Effectiveness of self-training using the mobile-based virtual reality program in patients with social anxiety disorder

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1. Introduction

Social anxiety disorder (SAD) is one of the most common psychiatric disorders with lifetime prevalence between 7% and 13% (Furmark, 2002; Kessler et al., 1994; Ruscio et al., 2008; Wittchen & Fehm, 2003). Although neglecting to treat SAD can evolve into a chronic state, two-thirds of affected individuals do not seek treatment (Pollack, 1999; Ruscio et al., 2008). They are hesitant to even receive outpatient treatments possibly due to their fear of negative evaluation by others or because they view their condition to be untreatable (Bruch, Hamer, & Heimberg, 1995). Other reasons are the uncertainty over where to receive treatment, costs, and reluctance to go outside of their comfort zone (Olifson et al., 2000).

Cognitive behavioral therapy (CBT) has been the most researched and effective nonpharmacological approach to the treatment of SAD (Heimberg et al., 1998; Mayo-Wilson et al., 2014), in which exposure is one of the frequently used techniques (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014; Hofmann & Smits, 2008). Since in-vivo exposure is impractical because it is costly, time-consuming, and difficult to control for external circumstances, group therapy may somewhat compensate by allowing the group to engage in role-playing with other group members, nonetheless, this too, has its challenges (Aderka, Hermesh, Marom, Weizman, & Gilboa-Schechtman, 2011; Gledhill, Lobban, & Sellwood, 1998). One of the technologies that medicine is embracing recently is virtual reality (VR). Due to its ability to reproduce “real-like” environments, VR has been a useful tool for the management of some psychiatric illnesses such as attention deficit hyperactivity disorder (Nolin et al., 2016), eating disorder (Marco, Perpina, & Botella,
speaking anxiety (Anderson et al., 2013; Wallach, Saexposure therapy is as effective as traditional CBT in treating public
Kavakli, 2013; Rus-Calafell, Gutierrez-Maldonado, Botella, &
Banos, 2013; Shibian, Schelhorn, Pauli, & Muhlberger, 2015), VR
exposure therapy is as effective as traditional CBT in treating personal-
ized treatments. The development of treatment options that allow
patients with SAD to train alone will not only have immediate
therapeutic gains but also can facilitate them to seek further
treatments in clinical settings. With the pressing need for easily
accessible options, we have developed a mobile-based VR program
that would allow individuals to train alone. This program features
various relatable environments and scenario options through
interactive and user-friendly means, and includes seven in-app
measures that allow objective performance evaluations and feedback
recordings. To the best of our knowledge, this program is the
only mobile-based VR application that offers SAD treatment cur-
riculum without human support.

The present study aimed to investigate the efficacy of this mo-
ible VR exposure self-training. In addition, we administered
cybersickness survey in order to gauge the safety of the immersion.
It was hypothesized that individuals diagnosed with SAD would
show greater decreases in post-treatment survey scores relative to
those in normal controls. We also hypothesized that SAD partici-
pants would exhibit greater performance improvements in in-app
variables from pre-to post-treatment in respect to those of
normal controls.

2. Methods

2.1. Participants

A total of 52 participants were recruited via online advertise-
ments. Exclusion criteria included pregnancy, current use of
medication for a medical or neurological illness, severe cognitive
impairment, and psychotic symptoms. All participants had normal
or corrected-to-normal vision. Participants were screened using the
Mini International Neuropsychiatric Interview module (MINI) for
DSM-IV to determine the presence of SAD (Sheehan et al., 1998).
However, the diagnosis was not disclosed to the participants.
Twenty-two participants were diagnosed with SAD (14 females;
mean age, 23.0 ± 2.6; education years 15.5 ± 1.1); 30 participants
were assigned to normal controls (16 females; mean age, 23.0 ± 1.9;
education years 15.3 ± 1.2). There was no significant difference in
age and education years between the two groups. All participants
gave informed written consent prior to partaking in the study, and
the study was approved by the Yonsei University Gangnam Sever-
ance Hospital Institutional Review Board.

2.2. Virtual environment setting

After being familiarized with the use of VR equipment, all par-
ticipants executed the mobile virtual presentation task by them-
selves based on the built-in instructions. The virtual
environment was displayed via the head-mounted display (HMD),
which consisted of a Samsung Galaxy S6 latched onto Samsung
Gear VR powered by Oculus. A pair of in-ear earphones with a
microphone was also utilized. Gear VR allowed a 360° view with
96° field-of-view. In addition, Samsung Gear S2, worn on the wrist,
was used to measure heart rates throughout the training sessions.
Instructions for the task were presented as text on the screen or by
voice via the audio system.

As shown in Fig. 1, the virtual environment offered three
different social situation sets: school, business, and everyday life.
Each set was comprised of 4 levels, and each level included 3 topics.
All levels depicted different situations that are relevant to the
particular environment, and all topics within a level were appro-
riate to the context. As the level advanced, the difficulty also
increased; and to minimize variances between the environments,
components like the number of avatars, number of gestures and
distractions such as nodding and yawning while the participant
was speaking, and topic difficulties were tailored to be as similar
across all VR environments. At the beginning of each topic, there
was a listening phase, in which one or two avatars briefly intro-
duced the topic via various means such as sharing its opinion,
asking a question and giving an introductory speech (Supplement
1). In each topic, participants’ task was to speak as long as possible
in response to the avatars’ (speaking phase) and finished it
by pressing the end button.

The in-app measures were made up of 7 different variables;
(1&2) Percent change in heart rate from baseline before starting the
program to the listening phase (Hb-Hl) or speaking phase (Hb-Hs)
of each program level; (3) eye contact percentage, percentage
watching the areas of interest (AOIs) drawn around each avatar
from the head to chest, and from shoulder to shoulder; (4) total
speech time, the time measured from the end of listening phase
until participant ended the topic; (5) voiced time ratio, the ratio of
actually voiced time to the total speech time; and (6&7) two self-
evaluations, level of nervousness and confidence in content
answered at the end of every topic within the virtual world.
The two self-evaluation questions were measured on a 3-point Likert
scale (0 = “very nervous” and “not confident,” respectively;
2 = “not nervous” and “very confident in the content,” respect-
ively). Participants could review each of the variables on the per-
formance evaluation page. All data were instantly uploaded and
made available on a cloud-based website.

2.3. Training procedure and performance measurements

All participants attended 8 training sessions (Supplement 2)
over 2 weeks in the VR center. To minimize background noise,
participants were in a room alone with an assistant, and were
seated in a revolving chair. The assistant simply provided help to
participants in the operation of the VR equipment. Once basic in-
structions were explained, participants chose one of the three en-
vironments, and then began the VR program. At each training
session, participants completed all three topics within a level. Each
level was repeatedly experienced for two sessions. Upon
completing one topic and answering the two subjective questions
in-app, participants were instructed to see the performance report
to go through each variable for further self-reflection, and were
suggested to reflect on the content, general flow, and areas they
could improve in to further facilitate participants to ruminate on
their performance; however, these were not recorded. This process
was repeated a total of three times per session.

Participants completed a set of questionnaires at two different
stages of the experiment: before treatment and after treatment. The
questionnaires included the Hospital Anxiety and Depression
Scale (HADS) (Zigmond & Snaith, 1983), the Liebowitz Social Anx-
xiety Scale-Self Report (LSAS-SR) (Liebowitz, 1987), and the Social
Interaction Anxiety Scale (SIAS) (Mattick & Clarke, 1998). To assess
the safety, participants repeatedly reported the severity of motion
sickness symptoms after every first round of each level using the
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