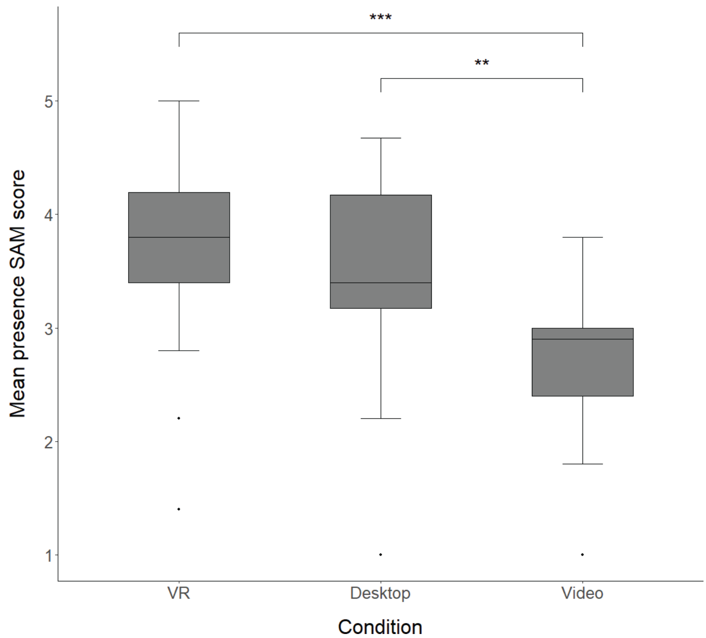


Figure 3. Mean enjoyment scores for each condition. Error bars represent standard errors. Significance codes: ** p < .01, *** p < .001.

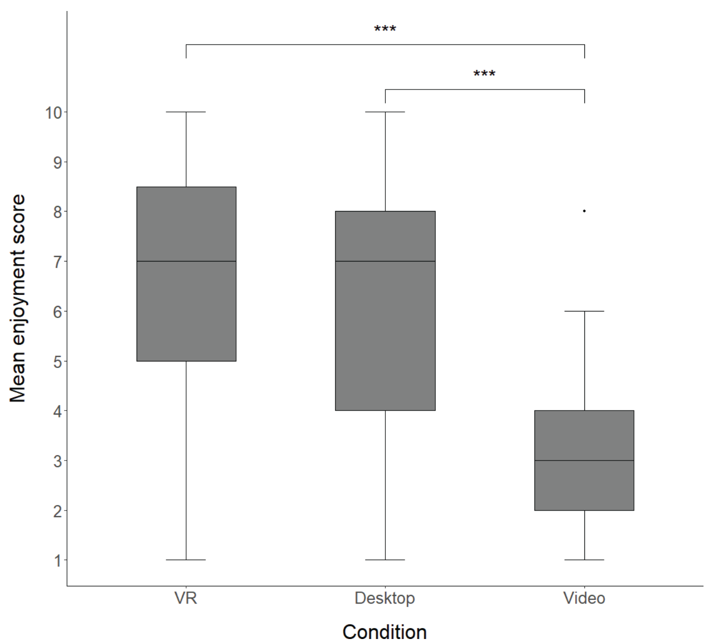
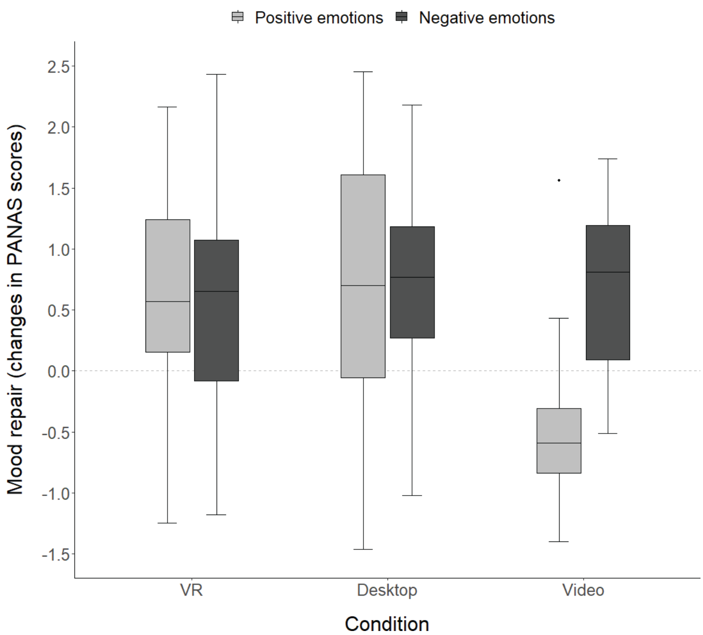


