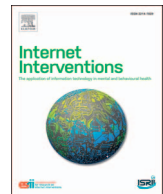




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Reducing procrastination using a smartphone-based treatment program: A randomized controlled pilot study

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ABSTRACT

Background: Procrastination affects a large number of individuals and is associated with significant mental health problems. Despite the deleterious consequences individuals afflicted with procrastination have to bear, there is a surprising paucity of well-researched treatments for procrastination. To fill this gap, this study evaluated the efficacy of an easy-to-use smartphone-based treatment for procrastination.

Method: N = 31 individuals with heightened procrastination scores were randomly assigned to a blended smartphone-based intervention including two brief group counseling sessions and 14 days of training with the *mindtastic procrastination* app (MT-PRO), or to a waitlist condition. MT-PRO fosters the approach of functional and the avoidance of dysfunctional behavior by systematically utilizing techniques derived from cognitive bias modification approaches, gamification principles, and operant conditioning. Primary outcome was the course of procrastination symptom severity as assessed with the General Procrastination Questionnaire.

Results: Participating in the smartphone-based treatment was associated with a significantly greater reduction of procrastination than was participating in the control condition ($\eta^2 = .15$).

Conclusion: A smartphone-based intervention may be an effective treatment for procrastination. Future research should use larger samples and directly compare the efficacy of smartphone-based interventions and traditional interventions for procrastination.

1. Introduction

Deferring commitments is a ubiquitous phenomenon that is not necessarily associated with significant psychological distress. For some people, however, initially harmless dallying can turn into a persistent behavioral pattern of voluntarily postponing important tasks, referred to as procrastination (Rozenal and Carlbring, 2013). Instead of working to meet important deadlines, procrastinators engage in activities that take their minds off the task at hand and, hence, lead to a short-term relief of the undesired feelings associated with approaching this task (Dryden, 2000; Pychyl et al., 2012). According to Badri Gargari et al. (2011), procrastination comprises cognitive, affective, or behavioral components. Depending on the individual's specific characteristics these components can lead to a variety of manifestations such as academic, decisional, neurotic, or compulsive procrastination.

Prevalence rates for procrastination ranging between 15%–20% in the general adult population prove as evidence for the frequency of this phenomenon (Day et al., 2000; Ferrari et al., 2005). Amongst the afflicted, university students represent the population most frequently

affected by procrastination. Here, estimates indicate that approximately 40% of university students engage in significant procrastinatory behavior (Ferrari et al., 2005; Harriott and Ferrari, 1996; Mahasneh et al., 2016; Özer et al., 2009) and almost 50% procrastinate consistently and problematically (Haycock et al., 1998; Onwuegbuzie, 2000; Solomon and Rothblum, 1984). In academic procrastination, affected students experience the pervasive and permanent desire to delay their academic obligations, causing them to spend over 30% of their daily activities in the engagement of procrastinatory behavior such as sleeping during daytime, playing, or TV watching (Pychyl et al., 2012).

Procrastination is a failure of self-regulation that is associated with various mental health problems. Studies found links between procrastination and low self-esteem (e.g., Stead et al., 2010; Steel, 2007) and poor individual well-being as measured by high levels of stress and physical illness (e.g., Tice and Baumeister, 1997). Moreover, people who procrastinate show a heightened risk for the development, maintenance, and exacerbation of mental disorders such as depression and anxiety disorders (e.g., Rozenal and Carlbring, 2013). Furthermore, studies examining university students show that academic

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procrastination is systematically linked to poor task-performance, depression, social anxiety, and self-handicapping behavior (Ferrari et al., 1992; Tice and Baumeister, 1997), thus having a negative impact on the psychological well-being of the afflicted and their academic success. Finally, several authors point out the link between procrastination and deficits in the successful application of emotion regulation (ER) skills (Höcker et al., 2013; Rebetez et al., 2015).

Treatments for procrastination and related problems often utilize well-researched strategies stemming from cognitive behavior therapy (CBT) such as goal-setting, time-management, modeling, success spiral, and learned industriousness (Steel, 2007; Uzun Ozer et al., 2013). Although informative and useful, these strategies are not well-researched in the context of procrastination as most of the few available studies lack crucial components such as validated outcome measures, randomization, long-term follow-ups, and mostly consist of single-case designs (Dryden, 2012; Karas and Spada, 2009; Neenan, 2008; Pychyl and Flett, 2012). Taken together, it is surprising that despite the alarmingly high prevalence rates and the negative impact of procrastinatory behavior on various health domains, clinical trials examining the efficacy of treatments for procrastination are scarce and available studies often lack fundamental quality criteria (Rozenal and Carlbring, 2014). Thus, unlike it is the case for most mental health issues, there is no “gold standard” treatment for procrastination (Glick and Orsillo, 2015).

In recent years, computer-based therapy approaches have made their way into therapeutic research and practice. Computer-based therapy has been shown to be highly effective by delivering treatment in high-dosages while simultaneously providing efficacious, cost-effective, scalable, and patient friendly interventions that can easily be disseminated (Barak et al., 2009). Even more promising are results from a meta-analysis by Andersson et al. (2014), suggesting that computer-based CBT and face-to-face treatment produce equivalent overall effects. Computer-based interventions targeting procrastination, however, are scarce. Our review of the literature yielded just one study on the effects of computer-based CBT on procrastination. Here, in a randomized controlled trial, Rozenal et al. (2015) evaluated the effects of a computer-based self-help intervention targeting procrastination, and found that participants in both intervention groups (guided and unguided) experienced greater reduction in procrastination than did the wait-list control group with between-group effect sizes ranging from $d = 0.70$ to $d = 0.81$. Despite their proven effectiveness in various domains, computer-based therapy, however, has several limitations including the lack of assimilation into the user's daily life (e.g., Martell et al., 2010), limited accessibility, and its dependence from both time and location (e.g., Mattila et al., 2008).

Mental health apps and computer-based therapy share most of the advantages of modern technology mentioned above. However, treatment programs run on smartphone apps hold additional benefits as smartphones (a) are ubiquitous and almost constantly available (e.g., Ben-Zeev et al., 2015), (b) cause almost no maintenance costs (e.g., Ly et al., 2012), (c) are already owned by a large number of people and therefore easy to disseminate (e.g., Juarascio et al., 2015), (d) are able to interact with the user allowing data input using multiple input channels (e.g., Porta, 2007), and (e) are generally designed to be easy to use (e.g., Mattila et al., 2008). Moreover, several studies have shown that adherence and dropout rates in traditional therapy can be improved using smartphones when used as technological adjuncts to traditional therapy (e.g., Clough and Casey, 2011; McTavish et al., 2012). Because of these advantages, smartphone-based interventions are recently becoming increasingly popular for the treatment of mental health problems.

Research is needed to verify if the aforementioned advantages can be used for the treatment of psychological problems. Promising results for the evidence of mental health apps come from a systematic review of several studies producing evidence for smartphone-based mental health interventions (Donker et al., 2013), showing that apps can be effective in the reduction of symptoms of anxiety, depression, stress,

and substance use. Corroborating these findings are studies showing that smartphone-based treatment programs can significantly reduce depressive symptoms as well as stress, anxiety, and overall psychological distress (Ahmedani et al., 2015; Harrison et al., 2011), decrease state and trait anxiety while simultaneously increasing self-efficacy and functional impairment (Grassi et al., 2007), and improve symptoms in patients with substance-use disorders (Garrison et al., 2015). However, research on smartphone-based interventions targeting mental health problems is still scarce. Available studies focus predominantly on the development and feasibility of mental health apps (Bush et al., 2015; Jiménez-Serrano et al., 2015; Prada et al., 2016). Moreover, our review of the literature yielded no studies examining smartphone-based interventions for procrastination.

To fill this gap, the aim of the present pilot study was to develop and evaluate a smartphone-based intervention protocol that reduces procrastination utilizing (a) an approach-avoidance training based on cognitive bias modification (CBM), (b) computer gaming principles, and (c) operant conditioning. CBM approaches are not only effective in measuring implicit bias (e.g., racial bias; Kawakami et al., 2007) but can also be used to improve treatment outcomes when used as systematic trainings using disorder-specific stimulus material (e.g., the Approach Avoidance Task, a computer-based program that asks participants to push or pull stimuli towards/away from themselves using a joystick which in turn led to a reduction in relapse rates in alcoholics; Wiers et al., 2011). Moreover, CBM approaches were shown to have an effect on brain regions (e.g. medial prefrontal cortex) associated with maladaptive approach biases (e.g., Wiers et al., 2015). The use of electronic gaming in psychotherapy has a strong research base (e.g., Horne-Moyer et al., 2014; Kauer et al., 2012; Merry et al., 2012) and smartphones are recently gaining popularity as gaming devices (Feijoo et al., 2012). Hence, it is surprising that current smartphone-based interventions only seldom utilize gamification principles to systematically enhance treatment outcomes (e.g., Franklin et al., 2016; Miloff et al., 2015). In most cases, smartphone apps for mental health problems focus on areas such as providing instructions, offering strategies for self-help, reminders and other components like a mobile diary or simple mood ratings but without making use of more innovative options and features offered by modern smartphone technology. Finally, Siang and Rao (2003) argued that learning principles such as operant conditioning are crucial in games by molding unconditioned user responses and eventually improving games by maintaining high user motivation.

Our app MT-PRO aims to reduce procrastination by systematically targeting users' motivations to approach/avoid stimuli relevant for procrastinatory behavior. The app asks users to either actively avoid dysfunctional stimulus material (e.g., pictures showing typical alternative activities such as a student sitting in a study environment engaging in social media activities; negative study-related statements) or to actively approach functional material (e.g., a student sitting in a study environment engaging in academic tasks; positive study-related statements). Thereby, MT-PRO aims at training attitude-contrary behavior and thus promoting a change of relevant attitudes in a particular domain. In MT-PRO, users are asked to decidedly wipe away pictures showing engagement in typical alternative activities and negative statements related to procrastination which appear on their smartphone screen and to determinedly wipe pictures of study environments and positive statements related to procrastination towards them, thereby fostering avoidance and approach. The stimuli are first small and then become larger until they fill almost the entire screen. MT-PRO includes gaming principles by making users gain stars for every five correct answers given. Finally, MT-PRO aims at systematically reinforcing possible training effects by providing immediate feedback using mechanisms from operant conditioning. When processing a stimulus correctly, a smiling emoticon and the word “Correct!” appear on the screen, whereas a frowning emoticon, the words “That's wrong!”, and a short vibration of the smartphone occurs upon every wrong answer.

In this study, we evaluated a blended smartphone-based

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