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## RESEARCH ARTICLE

# FROM KILLING TO LIVING: VIDEO GAMES, GENRES, AND THEIR EFFECTS ON ANXIETY

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**ABSTRACT**

Commercial-off-the-shelf (COTS) video games are easily accessible and widely used. Yet, there is limited literature about the effects these video games have on the anxiety levels of a general population of adults. With an increase in online presence and an advancement in technology, these video games have the potential to be used in mental healthcare settings, reducing cost, and increasing access. Aims: This study aims to investigate whether COTS video games have a measurable effect on the anxiety levels of young adults. It also probes if the genre of video games played make a difference to the kind of effect they have on anxiety. Methods: Participants (n=41) were split into two groups at random, with Group A (n=21) playing an action game and Group B (n=20) playing a non-action game. Each participant played the video game for an hour. A state anxiety test was administered before and after the gameplay. The difference between these scores for each participant was calculated as impact scores. This quantitative data was analyzed by through statistical testing using t-tests and correlation analysis. Results: For both participants with positive and negative change, the paired samples t-test results (Positive: $t19=7.109$, $p<0.01$; Negative: $t20=-6.415$, $p<0.01$) indicated a significant change in anxiety scores. The difference between the impact scores of Groups A and B was found to be not significant. Further, a negative correlation was found between pre-test scores and impact scores. Conclusion: COTS video games have a significant effect on the anxiety levels of young adults, irrespective of genre.



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# INTRODUCTION

Video games are an integral part of the modern-day lifestyle for many individuals. Consumers of videogames are not just young males, as is popularly believed; but in fact, in the United States, the average gamer is 34 years old and 41% of gamers are female (1) These videogame players (gamers) also account for huge proportions of spending on video games, contributing to a large-scale video-game industry valued at over US$174 billion, with China and North America being market leaders (2). With such a large presence and ever-increasing consumption, research into health implications of video games seems vital.

**Types of Games:** For a clearer understanding of the field, it is useful to differentiate between serious games and commercial-off-the-shelf games. Serious games are specialized games used specifically for purposes other than mere entertainment. They are developed in line with their primary objective which is something other than leisure and recreation: they often implement game-based learning in order to facilitate learning or behavioral change (3–5). An example of a serious game would be SPARX, developed to be a computerized Cognitive Behavioral Therapy-based digital intervention for adolescents seeking help (6) And while this intervention was found to be effective as an alternative form of treatment (Fleming *et al*., 2016; Li, Theng, & Foo, 2014), one of the major challenges it faced in gaining acceptance was its relatively old design in terms of graphics, language and interface; as well as lack of modern functions like multiplayer modes and customisation to the degree games today offer. To address these issues, a major overhaul would be required frequently, thereby exponentially increasing the cost of game development and maintenance (Iacovides *et al*., 2017). In contrast, commercial off-the-shelf (COTS) video games, also referred to as digital commercial games (eg., Panoutsopoulos & Sampson, 2012), are specifically designed for entertainment as their primary or sole

purpose – with no consideration for their therapeutic effects factoring into their design process (Colder Carras *et al.*, 2018a). Research into COTS games is still emerging, especially in the field of mental health, for use of video games as therapy (VGTx). For example, one of the more popularly studied video games is the Grand Theft Auto franchise, which has often been the centre of attention for both academic discussion and public discourse because of its graphic details of violence and overall aggressive character, as well as its seeming relationship with gun violence in American schools (Ferguson, 2008). COTS video games are usually more widely accessible and/or available to the general public because they are part of a large multi-million-dollar industry, they also have the market penetration as well as technological sophistication that serious games do not have. Thus, COTS videogames are the focus of this study.

**Current Research:** In the context of mental health, research into video games is usually focused on negative outcomes and potential for harm. This includes studies on Internet Gaming Disorder (IGD) (e.g., Kuss, Pontes, & Griffiths, 2018), videogame addiction and impact on sleep (e.g., Turel, Romashkin, & Morrison, 2016), increased aggressiveness (e.g., Hull, Brunelle, Prescott, & Sargent, 2014) and other impacts that may be medical or psychosocial (eg., Wood, Griffiths, Chappell, & Davies, 2004). Gaming Disorder, for both online and offline games, is now classified as a mental health disorder due to addictive behaviour in the International Classification of Diseases – 11th Revision (World Health Organization, 2018). This recent classification draws a lack of consensus within academic circles about the attribution of problematic video-gaming behavior as a disorder, due to overreliance on substance abuse and gambling as criteria for understanding such behaviors, as well as a low quality research base (Aarseth *et al.*, 2017). Furthermore, with an ever-increasing presence of Virtual Reality and Augmented Reality use in video games, other physiological problems may arise. For instance, Merhi, Faugloire, Flanagan, and Stoffregen (2007) investigated the nauseogenic (i.e. nausea inducing) properties of such gaming systems and found that these could induce motion sickness. While the importance of such research is acknowledged, it suffers from a tunnel vision in the types of effects picked out by the researchers to study – these are rather underrepresented by research into positive effects of video games, thereby creating a need for a more balanced point of view. Such a need for an impartial perspective has been identified by multiple researchers (Colder Carras *et al.*, 2018a; Granic, Lobel, & Engels, 2014). In recent times, however, this trend is changing, with videogames also being studied for their potential benefits - although these studies are far and few. One noteworthy systematic review by (8) did find that COTS videogames have a potential for treating anxiety, depression, stress, and low mood, however this study too found only limited research in the field. Specifically, primary research in this area is very limited. Aside from the general therapeutic potential of such games, one motivating factor for this research is the implementation of these games in specific settings, such as to be used as mobile app-based health (mHealth) or online web-based health (eHealth) tools for cheap and effective intervention in a world of ever-increasing healthcare costs. For instance, their use as a tool of distraction has been demonstrated in paediatric cases, such as their effectiveness in controlling conditioned nausea in children being treated through chemotherapy (Redd *et al.*, 1987), as well as in reduction of preoperative anxiety (Patel *et al.*, 2006).

**Study Aims and Research Questions:** From a comprehensive review of literature, the researchers found a significant gap in knowledge in scientific data available about the effect of COTS videogames on anxiety, especially to investigate if there is a possibility of therapeutic use of COTS video games for treatment of anxiety. Integration of real life elements into games and customization of various aspects of such games allows for a potentially lower cost solution to therapeutic use of COTS video games, compared to serious games that require expensive development and specialised equipment or platforms (Griffiths, Kuss, & Gortari, 2017). Two important questions thus remain: RQ1. Do COTS video games have a measurable effect on the anxiety levels of young adults? And, RQ2. Does the genre of video games played make a difference to the kind of effect they have?

As discussed previously, the most significant research that looks at RQ1 does not measure the change in anxiety levels, if any. Using a pretest-postest design, this study aims to measure this change so as to develop and understand of how significant this effect is. And because there is no research that could be identified within the past 20 years that accounts for the difference of genre, it was thought to be imperative to also investigate the change in anxiety and its link with the game's genre, especially in the context of video games that are deemed aggressive, and hereafter referred to as action games.

**Based on these factors, this study has two hypotheses:**

**H1.** There will be a statistically significant change in post-test state-anxiety levels. It is hypothesized that if patterns of findings in earlier studies of a similar nature are to be followed, then this study will find that video games will have an effect on the anxiety levels of individuals – which will be measured by the difference in pre-test and post-test scores. The primary null hypothesis thus becomes 'there is no statistically significant change in post-test state-anxiety levels.'

**H2.** There is a statistically significant difference in measured change of state-anxiety between different genres. The secondary hypothesis of this study is that there will be a difference the in the change in anxiety scores based on the genre of game played – this difference may be in terms of intensity, i.e. higher degree of change in one group versus the other, or in terms of direction, i.e. the change in one group may be a positive one whereas in another group may be a negative one. The secondary null hypothesis thus becomes 'there is no statistically significant difference in measured change of state-anxiety between different genres.'

## METHODS

**Participants:** This experimental study used convenience sampling methods to recruit 41 young adults, living in or around the city of Edinburgh. With the lack of a sampling frame, non-random sampling was used. Majority of the participants were female (n=25, 61%), followed by 36.6% men (n=15) and 2.4% identifying as neither (n=1). 14.6% participants (n=6) identified as non-heterosexual. The ethnic background of 43.9% participants was White (n=18), 29.2% was Asian – including Asian Scottish or Asian British (n=12) and 24.4% participants identified as African or Black (n=3), mixed ethnic groups (n=5), or other ethnic groups (n=2); while one participant chose not to disclose ethnicity data. The age range of participants was between 18 and 35 years at the time

of signing the consent form, with the mean age being M=24.76 (SD=3.51).

***Inclusion Criteria:***

Individuals Between 18-35 years of age, 2. Individuals fluent in English.

