Tetris: A Next Generation Stress buster?

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Abstract

This study was intended to test the effect of Tetris as an intervention for severe but sub-clinical life stress in young adults. Tetris has been indicated to be useful in many clinical populations, particularly having potential in reducing the occurrence of intrusive recollections in PTSD; and the mechanism it has been hypothesised to work on has cognitive and neurological connections to the experience of stress. Method: Tetris was administered as an intervention on a young adult population (30 males, 30 females between 18-20 years) in India, who had a minimum score of 16 as measured by the Perceived Stress Scale. The design used was a single group pre-test post-test method, where PSS scores were compared. Results: There was a significant reduction in the mean perceived stress levels of the group post intervention, and a significantly greater reduction in perceived stress among women as compared to men, respectively. The effect size score computed (0.759) for reduction in stress levels indicated that the use of Tetris has a high practical significance.

Conclusion: Tetris was found useful in controlling perceived stress; and can be a highly relevant intervention for the tech-savvy generation of young adults who spend a considerable amount of their time on their smart-gadgets. Its implications are that any comparable visuo-spatially oriented task could potentially be useful in controlling stress, and that technology can potentially be the next step in administering clinical interventions.

Introduction

Stress is defined as “the pattern of specific and nonspecific responses an organism makes to stimulus events that disturb its equilibrium and tax or exceed its ability to cope” (Gerrig, & Zimbardo, 2002). A moderate level of normal everyday stress lasting over a prolonged period of time can also lead to an exhaustion of bodily and mental coping resources.

The experience of stress negatively influences the working memory, because it reduces the level of brain-derived neurotrophic factor (BDNF) in the prefrontal cortex (van Donkelaar et al, 2009), which is a neurotransmitter that plays a major role in the functioning of the working memory (Galloway, Woo and Lu, 2008). Oei, Everaerd, Elzinga, Van Well and Bermond (2006) also showed that high levels of psychosocial stress, that caused the release of cortisol, greatly impaired the efficiency of the working memory. Therefore, to fight the effect of stress at a neurological level, a cognition-based intervention that affects the working memory could be considered.

Video games in general have already been found useful in stress management. It was proven that playing casual video games (CVG’s) could help to better mood and reduce stress, with participants also reported that they preferred playing CVG’s since they are easy to play and bring out spontaneous action from the participants (Russonio, O’Brien & Parks, 2009). Another research conducted in 2007 by Dandeneau, Baldwin, Baccus, Sakellaropoulos, and Proussner at McGill University reports how playing a testing simulation similar to a video game, that the researchers designed to implicitly train people to help develop their social skills and respond effectively to social threats, can bring down cortisol (the stress hormone) levels upto 17%.

Tetris is one such video game that has a lot of implications for research and intervention. Developed by Russian programmer Alexey Pajitnov, it is a casual video game, and its objective is to
manipulate falling tetrominos in space such that, as they fall, they fit into each other at the bottom of the screen. This requires the use of one’s visuo-spatial skills.

Tetris has been found useful in helping patients with retrograde amnesia (Stickgold et al., 2000). It has also been proven to reduce cravings in addicts, as it (hypothetically) uses up the visuo-spatial part of the working memory and creates a load on it, such that at the time the brain cannot produce images of the addictive substance, thus decreasing cravings (Skorka-Brown, Andrade & May, 2014). But most relevant to this present study is the work done on the use of Tetris in people with post-traumatic stress disorder or PTSD, wherein gameplay helped restrict the intrusion of traumatic images in to the conscious mind. (Holmes, James, Coode-Bate & Deeprose, 2009).

From another perspective, playing video games have been shown to release dopamine from the striatal area (Koepp et al, 1998). Therefore it is a pleasure inducing activity that activates the mesolimbic reward pathway, in the same way that any other endogenous activity like exercise or risky behaviour does. Dopamine releasing activities are known to mediate the effects of stress at a neurobiological level (Esch and Stefano, 2010). Exercise also stimulates release of BDNF (as cited in Esch & Stefano, 2010).Therefore if video games, in this case Tetris, affect the brain chemistry in the same manner as an endogenous process like exercise, it is possible that playing these games can also result in the release of BDNF and dopamine, thus decreasing the effects of stress.

