

A Smartphone Application of Alcohol Resilience Treatment for Behavioral Self-Control Training

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Abstract—High relapse rate is one of the most prominent problems in addiction treatment. Alcohol Resilience Treatment (ART), an alcohol addiction therapy, is based on Cue Exposure Treatment, which has shown promising results in preliminary studies. ART aims at optimizing the core area of relapse prevention, and intends to improve patients' capability to withstand craving of alcohol. This method emphasizes the interplay of resilience and resourcefulness. It contains 6 sessions with different topics according to the stage of treatment circuit, and each session consists of 6 steps. Due to the purity and structure of the treatment rationale, it is realistic, reasonable and manageable to transform the method into a smartphone application. An ART app in Android system and an accessory of bilateral tactile stimulation were developed and will be used in a study with behavioral self-control training. This paper presents the design and realization of the smartphone based ART application. The design of a pilot study, which is to examine the benefits of a smartphone application providing behavioral self-control training, is also reported in this paper.

I. INTRODUCTION

High relapse rate is one of the most prominent problems in addiction care. Outside the traditional alcohol treatment a person with a pathological drinking pattern will meet a lot of alcohol related cues or triggers in the surroundings. Triggers could be people, places, things (objects), times and inner conditions that have been used to be associated with drinking. Such triggers can include seeing and smelling ones preferred type of alcohol, places such as bars, beaches or homes where one used to drink, psychic and physiological state such as stress, anger or desire to party, certain times such as knocking-off time or Friday night and former drinking companies. The patients experience a lack of skills to cope with urges to drink, which increases the risk of relapse.

A method that focuses on confrontation with alcohol is Cue Exposure Treatment (CET), although it still provides controversial results in the field of addiction [1]. The rationale of CET is based on the idea that craving and substance intake (drinking alcohol) are mostly cue-controlled. During an exposure, a patient is exposed to conditioned substance related cues while being prevented from engaging in their habitual response (i.e., drinking alcohol) by the therapist. The model predicts that the cue reactivity will diminish when the cue-substance intake bond is interrupted by prolonged

and repeated non-reinforced exposure to cues. As a result, it is expected that the learned association between the cues and the subjective experience will diminish and that the conditioned cues will lose their predictive value and no longer evoke cue reactivity [2].

CET, in combination with various coping skills, has been shown to provide better treatment outcomes in addicts [3]. Approaches using in-vivo exposure are considerably more effective than in-vitro exposure utilizing imagination [4]. Contrary to what might be expected, short exposures have been shown to be as effective as long exposures [5]. The combination of exposure-response prevention (cues without substance intake) in a risky environment and priming dose exposure in a neutral environment (substance intake without cues) have been shown to be highly effective for binge-eaters [6].

Alcohol Resilience Treatment (ART) is an alcohol addiction therapy, which is based on CET and aims at optimizing in the core area of relapse prevention. It intends to improve patients' capability to withstand craving of alcohol. Treatments that fail to reduce craving predict a higher rate of relapse than treatments that succeed to reduce craving.

The design and refinement of ART have taken critical review of both the CET and the evidence-based methods into account. ART has performed promising results in relapse prevention [7]. This approach emphasizes the interplay of resilience and resourcefulness, and it contains 6 sessions with different topics, e.g., "Rewards of sobriety", "Support of relatives and friends", and "Irrepressible commitment to sobriety" [7]. Based on the rationale and experience with ART under the guidance of a healthcare professional, there will be disposed a behavioral self-control training for the study using the same principles of cue exposure and response prevention. Due to the purity and structure of the treatment rationale, it is realistic, reasonable and manageable to transform the method into a smartphone application. Comparing with the current ART guided by therapists, the ART smartphone application is designed for behavioral self-control training. This paper presents the design and realization of the smartphone based ART application. The design of a preliminary study to examine the benefits of a smartphone application providing behavioral self-control training is also reported in this paper.

