Experiments on Problematic Attachment to Mobile Phone Use and the Development and Implementation of an Online Intervention for People Suffering from Pathological Internet Gaming

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Summary

The evidence for harmful effects due to a dysfunctional attachment of people towards their smartphone and internet gaming is increasing. Studies provide support for negative consequences resulting from separating the smartphone from its owner and negative consequences for excessive internet gaming, possibly culminating in an *Internet Gaming Disorder* (IGD). Both phenomena are discussed as possible behavioral disorders, with IGD being included as a research-diagnosis in a classification system for mental disorders. In the first part, this work presents an investigation of the short-term effects of smartphone separation on anxiety, inhibition, and other variables. In the associated experimental designs, reported state anxiety is compared for problematic and non-problematic smartphone users after undergoing 15 or 20 minutes of smartphone separation. In the second part, the development and subsequent evaluation of an intervention for people showing signs of internet gaming disorder are described. In the associated third and fourth experiment, the usability, applicability, and effectiveness of a developed mindfulness-based online intervention (*Room2Respawn*) for people showing signs of internet gaming disorder is tested and reviewed. The results of the first and second experiment provide evidence for an increase in anxiety after smartphone separation without a distraction and a decrease in anxiety when a distraction is present, however, only for problematic attached participants. The results of the third and fourth experiment conclude that the developed intervention, *Room2Respawn*, shows promise as a low-cost and low-threshold treatment option for people suffering from IGD, comorbidities and related symptoms.

General Introduction

"With a little help from my friends" – was written by John Lennon and Paul McCartney and released in 1967. More than half a century later, a lot of people get by with a little help from their digital friends, mostly via the use of applications on their mobile phones or software on their computer. The present work discusses possible pathological consequences of the attachment between users and their mobile phones and gamers and their internet games.

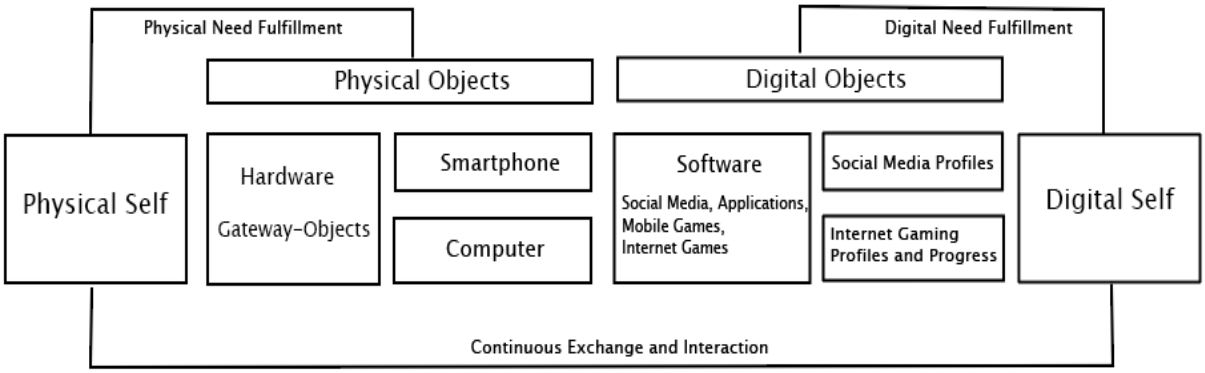
Focusing on the interaction with physical objects first, electronic devices, such as computers, video game consoles, tablets, smartphones, and wearables provide a never seen practicability and usefulness. Due to increasing amounts of usage, reliance on the virtual content of these objects have to offer steadily rises (Ellis, 2019). Focusing on mobile phones, the smartphone can be used for social interaction, as a status symbol, for entertainment and information seeking and seemingly endlessly other possibilities (Elhai et al., 2017). These are very enticing qualities incorporated into one device, which is at the same time highly portable, accessible and allows individuals to fulfill multiple interpersonal roles in parallel. Implications of intense usage can surpass the mere application of digital content to analogue situational demands, up to lasting effects on personal identity and self-concept, which is described below.

Since technological advances in the digital world increase rapidly, the amount of information we share and consume online increases too, especially through use of the smartphone (Montag, 2017). The Extended-Self Theory (Belk, 1988) was adjusted for this rise in dematerialization of interactive objects; with dematerialization referring to the

translation of physical objects into a digitized version, with chains of ones and zeros representing the physical object. The Extended-Self Theory entails the underlying rational, that we consider objects in our possession as extending parts of our individual selves which revolve around our core self. In its revised form, the Extended-Self Theory now encompasses as well identity correlates drawn from the digital realm (Belk, 2013). To avoid entanglement, the figure below (Figure 1) illustrates a concept with interactions between physical and digital self and selected objects. This overview is offered to ease understanding and provide a framework for the present work and following research questions.

Figure 1.

Simplified Overview of Dynamic and Continuous Exchange and Interplay Between Physical and Digital Objects and Physical and Digital Selves.



Presenting oneself to a large audience has never been easier attainable and individual needs like affirmation or appreciation can arguably be more conveniently fulfilled with an instant message or by sharing and receiving information online than face-to-face. Gateway-objects, such as the smartphone, which possess qualities of reliability, availability and can fulfill individual needs can bond with the user the same way a caretaker bonds with a

caregiver (Bretherton, 1992; Keefer et al., 2012). Thus, our fundamental need to belong (Baumeister & Leary, 1995) might translate to our interaction with the smartphone; yet, the question arises, whether the smartphone stands symbolically for the *cloth-* or the *wire-mother* in this relationship (Harlow et al., 1965). The first part of the present work deals with an investigation of the dysfunctional aspects between the user and their smartphone. The focus is on the smartphone as a gateway-object with its propensities to fulfill a range of individual needs and the exploration of associated effects that a separation from the device can bring with it. More specifically, the conditions under which smartphone separation leads to an anxious response with possible effects on executive functions are under scrutiny, with the aim to provide discriminant validity and additional support for suggested and already established associations.

Focusing on internet gaming behavior, one mechanism that is argued to increase the appeal for internet games can be related to the concept of *Reembodiment*, which refers to the identification with a digitally created representation of yourself (Belk, 2013). This mechanism can be exemplified by exploring the functions of avatars in internet games such as in *Massively Multiplayer Online Role-Playing Games* or *Multiplayer Online Battle Arena*'s and the associated resulting multiplicity of digital selves (Morcos et al., 2019).

A recently introduced research-diagnosis describing a dysfunctional attachment between a user and a form of digital content is the IGD which found its way into the *Diagnostics and Statistics Manual of Mental Disorders* (DSM-5; American Psychiatric Association, 2013; Falkai et al., 2018). The prevalence for adolescents is estimated around 1to 4 percent with higher reported frequencies for males (Fam, 2018). However, there are controversies in the scientific community whether IGD qualifies as mental disorder (Dullur & Starcevic, 2018).

IGD is discussed as behavioral addiction (Petry et al., 2018), showing similarities to gambling disorder and substance addiction (Mallorquí-Bagué et al., 2017). For instance, the implementation of *loot boxes* (an attainable virtual container which is distributed after meeting requirements in a video game with fixed or randomly generated content that holds a resource or item that benefits the player) in video games illustrate an example of a gambling element which is embedded into a video game framework (King & Delfabbro, 2018).

People affected by IGD are showing among others, signs of tolerance development, loss of interest for other areas and withdrawal symptoms. Due to the recency of the proposed criteria and high rates of comorbidities of people suffering from IGD (Carli et al., 2013), gold-standard treatment strategies are difficult to establish. Up to this point, a combination of cognitive behavioral therapy and bupropion seems most promising, although being associated with high costs (King & Delfabbro, 2014). In a recent review by Zajac et al. (2020) the mindfulness-based group-treatment *Mindfulness-Oriented Recovery Enhancement* (MORE; Garland, 2013), which was adopted for IGD (Li et al., 2017; Li, Garland, O'Brien et al., 2018), showed promise as an effective treatment without added psychopharmacotherapy, even in a three-month follow-up.

To bridge possible treatment gaps, diagnosed patients without receiving treatment, for a population with high tendencies to escape (Laconi et al., 2017), online-based interventions have the low-threshold potential to reach people who otherwise would not have been able to find support (Moessner & Bauer, 2017). In the second part of the present work, the development and review of an online intervention for people showing signs of IGD is described.

Problematic Smartphone Attachment

The literature investigating problematic smartphone attachment is discordant. The parallel existence of various terms to describe dysfunctional attachment, such as excessive, dependent, compulsive, pathologic, compensatory and problematic (De-Sola Gutiérrez et al., 2016) and controversial findings about prevalence and symptomatology, indicate the lack of an integrated framework. Due to differing underlying definitions and the used materials in the presented empirical studies, this work refers to *addicted* and *problematic* smartphone attachment synonymously by means of a dysfunctional use of the smartphone that diminishes psychological flexibility and restricts alternative coping strategies.

Billieux et al. (2015) proposed the *Problematic Mobile Phone Use* (PMPU) model to unify existing evidence, classifying problematic attached people into three pathways (Excessive-Reassurance, Extraversion, Impulsive-Antisocial). The Excessive-Reassurance pathway is described as a dependent form of smartphone use that presents itself with worry about the maintenance of personal bonds, elevated anxiety and elevated depression scores, increased and lower feelings of self-worth. The Extraversion pathway in the PMPU model characterizes people who use their smartphone to form new bonds, regulate cravings for appreciation and for sensation seeking purposes. The Impulsive-Antisocial pathway is described as the dominant pathway for people that have low self-control and high impulsivity and use their smartphone whilst driving, on inappropriate occasions, for cyberbullying, or to exchange sexual content.

In a review by Elhai et al. (2017) depression and anxiety were found to be related positively to problematic smartphone attachment. Besides existing correlational evidence,

research could also conclude a causal link between periods of smartphone separation and increases in anxiety as measured via self-reports (Cheever et al., 2014) and physiological markers (Clayton et al., 2015). In the study by Cheever et al. (2014) a linear increase in state anxiety of the participants was found for people upon being separated from their smartphones for a period from 20 to 75 minutes. However, this was only the case for moderately or highly problematic attached participants and results were obtained in an arguably highly artificial setting with smartphone separation comprising a mere waiting period, limiting the interpretability of the results.

In both of the following experiments, a short time duration of 15 and 20 minutes has been designed and the second experiment contained a distraction task (reading a neutral short story) which participants were asked to focus on whilst being separated from their mobile phones. Going beyond the link to anxiety, Hartanto and Yang (2016) provided substantial evidence for a decrease in executive functioning following a smartphone separation of Singaporean undergraduate students. On a secondary level, both experiments attempt to replicate these findings for a sample of German undergraduate students. The following is a brief description of the experiments investigating smartphone attachment by focusing on exploring the conditions under which a smartphone separation leads to anxiety and possible disturbances in executive functioning. For a more detailed review, hypotheses, operationalizations and statistical analyses please consult Manuscript 1.

Experiment 1 & 2

The research question guiding the conception of the first experiment was whether a short-term smartphone separation of only 20 minutes leads to elevated levels of self-reported

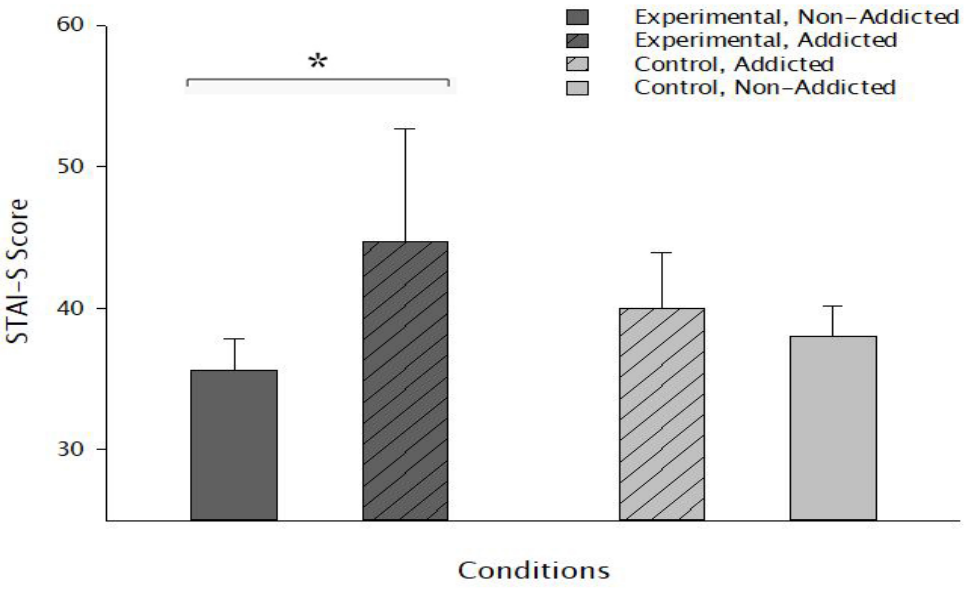
anxiety for people classified as addicted to their smartphones, and, if smartphone separation leads to diminished executive functioning.

The sample consisted of 85 male and female participants with a mean age of 23.38 years and a standard deviation of 3.58 years. Twenty percent of the sample was categorized, based on a self-report measure, as addicted to their smartphone. Outcome measures were participants' state anxiety as measured on a self-report measure and executive functions, being measured by computer tasks evaluating inhibitory skills. Using an experimental setting with randomized group allocation (smartphone separation as experimental and handing out identification as balanced control) participants had to surrender their respective belonging and were asked to wait in the laboratory, under pretense, for a duration of 20 minutes until they were tested. The anxiety measures were administered after separation and before the computer tasks and trait anxiety was implemented as a covariate for analyses of variance.

The smartphone separation results were mostly congruent with the posited hypotheses. A mere smartphone separation without categorization into addicted or non-addicted smartphone users did not conclude statistically significant differences. The state anxiety of addicted smartphone users in the control condition did not differ statistically significantly from non-addicted smartphone users. In the experimental condition, the state anxiety of addicted smartphone users was statistically significantly higher after having to surrender their smartphone for 20 minutes, than in non-addicted smartphone users (see Figure 2). Testing for implications that a smartphone separation has on executive functioning there was no evidence in changes in performance on a task measuring inhibitory control. Further exploratory analyses are described and discussed in Manuscript 1, Experiment 1, Results.

Figure 2.

Ninety-Five Percent Confidence Intervals Around Mean State Anxiety for Non-Addicted and Addicted Participants in the Experimental and Control Condition After Separation.



Note. The asterisk (*) indicates a statistically significant difference with $p < .05$.

To summarize, evidence for an increase in anxiety following a separation period of 20 minutes for addicted participants could be found. The results regarding the circumstance that a mere smartphone separation alone leads to increases in anxiety or to disrupted executive functioning were inconclusive. Possible internal and external confounding variables restrict the interpretability of the results.

Of primary interest in the second experiment was the comparison and exploration of effects on state anxiety for problematic and unproblematic smartphone attached participants undergoing a 15-minute separation period in which they were given a task (a neutral short story). Furthermore, possible differences on inhibitory control between unproblematic

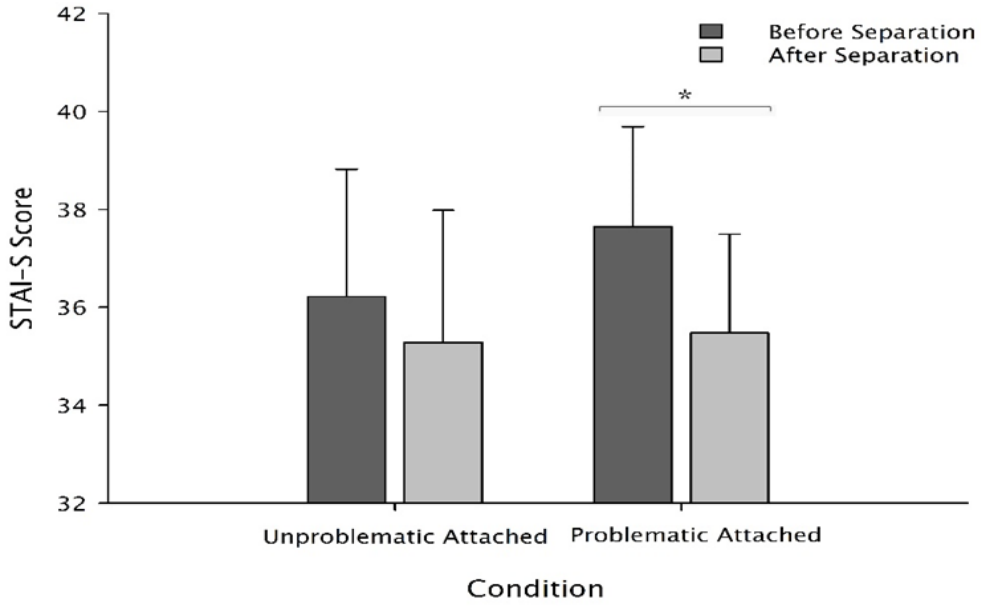
and problematic participants following a 15 minutes separation period were investigated. To get further insight on prevalence regarding differing problematic mobile phone attachment types, the participants were classified into one of the three proposed PMPU-pathways (Excessive-Reassurance, Impulsive-Antisocial, Extraversion) by Billieux et al. (2015) using a developed self-report measure.

The sample consisted of 95 female and male participants with a mean age of 21.97 years and a standard deviation of 2.43 years. 66 percent of participants classified themselves as problematic attached, using a self-report measure. To be able to categorize participants based on their PMPU-pathway, the *Smartphone-Attachment-Type-Scale* was developed for study purposes (see Manuscript 1, Appendix). Outcome measures were state anxiety operationalized through a self-report measure and inhibitory control measured by an established computer task. In the quasi-experimental design, participants filled out their pre-state anxiety, were categorized into unproblematic or problematic attached participants, had to surrender their smartphone for 15 minutes, were asked to indicate their post state anxiety, and, lastly, they were presented with the computer tasks.

The results were mostly congruent with the posited hypotheses. There was evidence that problematic attached participants undergoing a period of smartphone separation while solving a task showed statistically significant lower state anxiety scores after the separation than before. This was not the case for unproblematic attached participants (see Figure 3).

Figure 3.

Ninety-Five Percent Confidence Intervals Around Mean State Anxiety for Unproblematic and Problematic Smartphone Attached Participants Before and After Separation While Receiving a Distracting Task.



Note. The asterisk (*) indicates a statistically significant difference with $p < .05$.