Hence, this researcher proposed Tetris as an intervention technique that could relieve stress from both these perspectives. Video gaming as an intervention for stress could activate the reward pathways and increase the BDNF levels, which would positively affect the working memory. It could also occupy the working memory with an alternative, a task that creates a healthier cognitive load that does not have the psychological and emotional burden created by stressful situations.

A factor that could possibly affect the effectiveness of Tetris is gender. The factor of gender related evolutionary distinctions in spatial abilities have been extensively researched. On an average, men have better spatial skills, which include the ability for quick and correct mental rotation and orientation (Geary, Saults, Liu, & Hoard, 2000) which is the skill that make Tetris gameplay easier. Since the effectiveness of Tetris most likely lies in creating a visuo-spatial load on working memory, it could be more effective in women rather than men, since a majority of women would find the task more challenging (but no less engaging) than men; because the greater the working memory load, the more effective the distractor.

Tetris could be used as an effective intervention technique to mitigate this phenomenon of increased stress levels, not simply because of the hypothesised cognitive mechanism, but also since it is an activity that is likelier to be interesting and engaging to the tech-savvy population of young adults, who already spend a considerable deal of their time in playing games and other such activities on their smartphones or over the Internet. India presently has around 156 million smartphone users (Arthur, 2014), among whom more than 50% are around 25 years of age, according to a recent Nielsen survey, and 58% of app purchases are games. Therefore, as an intervention technique, this would be likelier to have a higher success rate, compared to other traditional methods like meditation, because it would fit into their daily pattern of tech-use.

Methods

The objectives of the study were to determine if playing Tetris regularly could bring down perceived stress levels in adults and to check if there was a gender bias in the effectiveness of Tetris in controlling perceived stress levels in young adults. As a result, two null hypotheses were formed:

H01: There will not be a significant difference in perceived stress scores between the pre-test and post-test, after two weeks of playing Tetris.

H02: There will not be a gender bias towards females in the effectiveness of Tetris.

The research designed was a quantitative quasi experimental design, (since there was no random sampling of members to groups) of the One group Pretest-Posttest type. There was no comparison or control group. While this method calls into account certain threats (Campbell, Stanley & Gage, 1963), measures were taken to counteract them and better the internal validity of the design.
The history effect is not applicable to this case since there were no significant changes in environment that affected the entire testing group, and the short time duration of the testing period ensured that there was no maturation effect as well. Since the same measure was used, there was no instrumentation threat and since there was enough of a time gap between pretest and posttest to nullify any priming caused by the pretest, testing threat can be discounted as well. The independent variable is the playing of the game Tetris, and the dependent variable is the stress level of the participant.

The sample for the study included young adults, both male and female, from the ages of 18 to 25, who were facing stressful life situations. The sample size was 60 – 30 males and 30 females. The sample was chosen by convenience sampling and snowball sampling. The important inclusion criteria was that participants were facing at least a predetermined minimum amount of stress, as brought on by normal life situations. Thus they had to score a minimum of 16 on the Perceived Stress Scale to be eligible for the intervention. The exclusion criteria were that the participants should not have had any trauma in the recent past nor be suffering from an illness that caused them clinically significant distress. Both these criteria were checked during a short face-to-face or telephonic interview, before administering intervention.

The tools used for the study were apps which stimulated the game Tetris as it was played on the original Gameboy’s of the 1990’s. These apps were downloaded by participants on their smartphones or tablets, and used to play the game daily. The Perceived Stress Scale (PSS) developed by Sheldon Cohen in 1983 was used to measure the perceived stress of the subjects before and after two weeks of playing Tetris, to account for whether the game-play brought about any reduction in stress. Cohen & Janicki-Deverts (2012) found the internal reliability of the scale to be .91.