II. REALIZATION OF THE PRELIMINARY PROTOTYPE

The 6 sessions in ART are conducted by systematic presentation of cue exposure techniques altering with guided imagery of effective coping skills. Each session consists

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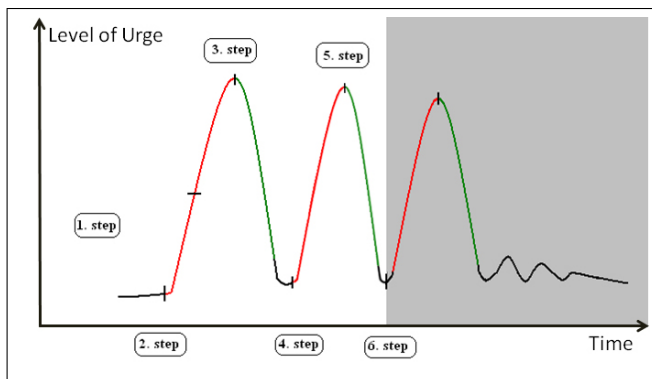


Fig. 1. Level of Urge and position of 6 steps

of 6 steps of training, and among the sessions, the training has similar procedures. A preliminary prototype was developed, in which we only focus on the training steps in the first session, “Rewards of sobriety”. The training procedures includes 1) Standard introduction of Activating of inner Resource (AiR), 2) First exposure of triggers, 3) First AiR, 4) Second exposure of triggers, 5) Second AiR, and 6) Complete the training. Fig.1 depicts the curve of the urge level to drink and the position for each step. The level of urge to drink increases rapidly due to cue exposures of triggers to alcohol related materials (step 2 and 4); when the level reaches the peaks, the first and second AiR (step 3 and 5) are introduced, which significantly diminishes the intensity of craving; craving symptoms finally disappear and are replaced by self-reinforcing thoughts and feelings due to state dependent learning.

The preliminary prototype includes a smartphone app and an accessory of bilateral tactile stimulation. The smartphone app provides information and material regarding treatment to patients. It also controls the bilateral tactile stimulation, which is a procedure during AiR to reinforce the resource. This section presents the design and realization of the smartphone based ART application.

A. Bilateral tactile Stimulation

Bilateral tactile stimulation is an important procedure during the ART treatment. The device of stimulation contains two (or more) vibrators holding by each hand that can vibrate alternately with an adjustable rhythm. Considering that patients may need to operate the software by themselves, it is necessary to have the hands free during the treatment. Therefore, we make a new design for the stimulation as a smartphone accessory, which can be attached on rings (see Fig.2.a for employing of two vibrators) or on a glove (with more vibrators as depicted in Fig.2.b). A standard cellphone vibration motor is adopted to provide vibration. As shown in Fig.2.c, it is placed centred in the box.

An Seeeduino Accessory Development Kit (ADK) (Seeed Studio, Shenzhen, China) is employed for the control of the accessory. It has both on board USB host and USB slave, and supports Android v2.3.4 and above devices. ATmega2560 micro-controller is used in the main board, which has 56

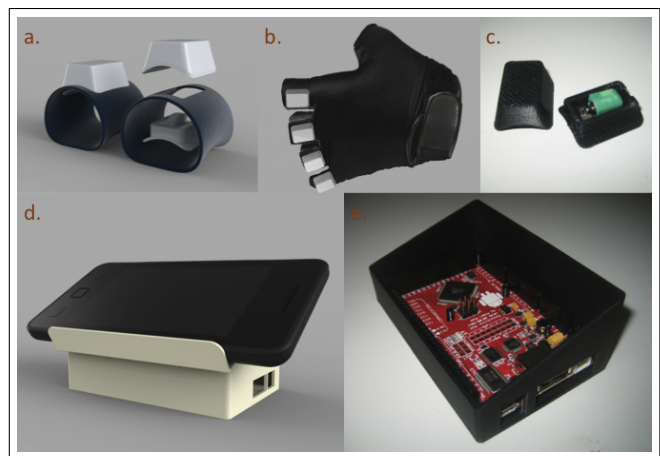


Fig. 2. Accessory of bilateral tactile stimulation and docking station for smartphone

digital IOs, 16 analog inputs and 14 Pulse-Width Modulation outputs [8].

In this application, two (or more) digital outputs are employed to drive the vibrators on each hand that vibrating alternately. By changing the signal of each output pins, the app is able to adjust the rhythm of alternating speed. An USB cable is used to connect the smartphone to the ADK main board. Via the smartphone app, the initial alternating speed is increased smoothly from minimum to maximum, while the value is displayed simultaneously on the screen. The purpose is that patient can first feel all the rhythms and then choose the one with the most pleasant alternating speed. This is an important procedure during the training steps with AiR. The bilateral tactile stimulation will keep the rhythm until the treatment continues to the next step. As shown in Fig.2.d, a docking station is designed to hold the smartphone for the convenience when patients processing the treatment, while the ADK main board is integrated in the docking station with USB interface and accessory connection ports on the right side (see Fig.2.e).