Regarding inhibitory control, there was a statistically significant higher interference in problematic attached participants than in unproblematic attached participants following a separation period of 15 minutes. In this regard, it is noteworthy that the performance of problematic attached participants was descriptively better in the baseline task in comparison to unproblematic attached participants, resulting in a larger disturbance in the interference task.

Lastly, 74 participants were categorized as belonging to the PMPU-pathway Impulsive-Antisocial, 20 as Excessive-Reassurance and one participant as belonging to Extraversion. In addition, the scores on the Smartphone-Attachment-Type-Scale were statistically significantly higher for problematic smartphone users than for unproblematic smartphone users, providing first validity for the developed self-report measure. For further exploratory analyses consult Manuscript 1, Experiment 2, Results.

To summarize, there is evidence that problematic attached participants show a decrease in anxiety within a separation period when they had been given a task. Under these circumstances, the state anxiety for unproblematic attached participants did not change note worthily. Moreover, problematic attached participants showed a larger interference in inhibitory control resulting from a smartphone separation than unproblematic attached participants. Seventy-eight percent of the sample categorized themselves as Impulsive-Antisocial, 21 percent as Excessive-Reassurance and only one percent as belonging to the Extraversion pathway.

Conclusions

Both experimental setups provide evidence for an association between a short-term smartphone separation, smartphone attachment and anxiety. On the one hand, a higher state anxiety following a separation period of 20 minutes was only shown for people who were classified as addicted towards their smartphone and were not provided with a distracting task. On the other hand, a decrease in initial state anxiety for problematic attached users after a waiting period of only 15 minutes could be observed when provided with a task.

Like a recently published article by Johannes et al. (2019), Experiment 1 did not provide further evidence that a smartphone separation alone increases anxiety or has effects on executive functioning (Clayton et al., 2015; Hartanto & Yang, 2016; Ward et al., 2017). Furthermore, the line of reasoning by Cheever et al. (2014) that for problematic smartphone attached individuals a task within the separation period might buffer against anxiety inducing effects fits the gathered evidence. Additionally, further evidence for the PMPU-pathway model and specific pathway associated population incidence rates and associated variables could be provided.

Besides the already discussed applying limitations and restrictions, the obtained results suggest that indeed there is a formed attachment between smartphone and user that is classifiable and interacts with anxiety if the smartphone is not available. However, this appears practically significant only if the already formed bond is characterized by some sort of dysfunctional overreliance combined with a lack of alternative tasks. This finding is of relevance since a classification of problematic smartphone use based on a mere high engagement with the device seems a misleading approach. Instead, the quality of the specific engagement and the underlying individual attachment with the smartphone is of importance to consider. If the reliance of future generations on digital devices increases to connect with others and reconnect to themselves, this might pose an indirect threat to the core-self, if appropriate digital boundary setting fails (Belk, 2013). The smartphone as a physical gateway-object is mostly reliable and controllable, however, the external selves in virtual spaces are often subject to rapid changes.

Intervention for Internet Gaming Disorder

Problematic internet gaming behavior represents one example of an overreliance on a digital self in which the urge to achieve and motivation for instant gratification in virtual rooms overshadow real-life opportunities (Molesworth & Watkins, 2016). Besides the fundamental need to belong (Baumeister & Leary, 1995), the fundamental need to play (Huizinga, 1949) has crossed the threshold from the analogue to the digital world since the midst of the last century (Kent, 2010). In addition to the reported positive implications that internet gaming can have on individuals (Granic et al., 2014) the implications of *too much play* can be distressing (Grüsser et al., 2007). Inabilities to stop and to control the amount of gaming are some indicators for problematic internet gaming behavior (King et al., 2018). With the inclusion of IGD as a research diagnosis into the DSM-5 (American Psychiatric Association, 2013; Falkai et al., 2018) reviews of possible treatments suggesting psychopharmacotherapy (Song et al., 2016), cognitive-behavioral therapy or combined treatment approaches as interventions (González-Bueso et al., 2018). Table1 contains the diagnostic criteria of the IGD in the DSM-5. Due to methodological inconsistencies and lack of follow-ups (King et al., 2017; Zajac et al., 2020) evidence-based gold-standard treatment approaches are currently unavailable (Wartberg et al., 2017).

Table 1.

Diagnostic Criteria of the IGD (DSM-5; American Psychiatric Association, 2013).

Criterion 1	Excessive employment (e.g. mental capture through computer games)
Criterion 2	Withdrawal symptoms (e.g. irritability, anxiety, or sadness) when playing is omitted
Criterion 3	Tolerance development (e.g. need for increasingly longer playing times)
Criterion 4	Unsuccessful attempts to control the game
Criterion 5	Loss of interest in previous hobbies and leisure activities (because of playing)
Criterion 6	Continuation of excessive play, despite insight into the psychosocial consequences
Criterion 7	Deception by family members, therapists, and others regarding the scope of the game
Criterion 8	Use games to escape or mitigate a negative mood (e.g. feeling of helplessness, feelings of guilt, anxiousness)
Criterion 9	Endangering or losing important relationships, job or training/career opportunity due to playing

Note. At least 5 out of 9 criteria must have been met in the last 12 months for diagnosis.

Mindfulness-based Cognitive Therapy (Segal et al., 2002) was developed mostly based on the work by Jon Kabat-Zinn (Kabat-Zinn, 1982; Kabat-Zinn et al., 1985) as a promising approach for the treatment of depression and stress by combining elements of psychoeducation with mindfulness exercises. The evidence for addiction treatment with mindfulness programs is plentiful (Westbrook et al., 2013; Witkiewitz et al., 2013). One program that has shown to be effective for people suffering from IGD is the *Mindfulness-Oriented Recovery Enhancement* (MORE) (Garland, 2013; Li et al., 2017; Li et al.,2018). MORE integrates aspects of mindfulness and positive psychology and is meant to be applied in a group-setting over a duration of eight or more weeks, depending on the treatment intention and the participant population. The main pillars of MORE comprise elements of *Mindfulness*,

Reappraisal, and *Savoring* and sessions are usually around two hours long, contain a mindfulness meditation, psychoeducation, practical exercises and a debriefing. Due to the promising results regarding IGD and the non-necessity of full abstinence in participants taking part in the program, MORE was selected to provide the basis for the proposed intervention and was adjusted for IGD and embellished with further exercises and psychoeducation. See Table 2 for an overview of the adopted content from MORE, which was then reworked, and consult Manuscript 2, Method for the developed intervention (*Room2Respawn*).

Table 2.

Overview of the Sessions and Content for the Mindfulness Oriented Recovery Enhancement.

Session	Title	Content
1	Mindfulness and the Automatic Habit of Addiction	Introduction of mindfulness Automatisms for dependencies
2	Mindful Reappraisal	Mindful reassessment
3	Shifting the Mind to Refocus on Savoring	Mindful enjoyment
4	Seeing through the Nature of Craving	The nature of desire
5	Overcoming Craving by Coping with Stress	Stress management Relaxation reaction
6	Walking the Middle Way between Attachment and Aversion	Connectedness and aversion Thought suppression
7	Mindfulness of the Impermanent Body	Impermanence of the body
8	Defusing Relationship Triggers for Relapse	Interpersonal relationships
9	Interdependence and Meaning in Recovery	Mutual dependencies
10	Looking Mindfully toward the Future	Mindful look into the future

Note. For detailed information about the listed sessions consult Garland (2013).

Furthermore, due to population characteristics and high rates of suffering or high-risk patients without receiving treatment (Kohn et al., 2004), to increase applicability the upcoming proposed intervention was shifted from a group face-to-face setting to an online format. Internet-based and mobile-based interventions seem to have good potential to bridge waiting-periods for patients, carve the way for a following face-to-face treatment or reach people that are afraid of stigmatization for treatment (Fuhr et al., 2018). Additionally, internet-based and mobile-based interventions show similar effectiveness (Wagner et al., 2014) and drop-out rates are slightly higher than in conventional settings, though still comparable to face-to-face therapy (Cuijpers et al., 2010; Melville et al., 2007, 2010). Nonetheless, since evidence suggests that people suffering from problematic internet gaming have an impaired executive control ability coupled with a high need for stimulating, rewarding and demanding activities (Dong & Potenza, 2014; Dong et al., 2011; King et al., 2018; Pawlikowski & Brand, 2011) keeping participants motivated to continue is challenging. Since the designed motivational mechanisms that contributed to the development of problematic internet gaming disorder are highly successful, it seems promising to use the same design elements to increase engagement and establish functional alternatives to internet gaming.

The implementation of design elements into the framework of online-based interventions, providing resemblance to game-like features can increase motivation and compliance (Sailer, 2016). The use of game elements, techniques, and principles to other areas than the video game itself is called *gamification* (Werbach & Hunter, 2012). Consequently, the implementation of elements of gamification incorporated into a mindfulness-based online-intervention for people suffering from IGD could increase the effectiveness of the

intervention (for further information about the added gamification elements refer to Manuscript 2 and Manuscript 3). In the following are to be found brief descriptions of the investigation of usability, applicability, and effectiveness for a developed online-based intervention with gamification elements for people showing signs of IGD.

Experiment 3

The third research question concerns the usability and applicability of a developed mindfulness-based, online administered, and gamified intervention containing elements of MORE, adjusted for people suffering from problematic internet gaming based on a sample with participants indicating some internet gaming experiences. Furthermore, possible effects on motivation due to a gamification of the intervention were scrutinized.

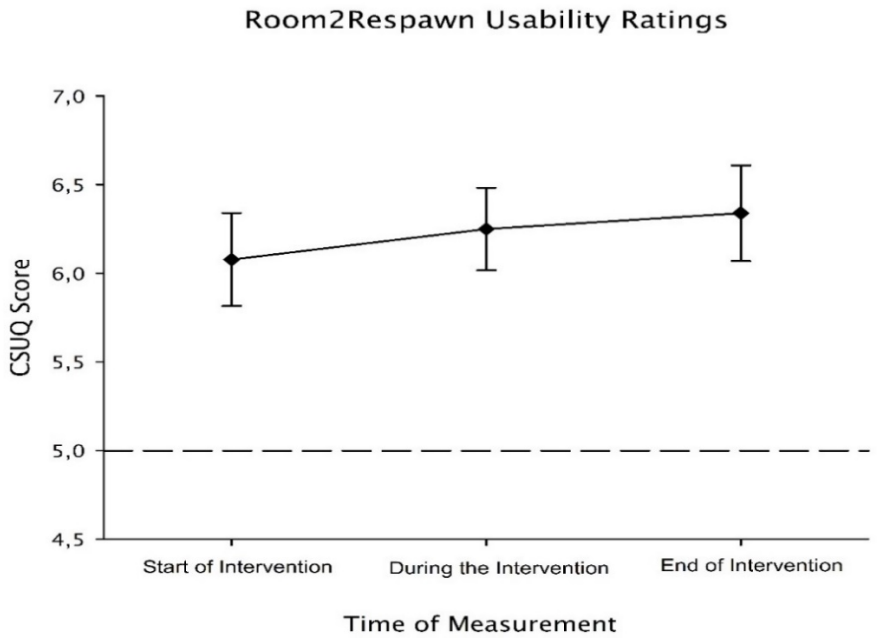
The sample consisted of initially 49 participants, which were randomly assigned to experimental (gamified intervention framework) or control (balanced, neutral intervention framework) conditions. Over the course of four weeks a total of 12 exercises were administered with three exercises per week to which participants got invited to every single session via email. The content for each exercise was published on a website and contained mindfulness meditations and psychoeducation. All gamification elements were embedded into the email communication with the participants (pseudonym, daily quiz, leaderboard, level, and badge). The evaluation of the usability was realized by extending already established self-report measures. For the evaluation of content and the applicability, a self-report measure, the *Usability Evaluation Questionnaire*, was developed, in which participants could rate email, psychoeducation, meditation and intervention content and comment open-ended

within a text box. Additionally, the experimental condition was asked to rate the implemented gamification elements.

Thirty-nine participants finished the intervention, with 25 percent dropout in the control condition and 16 percent dropout in the experimental condition. The usability of the developed intervention when considering the mean responses was good and satisfactorily, with an average rating of 6.20 and a standard deviation of 0.69 ranging from 1 = not good at all to 7 = very good in a self-report measure. The usability ratings remained satisfactorily over the course of the whole intervention (see Figure 4).

Figure 4.

Ninety-Five Percent Confidence Intervals Around Means for Usability Ratings at the Start, During and at the End of the Intervention.



Note. A cut-off at 5 (1 = not at all to 7 = agree completely, with higher values representing higher satisfaction) was a priori chosen as indication of the least satisfactory usability for the purposes of the intervention.

The overall evaluation for the content (applicability) regarding emails, psychoeducation and meditation was consistently positive and the length for each intervention session was rated adequate. The qualitative evaluation of participants' comments revealed that improvements could be made to email layout, gamification elements (badges), clearer instructions, shorter sentence structure, improvement of text layout and higher recording quality of meditations.

There was no clear overall change in intrinsic motivation after the intervention. Except for minor statistically significant differences on certain subscales a solid practically significant result in the posited direction, results favoring the gamification condition could not be obtained.

To summarize, the usability and applicability of *Room2Respawn* could be shown; limitations and restrictions to interpretability apply. The integration of gamification elements has not resulted in noteworthy differences in usability ratings, motivation or dropout rate. The participants' feedback was incorporated in a rework of the content, design and framework for the intervention.

Experiment 4

The research question revolved around testing the effectiveness of *Room2Respawn* for people showing problematic internet gaming behavior by collecting convergent validity on associated constructs with symptom reduction including a follow-up of three months.

The initial sample consisted initially of 52 male participants showing signs of IGD as indicated by three or more fulfilled DSM-5 criteria on a self-report measure. Participants were recruited through established cooperation's with clinics and counselling centers and by

online forums. There was a 42 percent dropout-rate with most dropouts in the first and second week of the intervention. Thirty participants with a mean age of 27.5 years and a standard deviation of 4.44 years participated throughout the whole course of the intervention. Twenty percent of the sample indicated at least one known comorbidity. On average, the investigated sample indicated to play 3.85 hours per day, with a standard deviation of 2.95 hours. 73 percent of participants reported back after one month for follow-up questions and 63 percent answered the questionnaires three months after the intervention.

The presented intervention content was adjusted based on comments and feedback of the participants in Experiment 3, the recorded mindfulness meditations were professionalized, the layout for the email communication was changed, avatars with a progress bar were added and a reward schedule was established. Furthermore, additional exercises were developed and offered on a voluntary basis. Participants were randomly assigned to experimental (gamification) condition or control (balanced, neutral) condition and a similar procedure as in Experiment 3 was applied. Outcome measures were self-report instruments corresponding to the extent of problematic internet gaming behavior, indices of well-being, depression and psychosomatic correlates, mindfulness, and stress. Usability and applicability were evaluated as well.

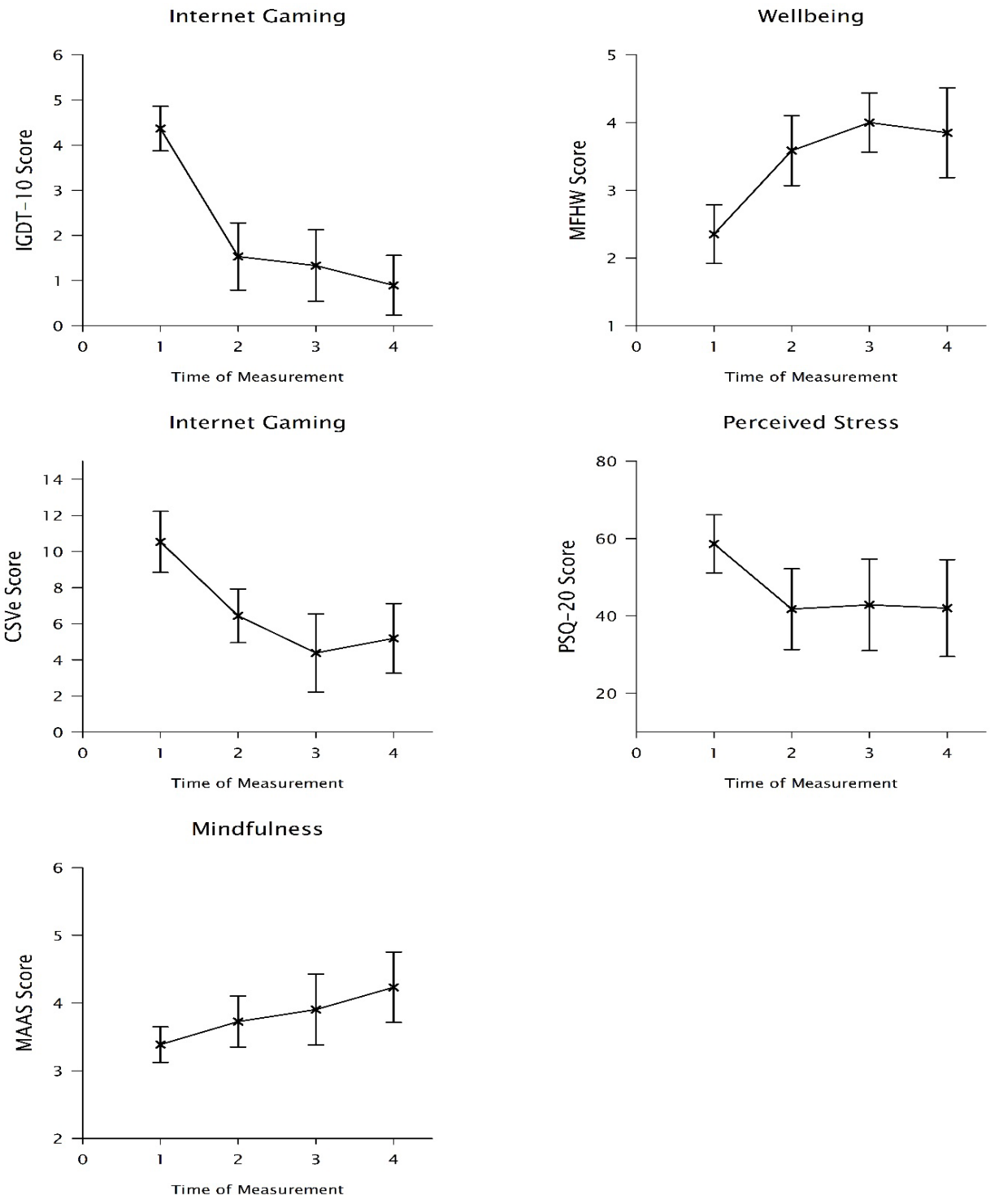
The obtained results were mostly in line with the posited hypotheses. Before the intervention, the IGD related self-report measures indicated a sub threshold IGD with an average of 4.46 and a standard deviation of 1.33 of criteria fulfilled in the DSM-5 (cut-off is 5 criteria out of 9 for a clinical diagnosis) and an abusive usage towards computer games. After the intervention, the indicated criteria went down to 0.92 with a standard deviation of

1.44 and participants were on average classified as unobtrusive computer gamers. Moreover, participants reported statistically significant higher well-being, higher mindfulness, lower depression, and lower perceived stress scores. Overall, usability and applicability ratings were good. The implementation of gamification elements was rated satisfactory. There was no statistically significant evidence that the gamification condition benefit more from the intervention. However, across all measures the descriptive trends pointed towards a synergistic interaction between the intervention and implemented gamification elements (see Manuscript 3, Figure 2). Results indicated by the one- and three-months follow-ups showed stable and long-term effects for the internet gaming associated measures, mindfulness, well-being, and perceived stress (see Figure 5).