Participants were contacted telephonically as well as via social media. Once their role in the study was explained, people who showed stress scores of 16 or more on the PSS scale were recruited for the study. The testing group included 30 males and 30 females. They were asked to play the game Tetris for ten minutes, 4 times in the day, each day for the next two weeks. They were also asked to refrain from practicing any personal methods of stress management like meditation during these two weeks. At the culmination of this time period, they were administered the questionnaire again and then debriefed. All required ethical guidelines were followed for this study, with approval from the affiliated institution.

The Cronbach’s Alpha values of the pretest and posttest PSS scores were calculated to check for the internal reliability of the test. The pretest and posttest scores were compared using Wilcoxon sign rank test (since the data was not normally distributed) to check for any significant differences, thus checking null hypothesis 1. The difference scores of pretest to posttest of the male and female groups were found after which they were compared using Mann-Whitney U test depending on normality of data, to identify whether there is any significant difference between the two, thus checking null hypothesis 2. Effect sizes were calculated for both the results.

Results

All 60 participants were distributed over the middle socioeconomic strata. There were no participants from a lower SES. The distribution of pretest scores was not normal while the distribution of posttest scores was normal. Thus, non-parametric statistical tests were used to check the hypotheses.

<table>
<thead>
<tr>
<th>Stages of testing</th>
<th>Cronbach’s Alpha</th>
<th>Cronbach’s Alpha Based on Standardized Items</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>.671</td>
<td>.673</td>
<td>10</td>
</tr>
<tr>
<td>Posttest</td>
<td>.831</td>
<td>.828</td>
<td>10</td>
</tr>
</tbody>
</table>

The Cronbach’s Alpha values as seen in table 2 are .671 for the pretest and .831 for the posttest. A value of .671 indicates that the pretest had acceptable internal reliability and a value of .831 indicates that the posttest scores had good internal consistency.
As seen from table 2, the mean of the posttest was lower than the mean of the pretest. According to Related Samples Wilcoxon’s signed rank test \( p = .000 \) at \( Z = -5.670 \) at a significance level of .05. Thus \( p < .05 \), indicated that the difference between the mean of the two groups was significant and that the null hypothesis 1 was to be rejected. To check the effect size of the intervention, the matched-pairs rank-biserial correlation that corresponds to the use of the Wilcoxon’s signed ranks test (as cited in Kerby, 2014) was used. Upon computing, it was found that \( r = 0.759 \).

Table 3
Comparing mean ranks of difference scores between gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
<th>U</th>
<th>Z</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>30</td>
<td>26.08</td>
<td>782.50</td>
<td>317.500</td>
<td>-1.963</td>
<td>.050*</td>
</tr>
<tr>
<td>Male</td>
<td>30</td>
<td>34.92</td>
<td>1047.50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( *p = 0.50 \)

As seen from the table, the mean of the difference scores do differ by gender. \( p = .50 \) at \( U = 317.500 \) and \( Z = -1.963 \). Thus \( p \) is significant at 95% significance level, which allowed us to reject null hypothesis 2. To check the effect size of the Mann Whitney U results, the Wendt formula for rank-biserial correlation (as cited in Kerby, 2014) was used. The correlation was found to be \( r = 0.295 \).

Discussion
The study intended to examine the effect of the casual video game Tetris on the experience of stress in young adults. The objectives of the study were two-fold – to ascertain whether playing Tetris could decrease perceived stress levels, and to check whether there is a bias toward the female gender in its effectiveness.

The first null hypothesis was rejected, which indicates that the intervention did bring about a significant reduction in the perceived stress levels of the participants. The effect size for this result was calculated using the Wendt formula for rank biserial correlation and it was found to have a high practical significance. This indicates that the effectiveness of the intervention was high and that it can be considered practically applicable on a larger scale.

The effect observed is most likely due to the interference of Tetris imagery into the visuo-spatial working memory, as was hypothesised by Stickgold et.al (2000). When the process of consolidating the procedural memories formed during Tetris happens through the day, the load incurred by the working memory would leave little space for stress inducing memories or thoughts. The work of Holmes, James, Coode-Bate & Deeprose (2009) also showed a similar effect wherein the Tetris imagery competed for the limited resources of the working memory. While this particular result may have been influenced by external factors too, the high significance of the result suggests that there is an internal mechanism unique to the kind of visuo-spatial tasks that Tetris represents, that play a role in bringing down stress levels.