B. Smartphone App

Android (Google Inc, Mountain View, CA) is a Linux-based operating system for mobile devices. Because it is open-source, we first choose this platform to develop the ART app. The programming language is a customized version of Java in Eclipse (Oracle Corporation, Redwood City, CA). The firmware for ADK main board is written in C with Arduino development environment.

The app will create a database for the storage of both patients’ information and the stage of treatment circuit. User behavior will be traced and recorded, which is reported to the therapist with the purpose of monitoring the treatment process and of using secondarily for improving the application. The database will be uploaded to the on-line server when the treatment is completed.

On one hand, the smartphone app performs as a visual therapist that guides the patient to complete the treatment. Following the 6 steps as shown in Fig.1, it provides the

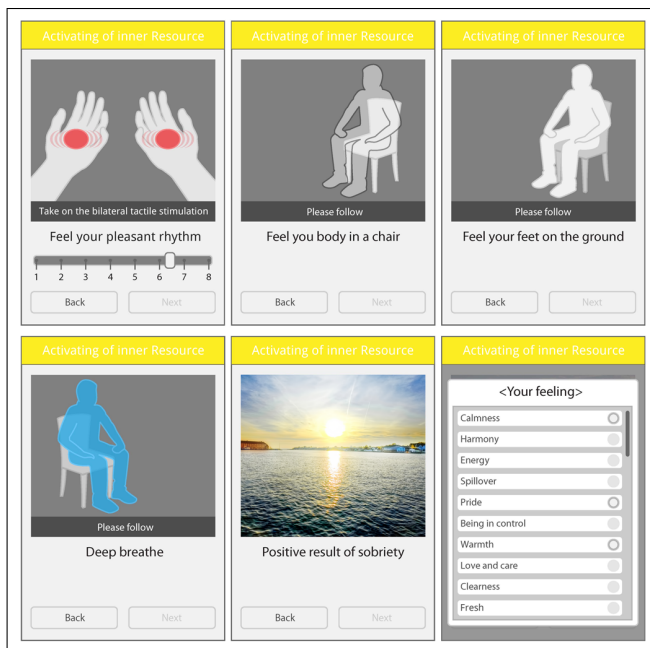


Fig. 3. Infinite loop of AiR

instruction step by step. Level of Urge will be asked after each step to test whether the treatment can move on to the next step. On the other hand, it also provides relevant materials regarding both exposure of triggers and positive states of resources. Both the exposures and the resources are presented aural and visual. For instance, a range of triggers can be displayed on the screen, such as a video of opening a bottle, filling a glass and drinking by a person.

Fig.3, which depicts step 1 of the treatment, shows an example of a scenario when a patient is using the smartphone app. Step 1 is a standard instruction that enables the patient to activate resources by repeated presentation of personal chosen cue words. The cue words become thereafter linked to various tactile stimulation with different alternating speed, which increases the effectiveness of positive thoughts at the peak of exposure. This step consists of several procedures, where the initial procedure is to find the most pleasant rhythm from the slowest to the fastest alternating speed between the vibrators on each hand. As presented previously, the value is displayed on the screen and can be adjusted manually by the patient. Once the pleasant rhythm is confirmed, an animation starts to show the guideline: “Feel your body in a chair, put you foot on the ground, and deep breathe.”. A picture showing positive result of sobriety, for example a nice view with sunrise, is displayed to help the patient in contact with the resource. Along with these procedures, a list of cue words will be provided to the patient, who can select three of them that best describe this pleasant state. And then the patient will be asked to feel the pleasant rhythm of the tactile stimulation again. By now, a loop of the procedures has been created following pleasant rhythm - chair - ground - breathe - picture - cue word A - cue word B - cue word C - pleasant rhythm. Repeat all the procedures in the loop until the patient is familiar with the procedure. To complete

this step, a Validity of Resource scale will be asked to the patient. The scale is from 1 to 7 representing the verification of the resource experiencing from superficial to very intense. If the score is 5 or more, the patient can continue to the next step.

III. PRELIMINARY STUDY DESIGN

The main idea of the study is to increase participants’ ability of self-regulation by emphasizing behavioral self-control training. The experimental group will be provided with a smartphone application, which enables them to obtain and maintain skills to reduce cue reactivity at home.