Figure 4. Mood repair in positive and negative emotions in each condition. In terms of positive emotions, stronger mood repair was found for the two gaming conditions compared to the video condition. Note that decreases in negative emotions (i.e. change in the desired direction) are shown as positive values to facilitate interpretation. Error bars represent standard errors.



Mood ratings were investigated to test the first hypothesis. Overall, there was a change in emotional ratings from before gaming to afterwards across conditions for positive, $t(76) = 3.82$, $p < .001$, $d = 0.44$, and negative emotions, $t(76) = -6.90$, $p < .001$, $d = -0.79$ (see Table 1 for descriptive statistics). This means that overall, a significant effect of mood repair in positive and negative emotions could be observed. In line with the first hypothesis, the strength of mood repair depends on immersion: There was a significant difference in the change of positive emotions between conditions, $F(2, 74) = 5.18$, $p = .008$, $\eta_p^2 = 0.12$ (see Figure 4). A planned contrast revealed that the *video* condition differed from the other conditions, $p = .002$. Successful mood repair in positive emotions could only be observed in conditions involving active gaming (see descriptive statistics in Figure 4: There was a decrease in positive emotions for the *video* condition). There was, however, no differential effect for mood repair in negative emotions between conditions, $F(2, 74) = 0.21$, $p = .811$, $\eta_p^2 = 0.01$ (see Figure 4). This means that the strength of mood repair was affected by the condition only in positive emotions, which partially supports the first hypothesis.

Hypothesis Two: The higher the level of individual presence, the stronger the effect of mood repair.

Weighted bivariate correlations were computed using the *weights* package in *R* (Pasek, 2018; R Core Team, 2019). The results show that individual presence is related to mood repair in positive emotions but not in negative emotions (see Table 2 for an overview). This means that a higher individual presence rating was associated with stronger mood repair in positive emotions. This partially supports the second hypothesis stating that individual presence levels enhance mood repair.

To control for a potential Simpson's paradox, moderated regression models with presence as a linear predictor and immersion as a factorial predictor were calculated. The dependent variables were mood repair in positive and negative emotions. The results for positive emotions are shown in Table 3. The model for negative emotions yielded no significant prediction of mood repair ($R^2 = .08$,

Table 2. Bivariate weighted correlations between variables (across conditions)

	1	2	3	4
1. Mood repair in positive emotions	-			
2. Mood repair in negative emotions	.20	-		
3. Pictorial Presence SAM	.34**	.14	-	
4. Enjoyment	.52***	.12	.51***	-

Notes: * p < .05, ** p < .01, *** p < .001 (one-tailed). All p-values were adjusted using the Bonferroni method. Mood repair in positive and negative emotions was log-transformed to obtain normally distributed residuals. N = 76 for Pictorial Presence SAM and 77 for all other variables

Table 3. Mood repair in positive emotions predicted by presence (focal predictor) and immersion (moderator)

Predictor	*b*	SE	95% CI	Predictor
Intercept	0.33	0.07	0.19	0.46
Presence	-0.06	0.07	-0.20	0.08
Desktop condition	0.25	0.08	0.10	0.40
VR condition	0.18	0.08	0.03	0.34
Presence x desktop condition	0.11	0.08	-0.06	0.27
Presence x VR condition	0.21	0.08	0.04	0.38

Notes: $R^2 = 0.27$, $F(5, 70) = 5.18$, $p < .001$. The video condition was used as the reference group (dummy coding). Presence was centered. Mood repair in positive emotions was log-transformed in order to obtain normally distributed residuals

$F(5, 70) = 1.14$, $p = 0.346$). A simple slope analysis revealed that presence predicted mood repair in positive emotions only in the VR condition ($b_{VR} = 0.15$, $p = 0.002$; other slopes both $p > 0.05$; see Figure 5). Therefore, the positive effect of individual presence on mood repair in positive emotions was limited to the VR condition.