This rationale can be supported from a cognitive perspective as well. The concept of cognitive load puts forth that our working memory inherently has a limited processing capability and every new task competes for this pace, particularly when multitasking. The elements of the game Tetris include a playing screen within which the tetrominos fall, and a bezel space wherein more data essential to successful playing of the game are displayed, such as the next piece to appear, the concurrent scores etc. The player has to integrate information from both areas to achieve mastery, an effort that occurs naturally when playing the game. This process involves dividing and alternating visual attention between the play field and the bezel area, which essentially creates the split attention effect, which in essence is the division of attention that occurs when the same modality has to be used to decipher and integrate various types of information from the same source.(Chandler & Sweller, 1991). A fact that followed from this effect is that when a task is to be performed that requires this division of attention, the extraneous cognitive load on the working memory increases (Sweller & Chandler, 1992). Thus when an external stimulus like Tetris creates a certain level of externally stimulated cognitive load, the...
internal stimuli that propagate stress and anxiety has a lesser likelihood of receiving enough processing space in the working memory.

Another effect, namely the problem completion effect, occurs when a worked out example of the problem is followed by a similar but unresolved problem in order to facilitate effectiveness (Paas, 1992) and which also results in the maximization of motivation to solve the problem. This takes place in Tetris as well – the previous brick has fallen into either a solution or a problem whose solution is apparent. The next brick that comes along has a better chance of being aimed at the correct solution due to the previous learning of the gamer. This also keeps the player motivated to continue playing, thus keeping the rate of individual successes high as compared to failures. In such a situation, wherein the player is motivated to play, also increases the chances of unwanted mental imagery and thoughts being suppressed in the wake of performing an activity that is enjoyable and satisfying.

The second null hypothesis was rejected as well, and the average of the female group’s d scores was lower than the male group’s. Thus the decrease in stress levels in the female group is significant enough to conclude that they experienced less stress than the male participants. This also leads us to the conclusion that Tetris is more effective for females than males. On the other hand, while being a statistically significant result, the effect size computed for these results showed that it had a low level of practical significance, indicating that the effect may not be easily observable in a larger population and might not need to be considered when planning an intervention. More studies that incorporate this element may need to be conducted and their effect sizes calculated, preferably when having normally distributed data, before this can be claimed with certainty.

Conclusion

The results, although not generalizable since the data sets were not normally distributed, indicate the usefulness of Tetris in the field of stress management. It is cost-free and easily available, accessible on smartphones as well as over the internet; and has the potential to appeal to the generation of young adults in a tech-savvy world as a previously unexplored stress-buster. This indicates its importance in the area of public health management and the need to study it further.

The major limitation of this study is that the usefulness of the intervention can only extend to those who are technology savvy and have access to a device that can run video games and is portable, such as a smartphone or tablet. This limits the reach of the intervention majorly to an educated, urban, middle and upper class population, save a few exceptions.

Another major limitation was within the research design adopted, which was a quasi-experimental one group pretest posttest design which usually shows low internal consistencies. However, it has been found that the data sets have acceptable and good internal consistency, thus balancing to a certain extent the limitations of the design. Furthermore, the study was designed and measures were taken in such a way as to counteract the various threats associated with this particular design, such as the history or the maturation thereat.

The implications of this study are twofold: firstly, one can determine that the game Tetris, and most likely, any similar task that is visuo-spatially oriented and of equivalent complexity, does have an effect on the experience of stress. Secondly, feedback collected from the participants after the study indicated that 92% of the sample found the experience enjoyable and felt a reduction in their stress levels, particularly due to the method used. Technology thus needs to be considered in further studies as a potentially participant-friendly method of administering interventions. Feedback at the end of the test also enquired as to whether the participants enjoyed more refreshing or restful sleep during the period of testing, of which 70% of the participants replied in the affirmative. Thus the possibility of Tetris as an intervention for bettering sleep quality is suggested from the feedback responses and may prove to be a useful area for further studies.

References: