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Artificial Intelligence and Depression: How AI powered chatbots in virtual reality games may reduce anxiety and depression levels

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Abstract: Depression is a prevailing issue of the 21st Century in dire need of a solution. Trained professionals such as therapists and psychologists are often limited in supply and charge a high price for sessions. This leads to an alternative of using customized AI powered chatbots in full immersion Virtual Reality (VR) games as a substitute for professionals for a consistent and supportive treatment to reduce anxiety and depression levels. However, not much research has been done specifically on AI chatbots in VR games for depression therapy. Therefore, this study is separated into three analyses: analyzing the effects of chatbots on depression, the effects of VR on depression, and the effects of games on depression. Various researches analyzed in this study have supported chatbot therapy to be effective in reducing anxiety levels. VR also provided a platform that can promote concentration and engagement in patients. Analysis of studies on games supported that games provide positive emotions and reduce anxiety. Nevertheless, future primary research must be conducted before reaching a conclusion because of limited data.

1. Introduction

From computers to smartphones to machines capable of automating factories, the 21st century was accompanied by speedy technological advancements. However, this technological advancement also caused many chronic conditions such as obesity in the US population (factory produced fast food was the cheapest option, but it causes obesity). Numerous studies have associated obesity with a greater chance of prevalent depression [6]. With the advancement of smartphone technology, social media has also caused an increase in depression in adolescents [7]. Now the world faces an urgent issue of increased patients with depression. In fact, 13.1 percent of adolescents in the US had some form of depression in 2017 (figure 1).

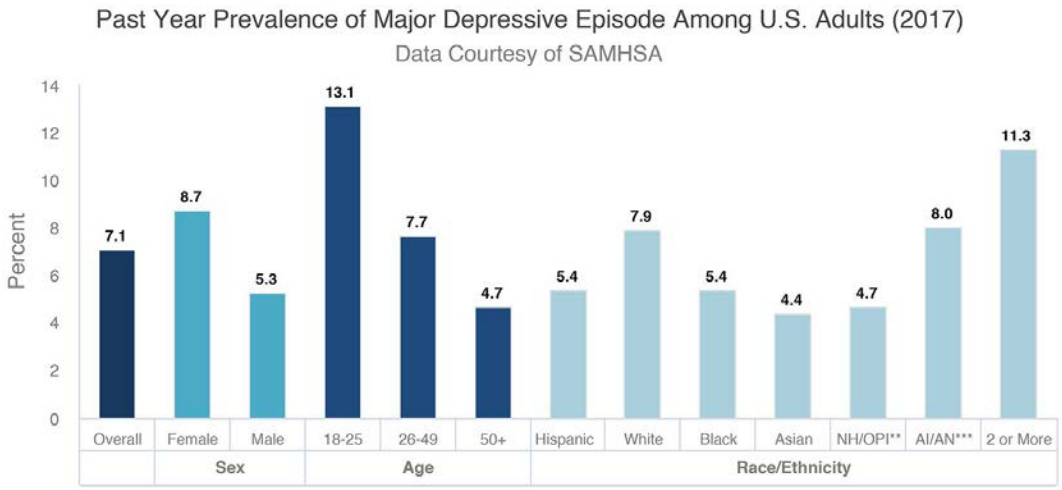

Figure. 1 Past year prevalence of major depressive episode among US adults in 2017

Games are one way people use to calm down when coping with depression. Conversing with others and professionals is another way to cure depression. With AI technology as advanced as today, we can combine the psychological conversing aspect by using AI chatbots with VR games to see if it may help with depression.

1.1 Background

Traditionally, games were associated with negative aspects such as addiction and violence. However, a new field called gamification, the usage of game elements in nongame contexts, has emerged with positive findings about the applications of games. From this perspective, games may be able to bring joy and accomplishment for the player. The result would be a reduction of the player's anxiety and depression levels.

This study investigates different researches that have been done on the effects of AI chatbots and games on depression and anxiety levels. The adolescent group has the highest percentage of people with depression while also being the highest percentage of people who play games (figure 2). Since adolescents are the future generation that would lead our society, it is essential that this demographic group have a healthy mental health.

