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Understanding the Relationship Between User Game Preferences and Depressive Symptoms: A Pilot Study

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AU4 ▶ Abstract

AU5 ▶ Following the initial measures taken to manage the repercussions of the COVID-19 pandemic, mental health conditions have become a critical concern. Mental health has become a foremost priority not only for health care providers but also for many other organizations, such as educational institutions, companies, and government agencies. A significant proportion of the Australian population having experienced mental disorders highlights the need for effective interventions. Those with pre-existing mental health issues experienced particularly pronounced effects. Among these challenges, advancements in technology offer new possibilities for mental health support. Videogames have shown effectiveness in mitigating symptoms of depression. Previous research has shown that game interface preferences correlate with players' emotional responses. This study aims to use *MoodJumper*, a game we designed, developed, and evaluated to examine the choice of game preferences in individuals with depressive symptoms. The results indicate a nonsignificant correlation between music preference, the direction of movement, and depressive symptoms meaning no significant relationship was found between depressive symptoms and chosen settings. However, a significant negative correlation was found between decision-making ability regarding game preferences and Patient Health Questionnaire-9 scores showing the difficulty of choosing preferred settings when having depressive symptoms. This contribution paves the way for designing and evaluating more impactful game experiences for individuals with mental health challenges.

AU6 ▶ Keywords: User preference, Mobile games, Mental health, COVID-19, Depression, Depressive symptoms.

Introduction

IN THE FAST-EVOLVING AFTERMATH of the COVID-19 pandemic, health care providers continue to grapple with the enduring challenge posed by mental health conditions. According to Australian Institute of Health and Welfare, more than two in five people aged 16–85 years are estimated to have experienced a mental disorder at some time in their life.¹ When the COVID-19 virus was discovered, the urgency of the situation led to widespread lockdowns and social distancing measures, which not only affected the world's stability in the economic and medical sectors but also affected individuals' mental health.

The impact of COVID-19

Considering how recent the pandemic was, the research around the impact of the measures taken to handle the pandemic is based on preliminary data and is constantly evolving. Using longitudinal data, a study published in 2022 found that there was a statistically significant decline in mental health for Australia as a whole, particularly for Victorians who endured more long-lasting lockdowns.² Another study evaluating the effect of COVID-19, on a representative sample of Australian adults, showed that changes to work environments due to decisions made to address the pandemic were correlated with stronger decrements in mental health

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compared with the number of people affected by the direct consequences of the virus.³ The study demonstrates that the initiatives undertaken during that period had a more profound impact on people's lives.

The impact on people with existing mental health conditions

Not everyone was equally impacted by the pandemic. The aftermath of measures that were put in place during the pandemic has caused an increased demand for mental health services in Australia. The pandemic led to an increased demand for health services causing heavier workloads, which have taken a toll on the health workforce in Australia, including the mental health workforce. The latter has been facing multiple challenges including shortages across most occupations, the mental health workforce being maldistributed geographically, and a negative workplace culture due to excessive stress without adequate support.⁴ The study done by Bowman et al. found that the effects were particularly visible among vulnerable groups including young people and people with an existing mental health issue.⁵ People with bipolar disorder reported worse cognitive symptoms,⁶ more stress and anxiety, and sleeping difficulties⁷ compared with healthy people.

Games for health

Among these challenges, the advancements in technology provide opportunities to reshape the approach to mental health support. Videogames are one of the most visible examples of digitalization merging entertainment and technology. With the continuous progress of technology, they have evolved into highly immersive and interactive experiences that can be enjoyed on a variety of platforms.