Hypothesis Three: Enjoyment is positively related to (a) mood repair and (b) presence.

Enjoyment was positively associated with mood repair in positive emotions but not negative emotions (see Table 2). Enjoyment was also positively associated with presence. Thus, hypothesis 3a was partially and hypothesis 3b fully supported.

To further investigate the relationship between the variables presence, enjoyment and mood repair in positive emotions, an explorative mediation model using the *jAMM* module in *jamovi* (Gallucci, 2019; The jamovi project, 2019) was performed. This tested whether enjoyment mediates the relationship between individual presence and mood repair in positive emotions. To again control for possible contextual effects, the immersion of the condition was entered as an additional explanatory variable (all possible moderation effects of immersion were non-significant and were therefore not included in the final model). An overview is provided in Figure 6. The results show that the relationship between presence and mood repair in positive emotions is mediated by enjoyment. The unstandardized regression coefficients between presence and enjoyment and between enjoyment and mood repair in positive emotions were statistically significant. The indirect effect was tested using bootstrapping procedures (1000 samples) as proposed by Hayes (2017). The unstandardized indirect effect of presence on mood repair in positive emotions was significant, $B = .29$, $SE = .14$, 95% $CI = .07, .62$. There was, however, no total and no direct effect of presence on mood repair in positive emotions (both $p > .05$). These results are consistent with indirect-only mediation (Zhao, Lynch, &

Figure 5. Simple slope analysis for the effect of presence on mood repair in positive emotions. Only the simple slope in the VR condition was significant (p = .002).

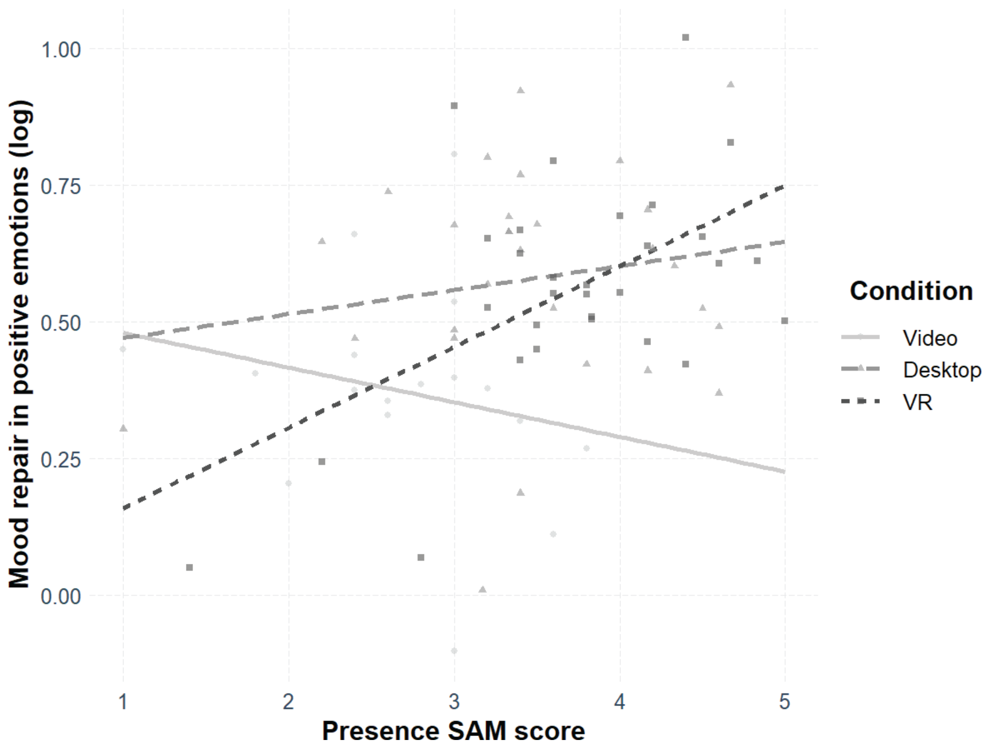
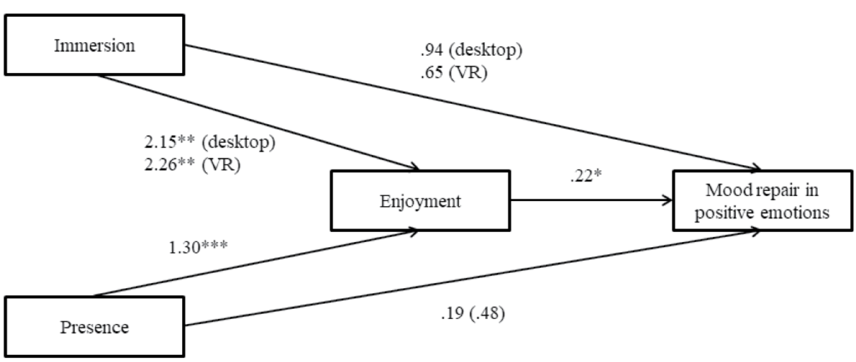


Figure 6. Unstandardized regression coefficients for the relationship between presence and mood repair in positive emotions as mediated by enjoyment. Immersion was entered as an explanatory variable to control for contextual effects. This categorical independent variable is shown with only one rectangle, but its effects are estimated using contrast variables (dummy coding with the video condition as reference category). Presence was centered. Covariances among independent variables are estimated but not shown. The total effect between presence and mood repair is in parentheses. Bias-corrected bootstrapping (1000 samples) was used to obtain p-values. *p < .05, **p < 0.01, ***p < 0.001.



Chen, 2010). The indirect effects of the immersion conditions on mood repair in positive emotions were not significant (both $p > .05$).

CONCLUSION

The present study investigated whether immersive gaming conditions led to improved mood repair after a stress-induction and whether the individual level of presence was associated with better mood repair. High immersion was operationalized with a VR gaming condition, medium immersion with a desktop gaming condition, and low immersion with a passive video condition. Supporting the authors' expectation, the level of presence varied between the conditions, with the *VR* condition evoking the highest levels and the *video* condition evoking significantly lower levels than the two active gaming conditions. The active gaming conditions were also evoking higher levels of enjoyment and stronger mood repair in positive emotions. This supports the idea that immersion in video games improves the overall state of mood after episodes of stress. However, whereas negative emotions generally decreased after the gaming activity, the immersion of the condition and the individual level of presence did not affect mood repair in negative emotions. Furthermore, using a moderation analysis, the present study could show that the individual level of presence was a significant predictor for mood repair in positive emotions, after controlling for immersion. However, presence only led to significantly improved mood repair in the VR condition. Finally, using an exploratory mediation analysis, the present study showed that only the individual level of presence led to improved mood repair in positive emotions by evoking higher levels of enjoyment (indirect-only mediation). Immersion was also associated with higher enjoyment but showed no indirect effect on mood repair.

The main result of the present study is that individual presence levels are favorable for attaining an overall improved mood state. This provides empirical support for the claim that presence experiences in gaming enhance well-being and mood (Collins & Cox, 2014; Reinecke, 2009a; 2009b; Reinecke et al., 2011). Previous research has linked effects of mood enhancement to the extent of experienced presence in relaxing VR environments (e.g. Freeman et al., 2004; Villani et al., 2007; Villani et al., 2009). The results from the present study suggest that presence contributes to mood repair not only in immersive environments designed to be relaxing, but also in games. The present study could show that presence was associated with mood repair in positive emotions. There seemed to be a weak association with mood repair in negative emotions, but this finding did not reach statistical significance. After controlling for immersion, the present study could demonstrate that individual presence affects mood repair in positive emotions independent of the differences between the conditions. However, this effect was limited to the *VR* condition. In the *desktop* condition, there was a small but non-significant effect, and in the *video* condition, the effect was negative but also non-significant. A possible explanation for these results is that presence plays a more important role in an immersive virtual world. This means that gaming itself is crucial for improved mood and that presence only enhances mood in VR gaming. Potentially, presence is only beneficial for mood repair if it is relevant for the respective medium: A simple yet non-immersive game can still evoke strong enjoyment in players, whereas a game like Star Conflict relies on immersive gameplay features to involve the user in the game narrative, which then leads to enjoyment. The immersive elements are even more important if the world is supposed to appear convincingly realistic as in a VR condition. A floor effect in the *video* condition could serve as an alternative explanation: the *video* condition was not able to lead to large enough presence and enjoyment scores to improve mood. Indeed, there were no high presence scores for the *video* condition (the highest score was 3.80). Additionally, very high scores (> 4.5) were mainly observed in the *VR* condition. Thus, it is possible that presence scores were not high enough in the *desktop* condition to evoke an individually increasing effect on mood repair, whereas the *VR* condition provided participants with the opportunity to experience large increased presence scores, leading to highly improved mood. There are also other possible explanations and additional studies using VR gaming are needed to confirm the results.