Ages	Less than 1 hour a week	1-2 hours a week	2-4 hours a week	4-7 hours a week	7-12 hours a week	12-20 hours a week	More than 20 hours a week	Average Hours Each Week
18-25 years old	9.1%	14.5%	16.9%	21.0%	16.1%	11.5%	11.0%	**7.48**
26-35 years old	8.0%	13.4%	19.2%	20.2%	17.0%	11.6%	10.5%	**7.50**
36-45 years old	9.3%	14.7%	21.1%	18.9%	15.0%	12.3%	8.8%	**7.09**
46-60 years old	15.9%	17.6%	18.9%	19.6%	14.7%	8.6%	4.9%	**5.72**
Over 60 years old	26.5%	20.3%	16.9%	14.0%	11.7%	6.1%	4.5%	**4.70**
All ages	**14.5%**	**16.4%**	**18.7%**	**18.6%**	**14.8%**	**9.7%**	**7.4%**	**6.33**

Figure. 2 Percentage of people who play games categorized by age groups

1.2 Virtual Reality Explained

Virtual Reality (VR) is the simulation of the environment with computer technology. Instead of viewing a screen monitor, the user would be able to interact 360 degrees with the simulated environment. VR has many real world applications including movies, games, and learning. VR creates an effect of full immersion where the user would be able to fully concentrate on the VR world. Concentration is essential for stress reduction.

1.3 AI Chatbots Defined

AI chatbots are computers programmed with the ability to reply to users' inputs. For example, Siri is an AI powered chatbot that can understand human speech inputs and perform tasks for them. There are many other uses of AI chatbots but in this study we will primarily focus on therapy chatbots that can diagnose and give treatments to the user.

	Pre		Post		Pre vs. Post			
	Mean	SD	Mean	SD	95% CI for Mean Difference	t	df	*d*
State of Mindfulness	4.10	1.12	4.97	1.01	-1.26, -.47	4.43***	42	0.76
Emotional State								
Joy	4.95	1.11	5.02	1.42	-.44, .30	.38	42	0.06
Sadness	1.83	1.17	1.30	.56	.19, .82	3.25**	42	0.44
Anger	1.40	.98	1.14	.35	.00, .50	2.04*	42	0.28
Surprise	2.86	1.54	3.23	1.96	-.86, .11	1.53	42	0.24
Anxiety	2.16	1.29	1.49	1.06	.19, 1.15	2.81**	42	0.51
Relax	4.67	1.32	5.58	1.34	-1.40, -.41	3.68**	42	0.68
Vigor	4.81	1.20	4.79	1.42	-.40, .45	.10	42	0.02

Note: M = mean; SD = Standard deviation; t(df) = t-value; *d* = Cohen's d. CI = Confidence Interval.
* $p < .05$
**p< .01
*** $p < .001$.

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Figure. 3 Effect of pre and post mindfulness on emotional state

2. Problem of Status quo

Depression has become a prevailing issue of the 21st century. According to the World Health Organization (WHO), depression has once hit 4% of the human population in 2015. Out of that 4 percent of the population, depression is most common among adolescents (Figure 1). Since the introduction of smartphones, especially social media apps on smartphones, cyberbullying has become one of the causes for the increase in depression rates [7, 10]. With the rising incidences of depression, the suicide rates will also rise alongside. According to the WHO, more than half of people with depression do not seek help. All of these lives will be lost because of not getting treatment fast enough. One explanation for people not seeking help may be because people always associated mental illness with demons or madness until psychology became mainstream after the 20th century. Although such viewpoints are rare today, there are still negative stereotypes on people who seek treatment for mental health issues. Besides trying to alter the whole societal view, we can offer alternatives that do not have such negative stereotypes.

2.1 Current Researches

2.1.1 Games can Generate Positive Emotions [11]

In a study on the effect of gameplay on personal wellbeing [11], the researchers examined 1304 high school students in three groups: those who have never played video games before, those with moderate play, and those who play daily. Contrary to popular belief, those who have never played games before are more prone to depression than moderate players [11]. People who play games are more likely to experience positive emotions regardless of game time. The following positive effects [11] can be generated:

a. Emotional Stability
   People who moderately play games are more emotionally stable and experience less emotional disturbance[11]
b. Relaxation and Stress Reduction
   Players who regularly play games have reported to be more relaxed and less stressed.
c. Happiness —
   Children and adolescents who encountered feelings of anger, guilt, or frustration in real life have reported to become less angry after moderate game play of games. Their happiness index increased after the game play.