Research has shown that using commercial videogames is an effective way of mitigating symptoms of depression and anxiety.⁸ Harmonious engagement with games appears to be associated with the potential to reduce psychological distress.⁹ A study made on the impact of games has shown that a shorter duration of gameplay could lead to a reduction of stress caused by daily struggles by enabling people to connect with like-minded people.¹⁰

The lockdowns enforced during the pandemic have greatly affected the dependence on software and electronic devices. Technology has been correlated with beneficial impacts on mental health based on its usage. A study made on the use of digital technologies (web-based platforms and videoconferencing tools) showed that it holds promise in bridging the mental health care gap during and after the pandemic.¹¹ Another study highlighted its benefits due to the online communities made to support others.¹² Nevertheless, a dependence on technology can have negative repercussions on individuals. A reliance on smartphones can lead to isolation causing serious mental illnesses, including depression, anxiety but also sleep irritability, and cognitive impairment.¹³ The impacts of technology are reliant on its usage.

During the pandemic, the world has known an all-time high in videogame playing with a significant increase among young people.¹⁴ A study that examined the impact of videogames during the COVID-19 pandemic revealed a positive correlation between gameplay and the perceived well-being of individuals.¹⁵ Another study has found that videogames

are stress relief tools for children as well as adults.¹³ However, videogames can also have negative impacts based on their usage. A study made on understanding how games are used to cope with stress found that playing as an avoidance of dealing with stressors, causing a denial of their problems, was linked to more problematic outcomes.¹⁶ It was stated to be a poor coping strategy since attempting to escape from real-life issues was shown to be correlated with several negative psychosocial and physical outcomes.

Nevertheless, playing games as a distraction approach, to divert one's attention away from problems, and thus using the activity as a break, can be beneficial. The same outcome was concluded with an immersion approach meaning an involvement in the narrative of the gaming world. It was found to have emerged as a "form of self-care" to relax. Another study has mentioned the use of escapism in videogames as a way to get temporary relief from stress, not as a standalone treatment for mental health challenges. It also concluded that the avoidance mechanism to be a proposed predictor of internet gaming disorder.¹⁰

Game interface preferences

The different preferences used in videogames have been shown to affect a player's emotional response. Significant effects on emotional responses were found for the colors red and yellow. In the experiments conducted, it was found that red elicited a highly aroused, negative emotional response, and yellow elicited a positive emotional response.¹⁷ In addition, the experience of videogame players is influenced by mood congruency. The mood congruent memory effect corresponds to the fact that individuals in a positive mood tend to recall more positive content, whereas those in a negative mood have a better recall for negative content.¹⁸

Music has been demonstrated to be correlated with emotions. A study focusing on the relationship between music and emotions revealed that listening to meaningful music can result in individuals having strong sensations and feelings of sadness.¹⁹ However, both listening to meaningful and pleasurable music led to intense emotions and a willingness to connect to others. Regarding music in videogames, a recent study has shown that music enhances the sense of immersion and flow during videogame sessions.²⁰

Another relevant preference in gaming is the direction of movement. Emotional valence, being the relationship between vertical space and mood, plays a significant role in shaping player experiences. Previous research has demonstrated that positive emotions and mood are associated with upper visual space and upward body movement, while negative emotions and mood are associated with lower visual space and downward body movement.²¹ A study conducted in 2022 supported these findings and concluded a space-valence congruency effect was identified, "the valence of emotional pictures is mapped onto the vertical space."²²

Research regarding the impact of different game preferences in individuals with depressive symptoms and/or a history of mood disorders remains very limited. A recent study²³ is the only one to our knowledge linking game interfaces to individuals with depression.²³ It examines art therapy which encompasses elements such as visual artistic creation, which includes colors or shapes being linked to the expression of emotions. The study also found that game

environments accompanied by tailored soundtracks have players who self-report improved depressive symptoms.