**Exclusion Criteria:** individuals who had Intellectual disability or physical limitations that precluded the use of the computer program or had a history of seizures upon exposure to flashing lights on screen. Applicants were screened for these through the sign-up form before being accepted into the study.

**Design:** The participants were allocated randomly into two groups - Group A (n=21) was to play Game A, an action-adventure game, whereas Group B (n=20) was to play a nonaction game. Demographic information collected included questions about gender, age, sexual orientation, ethnicity and video gameplay habits. To establish a baseline measure of anxiety for each participant, the Generalized Anxiety Disorder-7 (GAD-7) (Spitzer *et al*., 2006) was used. The GAD-7 uses criteria for the diagnosis of generalized anxiety disorder from the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (Spitzer *et al*., 2006) in order to determine the severity of anxiety based on the responses. The scale has been found to be reliable and valid for use with a general population of adults (Löwe *et al*., 2008). Its internal consistency is affirmed by a Cronbach's alpha of α=0.9. To measure the state anxiety of the participant before and after the gameplay, the State-Trait Anxiety Inventory (STAI) Form Y1 was administered both pre and post-test. The STAI consists of two parts, Y1 and Y2 – Y1 measures State Anxiety (how an individual feels at the moment) and Y2 measures trait anxiety (how an individual generally feels) (Charles Donald Spielberger *et al*., 1970). Since the measure was only needed for measuring state anxiety, Y2 was not used in the study. The state-anxiety measurement of the STAI has been found to demonstrate internal consistency and is considered reliable (Kendall, Finch Jr, Auerbach, Hooke, & Mikulka, 1976). For the age-range of 19 – 39, the state anxiety test has a Cronbach's alpha of α=0.92 (Charles Donald Spielberger *et al*., 1970). Furthermore, the GAD-7 was chosen for measuring trait anxiety over the STAI because the trait-anxiety section of the STAI has relatively poor validity, particularly for differentiation of anxious from depressed states (Julian, 2011). In contrast, the GAD-7 is accurate for identifying generalized anxiety disorder which is characterized by trait anxiety.

# MATERIALS

The video games were played on an Apple iPad Pro device, running iOS 11. A mobile device was chosen for the study instead of a gaming console, because mobile devices are most commonly used for playing video games, ahead of consoles or personal computers (Ofcom, 2017). The experiment was conducted in a controlled environment with minimal interaction with other individuals during the hour of gameplay, so as to reduce confounding variables. The video games used were as follows: Game A – Assassin's Creed: marketed by publisher Ubisoft as an "Action Role Playing Game", and Game S – The Sims Freeplay: marketed by publisher Electronic Arts as a Simulation game (Apple, 2018a, 2018b). Game A was used as the actiongame in this study, and it involves the player taking up the role of an assassin in and around medieval Europe. The game follows a storyline with missions that players complete in order to progress. These missions often include the performance of violent or aggressive acts on part of the player's character. Game S was used as the non-action game in this study, and it involves the player creating one or more characters to play the game with, building their house, and instructing these characters to lead a life that closely resembles modern lifestyle, with goals such as getting a job, making friends, cooking food and so forth. Each game had a short tutorial in the beginning, so as to ensure participants were able to familiarize themselves with the game and equipment that they were playing on.

**Statistical Analysis:** Quantitative analysis was conducted using SPSS version 22 (IBM Corp., 2013). Primary analysis included a check for missing data, and The Shapiro Wilk test for normality was performed on the data. The Shapiro Wilk test was chosen as more appropriate for the size of data being analysed as the sample size is under 1000 and the Shapiro Wilk test is more sensitive for smaller samples (Yap & Sim, 2011). Primary analysis indicated that there was no missing data in the collected dataset. For the first part of the analysis, the pre-test and post-test STAI results of all participants (from both Group A and B) were calculated. Upon visual inspection of data, it was apparent that the change in some participants was positive, while in others was negative.

Thus, the difference between these scores was calculated, and the data were grouped into two sets – items where the difference was positive and items where the difference was negative. A Paired Samples t-test was chosen for analysis, since in this case the difference being measured was between two groups of paired measures rather than two separate samples, i.e. for each case the two scores (pre and post) were from the same participant. The paired samples t-test was conducted to test for the first hypothesis of this study, which is "There will be a statistically significant change in post-test anxiety levels." For the second part of the analysis, an independent samples t-test was performed on the data, since the two samples were separate from each other – Group A consisted of subjects who played Game A, whereas Group B consisted of subjects who played Game S. This was conducted after a Levene's test to check if the assumption for equal variances could be met. For the purpose of the test, the test hypothesis used was X1: $\mu 1 = \mu 2$ ("the two population means - i.e. of Game A and Game S - are equal") and the null hypothesis was X0: $\mu 1 \neq \mu 2$ ("the two population means - i.e. of Game A and Game S - are not equal"). The results of this statistical test of difference were used to test the second hypothesis of the study, 'There is no statistically significant difference in the effect of video games on anxiety between different genres.' Finally, correlations were run to investigate how demographic variables related to the outcome measures (i.e., impact of video games on state anxiety scores).