2.1.2 Games that Can Help Reduce Depression [1]

According to a research called Developing Digital Intervention Games for Mental Disorders: A Review[1], the following games can successfully help with mental disorders:

a. Reach Out Central
   This game focused on identifying and developing stress coping skills with mood trackers. The results[1] showed that the participants were more likely to seek help after playing the game.

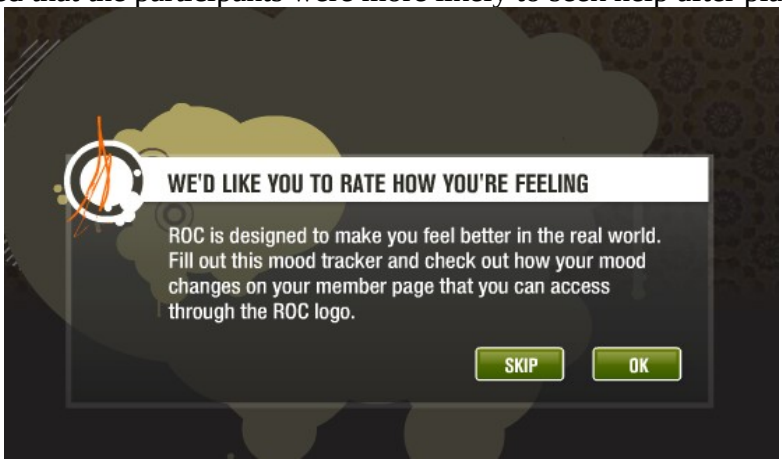

Figure. 4 Mood tracker of Reach out Central

b. Personal Zen

The game's objective is to trace the trails of a non-threatening sprite to implicitly train the player's brain to stay away from negative stimuli, which in turn reduces anxiety and stress significantly.

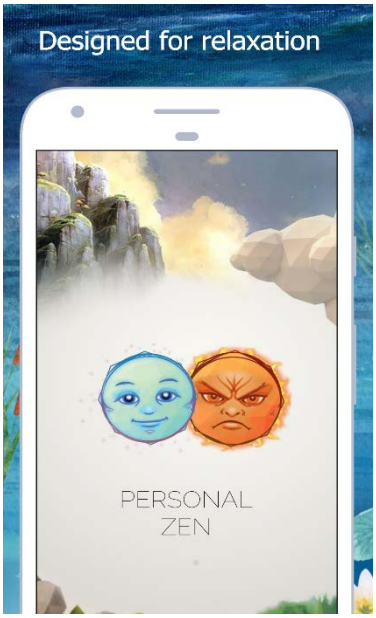

Figure. 5 Personal Zen's two sprites, the blue is a non-threatening sprite and the orange is a threatening sprite

c. Flowy

The objective of this game is to reduce anxiety and stress through breathing activities where the player would press the screen of the game while inhaling.

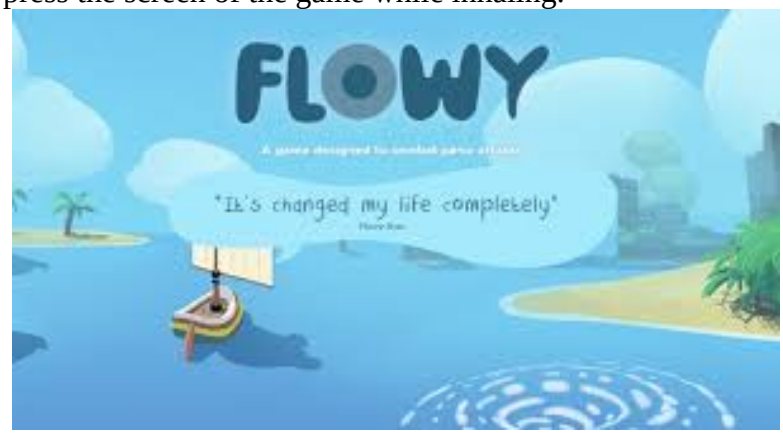

Figure. 6 The main menu of the game Flowy

d. MindLight

This game utilized neurofeedback CBT headsets as part of game play. When the player's brain is more relaxed, more light will be generated. The result showed reduced anxiety.

Figure. 7 A gameplay of the game MindLight, the yellow light is generated by CBT headsets when the player's brain is relaxed

e. Guardian Angel

This game was created for the individual patient. It is specifically geared towards resembling the individual player by creating characters in the game that are "almost exactly identical" [1] to the player/patient.