The presence of different preferences is important for several reasons. There is a correlation between gaming preferences, including role-playing games, combat games and music genres, and personality traits such as extraversion, agreeableness, and openness.²⁴ In addition, individual preferences for game dynamics have been associated with different emotional and physiological responses. These preferences for the game dynamics include the choices users can make for player–game interactions such as building, expanding, and developing a city, a village, or a base; managing cities, villages, or castles; and designing and game levels or game worlds. This suggests that individuals' gaming experiences vary depending on their preferences.²⁵

Furthermore, a study made on personalized gamification has concluded that it improves a user's performance. Higher task performance and a better overall experience were associated with a customizable version in which users could select games, compared with a generic version.²⁶ Finally, understanding user preferences for game design elements is crucial for developing effective gamified Health Behavior Change Support Systems. The game design elements that could be preferred by users include choosing an avatar that visually represents the user, the choice of experiencing narrative events, the inclusion of goals, and the collection of points. User preferences are influenced by the level of familiarity individuals have with various game designs, which is important to consider when developing games for health.²⁷

Our project aims to create a mobile game with multiple game preferences and examine the choice of game preferences in individuals with and without depressive symptoms. This study builds on our earlier work²⁸ and aims to identify if there is a correlation between the choice of game preferences and the presence of depressive symptoms.

Methods

Game design

The game we designed and developed is called *MoodJumper*. It is developed for Android users and was created using an open-source game. The latter was modified to include the possibility to customize specific game options related to the design. The game consists of jumping to the top of the level by moving the avatar from one platform to another. The avatar gradually gains height and collects coins while going up. The player is not able to control when the jump happens and is simply responsible for navigating the avatar's direction moving it left and right. When the player reaches a certain height, flying enemies moving from side to side will appear and will need to be avoided. The first level permits the avatar to utilize the same platform three times, the second one twice and the third one only permits one jump per platform. The game ends for one of two reasons: if the avatar touches a flying enemy or if the avatar reaches the bottom of the level at any point other than the start.

F1 ► The game contains a menu screen (Fig. 1) displayed when the game is started. Once the game ends, the player is redirected to this screen. This is where users get the possibility of starting the game, looking at the high scores and instructions explaining how the game should be played. They also can choose their game preferences. This includes

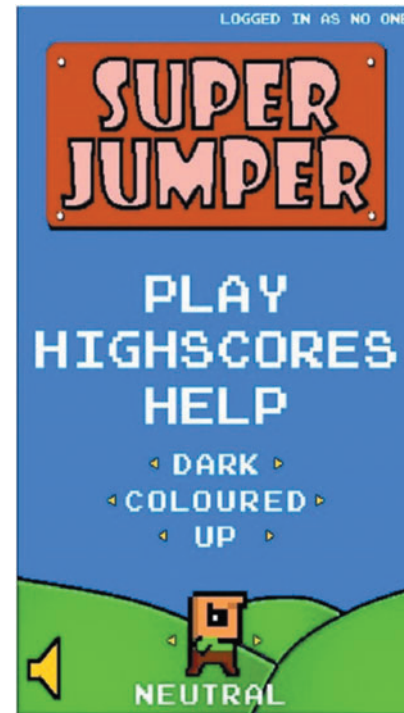


FIG. 1. Menu screen of *MoodJumper*. Color images are available online.

choosing the display options meaning getting the choice between a bright and dark display and a colored and a black and white display (Fig. 2). Users can also decide to choose between three different avatars, a man, a woman, and a gender-neutral one. Music is another option that can be toggled on or off. Finally, the last game preference that can be personalized is the direction in which the avatar jumps, which can be upward or downward.

When a game is started by the participant, the game settings along with the user ID are saved in a text file (see Fig. 3 for an example data set).

Recruitment

A pilot study was carried out with 20 participants (15 self-identified as male, 5 self-identified as female), after obtaining the appropriate "anonymized" Human Ethics committee's approval. Participation in the study was voluntary, and no inducement was offered to participants. The study commenced by providing participants with an explanation of the study's objective and requesting them to sign a standard consent form, indicating their willingness to participate. Subsequently, participants were asked to provide some personal details, including age, gender, ethnicity, and the types of games they played if any.

