'gamified' working memory training for addicted adolescents

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The proposed research project will examine the potential benefits of a *gamified* working memory training for adolescents in addiction care. The primary objective is to test whether a gamified working memory training will lead to improved working...

Ethical review	Approved WMO
Status	Recruiting
Health condition type	Psychiatric disorders NEC
Study type	Interventional

Summary

ID

NL-OMON38700

Source
ToetsingOnline

Brief title
'Gamified' working memory training for addicted adolescents

Condition

- Psychiatric disorders NEC

Synonym
Addiction, Substance Use Disorder (SUD)

Research involving
Human

Sponsors and support

Primary sponsor: Brijder Stichting (Alkmaar)
Source(s) of monetary or material Support: Ministerie van OC&W

Intervention

Keyword: Addiction, Adolescents, Game, Working memory

Outcome measures

Primary outcome

Change in working memory capacity from pre-test to immediate post-test will be the primary study outcome.

Working memory capacity will be assessed with the Span board task (Klingberg 2005). This task is commonly used in research on the effects of cognitive training on working memory capacity.

Secondary outcome

As secundary outcomes we will assess changes (differences between pre-test, first and second post tests) in other aspects of working memory, craving, mood, and delay discounting (preference for small, immediate rewards over large, long-term rewards) and changes (differences between Routine Outcome Assessment when entering the detix clinic and follow-up assessment) in substance use.

Other aspects of working memory capacity will be assessed by the following validated computer tasks:

Reading Span Task (Daneman, & Carpenter, 1980; Unsworh, Brewer & Spillers, 2009)

Drug Stroop task (Carpenter, Schreiber, Church, & McDowell, 2006; Waters, Marhe, Franken, 2012).

Substance use, craving and mood will be measured with scores on questionnaires:

Substance use questionnaire (including lifetime, 6-month and 30-day frequency measures, Alcohol Use Disorder Identification Test (AUDIT), Cannabis Use

Disorder Identification Test (CUDIT), number of non-using days)

OCDS (craving for substance use) (de Wildt, 2010; Hendriks, 2012)

BDI-II-NL (depression) (Van der Does, 2002)

STAI (state anxiety) (Van der Ploeg, 1980)

Delay discounting will be measured with the delay discounting task (Robles,

Huang, Simpson & McMillan, 2011).

Study description

Background summary

During adolescence, young people show a steady increase in new but sometimes risky behaviors, such as smoking, alcohol consumption and drug use (Steinberg, 2005). According to recent statistics, the lifetime prevalence of Dutch adolescents' alcohol and substance use increases from the age of 12. To illustrate, substance use estimates based on a representative sample of Dutch students in 2011 indicated that life-time prevalence rates for alcohol use varied between 35.4% in 12 year-olds and 93.4% in 17-18 year-olds and for cannabis use between 1.2 % in 12 year-olds and 44.6% in 17-18 year-olds (Verdurmen et al., 2012).

Use of alcohol and drugs can lead to a range of negative consequences on the short term e.g. acute health damage, accidents, vandalism, and sexual risk taking (Chen & Lin, 2009; Degenhardt & Hall, 2012; Rehm, 2011; Rehm, Taylor, & Room, 2006) but it can also affect long-term outcomes by increasing the risk of developing serious health problems and/or substance use dependence later in life (Chen, Storr, & Anthony, 2009; Ellickson, Tucker, & Klein, 2003; Norstrom & Ramstedt, 2005). As their brain and physique are not fully grown yet, adolescents show increased susceptibility to the effects of alcohol and drugs and to the associated risk of developing substance use problems and/ or dependence (Chambers, Taylor, & Potenza, 2003; Dayan, Bernard, Olliac, Mailhes, & Kermarrec, 2010; Schramm-Sapyta, Walker, Caster, Levin, & Kuhn, 2009). Problematic substance use and substance use dependence can already occur during the adolescent years and the mean age for developing a SUD is estimated at 15 (Merikangas et al., 2010). Prevalence estimates of the NEMESIS-study suggest that about 24.6 per cent of the 18 to 24-year-olds in the Dutch general population have ever experienced a SUD (De Graaf, Ten Have, & Van Dorsselaer,

2010). Unfortunately, recent data on substance use disorders among Dutch adolescents below 18 years of age are lacking.

Since the influential article by Leshner, addiction is recognized as *a chronic, relapsing brain disorder characterized by compulsive drug seeking* which should preferably be treated as early as possible (Leshner, 1997). This risk of developing a chronic disease stresses the importance of effective treatments for adolescents who already experience substance use problems. The need for addiction treatment is also warranted because of acute negative consequences that addicted adolescents and their families experience. Substance use disorders can result in significant problems across a range of domains including (psychological) health, school, family, friendships/social relations, and the law (Dennis, Dawud-Noursi, Muck, & McDermeit, 2002; Tims et al., 2002). Only part of the adolescent population with SUD enters treatment. In 2011, a total of 8,130 Dutch young patients received treatment for their addiction problems (Wisselink, Kuijpers, & Mol, 2012). Moreover, the number of patients in the ages between 10 and 25 years in Dutch addiction care facilities has increased slightly over the past 10 years.

Currently, evidence-based therapies for adolescents with SUD include mainly psychosocial interventions since there are few controlled studies assessing the effectiveness of pharmacotherapy in adolescent populations (Clark, 2012; Waxmonsky & Wilens, 2005). The most commonly applied and most frequently tested form of treatment is Cognitive Behavioral Therapy (CBT), often combined with Motivational Interviewing (Kaminer, 2002; Waldron & Kaminer, 2004; Winters, Botzet, & Fahnhorst, 2011). Also, family therapy (such as Multidimensional Family Therapy) has been shown effective in treating adolescents with SUD (Hendriks, van der Schee, & Blanken, 2011; Liddle et al., 2001). Unfortunately, despite significant reductions in substance use, post-treatment relapse rates remain high (Cornelius et al., 2003; Simpson, Joe, Rowan-Szal, & Greener, 1997; Winters, et al., 2011). For example, in the study by Hendriks et. al. (2011) only 17% of the patients remained abstinent after 1 year, and half of them still fulfilled the diagnostic criteria for SUD. These treatment outcomes emphasize the need for further improvement of current treatment practices. The proposed project aims to contribute to the advancement of adolescent addiction care programs by testing a new, promising intervention that can be included as an add-on to the usual treatment regimen.

Working memory, the main target of the intervention that will be tested, has become an influential concept in cognitive psychology and is described as a cognitive system that controls the active maintenance and storage of short-term information during additional cognitive processing and/or distraction (Conway et al., 2005). The system is recognized as a key factor in complex cognitive behaviors, such as comprehension, reasoning, and problem solving (Engle, 2002; Kyllonen & Christal, 1990; Myake & Shah, 1999). Deficits in working memory have been associated with learning (Gathercole & Alloway, 2006) as well as psychiatric disorders such as schizophrenia (Twamley, Jeste, & Bellack, 2003),

ADHD (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005) and SUD (Jovanovski, Erb, & Zakzanis, 2005; Sofuoglu, Sugarman, & Carroll, 2010).

Since the influential publication by Klingberg and colleagues (2002), evidence is accumulating that working memory can be trained, potentially leading to beneficial outcomes across different domains. In children and adults with ADHD, training of working memory resulted in improved executive functioning and higher-order abilities such as reasoning (Klingberg, Forssberg, & Westerberg, 2002). In another sample of children with ADHD, working memory training significantly reduced the severity of ADHD symptoms (Klingberg et al., 2005). Similar beneficial outcomes were found in non-clinical samples indicating that working memory training improved reasoning and problem solving skills (Jaeggi, Buschkuehl, Jonides, & Perriq, 2008). Moreover, even in patients with schizophrenia (Subramaniam et al., 2012) a working memory training resulted in diminished complaints.

For the treatment of substance use disorders, Aharonovich and colleagues already identified cognitive abilities, such as working memory capacity, as potential treatment targets based on their findings that addicted patients with relatively high levels of cognitive impairments were more likely to drop out from cognitive-behavioral treatment and showed higher relapse rates than patients with low levels of cognitive impairment (Aharonovich, Brooks, Nunes, & Hasin, 2008; Aharonovich et al., 2006; Aharonovich, Nunes, & Hasin, 2003). Following this line of reasoning, some researchers addressed the efficacy of computer-assisted cognitive rehabilitation programs (which include a wide range of different cognitive exercises to train different aspects of cognitive functioning) and found that this type of interventions can improve cognitive functions in adult patients with SUD (Fals-Stewart & Lam, 2010; Fals-Stewart & Lucente, 1994; Rupp, Kemmler, Kurz, Hinterhuber, & Fleischhacker, 2012). In addition, two recent studies provided support for the potential benefits of cognitive training programs that specifically target working memory capacity in problem drinkers (Houben, Wiers, & Jansen, 2011) and patients with stimulant addiction (Bickel, Yi, Landes, Hill, & Baxter, 2011). According to the findings by Houben et al. (2011) problem drinkers who had trained their working memory showed improved working memory and reduced alcohol intake one month after the training. Moreover, the working memory training was particularly effective in reducing alcohol consumption in participants with relatively strong automatic preferences for alcohol. In stimulant abusing patients, a working memory training reduced participants* level of delay discounting (Bickel, et al., 2011). Delay discounting refers to the preference of sooner, smaller rewards over later, larger rewards and is associated with risky and disadvantageous behaviors such as drug dependence, problem gambling, and obesity (Bickel, Jarmolowicz, Mueller, Koffarnus, & Gatchalian, 2012).

Based on these previous findings, we expect that a computer-assisted working memory training might also generate positive outcomes in adolescents receiving treatment for SUD.

However, current computer-assisted programs for working memory training involve a lot of repetitious and, for adolescents, often tedious exercises which might lead to low completion rates. A new direction for the development of computer-assisted and e-health interventions is the use of gaming formats and principles to encourage consumer*s motivation to adhere to the intervention (Baranowski, Buday, Thompson, & Baranowski, 2008; Deterding, Dixon, Khaled, & Nacke, 2001). Game-elements such as virtual worlds, rewards, challenges, competition, and social interaction generate experiences such as immersion, pleasure, or surprise which directly fulfill basic motivational behavioural needs (Przybylski, Rigby, & Ryan, 2010) and enhance players* motivation to commence or continue playing the game. Prins and colleagues (2011) demonstrated that application of game elements in a working memory training generated favorable outcomes in children with ADHD (Prins, Dovis, Ponsioen, ten Brink, & van der Oord, 2011). Following their example, we developed a working memory training in game-format for addicted adolescents.

Study objective

The proposed research project will examine the potential benefits of a *gamified* working memory training for adolescents in addiction care. The primary objective is to test whether a gamified working memory training will lead to improved working memory capacity in addicted adolescents. As a secondary aim of this project we wil explore the potentially advantageous effects of the gamified working memory training on addicted adolescents* capacities on other aspects of working memory, craving, mood states, relapse rates, delay discounting, and substance use patterns. Finally, in an additional research question, we will examine whether adolescent patients with an addiction will show less working memory capacity compared to healthy, non-addicted adolescents.

Study design

In a randomized controlled trial (RCT) with a pre-post design, 68 patients with a Substance Use Disorder (SUD) who receive inpatient treatment for their addiction will be randomly assigned to either a working memory training or a placebo-training (i.e., working memory exercises with low difficulty and not customized to participants* ability levels). In addition, 64 healthy, non-addicted peers will be recruited outside the treatment setting and will be asked to perform only the baseline assessment of the RCT. This non-addicted non-patient group will function as a reference group to examine differences in working memory capacity at baseline between addicted adolescents and healthy controls.

After having provided informed consent, addicted adolescent patients who participate in the RCT will be asked to perform the training program in the second month of their stay at the treatment clinic to ensure that they have

enough time to adjust to the usual treatment program first. Before starting the training, patients will complete a pre-test consisting of a short questionnaire and several computer-assisted exercises to assess their working memory capacity. The questionnaire will assess craving (desire) to use substances, feelings of anxiety and depression. Besides this questionnaire, data on participants* frequency of substance use before treatment entrance will be retrieved from the routine outcome assessment that patients fill in before entering the clinical detox program that precedes the clinical treatment program.

In the four weeks following the pretest, patients will receive the working memory intervention three times a week during sessions of 30 minutes (a total of 12 sessions). The training sessions will take place during fixed time points and will be integrated in the clinical treatment program. Patients will have access to the training via a computer at the clinic and will perform the exercises under supervision of a research assistant. The training will systematically teach patients how to utilize their working memory on a variety of domains.

At the end of the last training session (two months after the pre-test), patients complete the immediate post-test including the same measures as during the pretest (except frequency of substance use, since patients are still in the clinic where abstention is required). At the end of the usual clinical treatment program (about four months after the pre-test) patients will perform a second post-test including the same measures as the immediate post-test.

Finally, three months after ending the clinical treatment program, patients will receive a short follow-up assessment in the form of a telephone interview to determine whether the working memory training had a positive effect on adolescents* levels of substance use. Assuming that patients in the training condition have benefited from the working memory intervention, we expect that they will show a stronger decrease in substance use compared to patients in the control condition.

Intervention

The intervention consists of eight working memory exercises that are integrated in a computer game. This computer game can be characterized as a role-playing game (rpg) where players can develop and upgrade their playing character during the game. To upgrade their character, players have to battle against different enemies. The battles consist of working memory exercises. The difficulty level of these exercises are customized to the abilities of the player.

The training will systematically teach individuals to utilize their working memory on different domains. The working memory training consists of eight different memory tasks, i.e. two versions of the simon task, two versions of the digit span, the N-back task, the symmetry span task, the operation span

task and the figure task (see for a detailed description paragraph 3.1 of the research protocol).

The gamified working memory training and the placebo training are identical except that in the working memory training, the difficulty level of the exercises increases with the abilities of the player. In contrast, the difficulty level of the placebo-training does not increase and remains low. This way, adolescents who receive the intervention will train their working memory capacity while adolescents who receive the placebo training will not. The total duration of the intervention amounts to four weeks of three weekly sessions of 30 minutes resulting in 12 sessions.

Study burden and risks

No risks are associated with participation. The benefit is an earlier and possibly effective treatment outcome.

Contacts

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Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adolescents (12-15 years)
Adolescents (16-17 years)
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

Inclusion criteria addicted patient group:
- Diagnoses of Substance Use Disorder (SUD) assessed by psychiatrist
- Between 14 and 23 years of age;Participants in the addicted patient group are instructed not to drink caffeine before the experiment. In accordance with the policy of the clinical department where they stay, participants will maintain a sleep schedule of at least 8 hours per night and are not allowed to use alcohol and/or drugs. ;Inclusion criteria non-addicted, non-patient reference group:
- Between 14 and 23 years of age;Participants in the non-addicted, non-patient reference group are instructed to sleep enough (7+ hours) and not to drink alcohol or caffeine before the experiment.

Exclusion criteria

Exclusion criteria addicted patient group: Compulsive gaming behavior and/or gambling addiction assessed by psychiatrist.;Exclusion criteria non-addicted non-patient reference group:
-Risky level of alcohol (AUDIT-score >= 8) or cannabis use (CUDIT-R-score >= 8) or lifetime use of any hard drug.

Study design

Design

Study type:	Interventional
Intervention model:	Other
Allocation:	Randomized controlled trial
Masking:	Double blinded (masking used)
Control:	Placebo
Primary purpose:	Treatment

Recruitment

NL

Recruitment status:	Recruiting
Start date (anticipated):	24-09-2013
Enrollment:	132
Type:	Actual

Ethics review

Approved WMO

Date:	30-08-2013
Application type:	First submission
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

ID: 23672
Source: Nationaal Trial Register
Title:

In other registers

Register	ID
CCMO	NL44000.078.13
OMON	NL-OMON23672