Figure. 8 Gameplay of the game Guardian Angel. Each cloud represents a negative emotion

2.1.3 Treatment of Depression using VR [5, 12, 13]

Virtual Reality allows the patient to concentrate more during mindfulness sessions, a clinical training designed for people who are unable to concentrate [13]. In this research [13], 44 participants used the Oculus Rift VR headset to attend a mindfulness conference. Based on the questionnaires completed by the participants, those who went through this VR training showed significant improvements in mindfulness and a reduction in negative emotions.

In another study [12] where participants participated in an 8 week mindfulness-oriented meditation using Virtual Reality environments, participants showed a decrease in anxiety levels and sadness (figure 3). This result demonstrated that the application of meditation in immersive virtual environments (IVE) provided better results than those practiced in traditional in-person environments or through mobile applications.

From these studies, we can predict that a possible effective setting of VR games to implement the AI chatbot in would be meditation games.

2.1.4 Application of AI Chatbots in Depression Assistance [2, 6, 14, 15, 16]

There is an increased usage of AI Chatbots throughout the years. AI chatbots generate better patient responses, can reach out to populations that dislike in-person therapy, and free up time for medical professionals [16]. One usage of AI chatbots would be to assist in therapy for mental disorders. Depression is the most common focus of therapy chatbots [2].

Special applications of AI Chatbots can emulate a psychotherapist [6] by creating a system that can detect depression levels in an individual and suggest self-treatments. Training Professional psychotherapists and psychologists can take a lot of effort. However, machines can do it effortlessly. By making a machine that has a huge database of every disease, its corresponding symptoms, and possible treatment options, a patient will be able to self-diagnose with the chatbot by simply entering a few symptoms he/she have [15].

Limitations of using autonomous therapy agents such as chatbots include the fact that current chatbots might not understand long and complex messages, which may result in sending inappropriate replies to the patient. Another limitation is that AI chatbots require a learning curve where the user would select if the chatbot responded with the correct message. However, this may make the patient feel that the chatbot is not listening to them carefully [14].

3. Solution

Customized VR games with AI chatbots

Drawing from the results of current research, the customization of VR games will best suit the needs of curing depression. With a customized VR game, the person is more likely to increase their engagement and decrease their depression level. Through this game setting, the implementation of AI chatbot geared toward psychological therapy will increase in effectiveness in the reduction of depression levels and stress.

Such customized game should include the following elements:

1. Self Assessment of Depression using AI chatbots [15]

The chatbot should be created with a huge dataset of psychiatric disorders with the symptoms and treatments of each disorder. The chatbot should also be programmed to give out questionnaires that can detect the patient's depression level and disorder.

2. AI chatbot therapy [16]
   The customized chatbot should be able to speak to the patient, display responses as words, and show images that may help relieve depression. It needs to be programmed in a way that can read context and infer the emotional state of the patient. This will allow the chatbot to be a sufficient autonomous therapist that can work 24/7.
3. Engagement [1, 11]
   The setting of the game in VR should engage with all five senses to create maximum immersion. Increased immersion would mean an improvement in concentration which ultimately leads to reduced anxiety levels.
4. Relationship [1]
   Customized VR games should also implement a social interaction aspect in some patients. The AI chatbot needs to be programmed to have the ability to distinguish the depression level of the patient and allow the social interaction feature (friendlist, double meditation) to open when the depression level is moderate.
5. Generate Positive Emotions [11]
   Like all games, the AI powered chatbot VR game should be fun to play and generate happiness for the user. To generate such effect, a rewarding system and different levels of difficulty should be implemented.

3.1 Required Technology

1. VR headsets

VR Headsets are essential to the application of the results of this research. This is the technology that allows the patient to fully immerse in the Virtual Reality world.

Examples:

a. Oculus Quest VR

Figure. 9 White Oculus Rift Quest VR headset

The Oculus Quest is one of the most well known VR headsets that people use. It has a huge selection of games in its database available for purchase. However, it has a price tag of 299 dollars,

which may cause a burden for certain demographic groups.

b. Cost Efficient Smartphone VR Headsets [8]

In order to make the VR Chatbot more accessible, cost efficient phone VR headsets can make a great alternative. Low cost phone VR headsets did not show any difference [8] in learning, spatial presence, or usability when compared to higher end VR headsets like Oculus Rift. With price tags as low as 20 dollars, players of different demographics can experience the immersion brought by VR headsets. This allowed more inclusion and increased the impact of this research.