They were also asked to fill out a Patient Health Questionnaire-9 (PHQ-9) questionnaire,²⁹ which aimed to assess the severity of their depressive symptoms. Participants were then asked to play the game for a duration between 20 and 30 minutes. The participants played on an Android mobile screen in portrait format. Upon completing the game session, they were asked to fill out a questionnaire regarding their experience. The latter assessed their overall enjoyment of the game and solicited their preferences regarding settings

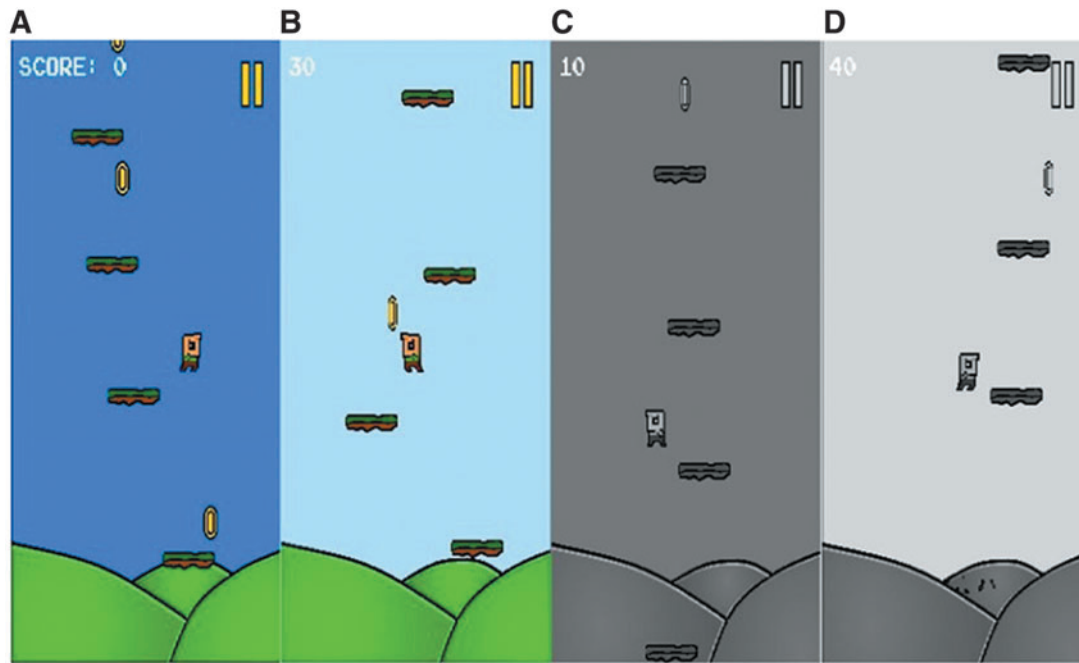


FIG. 2. Example of various layout settings. (A) Dark/colored. (B) Bright/colored. (C) Dark/black and white. (D) Bright/black and white.²³ Color images are available online.

and features. They were also asked how easily they could decide on the game preferences they found the most suitable.

All participants were university students aged between 19 and 28 years, with an average age of 24 years. The entire participant pool consisted of individuals of Chinese descent. This study provides valuable insights into this demographic group. It builds on our earlier work,²⁸ which was conducted with participants of Chinese descent. Among the 20 participants, diverse patterns of engagement with videogames were exhibited. Two participants stated not playing any type of videogames, six playing shooting games, six playing RPG and MOBA games, and the remaining six participants engaged in various other game genres (puzzles, indie games, and rhythm games).

We employed the PHQ-9 as a self-assessment tool to determine the presence of depression among the participants. The PHQ-9 questionnaire was chosen as it is widely recognized and validated as a reliable instrument for assessing depression severity in both clinical and research settings. It consists of nine items that capture various symptoms commonly associated with depression, such as feelings of sadness, loss of interest, and changes in sleep patterns. The participants were informed about several different support options available to them for mental health.