# RESULTS

The analysis of the data was performed by conducting a paired samples t-test on the data to investigate the primary hypothesis and an independent samples t-test to investigate the secondary hypothesis. Correlations between variables were also analysed for a more comprehensive understanding of the data.

**Table 1. Shapiro-Wilk Test of Normality Scores**

| | Statistic | df | Sig. |
|---|---|---|---|
| Impact Scores | .979 | 41 | .635 |
| Post Score | .978 | 41 | .590 |
| Pre Score | .977 | 41 | .574 |

**Table 2. Results of Paired Samples Test**

| | | Positive Change | Negative Change |
|---|---|---|---|
| Mean | | 8.650 | -8.667 |
| Std. Deviation | | 5.441 | 6.191 |
| Std. Error Mean | | 1.217 | 1.351 |
| Lower | 95% Confidence Interval of the | 6.103 | -11.485 |
| Upper | Difference | 11.197 | -5.848 |
| t = | | 7.109 | -6.415 |
| df = | | 19 | 20 |
| p = | | .000* | .000* |

**Table 3. Results of the Independent Samples t-Test**

| | | |
|---|---|---|
| Levene's Test | F | 0.572 |
| | Sig | 0.454 |
| t-test for Equality of Means | t | -0.335 |
| | df | 39 |
| | Sig (2 Tailed) | 0.739 |
| | Mean Difference | -1.1119 |
| | Std Error Difference | 3.3143 |
| | Lower 95% Confidence | -7.8156 |
| | Upper Interval of the | 5.5918 |
| | Difference | |

**Table 4. Results of Paired Samples Test Results of Correlation Analyses**

| | | | Impact Score | Pre Score |
|---|---|---|---|---|
| Game A | Impact Score | Pearson Correlation | 1 | -0.786 |
| | | Sig. (2-tailed) | | <0.001 |
| | | N | 21 | |
| | Pre Score | Pearson Correlation | -0.786 | 1 |
| | | Sig. (2-tailed) | <0.001 | |
| | | N | 21 | 21 |
| Game S | Impact Score | Pearson Correlation | 1 | -0.474 |
| | | Sig. (2-tailed) | | 0.035 |
| | | N | 20 | 20 |
| | Pre Score | Pearson Correlation | -0.474 | 1 |
| | | Sig. (2-tailed) | 0.035 | |
| | | N | 20 | 20 |
| | | | GAD7 Score | Impact Score |
| Game A | GAD7 Score | Pearson Correlation | 1 | -0.319 |
| | | Sig. (2-tailed) | | 0.159 |
| | | N | 21 | 21 |
| | Impact Score | Pearson Correlation | -0.319 | 1 |
| | | Sig. (2-tailed) | 0.159 | |
| | | N | 21 | 21 |
| Game S | GAD7 Score | Pearson Correlation | 1 | 0.136 |
| | | Sig. (2-tailed) | | 0.567 |
| | | N | 20 | 20 |
| | Impact Score | Pearson Correlation | 0.136 | 1 |
| | | Sig. (2-tailed) | 0.567 | |
| | | N | 20 | 20 |

Preliminary descriptive analysis indicated that the mean of the difference between impact scores: i.e. pre-test score subtracted from post-test scores; was found to be M = - 0.22, for n=41 participants. The impact scores ranged from -24 to +18, with a standard deviation of SD = 10.49. As the change was in both directions, the data was split by the direction of change before the paired-samples t-test was performed on the data.

**Table 5. Correlation of Impact Scores**

| | | Difference | GAD7 Score |
|---|---|---|---|
| Difference | Pearson Correlation | 1 | -0.119 |
| | Sig. (2-tailed) | | 0.458 |
| | N | 41 | 41 |
| GAD7 Score | Pearson Correlation | -0.119 | 1 |
| | Sig. (2-tailed) | 0.458 | |
| | N | 41 | 41 |

The Shapiro Wilk test for normality indicated that the data was normally distributed (Table 1). Results of the Paired samples t-test (Table 2) indicated that for the group with positive change, the result was $t19=7.109$, $p<0.01$, suggesting the change in state anxiety test scores was significant. For the group with negative change, the results: $t20=-6.415$, $p<0.01$; indicated that once again, the change in state anxiety test scores was significant. Based on these two results it was concluded that in both directions of change, the impact of the video game, as measured by the change in anxiety scores, was significant. Thus, the null hypothesis was rejected in favor of H1 – There is a statistically significant change in post-test anxiety levels. An independent samples t-test was administered on the data, grouped by the game played. The Levene's test result, $p>0.05$, indicated that equal variances could be assumed. The t-test result was $t39 = -0.335$; $p=0.454$, with mean difference between the impact scores of the two games being -1.1 (See Table 3). Based on the assumption of variance and the aforementioned result, the difference was deemed not significant because $p<0.05$. Therefore, the secondary hypothesis H2 was rejected in favour of the null hypothesis, thus finding no statistically significant difference in measured change of state-anxiety scores between the two genres of games played. Finally, correlation analysis was run on the GAD Scores and Impact Scores, and pre-test STAI Scores and Impact Scores to understand the correlation between anxiety scores and impact scores. Results, as reported in Table 4, indicate that between impact scores and pre-test scores, there is a correlation of -0.786 for Game A and -0.474 for Game S. Both of these correlations are negative and significant. For Game A, the correlation was significant at 0.01 level (and therefore also at 0.05 level) and for Game S, the correlation was significant at the 0.05 level. Between impact scores and GAD scores, a correlation of -0.319 was found for Game A and 0.136 for Game S. Neither of these were significant at the conventional cut-off point of 0.05.

# DISCUSSION

Results of the paired samples t-test indicate that while the direction of change in anxiety scores may be positive or negative, there is indeed a statistically significant difference in the levels of state anxiety after an hour of gameplay. These lead to a decisive answer to the first research question: COTS video games do in fact have a measurable effect on the anxiety levels of young adults. This result is consistent with the findings of Schoneveld *et al.* (2016) which indicated a decrease in anxiety levels in the case of 3rd to 6th grade children playing a serious game for a total of five hours across more than two weeks. The result of this study adds to their findings by demonstrating that changes in state anxiety do occur playing a video game, in young adults. Further, it may be inferred from these results that the duration of playing games does not need to be long; and that as little as an hour of gameplay can have a significant effect.

The independent samples t-test was performed to evaluate whether a statistically significant difference would exist in measured change of state-anxiety (impact scores) between different genres of video games. The results of the t-test indicate that there is no significant difference in the change of state anxiety between genres, that is, action video games and non-action video games. However, while attempting to interpret the results in the context of the second research question, it is worth noting that the mean of impact scores for Game A is -0.762, which indicates a marginal reduction in state anxiety levels after playing an action game. This is an interesting comparison to studies of video games and aggression that have found action-games with violent themes to increase aggression (Ferguson, 2008; Olson *et al*., 2009; Weber, Ritterfeld, & Mathiak, 2006). Therefore, the genre of video games played does indicate a marginal difference to the kind of effect they have on anxiety – Game A having a negative change and Game S having a positive one – but these are not statistically significant enough to be conclusive and necessitate further investigation. Yet, it can also be argued that a lack of difference between the two genres of games is coherent with the findings of Schoneveld *et al*. (2016), who also failed to find a difference between two dissimilar types of video games (A serious game and a COTS game) in the impact on anxiety. This also brings into question the popular assertion that playing aggressive video games leads to an increase in anxiety levels when compared with non-aggressive video games (Anderson & Ford, 1986; Gentile & Anderson, 2003).

Finally, the results of correlational analyses also indicate a few more striking findings. First, there is a direct correlation between the impact of video games and the level of state anxiety a person is experiencing (as indicated by pre-test scores). State Anxiety scores before gameplay and Impact scores correlated at 0.78 for Game A and 0.47 for Game S, both of which are significant correlations. This implies that if an individual is feeling anxious before playing a video game, then the impact is greater, and if they are feeling relatively less anxious, then impact is low. Further, the same correlation does not hold true for trait anxiety scores (as measured by the GAD 7) and impact scores – illustrating that this relationship is only visible in case of state-anxiety (See Table 5).

## Limitations

One limitation of this study is that the population set was not geographically diverse. All participants were based in the city of Edinburgh when the study took place. It is contended that results may have been influenced by factors such as slow internet speeds, lack of constant supplied electricity and extreme temperatures. Such factors are realistic conditions in most of the developing world (Akamai, 2017; Winkler *et al*., 2011). Another limitation of the study is that it uses self-report methods to collect data on state-anxiety. While this method is cost effective and a prevalent method of conducting psychological research, it has drawbacks such as conscious or unconscious bias on part of the respondent that may distort the responses and data (Baldwin, 1999). The results of this study would have been even more reliable if changes in electroencephalography (EEG) and heart rate variability (HRV) had been measured.

**Implications for Policy and Research:** This study has straightforward implications on theory and literature. Not only has a gap in literature in this area been identified but calls for scientific research into video games as therapy have increasingly been made in recent years (Baranowski *et al*., 2015; Colder Carras *et al*., 2018a). This study uses a structured methodology and standardised, reliable tests to measure the effects of COTS video games on anxiety, thereby adding a new insight into the literature available on this relationship and uncovering insights that will help shape the understanding of any potential video game-based therapy for anxiety. But the implications of this study are not simply limited to theory. In practice, the implications are twofold: in the area of Video Game Therapy and in the understanding of clients.

***Video Game Therapy:*** Baranowski *et al*. (2016) identify numerous stakeholders of videogame based therapy: including players, retailers and gaming companies, policy makers as well as organizational implementers such as national healthcare providers. This researcher contends that all of these stakeholders are affected by this research and further research along this line of inquiry. Amidst rising costs as well as demands for better mental healthcare, video game therapy can help reduce the financial burden on mental healthcare providers. Specifically, those related to the development of mental healthcare infrastructure and equipment. In 2005, an average of $6,475 was spent on medical costs for each patient diagnosed with any anxiety disorder (Marciniak *et al*., 2005). In England, the cost of services provided for anxiety disorders was estimated to be £1.2 billion, which has been projected to go up to £2 billion by 2026 (McCrone, Dhanasiri, Patel, Knapp, & Lawton-Smith, 2008). Video game-based therapy would offer a low-cost alternative that is easy to disseminate. Indeed, serious games such as SPARX and Mindlight have been developed keeping this very idea in mind (Fleming *et al*., 2016; Merry *et al*., 2012). But the cost of developing a video-game is quite significant, especially if it is also kept up to date so as to stay relevant in the fast-changing world of technology. So instead of budgeting for dedicated development of video games, games that have already been developed and are in popular use can be incorporated in treatment plans – thereby not only reducing costs of development of games, but also of servicing patients and expanding infrastructure for the same.

***Understanding the client:*** The findings of this study suggest that video gaming habits have a correlation with an individual's state anxiety. This can in-turn have impact on other aspects of the individual's lifestyle as well as mental and physical health, and wellbeing. Therefore, as part of designing a client's therapy package, therapists can use information about an individual's gaming habits to understand their condition better. On a larger scale, as 'big-data' accumulated through gameplay can also aid in the understanding overall patterns of video-game use and how to better manage video gaming habits so that they aid the betterment of mental health and are not detrimental to it. Big-data is defined as large scale datasets that are collected from large groups of individuals that are usually users of a particular web-based app or service, and such data is used for the development of artificial intelligence as well as creation of algorithms that may be used to identify patterns of behaviour and customize applications based on the same (Conway & O'Connor, 2016; Mohr, Burns, Schueller, Clarke, & Klinkman, 2013). Mohr *et al*. (2013) suggest the harnessing of big data acquired from web and mobile based applications to personalize and customise electronic behavioural intervention techniques. Taking this a step further, it can also be argued that big data can be used to create an optimal gaming habit for each individual. As exhibited by the results of this study, different individuals are affected differently by video games. Therefore, an optimal gaming

habit that is personalised for the individual by accounting for exposure time, genre and state-anxiety levels at which the game must ideally be played, will be useful in bringing out the positive influences of video gaming. Such a customised gaming habit plan can be incorporated in the individual's daily routine for a balanced and healthy lifestyle. This is much like a balanced diet and exercise are included for wellbeing (Jacka *et al*., 2011; Stathopoulou, Powers, Berry, Smits, & Otto, 2006). Thus, policies on preventive healthcare may also benefit from using such techniques.

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**Glossary of Abbreviations**

| Abbreviation | Explanation |
|---|---|
| COTS | Commercial: Off-The-Shelf |
| GAD | Generalized Anxiety Disorder |
| APA | American Psychological Association |
| SD | Standard Deviation |

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