Considering the differences before and after the intervention for various constructs, there is solid evidence that Room2Respawn has beneficial effects for the treatment of people showing signs of IGD. The results indicated by the follow-up measures were promising for possible long-term effects. Limitations and restrictions to interpretability and constraints to generalizability apply.

Figure 5.

Mean Values for Different Points in Time (1 = Baseline, 2 = After Intervention, 3 = One-Month Follow-Up, 4 = Three-Months Follow-Up) and 95 Percent Confidence Intervals of Constructs of Interest Across Conditions.



Conclusions

The evidence suggests that *Room2Respawn* is usable, applicable and effective. The usability was consistently rated as good across conditions, although there is still room for improvement. Experimental and control groups did not differ regarding their indications of applicability and the added elements of gamification were positively received. A gamified approach to the design of the intervention seems promising, however, it needs further refinement and rework of the embedded elements. Overall, participants reported benefiting from the program even after a three-month follow-up. The IGD symptom reduction and general improvement in well-being and other variables was substantial and shows potential for *Room2Respawn* to provide a useful addition as an intervention for people showing signs of IGD. Besides the already existing evidence (Li et al., 2017; Li et al., 2018), Experiment 4 was able to provide further evidence for the effectiveness of the main pillars of MORE, namely *Mindfulness*, *Reappraisal*, and *Savoring* and the combination of mindfulness meditations and psychoeducation for the treatment of people showing signs of IGD.

In order to treat people suffering from pathological internet gaming behavior, the benefits of being present (Brown & Ryan, 2003) can surpass possible treatment complications which are inherited to a heterogeneous, comorbid population, by focusing on a transdiagnostic approach such as mindfulness (González-Bueso et al., 2018). Furthermore, the combination with an online-based form of application for the intervention provides flexibility for patients and therapists at the same time. *Room2Respawn* can be used to shorten waiting periods, as add-on to conventional therapy or, for people at high-risk of becoming problem users, as a standalone intervention.

General Discussion

The aim of the present work was to explore the problematic attachment to smartphones and internet games and to introduce an intervention for people showing signs of IGD. The Extended-Self theory (Belk, 2013) and the *Simplified Overview of Dynamic and Continuous Exchange and Interplay Between Physical and Digital Objects and Physical and Digital Selves* (Figure 1., page seven) offer an accommodating framework to put the research at hand into context. Gateway-objects, such as the smartphone, that are reliable and readily available for a multitude of tasks, foster the development of a one-sided attachment. Since there are numerous ways a smartphone can be used to access virtual content (arguably as proxy for need fulfillment), what starts with an initial reliance can result in an overreliance on the device. Thus, the temporary loss of the smartphone can for some people lead to a loss of a part of the individual-self, this subsequently results in feelings of fragmentation, anxiety and loss of control (Clayton et al., 2015).

The concept of *Fear of Missing Out* (Przybylski et al., 2013) can serve as an alternative explanation for the anxiety induced by smartphone separation for *problematic* attached people. *Fear of Missing Out* describes that the possibility of missing out on enriching experiences, social interactions or other relevant correlates can lead to anxiety. However, and regardless of the underlying theory, anxiety has shown to lead to diminished executive functioning (Ansari & Derakshan, 2010; Derakshan et al., 2009; Eysenck et al., 2007). Although there is evidence for a link between smartphone separation and deteriorated executive functions (Hartanto & Yang, 2016), we were unable to fully replicate these findings. The larger

inhibitory interference in the problematic attached participants in Experiment 2 was mostly due to better performance in the baseline task.

The evidence gathered in Experiment 1 and Experiment 2 underlines the importance of considering the quality of attachment formed. The investigation of the consequences of smartphone separation in the present work has shown that a short-term smartphone separation of 15-20 minutes leads to an increase in anxiety, yet, only if the form of attachment is dysfunctional. In turn, the availability of a task given within the separation period leads to a decrease in anxiety for problematic attached participants. Hence, a mere task could already protect against increases in anxiety for problematic attached people, but additional research is necessary to clarify the underlying mechanisms even further. Categorization such as provided by the PMPU-pathway model (Billieux et al., 2015) shows promise to help to illuminate the scattered landscape of research surrounding dysfunctional smartphone use. The present work provides additional evidence for the existence of the Excessive Reassurance and Impulsive-Antisocial pathways and their association with problematic smartphone attachment.

Even though the smartphone can represent a status symbol by itself, its true capacities are unlocked with applications that are installed on the device. Hence, the addictive properties do not reside within the physical object itself, but with the virtual solution it has to offer for real-life problems or deprived needs. Internet games, regardless of the platform on which they are played, can provide a virtual world in which the digital self finds many of opportunities to fulfill needs, achieve goals, socialize and compete with others. The gamification principles used in the proposed intervention aim to reflect these dimensions with the goal of increasing motivation, compliance and promoting behavioral changes (Sailer, 2016;

Sailer et al., 2017). By incorporating gamification principles, it was aimed on putting a functional spin on the very mechanisms representing the cause and maintenance of IGD. Based on the gathered evidence, using gamification principles as a guide for the development for the design of *Room2Respawn* has concluded non-statistically significant, but promising results. Further rework and improvement of the gamification elements are necessary to investigate a hypothesized synergistic interaction regarding intervention effectiveness and gamification elements. Overall, the results obtained in Experiment 3 and 4 indicate that the developed online-intervention is usable, applicable and effective in treating symptoms associated with IGD.

To conclude, the present work provides evidence for the necessity to clearly evaluate the specific type of attachment being formed towards the smartphone and the available evidence does not support generalizations. Subsequent research can diminish the risk of misinterpretation by following an integrative theoretical framework and provide clear indications about the extent of dysfunctionality in the attachment that is present in the specific sample. Furthermore, an online intervention with gamified features is introduced that has the potential to provide a low-threshold and low-cost intervention for people suffering from problematic internet gaming behavior.

Internet and mobile-based interventions are going to play a significant role in the future of treatment for mental disorders. Depending on the development, design and implementation of those interventions, in the end, they might just be the little help we need.

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Manuscripts

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Exploring Problematic Mobile Phone Attachment and Associations to Anxiety and Inhibitory Control After a Short-Term Smartphone Separation

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Abstract

This study investigates problematic smartphone attachment under conditions of short-term smartphone separation. Two experimental studies with randomized group allocation were designed to investigate effects of smartphone separation on anxiety and inhibitory control. Problematic smartphone use pathways were explored using a self-report measure. In the first experiment ($N = 85$) smartphone addicted participants showed an increase in state anxiety after 20 minutes of separation from their smartphones compared to a control group of non-addicted participants. There was no evidence for impaired inhibitory control based on a period of smartphone separation. In the second experiment the methodology was slightly varied and the participants ($N = 95$) were provided with a task during a smartphone separation of 15 minutes. This led to a reduction of state anxiety for problematic attached participants but did not result in a change for unproblematic attached participants. Problematic attached participants showed a larger disturbance in inhibitory control undergoing a separation period than unproblematic attached participants. Moreover, the results provide supplementary evidence for the existence of specific problematic smartphone attachment pathways and further variables.

Keywords: problematic mobile phone use, smartphone separation, inhibitory control, anxiety, smartphone addiction

Exploring Problematic Mobile Phone Attachment and Associations to Anxiety and Inhibitory Control After a Short-Term Smartphone Separation

The digital companionship between smartphone and user which is formed after some time of usage might lead to an attachment with the chance of becoming problematic. The research on smartphone separation comes with variance regarding used methodologies and the definition of how a separation period is conducted and what the consequences are (Cheever et al., 2014; Clayton et al., 2015; Hartanto & Yang, 2016). Commonly used terminologies like *Fear of Missing Out* (Przybylski et al., 2013), *No-Mobile-Phone-Phobia* (King et al., 2013) or *Low Battery Anxiety*, as described in a press release from LG Electronics (2016), suggest that the link between smartphone separation and an anxiety inducing momentum is well on its way to be established. For instance, Przybylski et al. (2013) describe *Fear of Missing Out* (FoMO) as a constant worry to miss out on an enriching experience that friends, and acquaintances are having. In a study by Elhai et al. (2016) a positive association between an excessive smartphone use and FoMO was found. In a further study Cheever et al. (2014) implemented in their experimental design a 75 minutes smartphone separation period and were able to observe a linear increase in their participants' state anxiety. However, this occurred only for participants with moderate and high mobile phone usage times.

Due to smartphone-separation induced anxiety, Hartanto and Yang (2016) found an impaired executive function. A conflicting result when compared to Ward et al. (2017) who were able to show that not the smartphone separation induces

anxiety but instead the mere presence of the mobile device leads to deficits in executive functions.

In line with recent findings, it seems feasible that not only the time of deprivation or the frequency of smartphone usage matters but also the distinct type of attachment being formed to the smartphone. The attachment theory (Bowlby, 1969) was originally conceived as the bond between caregiver and caretaker. However, attachment research has shown that also inanimate objects which prove to be reliable and have the propensity of constant availability such as smartphones, can form these bonds (Bretherton, 1992; Keefer et al., 2012). Konok et al. (2016) observed that people having an anxious-preoccupied attachment are especially prone to becoming problematic smartphone users due to using their phone to satisfy an irrational need for contact.

Lacking a universally accepted concept of addictive behavior towards their mobile phones, Billieux et al. (2015) introduced the model of *Problematic Mobile Phone Use* (PMPU) to unify existing evidence and introduce a coherent framework for further research. Based on attachment theoretical considerations it is proposed that the three pathways (PMPU-pathways) Excessive-Reassurance, Impulsive-Antisocial, and Extraversion offer a classification to describe the relationship between owner and smartphone in a cohesive way. It is assumed that the PMPU-pathways overlap with respect to the associated concepts. In their model Billieux et al. describe the Excessive-Reassurance pathway by a dependent form of smartphone use that presents itself with worry about the maintenance of personal bonds, elevated anxiety and depression scores, increased neuroticism and lower

feelings of self-worth. The Extraversion pathway in the PMPU model characterizes people who use their smartphone to form new bonds, regulate cravings for appreciation and for sensation seeking purposes. The Impulsive-Antisocial pathway is described as being the dominant pathway for people that have low self-control and high impulsivity and use their smartphone whilst driving, on inappropriate occasions, for cyberbullying, or to exchange sexual content (Billieux et al., 2008; Billieux et al., 2010; Dir et al., 2013; Kokkinos et al., 2014).

All proposed pathways are described by the predominant way people are using their smartphone to regulate deprived needs and emotional states (Billieux et al., 2015). Consequently, for problematic smartphone users, this might lead to a period of increased deprivation for previously fulfilled needs which accompanies a separation from their mobile device. This need-deprivation period might then in turn lead to a state of augmented anxiety.

For this study, a short period of smartphone separation was selected to investigate possible changes in state anxiety after separation, as measured in the *State-Trait Anxiety Inventory* (Spielberger et al., 1970), for a sample of German adults. In both experimental designs the main interest was in possible group differences regarding state anxiety: people reporting an addictive attachment towards their mobile phone and non-addicted people following a short separation period. Furthermore, the quality of problematic attachment between smartphone and user during separation time was investigated by using the PMPU-pathways as orientation.

In the first experimental setting (Experiment A) it is assumed that a smartphone separation period of 20 minutes leads to a higher state anxiety among participants compared to a control condition. Furthermore, it is hypothesized that a smartphone separation leads to disrupted executive functions as measured via the use of a task focusing on inhibitory control. A similar methodology as in Hartanto and Yang (2016) is applied. More specifically it is assumed that state anxiety increases under separation conditions in addicted participants, yet not in non-addicted participants as measured by the *Smartphone Addiction Scale – Short Version* (SAS-SV) (Kwon et al., 2013). Lastly, the association between degrees of PMPU and state anxiety following a separation period are explored, while controlling for trait anxiety.

In the second experiment (Experiment B) a similar experimental setting is applied mainly to increase a salience of smartphone separation while exploring the interaction between PMPU-pathways and state anxiety, focusing on the edge between problematic and unproblematic smartphone attached participants. More specifically, it is hypothesized that a separation period (15 minutes) during which participants are presented with a task leads to a decrease in state anxiety for people classified as problematic attached, as measured by the *Smartphone Overuse Questionnaire* (Lee et al., 2017), but not for unproblematic attached participants. Accordingly, possible differences between problematic and unproblematic attached participants undergoing a separation-period regarding inhibitory control performance, as measured via the Stroop task (Stroop, 1935), are scrutinized. The PMPU-pathways are further explored with correlations between a developed

measured for the PMPU-pathways, indications of smartphone overuse, FoMO and attachment style.

Experiment A

Method

Participants

Participants were recruited at the Heinrich-Heine Universität in Düsseldorf in Germany via flyers and advertisements. Inclusion criteria were smartphone ownership, age between 18 and 35 years and no colorblindness. Our sample (*N* = 85, *mean age* = 23.38; *SD* = 3.58 years) consisted of 55 female and 30 male participants. The daily smartphone use in hours was as follows: 1-2 (27.1 percent), 3-4 (35.3 percent), 5-6 (18.8 percent), 7-8 (7.1 percent) and 11.7 percent were indicated as outliers with either a shorter or a longer duration than the majority. Using the suggested cut-off score for the SAS-SV, 20 percent of participants in our study were categorized as being addicted to their smartphone.

Analyses of differences in demographics for experimental (smartphone separation) and control (surrender identification) condition revealed no statistical differences in age, sex or education. The *Smartphone Bonding Questionnaire* (see Materials and Instruments) revealed that out of the analyzed sample, 43 participants assigned themselves to the Excessive-Reassurance pathway and 42participants to the Impulsive-Antisocial pathway and no participant chose the item that was assigned to the Extraversion pathway. The participation of the predominant student participants was remunerated via course credit or financial

compensation. Informed written consent was obtained from all participants. The study was approved by a local Ethics Committee.

Measures and Instruments

Fear of Missing Out scale (FoMOs). The FoMOs was developed by Przybylski et al. (2013) and was translated into German for this study. The self-report measure examines the wish to be in touch with people in the digital world following the concern of missing out on activities or experiences. Its scoring ranges from 1 to 5, with higher numbers reflecting a higher manifestation of the construct ($\alpha = .93$ in the original version). The internal consistency for the translated version was $\alpha = .71$.

Sociodemographic Questionnaire. A sociodemographic questionnaire contained questions about age, gender, marital status, educational attainment, daily smartphone usage, regularity of digital media use and drug use.

State-Trait-Anxiety Inventory (STAI). The German version of the STAI (Laux, 1981) was implemented, developed by Spielberger et al. (1970). State (STAI-S; $\alpha = .90$) and trait (STAI-T $\alpha = .90$) anxiety were assessed. Overall scoring ranges from 20-80, higher scores indicating higher trait (retest-reliability of $r = .68$ to .96) or state anxiety (retest-reliability of $r = .03$ to .76).

Smartphone Addiction Scale - Short Version (SAS-SV). The SAS-SV (Kwon et al., 2013) measures smartphone addiction ($\alpha = .91$). The short form of this 10-item-questionnaire was published in English and translated into German for this study. Item scoring ranges from 1 to 6 with an overall scale range from 10 to 60. In accordance to the authors, gender-specific cut-off values to classify someone as smartphone addicted are 33 for males and 31 for females.

Smartphone Bonding Questionnaire (SBQ). Three brief forced-choice items which were created for the purpose of this study for participants to indicate their smartphone attachment style according to the proposed pathways Impulsive-Antisocial, Excessive-Reassurance, and Extraverted by Billieux et al. (2015).

Stroop-task. A Stroop task (Stroop, 1935) task was implemented to examine inhibitory control. In the computer version, the Stroop task runs via the program Presentation over a single phase in its colored word paradigm (red, green, yellow and blue), presenting word/color incongruent or congruent trials (Font: Helvetica, size 16) on a 22-inch monitor, with participants being seated approximately 50 centimeters away from the screen. Participants were instructed to name the color into a microphone. A fixation-cross appeared for 500 milliseconds (ms) in the center of the screen, followed by 5000 ms (answer window) of stimulus presentation on a white background which was subsequently followed by an intertrial interval of 500 ms in form of a blank screen. The task consisted of 16 practice trials and 36 congruent and 36 incongruent trials and reaction times and errors were measured.

Procedure

First, participants were asked to fill in the first set of questionnaires online. This set contained information on the purpose of the experiment, an informed consent, sociodemographic questions and the STAI-T. In the laboratory the participants were randomly assigned to either the experimental (smartphone-separation) condition or the control condition and seated in the first of two rooms. Participants in the experimental condition were asked to surrender their smartphone under a pretense. The smartphone was locked up under the eyes of the

participant in a drawer. Participants in the control condition were asked to hand out their identification (ID; or student card, if the identification was missing). After 20 minutes of waiting, the STAI-S was administered. Afterwards, participants were asked to move into the second room to complete the computerized tasks. The Stroop task and the last set of questionnaires (SBQ, SAS-SV) followed. Lastly, participants received their belongings back and were thanked for their participation, debriefed, and received financial compensation or course credit.

Design and Data Analysis

This study followed an experimental design with randomized group allocation. Independent variables are the short-term separation from an object (smartphone or ID) and addicted or non-addicted towards their smartphone (based on the SAS-SV). The dependent variables were state-anxiety and inhibitory-control as being operationalized by the Stroop task. Outliers in reaction times and errors departing 2.5 *SD* below or above individual response means were removed.

The data was analyzed using SPSS Statistics 25 (IBM) with α level set to .05 and reported *p* values corresponding to one- or two-sided hypotheses. A priory power analyses (following obtained effect sizes in prior literature) for an assumed medium effect-size with power being set at .80 revealed a sample size of N = 85 as adequate (Faul et al., 2009). At first, state anxiety differences between separation condition and control condition after separation and for addicted or non-addicted smartphone users were investigated, using analyses of variance (ANOVA) while controlling for trait anxiety. Non-parametric analyses were implemented for follow-up due to deviations in normality caused by small sample sizes and are noted as

such. To test for differences in inhibitory control, a 2x2 RM-ANOVA for the reaction times and errors in the Stroop task with between-subjects' factors (experimental, control) and within-subjects' factors (congruent, incongruent) was used. Pearson-correlations were computed for further exploratory analyses.

Results

Statistics and Data Analysis

There were no differences between conditions, on degree of smartphone addiction (SAS-SV), FoMO (FoMOs) or trait anxiety (STAI-T) due to group allocation. Further descriptive data are depicted in Table 1.

Table 1.

Independent Samples t-Tests on Certain Variables Between Experimental and Control Condition With Standard Deviations in Parentheses.

Total (*N* = 85)	Control Condition (*n* = 41)	Experimental Condition (*n* = 44)	*t* (df = 83)	*p*	*d*
SAS-SV	24.95 (8.90)	25.64 (9.25)	0.35	.729	0.08
FoMOs	2.69 (0.59)	2.53 (0.58)	-1.31	.195	0.28
STAI-T	45.27 (10.35)	43.27 (10.23)	-0.89	.374	0.19

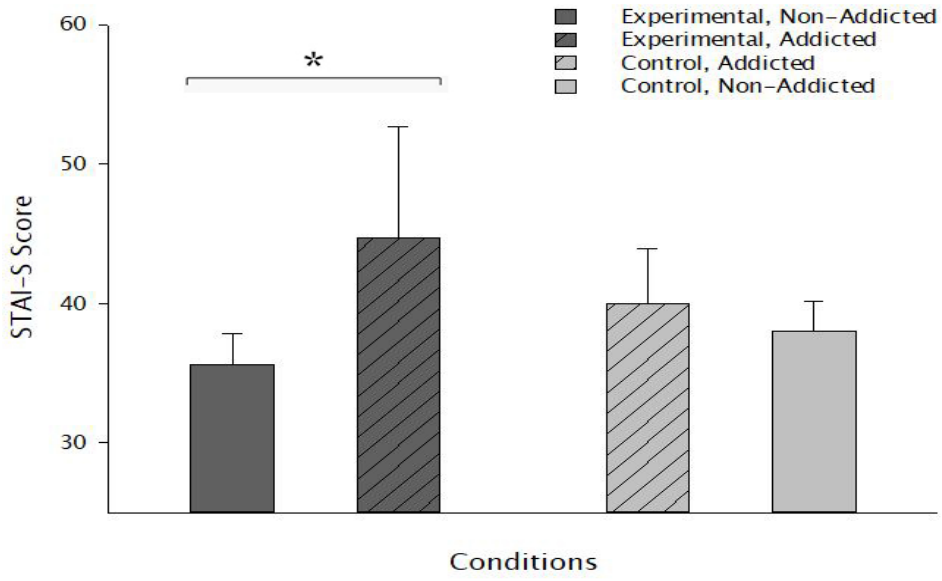
Note. SAS-SV = Smartphone Addiction Scale - Short Version (Kwon et al., 2013); FoMOs = Fear Of Missing Out Scale (Przybylski et al., 2013); STAI-T = State Trait Anxiety Inventory (Laux, 1981).

There was no overall difference between experimental (M = 37.68, SD = 8.53) and control condition (M = 38.41, SD = 5.83) regarding reported state anxiety, while controlling for trait anxiety as a covariate after separation, $F(1,80) = 1.488$, $p = .226$, $\eta p^2 = 0.2$. Moreover, there was a statistically significant effect between addicted (n = 17; M = 42.76, SD = 9.39) and non-addicted (n = 68; M = 36.85, SD = 6.27) participants on state anxiety, $F(1,80) = 8.433$, $p = .005$, $\eta p^2 = 0.1$. Furthermore, a statistically significant interaction effect between conditions and smartphone addiction was present, $F(1,80) = 4.26$, $p = .042$, $\eta p^2 = 0.1$.

Following up by comparing addicted and non-addicted smartphone users in the control condition, state anxiety after separation of addicted participants (n = 9) was higher (M = 40.00, SD = 1.71) than for the non-addicted participants (n = 32; M = 37.97, SD = 1.06) but did not differ statistically significant (U = 179.5, $p = .27$). In the experimental condition, the higher state anxiety scores for the addicted participants (n = 8; M = 45.88, SD = 4.34), than for the non-addicted participants (n = 36; M = 35.86, SD = 1.06), reached statistical significance, U = 216, $p = .028$ (see Figure 1).

Figure 1.

Ninety-Five Percent Confidence Intervals Around Mean State Anxiety for Non-Addicted and Addicted Participants in the Experimental and Control Condition After Separation.



Note. * $p < .05$.

As expected, a statistically significant main effect for the Stroop condition on reaction times was revealed $F(1,83) = 229.43$, $p < .001$, $\eta p^2 = .73$. There was no significant difference between groups, $F(1,83) = 0.40$, $p = .530$, $\eta p^2 = .01$ and no statistically significant interaction effect, $F(1,83) = 3.86$, $p = .053$, $\eta p^2 = .04$. Additionally, a statistically significant main effect for the Stroop condition on errors could be shown, $F(1,83) = 5.87$, $p = .018$, $\eta p^2 = .07$. There was no difference between groups, $F(1,83) = 1.17$, $p = .285$, $\eta p^2 = .01$ and no statistically significant interaction effect, $F(1,83) = .048$, $p = .827$, $\eta p^2 = .00$ (see also Table 2).

Table 2.

Mean Reaction Times and Errors and Stroop Effect With Standard Deviations in Parentheses Depending on the Condition.

	Reaction Times		Errors	
	Control Condition	Experimental Condition	Control Condition	Experimental Condition
Congruent Condition	654.80 (102.47)	652.80 (113.04)	0.46 (0.98)	0.91 (1.93)
Incongruent Condition	773.10 (134.48)	743.93 (120.82)	0.93 (1.40)	1.30 (2.79)
Stroop Effect	118.30 (63.43)	91.13 (63.95)	0.46 (1.21)	0.39 (1.92)

Note. Reaction times are in milliseconds.

Furthermore, the Pearson-correlation between smartphone addiction as measured by the SAS-SV and state anxiety while controlling for trait anxiety showed a statistically significant positive correlation of medium effect size for the separation condition, with $r(41) = .47$, $p = .002$, but no statistically significance for the control group, $r(38) = .25$, $p = .13$.

Discussion Experiment A

The primary goal in Experiment A was to investigate the general relationship between smartphone addiction, a short-time smartphone separation, anxiety and inhibitory control in a German, mostly student, sample. The first hypothesis that addicted participants show statistically significant higher levels of anxiety after smartphone separation for a period 20 minutes than non-addicted participants was confirmed. This was not the case for addicted participants surrendering their ID or student card. The second hypothesis of possible effects on inhibitory control after

smartphone separation could not be confirmed. Even though participants who surrendered their smartphone instead of their ID showed a smaller interference in their inhibitory control, this effect failed to reach statistical significance. Additionally, a positive relationship between increasing (problematic) smartphone attachment or addiction and state anxiety while controlling for participants trait anxiety could be found. This association was only present under the smartphone separation condition.

The gathered results are consistent with Cheever et al. (2014) for an increased anxiety following a separation period among people with an addictive relationship towards their smartphones. Since this was not the case for addicted participants who surrendered valuable personal belonging as a control, it is reasonable to conclude that the increased anxiety was due to the smartphone-separation.

While Hartanto and Yang (2016) presented strong evidence for the association between elicited anxiety due to smartphone separation and problems in executive functioning, Experiment A was unable to replicate these results in a sample with German adults using similar methodology. However, the sample in Experiment A indicated fewer hours of smartphone usage per day and scored on average lower regarding their smartphone addiction than in the described sample by Hartanto and Yang. It might be the case that the extent of smartphone addiction was too low to provide meaningful interference on computer tasks measuring inhibitory control under conditions of smartphone separation. Moreover, the observed trend was a reduction in interference, thus, participants' performances

indicated a better inhibitory control during smartphone separation which is congruent with Ward et al. (2017).

Limitations to the interpretability of the results are uncontrolled personal variables such as intelligence or motivational factors, external motivations (most participants belonged to a convenience sample) or possible external confounds during the period the data was gathered.

Experiment B

Method

Participants

The mostly student sample consisted of 95 participants (age: $M = 21.97$, $SD = 2.43$ years), 74 females and 21 males. Inclusion criteria were as follows: age between 18–27, smartphone possession and German mother tongue. Furthermore, participants were required to reach a cut-off score in the *Smartphone Overuse Screening Questionnaire* (Lee et al., 2017) of greater than 42. Exclusion criteria were as follows: suffering from a diagnosed mental illness, illegal substance use, colorblindness and previous participation in Experiment A. The daily smartphone use in hours of the sample was as follows: 1–2 (7.4 percent), 3–4 (53.7 percent), 5–6 (23.2 percent), > 6 (15.8 percent). The remuneration of the participants could be financial or course credits. Informed written consent was obtained from all participants. The study was approved by a local Ethics Committee.

Measures and Instruments

Following instruments and tasks were included but are already described under Measures and Instruments in Experiment A: *Fear of Missing Out Scale*

(Przybylski et al., 2013), *State-Trait-Anxiety Inventory* (Spielberger et al., 1970), *Stroop task* (Stroop, 1935), *Sociodemographic Questionnaire*.

Experiences in Close Relationships. The original version of the questionnaire *Experiences in Close Relationships* (ECR) from Brennan et al. (1998), *Bochumer Bindungsfragebogen* (BoBi) by Neumann et al. (2007) in German, measures attachment styles in relationships via two scales *Anxiety* and *Avoidance*. The underlying model for child attachment styles is based on Ainsworth et al. (1978) which according to Hazan and Shaver (1987) can be adopted to adult attachment styles. Overall scoring of the BoBi ranges from 1 to 7, for *Anxiety* (preoccupied attachment; $\alpha = .88$) and for *Avoidance* (fearful and dismissing attachment style; $\alpha = .85$) with higher scores indicating a higher manifestation of the construct.

Smartphone-Attachment-Type Scale (SAT-S). The SAT-S (see Appendix) was developed for this study to assess the problematic smartphone-attachment style based on the PMPU-classification (Billieux et al., 2015) in a differentiated manner. It contains 15 statements of which five items correspond to every pathway-type as measured on a 5-item Likert scale (1 = I do not agree at all to 5 = I agree completely). Excessive-Reassurance (maintenance of important relationships, reassurance about other's well-being, intense concern and sense of abandonment over delayed response from others and extreme need for self-supportive feedback; $\alpha = .69$), Impulsive-Antisocial (handling of boredom, longer use of the smartphone as anticipated, use of a smartphone in forbidden places, instant sharing of positive-negative experiences with others and irrational response to messages without taking the consequences into account; $\alpha = .39$) and Extraversion (facilitation of

communication with significant others, establishment of new relationships, risky use of smartphones, sending of sexual content and occupation with gambling and action games; α = .45). In case the participants' score was the same in two categories of the SAT-S, a forced-choice item was consulted to select the primary pathway-type: "I mainly use my smartphone to maintain the relationship with the significant others in my life" (Excessive-Reassurance) or "When I get bored, or I don't have to do something, I preferably occupy myself with my smartphone" (Impulsive-Antisocial) and "I mainly use my smartphone to communicate with my significant others and to build new relationships" (Extraversion).

Smartphone Overuse Screening Questionnaire (SOS-Q). The SOS-Q (Lee et al., 2017) differentiates between non-problematic and problematic smartphone users. The questionnaire was translated into German for the purpose of this study. It contains 28 items in six main categories: Preoccupation, Loss of control, Craving, Insight, Overuse and Neglect of other areas. Answer possibilities range on a 4-item Likert scale. For the investigation a cut-off score of > 49 was applied to classify people as problematic attached towards their smartphone. In its translated version The SOS-Q showed in the present study an internal consistency of α = .87.

Procedure

First, eligible participants were provided online with information about the experiment and an informed consent. After creating their unique identification code further questionnaires were administered, containing sociodemographic characteristics and the SAT-S and SOS-Q. Within a week all participants meeting inclusion criteria received a second link forwarding to another set of questionnaires

(STAI-T, BoBi). After this, participants were randomly assigned to the control or treatment group and categorized into one of the smartphone attachment pathways.

Afterwards, participants had contact with the researcher in the laboratory. Participants were asked to fill out the STAI-S (pre) and to surrender their smartphones in a large container. Then, they were led into the recording room which was freed from distracting stimuli. Within the waiting period of 15 minutes, participants received a neutral short story (Hawking & Kober, 1997) as used in Göritz (2007) for distraction purposes and acoustic cues were presented two times (a vibrating smartphone for 5 to 10 seconds which was set up in a small bowl above the box containing the participants' smartphone).

Next, participants were asked to fill in the STAI-S (post) before they were seated in front of the computer on which the FoMOs and the forced choice item of the SAT-S had to be answered digitally and the Stroop task was given. Lastly, participants received their belongings back, were debriefed, remunerated and thanked for their participation.

Design and Data Analysis

This study follows a quasi-experimental design with a separation period of 15 minutes from their smartphones during which the participants were provided with a distraction. Independent variables were problematic or unproblematic smartphone use and smartphone attachment type. Dependent variables were post-separation state anxiety and inhibitory control. Similar statistical analyses as in Experiment A were applied. Concerning to the primary hypothesis whether a smartphone separation of 15 minutes leads to a change in reported state anxiety

for participants classifying as problematic attached or unproblematic attached when presented with a task, ANOVAs were carried out with the above-mentioned independent variables as between-factors. To test for a resulting difference in inhibitory control, a 2x2 RM-ANOVA for the reaction times in the Stroop task with between-subjects' factors (problematic, unproblematic) and within-subjects' factors (congruent, incongruent) was carried out. The PMPU-pathways were further explored by computing Pearsons-correlations on the participants' smartphone use, FoMOs and the BoBi subscales.

Results

There was as statistically significant difference in smartphone use in hours between problematic and unproblematic smartphone users (see Table 3). In addition, the Excessive-Reassurance- and Impulsive-PMPU pathway scores on the SAT-S were statistically significantly higher for problematic smartphone users than for unproblematic smartphone users.

Table 3.

Independent Samples t-Tests With Means and Standard Deviations in Parentheses for Comparisons on Smartphone Use in Hours and Attachment Between Problematic and Unproblematic Smartphone Attachment.

(*N* = 95)	Problematic Smartphone Use (*n* = 63)	Unproblematic Smartphone Use (*n* = 32)	*t* (df = 93)	*p*	*d*
Smartphone Use	4.68* (1.55)	4.00* (1.48)	-2.06	.043	-0.45
SAT-S					
Excessive	17.27* (3.28)	15.78* (3.05)	-2.14	.035	-0.47
Extraversion	13.11 (3.11)	11.88 (2.39)	-1.93	.052	-0.43
Impulsive	19.30* (2.41)	17.88* (2.03)	-2.87	.005	-0.62

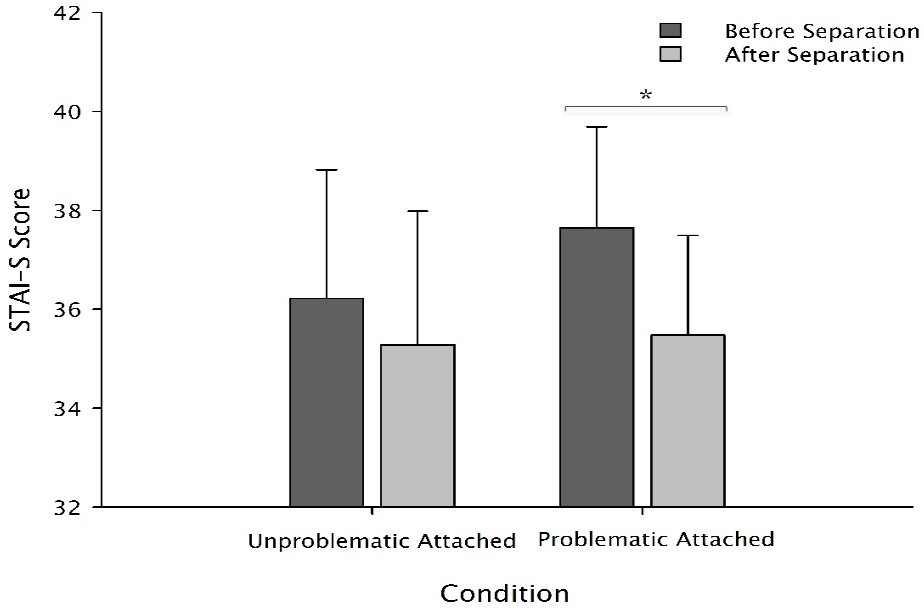
Note. SAT-S = Smartphone Attachment Type Scale, answers range from 5-25 with higher scores indicating a higher extent of the underlying construct.

* $p < .05$.

A one-way ANOVA revealed statistically significant differences for conditions on pre- and post-anxiety, $F(1,93) = 4.677$, $p = .033$, $\eta p^2 = .05$. More specifically, for participants reporting a problematic attachment to their smartphone the level of anxiety was statistically significant higher before the separation period ($M = 37.65$, $SD = 8.0$) than after ($M = 35.48$, $SD = 8.03$), ($t(62) = 2.43$, p = .018, $d = .271$), this was not the case for unproblematic attached participants with $M = 36.22$, $SD = 7.23$ before and $M = 35.28$, $SD = 7.49$ after ($t(26) = 0.484$, $p = .632$, $d = .08$). See Figure 2 for bar plots with 95 percent Confidence Intervals.

Figure 2.

Ninety-Five Percent Confidence Intervals Around Mean State Anxiety for Unproblematic and Problematic Smartphone Attached Participants Before and After Separation While Receiving a Distracting Task.



Note. * $p < .05$.

Furthermore, a statistically significant effect for the Stroop condition on reaction times was shown $F(1,93) = 67.43$, $p < .001$, $\eta p^2 = .42$. There was no difference between groups, $F(1,93) = 0.09$, $p = .764$, $\eta p^2 = .01$ and a statistically significant interaction effect was present between groups and condition, $F(1,93) = 8.63$, $p = .004$, $\eta p^2 = .085$ (see Table 4). The Stroop effect on reaction times for both conditions revealed statistically significant higher interference for problematic attached participants than for unproblematic attached participants.

Table 4.

Mean Reaction Times and Stroop Effect for Problematic and Non-Problematic Smartphone Users With Standard Deviations in Parentheses.

N = 95	Unproblematic Smartphone Use (*n* = 32)	Problematic Smartphone Use (*n* = 63)
Congruent Condition	816.24 (189.68)	771.88 (163.97)
Incongruent Condition	876.60 (187.28)	899.47 (186.91)
Stroop Effect	60.36 (82.46)	127.59 (115.25)

Note. Reaction times are in milliseconds.

Further exploratory analyses were conducted to investigate the properties of the SATS-S and variables relating to individual PMPU-pathways. Based on the SAT-S, 74 participants were assigned to the PMPU-pathways of Antisocial-Impulsive (M = 18.82, SD = 2.37), 20 to Excessive-Reassurance (M = 16.77, SD = 3.26), and one as Extraversion (M = 12.69). The participant belonging to the Extraversion pathway was excluded from further analyses. Participants in the Impulsive-Antisocial pathway showed no statistically significant associations between their SOS-Q score and the subscales in the BoBi (anxiety: $r(74) = .072$, $p = .539$; avoidance: $r(74) = -.034$, $p = .773$); yet a statistically significant positive relationship of medium size between the SOS-Q score and FoMO, $r(74) = .377$, $p = .001$. Participants belonging to the Excessive-Reassurance pathway showed a strong positive correlation between the SOS-Q score and the anxiety subscale in the BoBi ($r(20) = .566$, $p = .009$). The avoidance subscale in the BoBi ($r(20) = -.299$, $p = .200$) and the FoMo scale ($r(20) = .158$, $p = .505$) shared no statistically

significant relationship with the SOS-Q score in the Excessive-Reassurance pathway.

Discussion Experiment B

In experiment B, participants classified as being problematically attached reported lower anxiety after separation than before; the anxiety level for unproblematic attached participants did not change note worthily after 15 minutes of separation. Problematic attached participants showed a statistically significant larger disturbance in inhibitory control than non-problematic attached participants. Scrutinizing the PMPU-pathways further, a self-report measure revealed that 78 percent of the participants categorized themselves as Antisocial-Impulsive, 21 percent as Excessive-Reassurance and only one participant chose the Extraversion pathway. The overall scores on the SAT-S were statistically significantly higher for participants classified as problematic attached than for unproblematic attached participants. Moreover, associations between the proposed PMPU-pathways, as indicated by the SAT-S, and established instruments measuring constructs which are assumed to belong to the proposed classification were explored. For participants categorizing as Impulsive-Antisocial there was evidence supporting that the extent of problematic smartphone use correlates positively with FoMO. The strength of this relationship was of medium-sized. Lastly, the relationship between the degree of problematic smartphone attachment and relationship anxiety for participants classified as belonging to the Excessive-Reassurance pathway was of large size.

In Experiment B participants had to focus on reading a neutral short story while they were separated from their mobile device. This distraction could explain the decrease in anxiety for problematic smartphone attached participants after a separation period. Cheever et al. (2014) stated that working on a task during the smartphone separation might buffer against the anxiety evoking effects. Since there was no change in anxiety for unproblematic attached participants, this line of reasoning seems plausible.

The experimental setup included a design in which the smartphone was not visible and not accessible for the participants and additionally provided two cues to increase the salience of the inaccessibility. In previous research it was shown that spatial distance and location plays a significant role in how the separation period is perceived if there is a strong reliance on the mobile device (Johannes et al., 2019). In accordance to Ward et al. (2017), cognitive capacity was increased the more distant the smartphone was from its owner. Hence, given the larger state anxiety of problematic attached participants before separation and the reduction of state anxiety after the separation period, the cues could have acted as a reassuring reminder for participants that their smartphone is out of sight but only temporarily inaccessible.

To allow a classification of the problematic smartphone attached population, a self-report measure was developed to capture the most dominant PMPU-pathway as proposed by Billieux et al. (2015). Except for the subscale Excessive-Reassurance for which adequate internal consistency was found, the internal consistencies for the Extraversion and Impulsive-Antisocial subscales were insufficient. However, the

scores belonging to the Excessive-Reassurance and Impulsive pathway types in the developed questionnaire were substantially higher for problematic attached participants than for unproblematic attached ones. Thus, the SAT-S shows promise, though it needs further substantial rework to allow valid classification of the dominant pathway type.

Billieux et al. (2015) mention, that a clear assignment to one of the pathways is not always possible due to an overlap in the associated constructs. Since there was no evidence for participants belonging to the Extraversion pathway, this could mean that the SAT-S was unable to capture the true nature of the pathway and not necessarily implies that this pathway does not exist. The positive association between FoMO and Impulsive-Antisocial pathway and the strongly positive association between Excessive-Reassurance pathway and attachment anxiety is providing supplementary evidence for the existence of the two proposed pathways and benefits future model reworks.

General Discussion

In summary, there was evidence that addicted smartphone users already suffer from an increase of anxiety after a smartphone separation period of 20 minutes, when there is no distraction during the waiting period. The data showed a reduction in anxiety when problematic attached participants were separated from their smartphone and provided with a task while waiting. There was no evidence that a mere smartphone separation without some prior form of attachment leads to an increase in anxiety or a disturbing effect on inhibitory control. Yet, problematic attached smartphone users showed a larger cognitive

interference in Experiment B. Although not reaching statistical significance it is noteworthy that the response times of problematic attached participants in the Stroop task was better in the congruent condition than for unproblematic attached participants.

In both experiments, the developed self-report measures revealed that (except for one person in Experiment B) participants did not classify themselves as belonging to the Extraversion pathway (Billieux et al., 2015). Besides the already discussed internal consistency issue of the developed measure, behaviors belonging to the Extraversion pathway, such as actively seeking recognition and appreciation could, due to its arguably less societal approved form of behaving in the digital world, represent a social desirability issue that people either do not want to admit or are incapable to reflect on. The importance to consider the specific type of attachment between smartphone and owner should be considered when it comes to the development of viable treatment options for people suffering from problematic smartphone behavior implications.

One of the limitations of this study was the unavailability of a physiological measure for anxiety. The STAI is a self-report measure and although autonomic arousal might not match individuals feeling states, further research can benefit from an experimental setup with physiologic measurements such as skin conductance or heart rate. This goes hand in hand with an overall reliance on self-report measures since participants might have under- or overestimated their smartphone usage or smartphone behavior. Although this study was conducted with adults and not with adolescents, as it is the case for most research focusing on

this topic, the study sample was still very young, so generalizations to an older population are not recommended.

Conclusions

This study aimed at understanding the specific nature and implications of smartphone separation by distinguishing between dysfunctional forms of attachment. The first experiment provided further evidence that for addicted users a short-term smartphone separation of 20 minutes can already lead to increased state anxiety. However, detrimental effects on inhibitory control following smartphone separation were inconclusive. The second experiment revealed that a task provided within a separation period of 15 minutes might have a buffering effect against an increase in anxiety for problematic attached smartphone users. Additionally, classifying problematically attached smartphone users on the basis of the PMPU-pathways (Billieux et al., 2015) by a self-developed questionnaire showed that 78 percent of the participants categorized themselves as Antisocial-Impulsive, 21 percent as Excessive-Reassurance and only one participant indicated to belong to the Extraversion pathway. Overall, this study provides additional data to design further studies to clarify parts of the heterogeneous landscape of problematic mobile phone attachment research and to develop tailored interventions for people suffering from it.

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Author Note

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Appendix

Smartphone Attachment Type Scale

I – Structured Questionnaire

Answer format 5-Likert Scale

1) I do not agree at all
2) I do not agree
3) neither nor
4) I agree
5) I totally agree

Instruction for the subject:

Below you will find statements that describe a daily use of the smartphone. Please indicate for each statement to what extent it applies to you. For this purpose, a scale from 1 (I do not agree at all) to 5 (I totally agree) is available with corresponding anchors. Please indicate the number that reflects the degree of your consent. The term *important reference persons* refer to friends, family members and partners.

1. I send text messages/messages to important reference persons more often during the day to assure that they are doing well.
2. I mainly use my smartphone to maintain relationships with important people in my life.
3. If I had a particularly positive/enjoyable experience, I would like to report it immediately to important reference persons.
4. Sometimes I use my smartphone in inappropriate situations (e.g. during a divine service, in the cinema/theater/opera, in a lecture, during a date).
5. I respond automatically to SMS/messages/posts on social networks and reply without further consideration.
6. Positive comments among my posts on social networks help me to feel better.

7. Sometimes I use my smartphone while driving (e.g. reading/writing SMS/messages).

8. I often use my smartphone longer than I intended.

9. I use my smartphone most often to communicate with important reference persons.

10. If I have nothing to do or when I am bored, I like to play with my smartphone.

11. If I play something on my smartphone or gamble, I can continue for hours.

12. If an important reference person does not contact me or is not responding to my messages for a longer time, I feel neglected by them.

13. I am very interested in building new relationships/contacts with other people through social networks and instant messengers.

14. Sometimes I send erotic pictures of me or send messages with sexual allusions to my partner or potential sexual partner.

15. I get restless when I cannot reach important people immediately via their mobile phone.

II – Forced Choice Questions

Answer format: Forced Choice

Next to each of the three statements is a box. Only one of the boxes can be ticked and one answer must be indicated.

Instruction for subjects:

Please read the following short descriptions and check the ones that most closely apply to you:

1. I mainly use my smartphone to maintain relationships with important people in my life.
2. If I have nothing to do or when I am bored, I like to work with my smartphone.
3. I use my smartphone mostly to communicate with important reference persons and build new relationships.

Usability and Applicability of a Mindfulness Based Online Intervention Developed for People With Problematic Internet Gaming Behavior

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Abstract

In this study, the usability and applicability of a mindfulness based online administered gamified short-term intervention for people suffering from internet gaming disorder is investigated in a subclinical sample ($N = 49$). Within a four-week intervention program (*Room2Respawn*) participants were randomly allocated to a gamified condition (experimental) or a neutral condition (control). Participants were provided with three intervention sessions per week consisting of psychoeducation on internet gaming disorder and mindfulness-exercises. Most of the intervention content has been adopted from a group-therapy intervention to an online platform. The 39 participants who participated over the course of the whole intervention rated the usability of the online-intervention overall and across all measures as good or very good. There was no evidence for beneficial effects of gamification on motivation when compared with ratings from a control condition. Areas of improvement and study limitations are discussed. Due to an easy applicability and very good usability, *Room2Respawn* shows potential to develop into a low-threshold treatment option, which, after rework, needs to be put to test on a sample showing clinical symptoms of pathological internet gaming.

Keywords: mindfulness, internet gaming, gamification, internet gaming disorder, usability, applicability

Usability of a Mindfulness Based Online Intervention Developed for People With Problematic Internet Gaming Behavior

Most internet gamers are casual players; however, some develop an attachment to internet games that can be considered pathological. The *Internet Gaming Disorder* (IGD) was included in the latest version of the Diagnostic Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) as research diagnosis. The reported prevalence rates for IGD vary from less than 1 percent to 10 percent (Lemmens et al., 2015; Petry et al., 2014; Wartberg et al., 2017) and comorbid disorders such as social phobia, attention deficit disorder, depression and obsessive compulsive disorder appear commonly (Carli et al., 2013; Mallorquí-Bagué et al., 2017). The internet gaming population still suffers stigmatization and since prevalence rates IGD are relatively low, the risk of pathologizing normal behavior is comparably high (Kardefelt-Winther et al., 2017).

Assessment methods and construct conceptualizations for IGD are quite diverse (King et al., 2013). Literature focusing on the treatment of IGD however, is relatively sparse in comparison to other potential behavioral addictions and more readily available treatment options (advisory interventions and psychopharmacotherapy) are often associated with high costs and/or side effects. Focusing on treatment effectiveness the research on psychotherapeutic interventions in the form of cognitive behavioral therapy seems promising, especially when combined with psychopharmaceutic interventions (Han et al., 2010; King & Delfabbro, 2014). The IGD population is heterogeneous, with a lack of recommended treatment strategies, large numbers of relapses and treatment often

involves the necessity of high-cost interventions (for an overview of reviews and studies, see King, Delfabbro et al., 2017; King, Kaptsis et al., 2017; Torres-Rodríguez et al., 2018).

This study introduces an intervention with a low entry threshold and short-term focus which encompasses resulting trans-diagnostic psychological deficiencies of people suffering from IGD such as emotion regulation problems, attentional disturbances, automatic dysfunctional behavioral patterns and diminished awareness towards deprived needs. It was decided to transfer and expand an already established alternative method for people suffering from addictions which is *Mindfulness-Oriented Recovery Enhancement* (MORE; Garland, 2013).

Originally, MORE is applied in a group-setting over eight or more consecutive weeks. Evidence for the effectiveness in treating IGD could already be provided (Li, Garland et al., 2017). MORE combines mindfulness meditation, elements of reappraisal of negative events and positive psychology into an integrative treatment to disrupt dysfunctional behavioral and cognitive patterns and to re-establish awareness for deprived needs. The benefits of mindfulness interventions for treatment and motivation for people suffering from (substance) addiction (Li, Howard et al., 2017) and gambling addiction (Toneatto et al., 2014) is plentiful.

To circumvent the treatment gap (Kohn et al., 2004) and add flexibility to the application of the intervention, a transfer of the adopted content to an online setting seems promising. The effectiveness of online based interventions to bridge waiting period was already shown (Fuhr et al., 2018). Furthermore, an online

application of an intervention represents a low-threshold and cost-effective possibility to reach people who otherwise would not have been able to find help.

In the best-case scenario an intervention should be as motivating as internet gamer are captivated by internet games. Regarding underlying motivational mechanisms, Yee (2006) offered a conceptualization of player types via the distinction into three categories (Achievement, Social, Immersion). The components of “Achievement” entail advancement, mechanics and competition. “Social” comprises socializing, relationship and teamwork whereas “Immersion” contains discovery, role-playing, customization and escapism. Yet, these motivational concepts described above are not only present in games but have also been adopted via the use of operationalized gamification principles in a variety of other domains.

Implementing gamification principles can enhance work or learning processes, increase motivation and subsequently performance (Sailer, 2016). It can be argued that using the familiarity with gamification principles by applying these principles to an intervention for people suffering from pathological internet gaming offers a non-intrusive way to help shift dysfunctional behaviors to a functional need fulfilling behavior. For instance, in a study by Miloff et al. (2015), a gamified intervention for people suffering from social anxiety was introduced which incorporated a high degree of personalization, anonymous social interactions and further gamification techniques. Instead of condemning addiction maintaining learning mechanisms, an implementation of those same mechanisms for a functional transfer to alternative coping behaviors seems helpful and resource

oriented. The developed intervention *Room2Respawn* uses gamification principles in its design by focusing on the following dimensions: points as a reward system, see also (Sailer et al., 2017; Werbach & Hunter, 2012), levels to structure tasks and increase salience of goals (Stinson et al., 2013), badges as collectibles to promote motivation (Eickhoff et al., 2012), personalized contact to increase identification (Reeves & Read, 2009) and leaderboards for social comparison and competition (Burguillo, 2010; Crumlish & Malone, 2009).

This study aims at exploring the applicability and usability of an online administered treatment with mindfulness elements for people suffering from IGD. Gamification principles were incorporated to deliver the intervention content in a known framework for an internet gaming population. Since the usability of a gamified intervention for people suffering from IGD has to the author's knowledge never been tested, a framework with a gamified experimental condition and a balanced, neutral condition was chosen as control. Of primary interest for this investigation is an adequate usability over the duration of the intervention (four weeks). It is assumed that participants will rate the usability of the intervention elements across all measures as above average. On a secondary level it is hypothesized that the reported (intrinsic) motivation for people to reduce internet gaming behavior will increase after the intervention. Overall, it is expected that usability and motivation will be rated higher for people in the gamification condition than for people in the control condition. On an exploratory level the comments made by participants regarding the intervention will be qualitatively investigated. Lastly, participation and dropout-rates between groups are explored. A subclinical

sample with gaming experience was chosen as a first step for further optimization of the intervention.

Method

Participants

Inclusion criteria were age between 18 and 40 years, German mother tongue and gaming experience. Exclusion criteria were the use of illegal substances, mental illness and pathological signs of internet gaming disorder. Interested participants who reported having experiences with internet gaming were chosen and randomly allocated to the neutral control or gamified experimental condition. Participants were recruited via flyers on the university premises, in online forums and social media. The starting sample consisted of 49 participants (24 females; 25 males) between 18 and 35 years of age *(M* = 24.41, *SD* = 3.72 years). Participants missing four or more sessions were excluded (dropout: four participants experimental condition, six participants control condition) resulting in a final sample of 39 participants for analyses. The remuneration of the participants was either financial or with credit points as a trial subject. Informed written consent was obtained from all participants. The study was approved by a local Ethics Committee.

Instruments and Intervention

Computer System Usability Questionnaire (CSUQ)

The German version by Böckermann et al. (2015) of the CSUQ (Lewis, 1995) was used and for study purposes, the original 19 items were extended by 11 additional items to capture usability ratings regarding email interactions.

Statements range on a Likert scale from 1 = don't agree at all to 7 = completely agree.

Control Questions (CQ)

Two questions succeeding every intervention session were implemented to control whether the participants revised the exercise content for each session. The questions were designed by the authors and presented in a multiple-choice format with one correct answer possibility.

Intrinsic Motivation Inventory (IMI)

The IMI (first used in Ryan, 1982) is rooted in Self Determination theory and consists of 45 items on six subscales. These were reduced to 27 items with a changed reference from *this activity* to *this exercise* and translated into German for the purpose of this study. Answers are recorded within a 7-point Likert scale ranging from 1 to 8 with higher overall values indicating stronger approval of the respective subscale (1 interest or pleasure, 2 perceived competence, 3 perceived choice, 4 effort, 5 feeling pressure or tension, 6 usefulness); Cronbach's α ranging from .82 to .91 (Monteiro et al., 2015).

Sociodemographic Questionnaire

In addition to age, gender, education and knowledge of German, the sociodemographic questionnaire also covered previous experience with meditation, diagnosed mental illnesses, illegal substance use and frequencies of digital media and video game consumption of the participants.

Ten-Item Internet Gaming Disorder Test (IGDT-10)

The IGDT-10 (Király et al., 2017) contains 10 items which measure the extent of pathological internet gaming behavior based on the DSM-5 criteria for Internet Gaming Disorder. Item nine and ten refer to the same facet of the disorder and contribute each 0.5 points towards the sum of the scale. The IGDT-10 was translated into German for the purposes of the study. A cut-off score of five out of nine points represents a strong indication of an underlying disorder. In the response format, answer possibilities are Never, Sometimes, and Often. The IGDT-10 has an internal consistency of Cronbach's $\alpha = .68$.