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Game Session: 4
User ID: MJ0000
App first started: Tue Jul 24 18:37:24 GMT+08:00 2018
Game Session 4 started: Tue Jul 24 18:40:41 GMT+08:00 2018
Brightness Mode: light
Color Mode: coloured
Game Score: 100
Game Time: 30
Gender: neutral
Levels Completed: 0
Direction: up
Sound: false
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```

FIG. 3. Example data of a game session.

The data collected for this study were not divided into separate groups based on depression status and were instead analyzed as one cohesive data set encompassing the entire sample. This maximized the sample size, which was beneficial in our study given the limited number of participants.

Results

Statistical analyses were conducted using SPSS version 29.0.1.0 and rStudio version 4.2.3. When analyzing sound preferences, an even distribution was observed, with 10 participants preferring to play the game with sound, and the remaining 10 without. A more distinct preference emerged when examining the movement direction feature. The majority of participants ($n=17$) preferred the upward-moving game direction, where the avatar jumped from the bottom of the screen in an upward direction, while only three participants favored the avatar moving downward. When participants were asked about their enjoyment of the game and its appeal to their visual senses, the average score given on a scale of 1 to 5 (with 5 indicating strong agreement) was 3. When participants were asked whether it was easy to choose these preferences, the average score given was 4.25.

The average PHQ-9 score was 8.15 (standard deviation [SD]=3.88). Based on the PHQ-9 self-assessment criteria, 17 participants have high depressive symptoms. Of these participants, 11 were considered to have low depressive symptoms, 5 moderate, and 1 participant had severely high depressive symptoms (Fig. 4). The depression level and PHQ-9 score were also plotted against the sex of the participants and their age (Figs. 6 and 7).

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Music preference

Ten participants preferred the music off. The participants who preferred the no music had an average PHQ-9 score of 8.8 (SD=4.49). The participants who preferred music had

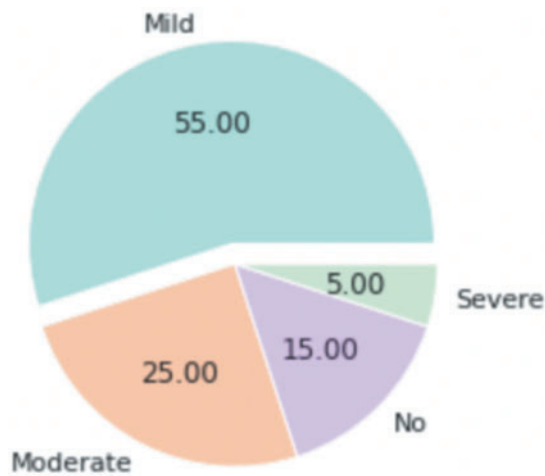


FIG. 4. Participants' depression levels. Color images are available online.

lower PHQ-9 scores on (mean [M]=7.5, SD=2.9). Despite this difference in mean PHQ-9 score, an independent *t*-test showed no significant difference between PHQ-9 scores and music preference [$t(18)=0.73, P=0.47$].

Direction of movement

There was no significant relationship between the directional movement variable (upward game movement or downward movement) and PHQ-9 scores ($r=0.13, P=0.581$). Therefore, based on this pilot study, there is insufficient evidence to support a significant relationship between these game preferences and the severity of depressive symptoms.

Color preference

Among all 20 participants, 10 expressed a preference for the light-colored layout (light and color setting activated), while 8 indicated a preference for the dark-colored layout (dark and color setting activated). Only two participants favored the combination of the light and black and white settings activated. No participants chose the dark black and white option.

When analyzing the relationship between color preferences and depression, participants who preferred white had higher PHQ-9 scores on average (M=8.4, SD=4.91) than those who preferred black and white (M=7.5, SD=3.53) and dark colors (M=8, SD=2.67) (Fig. 8).

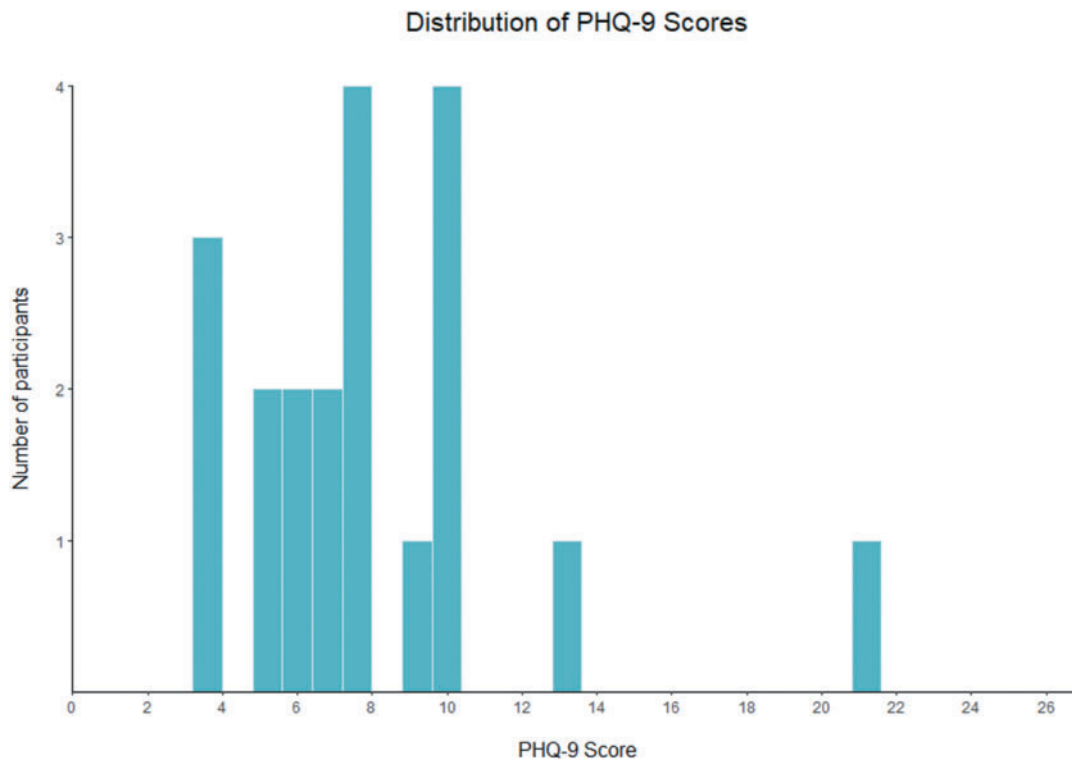
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Game preference decisions

At the end of the study, participants were asked to rate the statement "I easily decided which setting I preferred more" on a scale of 1 to 5, with 5 indicating strong agreement. This was used to assess the ease of decision-making regarding their preferred setting. The analysis examining the relationship between the ability to decide on the game preferences preferred and PHQ-9 scores yielded a significant negative correlation ($r=-0.56, P=0.01$). These findings may suggest that individuals with more severe depressive symptoms may struggle with decision-making.

Discussion

We used *MoodJumper* to evaluate the relationship between game preferences chosen and depressive symptoms. To the best of our knowledge, evaluating different game settings in users with and without depressive symptoms has not previously been conducted in detail. Given the surge in



AU13 ▶ FIG. 5. Distribution of PHQ-9 scores. PHQ-9, Patient Health Questionnaire-9. Color images are available online.