Apart from the effect of presence on mood repair, the results from the present study also confirm previous findings: A gaming activity led to an overall improved mood state after a stress-induction (cf. Collins & Cox, 2014; Reinecke 2009a; 2009b). The size for this effect was small to medium in positive emotions (0.44) and large in negative emotions (-0.79; Cohen, 1988). As in previous studies, active gaming led to an overall improved mood state compared to watching a video (Chen & Raney, 2009; Collins et al., 2019; Reinecke et al., 2011; Rieger et al., 2015). Thus, positive mood only increased in the gaming conditions. There was no difference between the VR and the desktop condition, which means that VR as a medium might not be overall better at improving mood than desktop gaming, despite offering a higher potential for strong presence experiences. It is possible that the interactivity of active playing led to already strong mood repair in the gaming conditions and that the VR condition was simply not offering an additional benefit in the present study. After all, Star Conflict is described as fun to play in online forums (Oculus VR, 2015). This assumption could be tested in future studies by comparing VR and desktop conditions using games with different potentials for mood improvement.

In contrast to the active gaming conditions, positive mood showed a small decrease in the video condition. Generally, this is in line with the authors' expectations but could indicate that watching a pre-recorded gaming session does not provide a boost in positive emotions. This is an important finding because watching others playing games on YouTube, Twitch.tv, or at e-sports tournaments is increasingly popular among gamers (Gandolfi, 2016; Smith, Obrist, & Wright, 2013). Studies suggested that watching such videos involves experiences of presence (Collins et al., 2019; Wong et al., 2017). In a previous study by Chen and Raney (2009), the increase in positive mood was higher in an interactive condition but was also positive in a non-interactive condition and a control condition. Rieger et al. (2015) found a similar increase of positive emotions in all interactivity conditions. In contrast to positive emotions, negative emotions in the experiment decreased in each condition to about the same amount, indicating no advantage of active gaming and VR technology. Interestingly, previous studies (Chen & Raney, 2009; Rieger et al., 2015) found that negative emotions did not decrease in a non-interactive condition but only in an interactive condition. Thus, the *video* condition in the experiment showed a surprising decrease in negative emotions but also a decrease in positive emotions. A reason for this could be the different choice of games. Star Conflict probably involves more action and strategy than games used in previous studies, which could enhance the potential for increasing positive emotions. Another reason could lie in different measurements of mood repair: Rieger et al. (2015), for example, operationalized positive and negative mood with measures for happy and depressed mood. In contrast, the PANAS questionnaire, which was used in the present study, is targeted at more general mood states, including items such as *attentive* and *nervous*. However, the *video* condition in the present experiment evoked also less presence and enjoyment scores than the active gaming conditions. This is in line with anecdotal reports of participants. It is plausible, therefore, that the low overall enjoyment of the video led to the unimproved positive mood. Additionally, there was arguably a lack of competition in the *video* condition. According to Reinecke (2009a; 2009b), successful recovery demands for a task structure that enables competence and mastery experiences. The same could be true for mood repair. As for negative mood, it is possible that negative emotions decreased naturally over time. It is not possible to separate the effect of time from the overall effect of the gaming activity since there was no non-medium control condition. Thus, further studies should investigate the specific advantage of watching others play by contrasting it with a non-medium control condition.

Another important point is that no meaningful associations involving mood repair in negative emotions were found. Interestingly, the two measures of mood repair showed no substantial correlation. Negative emotions could, therefore, activate other processes than positive emotions. It is possible that gaming is especially helpful for restoring positive affect but not as effective as previously thought in reducing negative affect. Interestingly, recent findings from organizational psychology provide evidence that recovery from work-related stress goes beyond the replenishing of depleted resources and involves preemptively building up resources to increase coping capabilities and to avoid future loss of resources (Conservation of Resources Theory; Hobfoll, 1989; cf. Reinecke & Eden, 2016). Thus, preemptively building up a positive mood state by increasing positive emotions could be more functionally relevant for gamers and more easily achievable than eliminating negative emotions. It is worth noting, however, that previous studies did find a beneficial effect of gaming for negative emotions. Context (i.e. the type of game and the method for inducing a negative mood state) could play an important role. This discrepancy should be addressed in further research by specifically comparing the effects of positive and negative mood repair and by varying the type of computer game and other variables such as the length of media exposure.

Lastly, the present study showed that enjoyment mediated the effect of presence on mood repair in positive emotions. This supports the expectation that presence is beneficial for mood repair because it leads to a higher enjoyment of a game. Wirth et al. (2007) suppose that increased presence in entertaining media leads to increased enjoyment of the media's content. Accordingly, Teng (2010) proposes that immersion in games is pleasurable and satisfies the user's need. In accordance with this assumption, Weibel and Wissmath (2011) were able to show for various computer games that presence has a positive influence on enjoyment. Reinecke and coworkers (2011) noted that enjoyment could be an important amplifier for the recovery effect. Enjoyment was also related to involvement in their study. The results from the present study support these conclusions. Presence was highly correlated with enjoyment and higher enjoyment led to increased mood repair in positive emotions. However, these results should be considered exploratory and further studies are needed to confirm this relationship.

The results from the present study clearly demonstrate positive effects of gaming. However, it is important to note that this might not always be the case and that there could also be negative effects. Bowman and Tamborini (2012; 2015), for example, showed that high task demand – as opposed to medium demand – led to less mood repair. Task demand was not measured, but it is likely that task demand was medium and not high in the present study: the control of the ship in Star Conflict is comparatively complex, but participants only played a beginner's tutorial. Consequentially, all participants managed to complete the tutorial successfully. However, if the demand of a game is too high, effects of mood repair could be severely impaired (Bowman & Tamborini, 2012; 2015). Furthermore, a recent experience sampling study found that more than half of the studied media occurrences (including gaming) showed at least some degree of conflict with other goals and responsibilities (Reinecke & Hofmann, 2016). This goal conflict as well as the evaluation of one's own media use as a form of procrastination can result in feelings of guilt that reduce enjoyment and impair situational well-being (Reinecke, Hartmann, & Eden, 2014; Reinecke & Hofmann, 2016). Reinecke and Eden (2016) propose that prolonged media exposure may turn media use from a resource-providing into a resource-consuming activity. Thus, prolonged gaming could lead to impaired mood, even when short-term effects are positive. Successful media-induced recovery and mood repair seem to depend on the right dosage.

In conclusion, the results from the present study show that gaming improves mood. Furthermore, the individual level of presence enhances the effect of mood repair in VR and presence is also strongly related to media enjoyment. The results show that the presence experience in a game affects mood repair beyond the effect of the game's immersion and that only presence might influence positive emotions by evoking higher enjoyment. The individual level of presence is especially important for VR games as they may potentially offer greater opportunities for experiencing high levels of presence. Presence experiences effectively enhance mood states and build up resources. This has implications for the VR gaming industry as well as health research. The positive effect of presence in VR could be used for the treatment of stress and negative affect. In addition to relaxing environments, games offer challenges and competition and are a form of treatment that can draw from thousands of readily available experiences. Additionally, immersive experiences in games are beneficial for mood repair and show that the immersion of a game combines with the individual's reaction towards the game to promote psychological well-being and recovery from stress and negative mood states.

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