Usability Evaluation Questionnaires (UEQ)

The self-developed questionnaire for the evaluation of the intervention content is divided into four sub-scales: email (five items), psychoeducation (two items), meditation (four items) and intervention in general (two items). Dimensions are length, interestingness, favorability and comprehensibility evaluated on a 7-point Likert scale with corresponding varying anchors. Furthermore, participants could also comment open-ended within a text box. In the experimental group the level of gamification of the intervention content was also evaluated using a questionnaire including 42 items with seven questions each for the implemented gamification elements (pseudonym, daily quiz, score, leaderboard, level and badge). Answers were recorded using a 7-point Likert scale ranging from 1 = not at all to 7 = agree completely and a commentary box for open-ended answers.

Design

In the quasi-experimental design of the study the experimental condition received a gamified intervention content whereas the control condition received a neutral version with the same, balanced content.

Gamification Elements

The email communication with the participants contained the gamification elements that were implemented. In the gamification condition participants were asked to create a personal username (1a Personalization), interventions were referred to as levels (2a Levels), a leaderboard (3a Leaderboard) showed the current score (correct responses in control questions and working through content awarded points) and ranking in comparison to fellow participants and lastly a badge (4a Badge) depicting a progressively more evolving meditating person after the first and with every three successfully completed session. The gamification elements were balanced as follows in the neutral condition: a standardized neutral code (1b Subject Code), interventions were referred to as sessions (2b Session), an overview (3b Overview) about the weekly content was shown and the logo for *Room2Respawn* was depicted (4b Logo).

Content for the Intervention

The main content for the intervention has been adopted largely from MORE (Garland, 2013), translated into German for the purpose of this study and adjusted for internet gaming behavior. All mindfulness-meditations were recorded by a trained psychotherapist and adjusted in content for internet gaming behavior. The fifth session had to be completed solely in writing, all other exercises contained a

meditation (7 minutes and 25 seconds on average). Consult Table 1 for an overview about the sessions, topics, psychoeducational content, mindfulness-exercises and the implemented questionnaires.

Table 1.

Overview About Intervention Content and Implemented Questionnaires.

Session	Topic	Psychoeducation	Mindfulness-exercise	Questionnaires
Screening				Privacy Policy; SD; IGDT-10
Pre-test (t00)				
1 (t01)	Introduction	What is mindfulness?	First meditation	CQ; CSUQ; IMI
2 (t02)	Automatisms on dependency	Automatisms on dependency	Breathing meditation	UEQ; CQ
3 (t03)	Automatic behavior	What are (your) triggers?	Chocolate-exercise	UEQ; CQ
4 (t04)	Mindful evaluation	Cognitive restructuring/ mindful appreciation	Mindful enjoyment	UEQ; CQ
5 (t05)	Positive experience	Acceptance through mindfulness	Hitlist of the most common negative thoughts**	UEQ; CQ
6 (t06)	Overcoming the pressure of addiction	The nature of desire	Raisin-exercise	CSUQ; CQ; UEQ; IMI
7 (t07)	Dealing with stress	Craving & stress	Imagined stress & relaxation reply	UEQ; CQ
8 (t08)	The ephemeral body	The nature of transience	Transience-exercise	UEQ; CQ
9 (t09)	The relevance of human relationships	How relationships affect dependency	Loving-kindness meditation	UEQ; CQ
10 (t10)	Internal criticism and willingness to change	Diffusion - defending yourself against the inner critic	Readiness - "the brittle dam"*	UEQ; CQ
11 (t11)	The mindful view of the future	What have we learned?	Future music	UEQ; CQ
12 (t12)	Target and value-congruent action	Target and value-congruent action	Mindful breathing	CQ CSUQ; IMI; EQ
Post-test (t13)				IGDT-10 Debriefing

Note. UEQ = Content Evaluation via UEQ. CQ = Control Questions. SD = Sociodemographic Questionnaire. IGDT-10 = Ten-item Internet Gaming Disorder Test (Király et al., 2017). CSUQ = Computer System Usability Questionnaire (Böckermann et al., 2015). IMI = Intrinsic Motivation Inventory (Ryan, 1982). EQ = Evaluation of Gamification. All exercises were adopted from MORE (Garland, 2013) or from indicated sources.

*(Luciano-Soriano et al., 2001), **(Wengenroth, 2016).

Procedure

Interested possible participants contacted the researchers via email and received a link for the online screening. The latter consisted of an informed consent, a declaration of data protection, sociodemographic questions and the IGDT-10. All answers were collected and carried out via the online questionnaire service SoSciSurvey (Leiner, 2018). Subsequently, all included participants received an email with general information about the course of the study and an invitation to participate in the pretesting (t00).

The intervention content was published on each intervention day (three times a week; on Monday, Wednesday and Friday) at 10 a.m. on an intervention blog entitled *Room2Respawn* which was created for the purpose of this study. After each session, the content remained on the blog for the remainder of the intervention. The content could be edited until 10 p.m. on the evening of the subsequent intervention session. Since participants received an email for each individual session, this email also included a link to the post-session survey. The post-session survey included a question of conscience to check whether the content was revised, a control question in a multiple-choice format regarding the psychoeducation and mindfulness-exercise, and evaluative multiple-choice questions regarding the intervention content.

In case a session was missed, participants received an email asking them to attend the next session again, stating that it was not possible to complete the intervention at a later point in time. After having missed three sessions altogether a warning was sent, describing that the next miss would lead to exclusion from

participation. At the end of the last intervention session all subjects were invited via email to take part in the final post-intervention survey after which they received an email of appreciation for their participation, a debriefing and their renumeration.

Data Analysis

All statistical analyses were carried out at a significance level of 0.05, using IBM SPSS Statistics (25). Independent variables are condition, operationalized as gamification (experimental) or neutral (control) group and time of measurement. Dependent variables were usability ratings (dimensions: email, psychoeducation, meditation, length) and (intrinsic) motivation. Data was collected at 15 timepoints (screening, pre-measurement, 12 interventions, post-measurement). Of primary interest for this study was the evaluation of overall usability measured in timepoints t1, t6 and t13 with the CSUQ and over all timepoints with the UEQ. For the main analyses, t-Tests for independent samples or analyses-of-variance (ANOVAs) were calculated. A 3x2 mixed-factors ANOVA was employed to explore changes in ratings for the usability throughout the course of the intervention (t1, t6, t13) for the different conditions (experimental and control). For the applicability of content, the mean values for the scales Email, Psychoeducation and Meditations were computed and together with the dimension of Length, *t*-Tests between conditions were computed. In order to test whether a change in (intrinsic) motivation took place during the intervention phase, the subscales of the IMI were analyzed with 2x2 ANOVA with the between-factor conditions (experimental, control) and the within-factor time of measurement (t1, t12).

Results

Statistics and Data Analysis

Comparison of age, media usage times and computer gaming experience (see Table 2) in a sample of $N = 39$ participants who completed the intervention showed no statistically significant differences between control ($n = 18$) and experimental ($n = 21$) condition, except for computer gaming experience in years (see Table 2).

Table 2.

Mean Differences With Standard Deviations in Parentheses in Internet Gaming Related Behaviors Between Control and Experimental Condition.

	Experimental Condition	Control Condition	*t*-Test Values With df in Brackets	*p* Values
Age	23.44 (2.76)	25.42 (4.35)	$t(47) = -1.91$	.063
Computer Gaming Behavior				
Daily Hours	1.83 (1.25)	1.67 (1.24)	$t(34) = 0.40$	.69
Game Console Behavior				
Daily Hours	1.67 (.52)	2.00 (1.63)	$t(11) = -0.48$	.642
Mobile gaming behavior				
Daily Hours	1.17 (.75)	1.44 (1.42)	$t(13) = -0.44$	.67
Computer Gaming Experience in Years	10.5 (5.57)	13.5 (3.62)	$t(45) = -2.23$	.031*

Note. * $p < .05$.

The usability of the developed intervention as indicated in the CSUQ was good, $M = 6.20$, $SD = 0.69$, ranging from 1 = “not good at all”, to 7 = “very good”. A dependent samples *t*-Test on a conservatively chosen cutoff of 5 as indication of

adequate usability revealed a statistically significant difference from this cutoff ($t(31) = 10.12$, $p < .001$), thus, providing evidence for the first hypothesis (see Figure 1). There was no statistically significant difference for time, $F(2, 60) = 1.75$, $p = .182$, $\eta p^2 = .06$, groups, $F(1, 30) = 1.77$, $p = .192$, $\eta p^2 = .06$ and no interaction effect ($F(2, 60) = 1.00$, $p = .372$, $\eta p^2 = .03$).

Regarding the overall evaluation of content for emails, psychoeducation and meditations, indications in the UEQ were consistently positive and the length of each intervention session was rated adequate. There were no differences between groups regarding the perceived quality of content ($F(3, 35) = 1.63$, $p = .200$) or length ($t(37) = 1.75$, $p = .088$, $d = .06$) of the intervention (see Table 3).

Figure 1.

Ninety-Five Percent Confidence Intervals Around Means for Usability Ratings in the Computer Systems Usability Questionnaire at the Start, During and at the End.

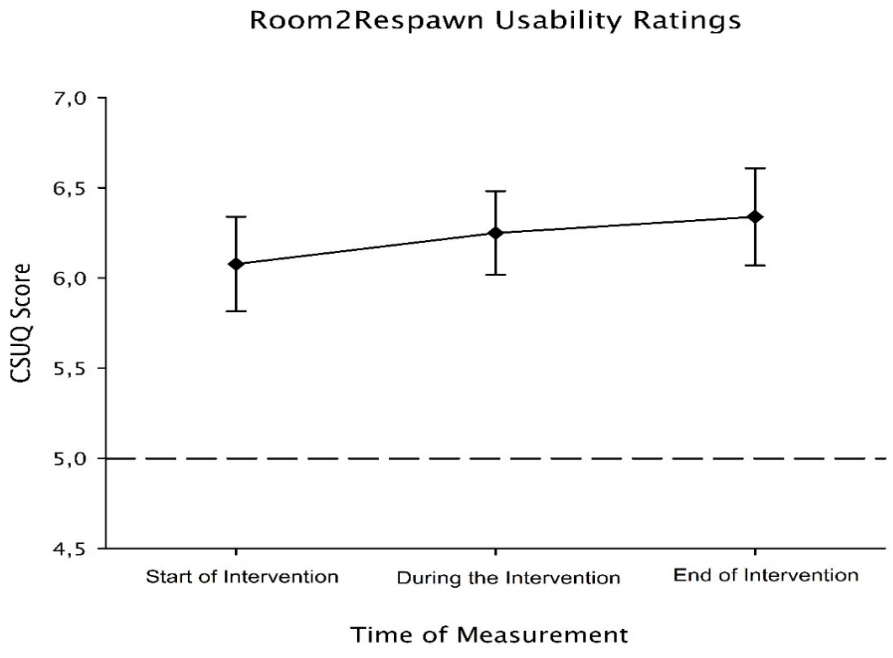

Table 3.

Means With Standard Deviations in Parentheses of the Dimensions of the Usability Evaluation Questionnaire for Conditions.

	Experimental Condition	Control Condition	Total/Overall
N	21	18	39
Email	2.57 (.78)	2.07 (.81)	2.34(.79)
Psychoeducation	2.17 (.49)	1.95 (.68)	2.07 (.59)
Meditation	2.50 (.70)	2.39 (.72)	2.45 (.71)
Length	4.31 (.34)	4.13 (.30)	4.23 (.32)

Note. Answers for Email, Psychoeducation and Meditation range on a Likert scale from 1 = *positive evaluation* to 7 = *negative evaluation*; Length ranges from 1 = *too short* to 7 = *too long*.

Concerning the motivation hypothesis, the mean values and standard deviations for the subscales can be seen in Table 4. The perceived choice was statistically significantly higher after the intervention ($F(1, 30) = 5.78$, $p = .023$, $\eta p^2 = .16$) and indications of the participants regarding usefulness of the intervention was statistically significantly lower after the intervention ($F(1, 30) = 5.33$, $p = .028$, $\eta p^2 = .15$). Except for that, no statistically significant changes in respecting subscales could be observed. There were no statistically significant interaction effects for time and condition.

Table 4.

Means and Standard Deviations of the Subscales of the Intrinsic Motivation Inventory Before and After the Intervention for Conditions.

Subscale	Time of Measurement	Experimental Condition	Control Condition	Overall
Interest or Pleasure	t1	5.31(0.99)	5.22 (1.14)	5.26 (1.06)
	t12	5.13 (1.42)	5.59 (1.21)	5.38 (1.31)
Perceived Competence	t1	4.13 (0.76)	4.11 (0.90)	4.12 (0.82)
	t12	4.37 (0.65)	4.26 (0.70)	4.31 (0.67)
Perceived Choice	t1	5.12 (1.01)	5.13 (1.20)	5.13 (1.09)
	t12	5.35 (1.09)	6.01 (1.11)	5.70 (1.13)
Effort	t1	4.22 (1.03)	4.05 (0.53)	4.13 (0.80)
	t12	4.23 (1.10)	4.02 (1.03)	4.12 (1.05)
Felt pressure or tension	t1	2.45 (1.18)	2.65 (1.31)	2.55 (1.23)
	t12	2.38 (0.85)	2.19 (0.88)	2.28 (0.86)
Usefulness	t1	5.67 (1.08)	5.82 (0.93)	5.75 (0.99)
	t12	5.13 (1.45)	5.69 (1.01)	5.43 (1.25)

For exploratory reasons, participation and dropout rates between experimental and control condition were compared. Participants in the control condition missed on average 0.61 (SD = 0.85) interventions, whereas participants in the experimental group missed 0.71 (SD = 0.90) interventions. This difference was not statistically significant, $t(37) = 0.37$, $p = .717$. Analyses of the dropout rates between control group (25 percent) and experimental group (16 percent) did not conclude statistically significant results, $U = 273.000$, $p = .439$.

Qualitative evaluation of the main comments regarding improvable aspects of the intervention, revealed an improvement of email layout, rework of

badges, clearer instructions, shorter sentence structure and improvement of the text layout. For the meditations, background music, slower pace, and slightly longer durations were suggested.

Discussion

The goal of the present study was to determine the usability and applicability of a newly developed online intervention (*Room2Respawn*) for people suffering from IGD. Overall, the usability of *Room2Respawn* was rated as good and participants evaluated all associated subscales positively. Applicability of content, email, psychoeducation and length of exercises were rated as good and satisfactorily. Usability ratings did not differ between gamified experimental or balanced control condition. Participants in both conditions reported higher perceived choice and lower usefulness at the end of the intervention. Since these results are inconclusive, the motivation hypothesis needs to be rejected. Additionally, there was no statistically significant indication that the gamified version of the intervention was more motivating for participants. Descriptively, there were fewer dropouts present in the gamified condition.

Participants rated the website as good and easy to use. However, some participants commented that the design could be improved. More experience with digital media means higher expectations regarding the interface (Crumlish & Malone, 2009). Reviewing the comments which the participants made it seems promising to further professionalize the recorded meditations by adding more structure, a slower pace and more breaks. Due to the structure of the intervention it was not possible for participants to individualize their treatment schedule. Adding

more opportunities for personalization could lower dropout-rates and encourage participation. However, finding a sensible balance regarding autonomy and freedom is a challenging task for further redesign.

The effects of gamification are context-dependent and controversially discussed. Benefits on performance and (intrinsic) motivations are reported (Sailer, 2016), yet, the collected data does not provide evidence towards this. Due to continuous exposure to gamified digital content, people become increasingly familiar with its mechanics. Thus, implementing only a few basic options, such as leaderboards, badges, levels and a pseudonym, this could have an adverse effect on participation and motivation by making a lack of quality in implementation salient. The reduced perceived usefulness could be explained by an emerging redundancy in psychoeducational content. The observed increase in perceived choice hints at an increase in perceived autonomy in participants due to the intervention but needs to be scrutinized in a follow-up study. Furthermore, in a revision of *Room2Respawn*, the inclusion of a chat forum for participants could represent a further step to increase feelings of belonging (Lavigne et al., 2011) and help foster collective growth orientation. The lack of social embeddedness represents one of the most apparent differences of this intervention compared to MORE (Garland, 2013).

One limitation of the present study is the lack of validation of the translated intervention and meditation texts taken from MORE (Garland, 2013), the translation of the IGDT-10 into German and adjusting the IMI. Also, the CSUQ was extended by adding a dimension of email usability. Additionally, sample characteristics could limit generalizability since the sample was well-educated and had some experience

with internet gaming but not in clinical amounts. There were some technical issues due to which some emails were not received by the participants or human error occurred and wrong badges were sent to participants. Besides possible influences on usability that these issues might have caused, reduction of the interference of technology could be achieved by adjusting the intervention content to run on a single platform or by automatizing communication via email.

To summarize, content from a mindfulness-based intervention which has already proven effective for the treatment for IGD was successfully adopted to an online platform (Garland, 2013; Li et al., 2017). *Room2Respawn* was conceptualized as a short-term intervention that uses a gamified framework to approach people suffering from IGD to alleviate symptoms and promote a needs-congruent way to learning alternative coping mechanisms. Due to the more rapidly growing digital world and the increasing demands on the individual to cope with this, it is crucial for research and treatment to keep up. After taking the results of this study into consideration and redesigning some parts of the intervention, the effectiveness of *Room2Respawn* should be tested on a sample with participants showing clinical symptoms of internet gaming disorder.

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Effectiveness of a Mindfulness Based Gamified Online Intervention for People Showing Symptoms of Internet Gaming Disorder

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Abstract

This study explores the effectiveness of the short-term online intervention *Room2Respawn* with a final sample ($N = 30$) of people that are exhibiting symptoms of internet gaming disorder (IGD) and were randomly allocated to a gamified, experimental ($n = 13$) or neutral, control ($n = 17$) group. Over the course of four weeks, participants received a minimum of 12 mindfulness exercises in combination with psychoeducation in an online setting. There was evidence for a reduction in IGD related symptoms following the intervention. Ratings of depressiveness and perceived stress declined significantly after the intervention and mindfulness and well-being increased. Participants in the gamification condition did not benefit statistically significantly more from the intervention than those in the neutral condition. A symptom reduction and an improvement in constructs of interest was still present in a three-month follow-up. To solidify findings, future studies should focus on using larger samples sizes, implementing a waitlist or treatment-as-usual as control condition and a larger follow-up period. *Room2Respawn* has the potential to becoming a low threshold and cost-effective intervention for people showing symptoms of IGD.

Keywords: online intervention, internet gaming disorder, mindfulness, well-being, effectiveness

Effectiveness of a Mindfulness Based Gamified Online Intervention for People Showing Signs of Internet Gaming Disorder

Internet Gaming Disorder (IGD) was included into the diagnostic and statistical manual of mental disorders 5 (DSM-5; American Psychiatric Association, 2013) as diagnosis with the necessity of further research. IGD is discussed as possible behavioral addiction (Petry et al., 2014) and shows similarities to gambling disorder and substance addictions (Hellman et al., 2013; Ko, 2014). Prevalence rates range between 1 and 15 percent depending on the applied methodology and the sample (Feng et al., 2017). The implications for people suffering from IGD are often loss of control and inability to stop. A resulting psychological inflexibility can be explained because of overreliance on gaming as a coping strategy (Yu et al., 2018). In accordance to Chang et al. (2018) gaming can be used to escape from difficulties (*push effect*), however, at the same time leading to an intense emotional bond through immersive qualities and personalizable in-game designs (*pull effect*).

However, due to population characteristics of people affected and suffering by IGD, which are mostly adolescent and young adults with one or two comorbidities (see González-Bueso et al., 2018), there is a reluctance to seek help (Wang et al., 2007). Access to treatment options is often difficult due to unavailable support centers or therapists and long waiting lists (Andrade et al., 2014). Online treatment provides a valuable addition to bridge this treatment gap (Luquiens et al., 2016). According to Moessner and Bauer (2017), online based e-mental health interventions have the potential to improve the current landscape of psychotherapeutic intervention possibilities.

The current literature reveals cognitive behavioral therapy and mindfulness-based psychotherapy as promising candidates for the treatment of IGD, especially when it comes to a conscientious consumption of internet games and overall symptom reduction (King et al., 2017; Torres-Rodríguez et al., 2018). Scerri et al. (2019) concluded that interventions for IGD should prioritize focusing on the regulation of psychological needs over comorbidities such as depression or anxiety. Mindfulness trainings such as *Mindfulness Oriented Recovery Enhancement* (MORE; Garland, 2013) aim at increasing awareness to automatic behaviors, need deprivations, cravings and maladaptive cognition. There is evidence that MORE is effective for the treatment of IGD related symptoms (Li et al., 2017; Li et al., 2018). The presently introduced intervention *Room2Respawn* is based on MORE and has already shown good usability and applicability in a previous study (Reichrath & Pietrowsky, under revision).

In *Room2Respawn,* elements of the formerly group-based intervention are transferred into an online format and additional mindfulness exercises and psychoeducational texts were integrated. Over the course of four weeks participants receive three times a week personalized emails with a link to an online platform on which they are provided with psychoeducation about IGD and exercises in the form of a written task and/or a meditation. Feedback from the previous study was incorporated in the revised form of *Room2Respawn* and additional material which the participants could revise was added, psychoeducational texts were improved in language and content and the recorded meditations were professionalized.

Due to IGD population characteristics, a gamified framework was chosen to lower attrition rates, maintain motivation and to make the intervention process as enjoyable as possible by providing resemblance to a known learning environment (Fleming et al., 2016; Lumsden et al., 2016; Sailer et al., 2017). Some parts of the former framework of the intervention were redesigned and further gamification elements (improved layout for email contact, added avatars) were added.

Based on a quasi-experimental design for the present study, the effectiveness of *Room2Respawn* for people showing symptoms of IGD is investigated. IGD symptoms before and after the intervention are compared and a symptom-reduction is assumed for a gamified (experimental) and a neutral (control) condition as measured via two questionnaires. Since people affected from IGD show high rates of comorbidities the scores on further questionnaires measuring depression level, global severity of symptoms, perceived stress, mindfulness and well-being are assumed to improve. Furthermore, it is hypothesized that the participants in the gamification condition will benefit more from the intervention than the participants in the control condition. For exploratory reasons and due to the redesign of several aspects (content, layout, gamification), the usability of the intervention is evaluated. Lastly, it is assumed that intervention effects will still be present in a one- and three-month follow-up for IGD symptom, well-being, mindfulness and perceived stress.

Method

Participants & Sampling

Inclusion criteria were male sex, German mother tongue, age between 18-40 years and symptoms of IGD (a minimum of three out of 9 criteria of the ten-item Internet Gaming Disorder Test). Exclusion criteria were consumption of illegal substances. Since comorbidities in IGD are very likely, they did not lead to an exclusion from the study but were screened for. Possible participants were approached via analogue (flyers, posters) and digital (forums, social networks) contact and via the referral through institutions focusing on the treatment of pathological internet gaming behavior (mental health centers, clinics, outpatient departments). 52 participants started the intervention and were randomly allocated to either gamified, experimental (n = 26) or neutral, control condition (n = 26). There was a dropout-rate of overall 42 percent with most dropouts (77 percent) in the first and second week of the intervention.

The final sample (*mean age* = 27.5; *SD* = 4.44 years) consisted of 30 male participants in the experimental (n = 13) and control (n = 17) condition. Experimental and control group did not differ statistically significantly regarding relevant sociodemographic data (age, education). Twenty percent of the final sample indicated at least one known comorbidity. According to *Beck's Depression Inventory*, 70 percent of the whole sample showed signs of moderate to severe depressiveness. Participants reported playing computer games on average 3.85 hours per day (*SD* = 2.97). Six percent of the sample indicated meditating on a regular basis. Informed written consent was obtained from all participants.

Participants were remunerated and automatically participated in the raffle for a voucher. The study was approved by a local Ethics Committee.

Measures and Instruments

Beck's Depression Inventory (BDI-II)

The German version of the BDI-II (Hautzinger et al., 2006) constructed by Beck et al. (1996) which consists of 21 statements ranging from 0 = never to 3 = most of the time was used. Total values ranging from 0 to 8 are indicating no depression, from 9 to 13 minimal depression, from 14 to 19 mild depression, from 20 to 28 moderate depression and from 29 to 63 severe depression (Cronbach's $\alpha = .92$).

Brief-Symptom Inventory 18 (BSI-18)

The BSI-18 (Spitzer et al., 2011) was implemented to measure somatization, depressiveness and anxiety of participants. Items were coded on a 5-point Likert scale ranging from 0 = never, to 4 = very strong (α ranges between .63 and .93). The total sum score indicates the general burden of psychopathological symptoms (Global Severity Index, GSI).

Computer System Usability Questionnaire (CSUQ)

The German version by Böckermann et al. (2015) of the CSUQ (Lewis, 1995) was used and the original 19 items were extended by 11 additional items to encompass email interactions as well. Statements range on a Likert scale from 1 = do not agree at all to 7 = completely agree, with higher values indicating higher usability.

Marburg Questionnaire on Habitual Well-being (MFHW)

The MFHW (Basler, 1999) consists of seven personal statements describing well-being during the last two weeks on a six-items Likert scale, ranging from 1 = does not apply to 6 = is completely true (α = .91). Higher mean scores indicate higher well-being.

Mindfulness Attention and Awareness Scale (MAAS)

The MAAS (Brown & Ryan, 2003) measures with 15 items on a 6-point Likert scale ranging from 1 = almost exclusively to 6 = almost never, awareness and attentiveness to surroundings; higher scores indicate higher mindfulness. The German version of the MAAS was implemented (α = .83; (Michalak et al., 2008)).

Perceived Stress Questionnaire (PSQ20)

The PSQ20, constructed by (Levenstein et al., 1993), was used in its German adaptation (Fliege et al., 2001). The questionnaire consists of 20 items on four scales (concerns, tension, joy, demands) with five statements, ranging from 1 to 4 (1 = almost never, 2 = sometimes, 3 = frequent, 4 = usually) with higher scores indicating higher amounts of perceived stress (α = .79-.85).

Scale of Adult Computer Gaming Behavior (CSVe)

The CSVe (Wölfling et al., 2011) measures addictive computer-gaming behavior within the last six months via 16 questions with a varying answer format. The CSVe post intervention has been adjusted in time reference for the duration of the intervention. Scores are added and weighed in accordance with their relevance, ranging between 0-6.5 (unobtrusive usage), 7-13 abusive usage and from 13.5 to a maximum of 27 (addicted usage) with α = .86.

Sociodemographic Questionnaire

In this questionnaire, data concerning age, gender, language skills, nationality, education, occupation, meditation experience, diagnosed mental disorders, drug consumption and computer gaming duration were collected.

Ten-item Internet Gaming Disorder Test (IGDT-10)

The IGDT-10 (Király et al., 2017) contains 10 items that measure the extent of pathological internet gaming behavior based on the DSM-5 criteria for IGD with a cut-off score of five out of nine points for a strong indication of an underlying disorder. Answer possibilities are never, sometimes or often and item nine and ten refer to the same facet of the disorder ($\alpha = .69$). In the current study, participants who met 3 or more criteria were identified as meeting inclusion criteria. The timeframe in the IGDT-10 was adjusted after the intervention period.

Usability Evaluation Questionnaires (UEQ)

This self-developed questionnaire (see Reichrath & Pietrowsky, under revision) was used for the evaluation of the intervention content. The UEQ is divided into four sub-scales: email (five items), psychoeducation (two items), meditation (four items) and intervention in general (two items). Dimensions are length, interestingness, favorability and comprehensibility, evaluated on a 7-point Likert scale with corresponding anchors. Furthermore, participants could comment open-ended within a text box. In the experimental group, the level of gamification of the intervention content was also evaluated using a battery of questions (42) with seven items for each of the implemented gamification elements (pseudonym, daily quiz, score, leaderboard, level and badge). Answers were recorded using a 7-point Likert

scale ranging from 1 = not at all to 7 = agrees completely, with higher values indicating higher usability.

Design and Procedure

Design

For this study, a quasi-experimental design with randomized assignment to experimental or control condition was used. The intervention content itself was equal for both groups and the data for the study was collected on overall 16 timepoints including the screening, the pretest, the 12 intervention timepoints, the post-test and a 1-month and 3-month follow-up.

Content for the Intervention

Each of the 12 main sessions included a psychoeducational text and a mindfulness exercise. The Manual *Mindfulness-Oriented Enhancement Recovery for Addiction, Stress and Pain* (Garland, 2013) served as template (see also Reichrath & Pietrowsky, under revision). The content was adapted to problematic computer game behavior. All mindfulness exercises (except for the fifth session which had to be solved in writing) were recorded by a trained psychotherapist and made available as an audio file (7 minutes and 36 seconds on average) on the intervention blog. Furthermore, six additional exercises could be unlocked after progressing in the intervention: identifying avoidance strategies (writing task), positive and negative thoughts and feelings during negative experiences (writing task and meditation, mindful conversion of problems as their own (meditation), recovery strategies (meditation), relapse as gain (meditation), and recovering from a relapse (meditation).

Gamification Elements

The gamification elements were implemented in the email communication with the participants. In the gamification condition participants created a personal username (1a Personalization), interventions were referred to as levels (2a Levels), a leaderboard (3a Leaderboard) depicted the current score and ranking of participants compared to fellow participants, and lastly an avatar (4a Avatar) showing a person with an experience bar which progresses in the course of the intervention. All elements were balanced in the control condition: a standardized neutral code (1b Subject Code), interventions were referred to as sessions (2b Session), an overview (3b Overview) about the weekly interventions was shown and the logo of the intervention blog was depicted (4b Logo).

Procedure

Interested participants contacted the researchers via email and received a link to the online screening. The online screening consisted of an informed consent, a declaration of data protection, sociodemographic questions and the IGDT-10. All answers were collected and carried out via the online questionnaire service SoSciSurvey (Leiner, 2019). Subsequently, included participants received an email with general information about the course of the study and an invitation to participate in the pre-testing. Participants received all necessary instructions, links to the blog and questionnaires and an overview about their progress via email.

The intervention content was published on each intervention day on the blog at 8 a.m. After each session, the content remained on the blog for the remainder of the intervention. Each exercise could be edited until 8 p.m. on the evening of the

following intervention session. In addition, the email included a link to the post-session survey which included a question of conscience whether the content was edited, a control question in a multiple-choice format and, at three timepoints, evaluative questions regarding the intervention content. After two weeks in the intervention, the optional material for the participants got unlocked.

Participants who did not complete overall four intervention sessions were excluded from further participation. In case a session was missed, participants received an email asking them to attend the next one again, stating that it was not possible to redo a session at a later point in time. After having missed overall three sessions a warning was sent that the next miss will lead to exclusion from participation. At the end of the last intervention session, all participants were invited by email to take part in the final post-intervention survey after which they received an email of appreciation for their participation a debriefing and their renumeration. After one and three months, a follow-up survey was sent.

Data Analysis

All statistical analyses are carried out at a significance level of $\alpha = 0.05$, using IBM SPSS Statistics (25). The independent variable is condition, operationalized as gamification (experimental) or neutral (control). Dependent variables were problematic internet gaming behavior, mindfulness, well-being, global severity of symptoms, depression, perceived stress and usability. To test for differences in IGD symptoms, a 2x2 RM-ANOVA was performed with between factor condition (experimental, control) and within factor time (before intervention, after intervention) for the IGDT-10 and the CSVe. For the MAAS and the MFHW scores,

2x3 RM-ANOVAs were calculated, with corresponding between factor condition (experimental, control) and within factor time (before intervention, during intervention, after intervention). For the BDI-II and the PSQ-20, 2x2 RM-ANOVAs with corresponding factors were used. Ratings of usability were explored by 2x4 RM-ANOVA with between factors condition (experimental, control) and within factors time (third intervention, sixth intervention, ninth intervention, twelfth intervention). Effects of the stability of results after intervention were assessed for IGDT-10, CSVe, MAAS, MFHW and the PSQ-20 scores by RM-ANOVAS with factor time of measurement, including post-treatment, one- and three-months follow-ups. Corrective computations for missing values were omitted due to small sample sizes after dropouts.

Results

Statistics and Data Analysis

The mean values for the constructs of interest for experimental and control condition before and after intervention are shown in Table 1.

Table 1.

Mean Values With Standard Deviations of the Interventions' Constructs of Interest.

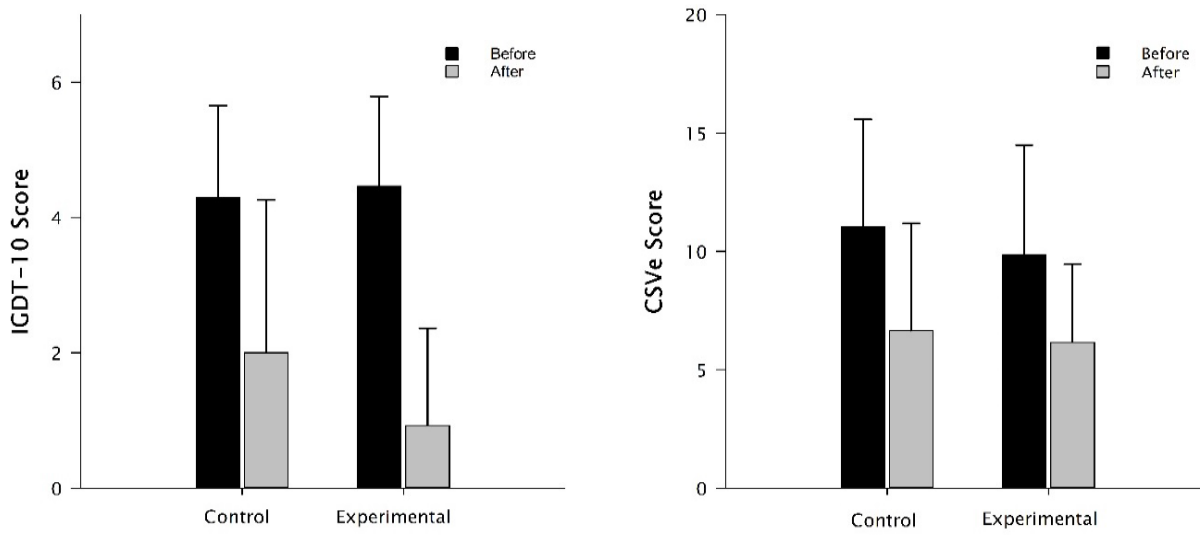
N = 30	Experimental Condition (n = 13)		Control Condition (n = 17)	
Time/ Scale	Before Intervention	After Intervention	Before Intervention	After Intervention
IGDT-10	4.46 (1.33)	.92 (1.44)	4.29 (1.36)	2.00 (2.26)
CSVe	9.84 (4.65)	6.15 (3.29)	11.1 (4.51)	6.65 (4.53)
MAAS	3.36 (.677)	4.08 (.992)	3.40 (.740)	3.45 (.962)
MFHW	2.16 (1.86)	3.86 (1.61)	2.50 (1.02)	3.38 (1.19)
BSI-18	14.9 (10.7)	13.2 (13.4)	21.5 (17.3)	17.7 (18.0)
BDI-II	22.9 (12.3)	12.9 (13.7)	25.6 (13.9)	18.5 (17.1)
PSQ-20	61.5 (17.2)	36.9 (28.1)	59.8 (18.6)	47.8 (27.9)

Note. IGDT-10 = Ten-Item Internet Gaming Disorder Test (Király et al., 2017); CSVe = Scale of adult computer game behavior (Wölfling et al., 2011); MAAS = Mindfulness Attention and Awareness Scale (Michalak et al., 2008); MFHW = Marburg Questionnaire on Habitual Well-being (Basler, 1999); BDI-II = Beck's Depression Inventory (Hautzinger et al., 2006); PSQ = Perceived Stress Questionnaire (Fliege et al., 2001).

To test for a reduction in IGD related symptoms there was a statistically significant main effect for IGDT-10 values for time of measurement with lower values after treatment $F(1,28) = 69.64$, $p < .001$, $\eta p^2 = .71$. There was no difference between conditions, $F(1,28) = 0.795$, $p = .380$, $\eta p^2 = .03$ and no statistically significant interaction effect, $F(1,28) = 3.17$, $p = .086$, $\eta p^2 = .10$ (see Figure 1, left panel). For CSVe, there was a statistically significant main effect for time of measurement with lower values after the treatment ($F(1,28) = 13.83$, $p = .001$, $\eta p^2 = .33$), no difference between conditions ($F(1,28) = 0.542$, $p = .468$, $\eta p^2 = .02$) and no statistically significant interaction effect present, $F(1,28) = 0.109$, $p = .744$, $\eta p^2 = .00$ (see Figure 1, right panel).

Figure 1.

Means and Standard Deviations of IGD Symptoms as Assessed by the IGDT-10 and CSVe Scores Before and After the Intervention for Control and Experimental Condition.



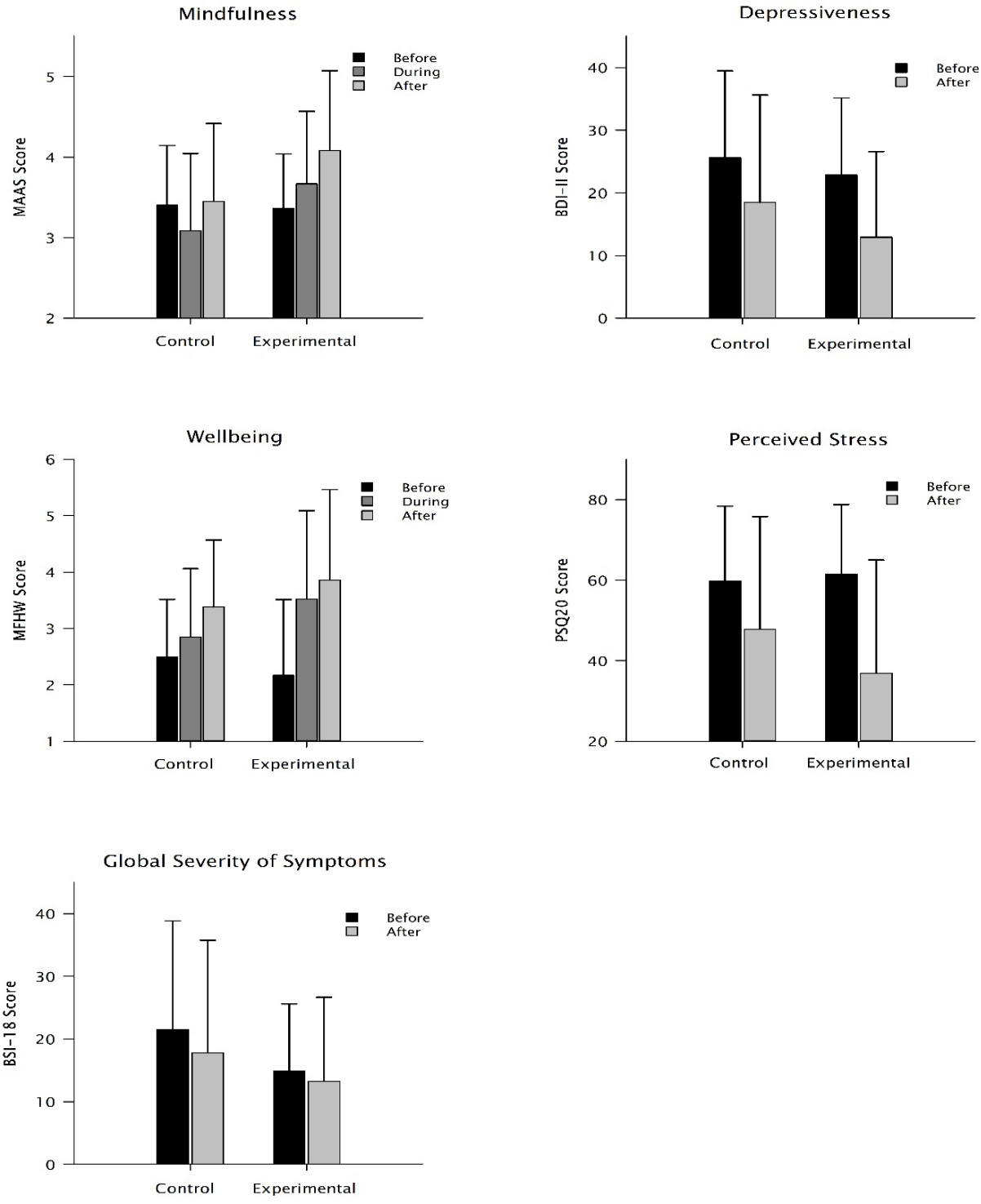
Note. IGDT-10 = Ten-item Internet Gaming Disorder Test (Király et al., 2017); CSVe = Scale of adult computer game behavior (Wölfling et al., 2011).

Analyzing further constructs of interest, there was a statistically significant main effect for mindfulness on time of measurement, with higher values after treatment $F(2,27) = 3.379$, $p = .041$, $\eta_p^2 = .11$, no effect for conditions ($F(1,27) = 2.650$, $p = .115$, $\eta_p^2 = .09$) and no interaction effect present $F(2,28) = 2.234$, $p = .117$, $\eta_p^2 = .07$. There was a statistically significant main effect for time of measurement for well-being, with higher values after treatment $F(2,27) = 21.481$, $p < .001$, $\eta_p^2 = .44$, not for conditions ($F(1,27) = 0.851$, $p = .365$, $\eta_p^2 = .03$) and no statistically significant interaction effect,

$F(2,27) = 3.056$, $p = .071$, $\eta_p^2 = .10$. For global severity of symptoms, there was no main effect for time of measurement, $F(1,28) = 0.756$, $p = .392$, $\eta_p^2 = .03$, none for conditions, $F(1,28) = 0.795$, $p = 1.354$, $\eta_p^2 = .05$ and no interaction effect, $F(1,28) = 0.109$, $p = .744$, $\eta_p^2 = .00$. Depression showed a statistically significant reduction over time with, $F(1,28) = 13.58$, $p = .001$, $\eta_p^2 = .33$, no effect for condition ($F(1,28) = 0.736$, $p = .398$, $\eta_p^2 = .03$) and no interaction effect, $F(1,28) = 0.368$, $p = .549$, $\eta_p^2 = .01$. For perceived stress, there was a statistically significant main effect for time of measurement, with lower scores after treatment, $F(1,28) = 18.38$, $p < .001$, $\eta_p^2 = .39$, no differences between condition, $F(1,28) = .370$, $p = .548$, $\eta_p^2 = .01$ and no statistically significant interaction effect ($F(1,28) = 2.20$, $p = .149$, $\eta_p^2 = .07$). Figure 2 depicts the changes for the relevant constructs.

Figure 2.

Means and Standard Deviations of Constructs of Interest as Assessed by the Corresponding Scores Before and After the Intervention for Control and Experimental Condition.



Seventy-three percent of participants (n = 22) reported back after one month for follow-up questions and 63 percent (n = 19) answered the questionnaires three months after the intervention. Table 2 depicts the mean values with standard deviations for the follow-ups. Due to the lack of condition and interaction effects for the treatment and smaller sample sizes, the following analyses were conducted using the integrated sample. The Greenhouse-Geisser corrected degrees of freedom and the corresponding *p*-value is reported in case of violations in sphericity.

Table 2.

Mean Values With Standard Deviations of the Constructs of Interest for the Follow-Up Responses One- and Three-Months After the Intervention.

Time/ Scale	One Month After Intervention (*n* = 22)	Three Months After Intervention (*n* = 19)
IGDT-10	1.27 (1.72)	0.89 (1.37)
CSVe	5.07 (5.16)	5.18 (4.01)
MAAS	3.91 (1.12)	4.23 (1.08)
MFHW	4.07 (0.89)	3.85 (1.37)
PSQ-20	46.5 (26.5)	44.0 (25.9)

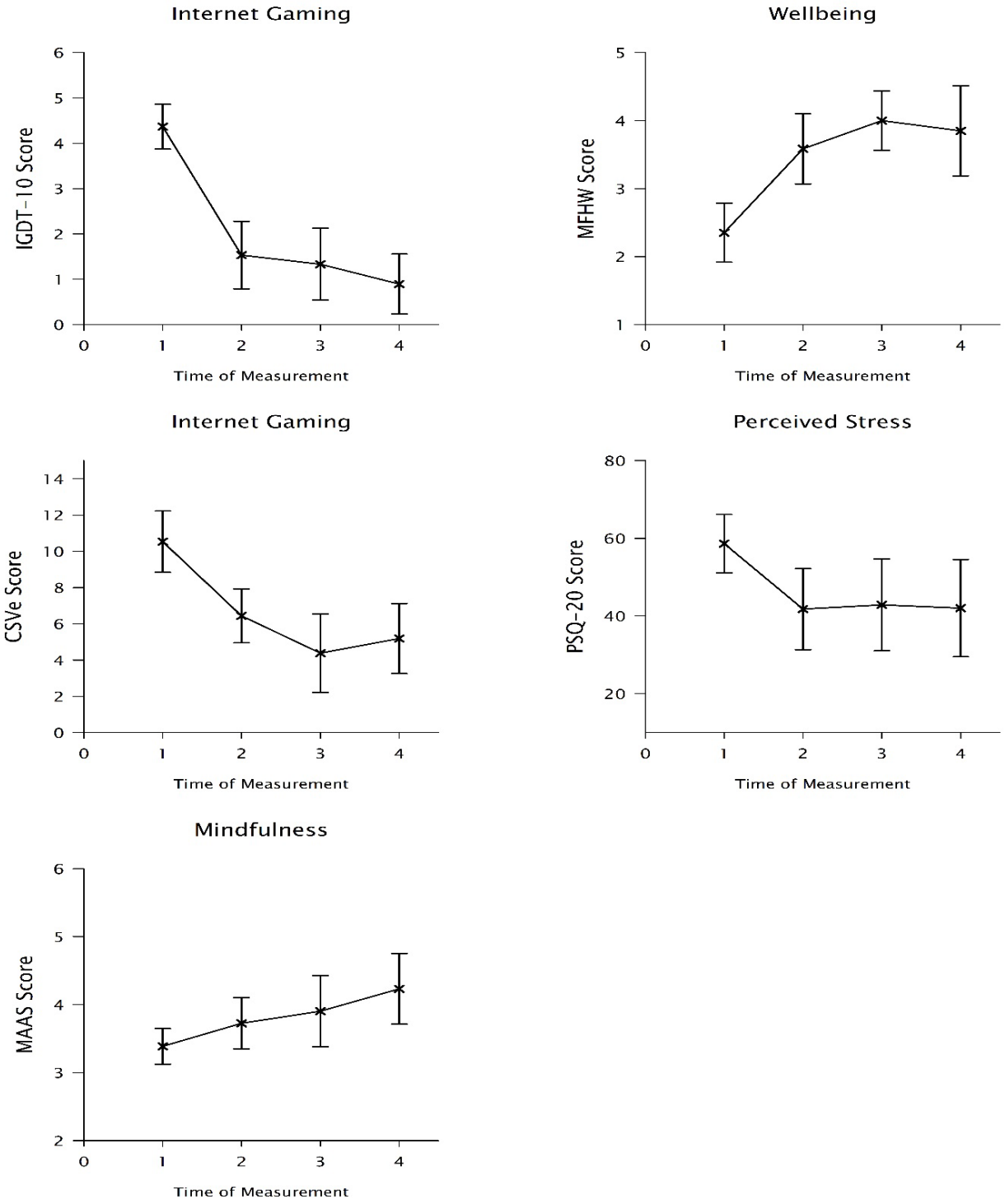
Note. IGDT-10 = Ten-item Internet Gaming Disorder Test (Király et al., 2017); CSVe = Scale of adult computer game behavior (Wölfling et al., 2011); MAAS = Mindfulness Attention and Awareness Scale (Michalak et al., 2008); MFHW = Marburg Questionnaire on Habitual Well-being (Basler, 1999); PSQ-20 = Perceived Stress Questionnaire (Fliege et al., 2001).

Analyzing the stability of findings including all relevant times of measurement after the treatment (post treatment, one month follow-up, three months follow-up), there was no statistically significant difference for IGDT-10 (F(1.45,23.12) = 0.342, p = .32, η_p^2 = .02), a statistical significant difference for CSVe (F(1.69,27.1) = 4.095, p = .034, η_p^2 = .20), no statistically significant change in MAAS, (F(2,32) = 1.660, p = .206, η_p^2 = .09), the MFHW (F(1.43,22.90) = 2.410, p = .125, η_p^2 = .13 and the PSQ-20 (F(2,32) = 0.356, p = .705, η_p^2 = .03). Figure 3 depicts the mean values and corresponding confidence intervals for the included timepoints.

Ratings concerning overall usability between experimental (M = 5.96, SD = .74) and control condition (M = 5.76, SD = .69) indicated satisfactorily usability. There was no statistically significant difference for usability ratings for time of measurement, F(3,22) = 1.119, p = .348, η_p^2 = .05, condition, F(1,22) = .686, p = .416, η_p^2 = .03 and no interaction effect present, F(3,22) = .807, p = .494, η_p^2 = .04.

Figure 3.

Mean Values for Different Points in Time (1 = Baseline, 2 = After Intervention, 3 = One-Month Follow-Up, 4 = Three-Months Follow-Up) and 95 Percent CI of Constructs of Interest Across Conditions.



Discussion

This study provides evidence for the effectiveness of the developed online intervention *Room2Respawn* for people suffering from problematic internet gaming behavior. Thirty participants completed the four-week long mindfulness-based intervention in either a gamified or a neutral version. The results provide a solid basis for the decrease in IGD related symptoms with medium and large effect-sizes. Furthermore, there was support for an improvement in pathology related and IGD related constructs and comorbidities. Participants showed statistically and practically significant decreases in depressiveness and perceived stress after the intervention. Mindfulness improved statistically significantly after the intervention period. Furthermore, well-being improved substantially after the intervention. There was no support for an assumed statistically significant decrease in the global severity of symptoms in accordance to one questionnaire. Follow-up testing revealed that the decrease in IGD related symptoms and comorbidities was still present or improving three months after the intervention period. Participants indicated an overall good to very good usability for the intervention across groups.

The intervention *Room2Respawn* revolves around mindfulness and psychoeducation regarding IGD. The adaptation of MORE for internet gaming behavior had already shown viable for a group-setting (Li et al., 2017). There was evidence that a transfer of the content to an online intervention is possible and effective, exploiting the possibilities of bridging the treatment gap for people suffering from IGD related symptoms and lowering thresholds to seek help (Luquiens et al., 2016). Using two well-established measures that were adjusted for

time, the decrease in reported IGD associated symptoms after the intervention was substantial. Furthermore, this effect was still present after *Room2Respawn* has already been completed for over three months.

Due to population characteristics, seeking help for people suffering from IGD can be challenging. Comorbidities, lack of support centers or long waiting lists in clinics or for therapists can create a hurdle that is too difficult to overcome for the affected (Andrade et al., 2014; González-Bueso et al., 2018; Wang et al., 2007). On average participants showed depressive symptoms classifying them as moderately depressed (BDI-II) prior to the intervention. This average went down to minimal depressive levels after the intervention, possibly creating opportunity for the affected to seek further help due to a lessened burden. The supportive and protective factors associated with mindfulness and positive psychology were already stated by Yu et al. (2018). It is argued that instead of supplementing deprived needs from external interventions or interfering with stimuli availability (like for example in abstinence programs), providing people suffering from IGD with awareness towards their own needs, offers a gateway towards new functional coping mechanisms, especially in the long-term (Allen & Anderson, 2018). This implies that having additional coping strategies is a key feature to limit excessive gaming-related behavior and to reduce the chance of loss of control or other dysfunctional aspects of IGD (King et al., 2016).

In this sample mindfulness did increase statistically with a positive trend beyond the intervention period. The reported decrease in perceived stress was

statistically and practically significant for *Room2Respawn* and also well-being increased and stabilized after the intervention on an elevated level.

In an earlier study (Reichrath & Pietrowsky, under revision), the usability of a previous version of the intervention was evaluated and good and satisfactory levels were found. Due to the redesign and the newly added gamification elements and content, the current applicability and usability was evaluated again and similarly satisfying results were found. Gamifying the intervention framework seems promising. A further rework of the proposed intervention and an investigation with a larger sample-size will be necessary to evaluate its possible advantage.

Limitations

IGD is young when it comes to its inclusion as a research-diagnosis into the DSM-5 (American Psychiatric Association, 2013). With that, the availability of appropriate measurements to capture the addictive facets of problematic internet gaming behavior are sparse (Király et al., 2019). In the present study, the timeframe for the IGDT-10 (Király et al., 2017) and the CSVe (Wölfling et al., 2011) in the post testing were adopted to accommodate for the respective time-periods of the intervention. Taking this and the translation of the IGDT-10 into German into account, a generalizability of the results is advised against. In a following study, a longer follow-up period and a wait-list control condition should be included for better comparability. Moreover, even though the sample showed strong signs of IGD, on average it was below the threshold for a clinical diagnosis. This might restrict the interpretability of the results to a part of the population which is not overly reliant on internet gaming to cope with stress and regulate deprived needs.

Finally, one issue that constrains interpretability of the results is the occurrence of a world-wide pandemic in the second half of the data gathering.

Implications and Conclusions

Room2Respawn has proven effective as a low-threshold intervention for people showing signs of IGD and shows potential to benefit people who struggle to find alternative coping mechanisms and are suffering symptoms resembling behavioral- and gambling addictions. The application of gamification principles as a framework has been shown successfully; yet, further redesign, optimization and, most importantly, larger sample sizes in following studies are necessary to provide even clearer results. Further research should focus on long-term effectiveness of interventions for IGD and the next study should entail a wait-list control condition and treatment-as-usual for further comparisons. *Room2Respawn*, at this point in development, is no substitute for in-person treatment, support groups or combined treatment approaches for people suffering from IGD. However, for people showing signs of IGD, being reluctant to seek help or to bridge treatment gaps and waiting periods, it can be confidently recommended.

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Author Note

Parts of these findings were submitted as graduate theses. We have no conflicts of interest to disclose.

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Explanation of Contributions

All presented studies in the manuscripts were conducted at the Institute of Experimental Psychology in the Department of Clinical Psychology by me, Benedict Reichrath, under the supervision of Prof. Dr. Reinhard Pietrowsky.

The described studies were primarily carried out independently by me. The data collection was assisted under my supervision by students who are mentioned in the acknowledgements of the respective manuscripts.

All statistical evaluations were carried out independently by me. All tables and figures in the manuscripts were created by me, if not otherwise specified with sources or acknowledgements.

I, Benedict Reichrath, assure that I have written the manuscripts independently and have not used any sources other than those I have indicated.

Düsseldorf, February 2021

(Benedict Reichrath)

Declaration of Independence

I hereby declare that I have prepared the presented dissertation independently and without unauthorized assistance under recognition of good scientific practice at the Heinrich-Heine Universität Düsseldorf.

The presented dissertation has not been submitted in this or in similar form to any other institution. No prior unsuccessful doctoral attempts have taken place so far.

Düsseldorf, February 2021

(Benedict Reichrath)