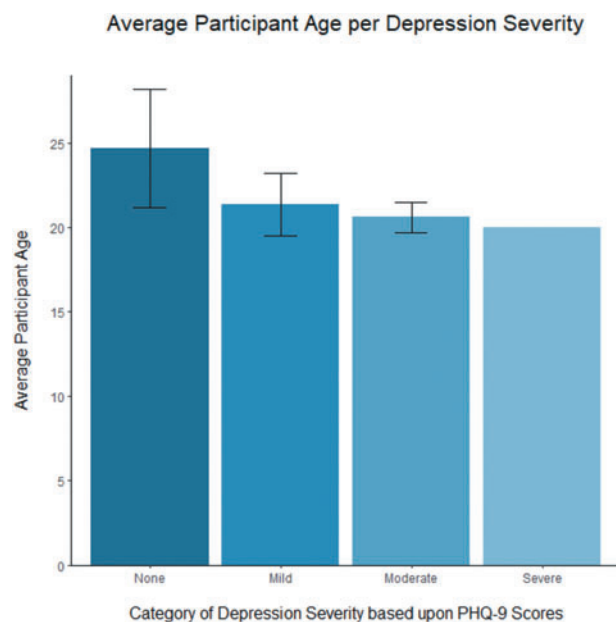


FIG. 6. Depression levels by age with 95% confidence intervals. Color images are available online.

the demand for mental health services following the measures enacted during the pandemic and the popularity of videogames, it is essential to investigate the impact of user preferences on gamification within the health industry. Based on the initial findings, it was observed that 18 of all 20 participants preferred the colored layout, with 10 specifically favoring the light-colored setting. The preference for background music was evenly divided. The majority of participants (17/20) indicated a preference for upward movement.

No statistically significant differences were observed based on the PHQ-9 score and the preferences chosen. These

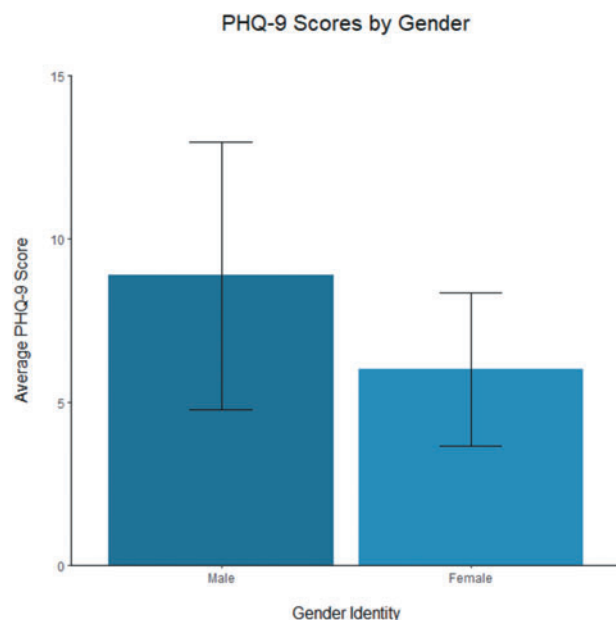


FIG. 7. PHQ-9 score by sex with 95% confidence intervals. Color images are available online.

results indicate that user preferences are not influenced by whether a user has depressive symptoms. However, a statistically significant correlation was discovered between the PHQ-9 score and a participant's ability to make decisions regarding their preferences. Participants who had a higher PHQ-9 score (meaning more severe depressive symptoms) are more likely to struggle choosing the preferences favored. It is supported by a study suggesting that using executive functioning assessments in clinics could help identify individuals with cognitive weaknesses meaning those with a higher PHQ-9 score.³⁰ In addition, this is also supported by earlier research that found that manic and depressed patients experience cognitive and executive functioning impairments.

This study serves as a significant step in understanding the relationship between user preferences and individuals with depressive symptoms, which is crucial to creating targeted game experiences that enhance well-being and promote effective therapeutic experiences.³¹

Limitations

The limitations imposed by our small sample size need to be considered when interpreting the results. Due to the small sample size, the statistical power of our analysis may have been reduced, potentially impacting our ability to detect significant relationships accurately. However, given this is a pilot study, the significant results yielded from this smaller sample emphasize the need for further research in this area.

In addition, the sample used lacks diversity. Most people are familiar with videogames; all participants were from the same ethnicity and are all university students. Furthermore, there was only 1 participant who met the criteria for having high depressive symptoms and 17 of participants for having mild symptoms. However, the National Study of Mental Health and Wellbeing conducted in 2021 found that one in five (equivalent to 21% of Australians) aged 16–85 years experienced a mental disorder in the previous 12 months.³² The sample is not representative of the current population. Consequently, caution should be exercised when generalizing our findings to the larger population.

It is also important to acknowledge the limited range of options available for preference assessment, which was primarily restricted to binary choices. Moreover, the interface of the *MoodJumper* game differs from modern standards seen in newer game releases and that could have affected the results. The discrepancy in design could have resulted in reduced user engagement and diminished interest in actively participating in the game.

Future work

Future research should focus on enhancing the user interface of the game by incorporating design principles aligned with Nielsen's heuristics. More options relating to game preferences including the personalization of music genre and different color themes and palettes could result in more reliable results and a more comprehensive understanding of the potential relationship between of game preferences and mental health status. In addition, a larger study with a bigger and more diverse sample including people clinically diagnosed with a disorder rather than self-reported cause increased the reliability of the results found.

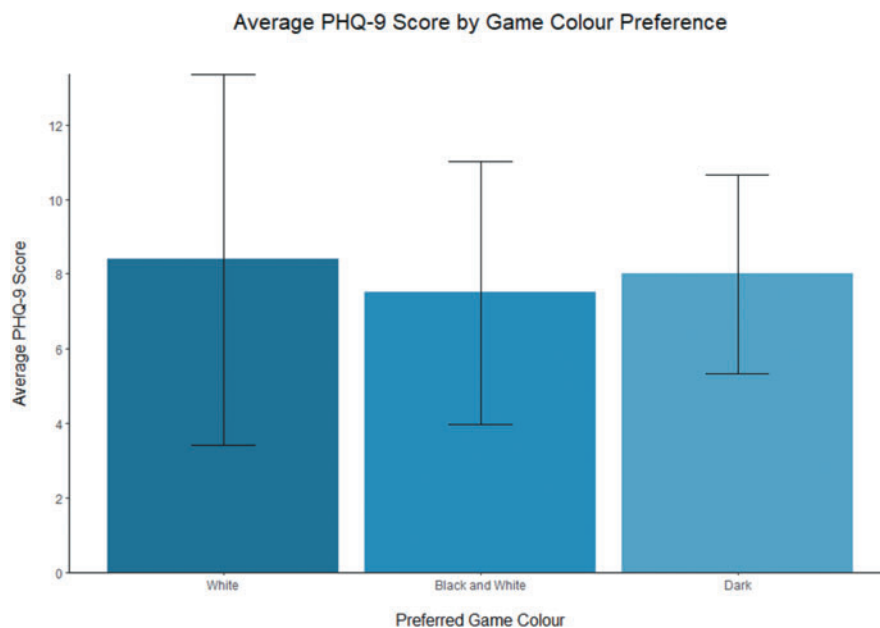


FIG. 8. Average PHQ-9 score by game color. *Note:* Error bars show standard deviation. Color images are available online.

A future direction should also involve investigating the relationship between decision-making abilities related to game preferences and mental health indicators, particularly in individuals experiencing depressive symptoms. This would allow the understanding of these individuals being possibly more prone to specific types of decision-making errors.

Finally, further research must prioritize the exploration of codesign since it is crucial for the personalization of games. By involving users in the design process, game options would be tailored to their specific preferences and needs. Examining factors such as game performance and enjoyment when given the option to select preferences and comparing them to when presented with generic options could shed light on the potential benefits of personalized games for people with depressive symptoms. We believe this contribution paves the way for designing, developing, and clinically evaluating fully fledged games for people with depression.

Authors' Contributions

All authors have made scientific contributions to this work with the first two authors having contributed the most.

Data Availability

The data sets are available upon request to the corresponding author.

Author Disclosure Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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