A. Purpose

The primary purpose of the preliminary study is to examine the benefits of a smartphone application providing behavioral self-control training. Self-control training programs are in general characterized by “low cost” because of the reduction of the presence of healthcare professionals. It also increases the self-commitment and self-responsibility of patient at any stage of treatment circuit. The presented smartphone application teaches patients suffering from alcohol abuse coping skills, which supports them to take control over cue reactivity when confronted with alcohol in real life. Providing self-control training by the ART app enables to obtain and improve these coping skills on a regular basis regardless of time and place. The cue exposure paradigm demands on patients to be systematically confronted with the distress of high risk cues and high-risk situations instead of avoiding or neglecting them. Providing the self-control training also enables additionally to validate the skills in high-risk situations regardless of time and place. The experimental group will undertake the short term intervention of behavioral self-control training by using the smartphone application.

B. Method and Material

Before applying the smartphone application in the experimental group, a pilot study to test the user confidence and comfort of the application will be performed. Feedback of relevant users by qualitative interviews will be analyzed before disposal of the final version of the application.

Two groups of patients will be recruited by the ambulant alcohol treatment center in Odense and Sønderborg, Denmark, including a) experimental group of patients using the smartphone application and b) control group of patients with receiving treatment as usual. Each group will be randomized with 75 participants. Participants are characterized by moderate/severe alcohol abuse allocated to outpatient treatment. The global functioning level is minor reduced, and their drinking profile indicates a high grade of loss of control concerning frequency and amount of alcohol intake as well as a wide range of high-risk situations. The intervention will be placed in the very beginning of treatment.

The experimental group will undertake the short term intervention of behavioral self-control training by using the smart phone application. Healthcare professionals are only

involved at one instruction session, one follow-up session, and one session for evaluation. Patients are requested to train resilience and resourcefulness by themselves on a regularly basis of five times a week during the eight weeks of treatment. The first two weeks training is focused solely on resourcefulness, and the follow six weeks training is also on resilience by including exposure. The sessions are consecutive with increasing level of challenging the patients' new adapted skills. The likelihood of motivation maintenance and hence compliance will be increased by the amount of successful completed training sessions. The effect will be compared with one control group following treatment as usual with highly inclusion of healthcare professionals and treatment of four times longer duration. The effect will be measured by psychometric scales, relapse quota and social functioning.

IV. CONCLUSIONS

This paper presents the design and realization of a smartphone based application for patients suffering from alcohol abuse. It transforms a highly structured and proven therapy of Cue Exposure Treatment into behavioral self-control training. This application consists of an Android app and an accessory of bilateral tactile stimulation. The app has a friendly user interface that works as a virtual therapist guiding patients to complete the treatment, and it also provides relevant materials regarding both exposures of triggers and positive resources. The accessory of bilateral tactile stimulation has a smart design that frees the hands, which is very convenient for the patient to operate the app during the self-control training. This smartphone application provides a "low cost" approach for patients to obtain and improve the coping skills by themselves on a regular basis regardless of time and place. A preliminary prototype was developed, which is depicted in Fig.4.

The present contribution also has some limitations. Firstly, the preliminary prototype of the smartphone application only focuses on one session of the alcohol resilience treatment. Although the training steps in other sessions are similar, individual developing process for each session is still required. Secondly, the preference of cue exposure in the smartphone application is based on picture, sound, video, and imagination. Comparing with the ordinary ART guided by therapist, in which real objects e.g., a bottle of Whisky, can be used as triggers, self-control training has the limitation of providing such triggers. Accessories that only contains the smell of alcohol will be considered with significant importance in future study. Moreover, the development of the on-line server for receiving data from the smartphone is not completed yet.

This paper also presents the design of a preliminary study to examine the benefits of a smartphone application providing behavioral self-control training. Two groups of patients, who will receive different treatments, will be recruited for comparison in the study. It is intended to evaluate a treatment approach focusing on self-reducing of cue reactivity in real life situations targeting a higher grade



Fig. 4. Preliminary prototype

of self-responsibility and empowerment. In the long run, it is targeting to reach citizens at an early stage of critical consumption, where there are estimated 150,000 citizens in Denmark with severe alcohol consumption, while only 10.000 of them obtain contact to alcohol treatment units. The smartphone application may become a feasible intervention for problem drinkers to return to low-risk drinking habits guided by general practitioners. New insights regarding the neuronal cue reactivity are intended to be found.

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