3.2 Why use the AI chatbot in VR game alternative than therapists or psychologists

1. Cost

Therapists and Psychologists need to go through extensive training before they can help out patients. Therefore, they usually charge a lot of money for visits. People in lower economic status or of younger age (adolescents is the primary group of people with depression) might not be able to afford therapy sessions, yet they are the group with the highest rates of depression (figure 1 and figure 2). However, by using AI chatbots in a full immersion VR game geared toward relaxation games are usually priced reasonably and can be repeatedly used. This allows the patient to receive AI therapy whenever he/she needs at no extra cost in the subsequent uses.

2. Limited Supply of Professionals

Psychologists, Psychiatrist, and Psychotherapists are all high skill labor. This would mean that there is a limited supply of these professionals that can help with depression. The result would be that there would be more people that need assistance than the amount of professionals available. To solve this issue, AI chatbots can help as many patients as needed with great efficiency and low cost.

3. Efficiency and Accessibility [1]

Chatbots offer a more efficient and cost-effective approach [3] for giving cognitive behavioral therapy (CBT) than traditional in-person therapies. AI chatbots can offer a convenient, affordable, and secure support for the patient with an objective focus.

4. Negative Stereotype of Psychological Visits

There is a societal stereotype that associates a person visiting a mental hospital with craziness. This stereotype caused a lot of patients who may have the opportunity to cure their depression before it gets worse to step away from seeking professional help. However, with AI chatbots in VR games, the worst anyone can say is to play less games. There is no association between playing games and abnormality. Therefore, this research solution would be able to reach a larger demographic of patients.

5. Engagement and Concentration

Using AI chatbots in VR environments can create a full immersion experience which would increase engagement. Analysis of previous studies suggest that IVEs provide a better result on increased concentration and anxiety reduction [9] than traditional environments.

3.3 Possible oppositions

There is a study [4] that shows a failure of popular mobile phone apps in curing anxiety. The study reviewed 27 popular apps that included empirically supported treatment qualities. The content areas for anxiety and depression such as exposure and restructuring were rare. This caused it to not be effective in reducing depression levels.

AI might replace psychologists and therapists [16] in their job fields. This might cause fear in the

public because AI has been historically presented in movies as an entity capable of betraying humans. Scientifically speaking, if AI is misused, consequences such as privacy leak would be severe as well.

Game development costs are high for customized VR games specifically geared towards depression treatment. Non-VR traditional mobile games that are customized may already take three years to develop [1]. This creates a very high cost for developing AI chatbots with a huge database in VR game settings.

The use of artificial intelligence as a therapist may also lead to ethical problems. AI chat bots do not have emotions nor can they analyze complex and long responses from patients. Due to this reason, there is a possibility for the AI to give a wrong reply to the patient and ultimately lead to worsening the depression level of the patient.

4. Conclusion

4.1 Future Problems

Addiction to the VR game might be a problem in the future. Game addiction has been a commonly researched topic and results [11] showed that every type of game can cause an addiction. Another potential issue of this solution would be the possibility of the patient unable to self adjust to depression in the future. In other words, the patient might develop a reliance that hinders his/her ability to self adjust on their own.

4.2 Future Research Areas

This research did not take into account gender differences in the reduction of depression levels. Females are more prone to depression than males (figure 1 and 2) Therefore, the next step would be to start a comprehensive analysis of the difference in the effects of AI chatbots in VR games between females and males. Another potential research area would be to focus on people with disabilities. People who are blind will most likely not benefit from VR game chatbots. However, no study has been done previously so there might be a solution to this methodology for people with disabilities.

4.3 Problems during Research

Because this is a secondary desk research report in an area that is not researched frequently, data tables were almost impossible to gather. The solution in this study is a hypothesis drawn from different sections of existing research that relate to the central topic of the study. Another problem would be the limited amount of data that supports gaming as beneficial to a person’s mental wellbeing. Most studies conducted on games focused on the negative effects, particularly aggression and addiction.

4.4 Applications of Results

The results of this research have the potential to help the majority of people who were unable to afford therapy sessions and those who chose not to go to mental hospitals because of societal stereotypes. This can lead to a decrease in depression in the world, which would in turn decrease suicide rate. Since the majority of patients with depression were adolescents, more people would graduate from college. This would result in an overall increase in the education level society.

Furthermore, more people were able to recover from depression with increased happiness, the crime rate will also decrease because depression is also associated with violent and aggressive behaviors.

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