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Chapter 7

Psychological Fitness in Young Adult Video Game Players

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http://dx.doi.org/10.5772/47921

1. Introduction

Video games have been available to the public for several decades and are increasingly used by persons of all ages, mostly as part of the entertainment world (Kent, 2001). The games are thought to have either positive or negative effects on the users; the unsettled effects are a matter of scientific scrutiny of late (for a review see Ferguson, 2007; Papastergiou, 2009). The games are often portrait as a potential source of social and health problems, which is of increasing concern to legislators and policymakers (Phillips, 2004; Gray & Nikolakakos, 2007; Collier et al., 2008, Weaver et al., 2009). A number of studies show an impact on individuals of using video games. The use, or overuse, of certain types of games may increase aggressive behaviors. That concerns mostly 'violent games' which were found to increase children's aggression and to decrease school performance and attention (Hastings et al., 2009). In adults, interestingly, the more the game pertains to the real life situation, the more the players display aggressive thoughts and attitudes, and physiological arousal. Such effects are seen as quickly as 45 min into the play (Barlett & Rodeheffer, 2009). The studies which pertain to the detrimental influence of games on behavior are however riddled with controversies stemming mostly from inadequate methodological issues. The great majority of these studies is carried out in children. The most common methodology consisting of the observation of free play does not fulfill the criteria of scientific scrutiny. Moreover, as in the study on the effects of violent video games alluded to above, usually short-term measures of aggressive consequences are taken into consideration. The negative effects of playing the video games are often associated with the games that include violent scenes and enable the player to virtually harm the other players' avatars (Griffiths, 1999).

The psychological maleficency of games, particularly when overused, is however debatable as there also are reports to the contrary, indicating that games may help manage untoward behaviors such as conflicts, frustration, aggression, and do not necessarily result in social withdrawal (Kestenbaum & Weinstein, 1985).

On the health front, there is considerable evidence that excessive use of video games may lead to elevated levels of anxiety, depression, and poorer general health status in both younger (Schmit et al., 2011) and older adults (Weaver et al., 2009; Mentzoni et al., 2011). Interestingly, sexually-oriented content of video games may give rise to sexual stereotypes. In a study by Behm-Morawitz & Mastro (2009) undergraduate students were assigned to play a game containing a sexualized female character or no such character. The sexualized fable gave rise to unfavorable beliefs about women and the female player's self-esteem was unfavorable affected.

On the other side, evidence accumulates that video games may have an overall positive influence, particularly in young persons, in such domains as health and physical education, and social attitude, to the extent that games might be considered a useful incorporation in healthcare programs (Papastergiou, 2009). Playing action video games may improve a variety of visual and attentional skills, and the processing of multitask information or, in other words, of multiple sensory signals arriving from the periphery (Green & Bavelier 2003; Boot et al., 2008).

Relatively little is known whether video games can be used to improve our brain, to enhance intellectual performance, or to alter one's psychological characteristics. Recent advances in neuroscience give us strong support it might be so. Video games offer a unique, still untapped opportunity to gain insight into the neural mechanisms underlying cognition, as they approach a real life-like environment in terms of problem solving complexity. Cognitive and emotional capacity comes from having more synapses in the hypothalamic areas of amygdala and hippocampus. Multitask training leads to the recruitment of new neuronal circuits which are used more efficiently and flexibly (Maclin et al., 2011). The brain may get a functional boost or even be physically altered and restructured, as the regions involved in specific sensory inputs expand, particularly if the task are used on a repetitive basis.

2. Video games and mental fitness

Video games, particularly the multitasks ones, involve all kinds of dynamic transformations of fictitious action the player encounters on his way, ranging from the shape and size of objects to the placement and location in time and environment. The games represent a highly variable stimulation of one's senses and put a demand on cognitive performance, which makes them obvious candidates for improving brain adaptive capacity. Nevertheless, reports on the enhancing effects on brain prowess of video games are, at best, scanty and confusing. A criticism often is raised that games used for the assessment of one's cognitive performance are created for the purpose of a study, subjects are recruited from the population of 'non-often players' and the time and intensity of 'training' is set by the researcher (Maclin et al., 2011), all of which being biases. In an attempt to sidestep this criticism, we performed a series of studies which seek to determine the effects of a computer-based action game on psychological fitness of habitual game players recruited from their community environment. We chose a video game called *Counter Strike*, because of its widespread popularity (Remo, 2008). This, created only for entertainment, game is set in a fictive violent battlefield and enables a player to impersonate a member of a military unit on a mission that requires players to shoot missiles, attack an enemy, or defend the player's position; the actions requiring the engagement of various cognitive and psychomotor skills. The rationale was to ensure strong mental stimulation and to make the optimal use of brain neuronal networks. We addressed the issue by examining the ability to control and switch attention between multiple gaming tasks, visual-spatial skills, memory, decision making, perceptual skills, and emotional and personality features of young adults who were habitual video game players and by comparing the results with those obtained in a matched control group of never-players.

There were 30 game players (F/M – 3/27; age range 20-25 years), who confirmed a regular use of the game *Counter Strike*, and 30 never-users entirely naïve to video gaming (F/M – 4/26; age range 20-25 years) enrolled into the study. The regular use was considered as playing the games at least 3 days per week for 2 hours or more each time, and at least for the six months preceding the study time. All participants were university students. The game players were all using a standard PC computer with a keyboard and mouse as the main accessories for playing and all of them declared using the multiplayer mode to interact with other players. Participation in all tests and tasks was anonymous and voluntary.

Cognitive functions were investigated using sets of neuropsychological assessment tools that consisted of various thinking, memory, intelligence, and visual-spatial ability measures, such as the RehaCom (Hasomed GmbH, Magdeburg, Germany), the Vienna Test System version 6 (Dr. G. Shuhfried GmbH, Mödling, Austria), and the Wechsler Adult Intelligence Scale (Polish adaptation-WAIS-R PL) (Brzezinski & Hornowska, 1998). Specifically, episodic memory was tested with a WAIS-R Digit Span which assesses the number of digits remembered, and visual working memory with a RehCom BILD test, in which the person should recognize whether among many flashing names of objects on the screen is that that corresponds to one of the objects shown some time before. In the latter test, three arbitral break periods were used of 5-25, 26-55, and 56-85 sec; the longer the break and sustained good object recognition, the better is the visual memory.

Conceptual thinking, in turn, was tested with a WAIS-R Similarities test, logical reasoning with a RehaCom LODE test in which the subject has to add missing elements to the logically-structured column of symbols, perception of details with a WAIS-R Picture Completion test, perceptive processing with a VTS ATAVT Adaptive Tachistoscopic Traffic Perception test in which the respondent is quickly presented with a series of traffic pictures and then asked to report noticed details, and decisiveness and impulsiveness with a VTS AHA Attitudes to Work-Comparing Surfaces test in which the subject decides which of the two presented shapes is larger.

Emotional and personality aspects were assessed with the Coping Inventory for Stressful Situations (CISS) (Endler & Parker, 1999) and the Eysenck Personality Questionnaire-Revised (EPQ-R) (Eysenck et al. 1985).

The computerized paradigms and psychometric tools above outlined are all well standardized and sanctioned for the assessment of executive-control and emotional functioning.

2.1. Cognitive enhancement of video game players

The findings from our work concerning the cognitive fitness of video game players and the comparison with non-players are displayed in the consecutive figures. Fig. 1 demonstrates the results of episodic memory. The players scored significantly better on a WAIS-R Digit Span test than the non-players (16.7±0.8 *vs.* 11.3±1.0 digits remembered, respectively). The players also performed better on visual working memory. Here, a significant majority of 19 out of the 30 game users recognized the descriptions of pictures after the longest time break of the 55-85 sec range as opposed to none of the non-players, where the quickest lapses of memory prevailed (Fig. 2, Panel A). There were significant differences in favor of the game players noted in logical reasoning as well, where 20 out of the 30 players accomplished the highest number of positive hits compared with none of the non-players (Fig. 2, Panel B). In these two tests, the null hypothesis that there is no difference between the two distributions of subjects, video game players and non-players, was rejected.

Conceptual thinking also turned out significantly superior in the game players (15.5±1.2 *vs.*10.0±1.0 points in the non-players (Fig. 3). Concerning the decision making, the players displayed better results in decisiveness (19.3±1.9 *vs.* 12.5±2.2 points in the non-players; $P<0.001$, Mann-Whitney U test) (graphic data not shown) and also had a higher mean score in impulsiveness (19.6±0.6 *vs.* 17.9±0.7 points, respectively) (Fig. 4). Finally, the players' superiority in cognitive tasks was completed by better outcomes in the perception of details (16.4±0.8 *vs.* 10.6±1.0 points in the non-players) (Fig. 5) and in the perceptive processing assessed with a VTS ATAVT Adaptive Tachistoscopic Traffic Perception test (55.2±1.5 vs. 38.0±2.2 points in the non-players; *$P<0.001$, Mann Whitney U test) (graphic data not shown).

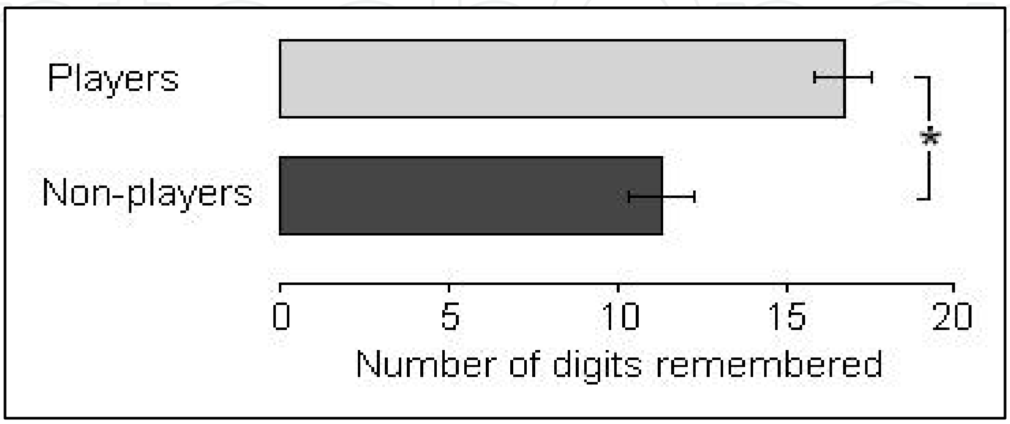

Figure 1. Number of digits remembered by game players and non-players in the WAIS-R Digit Span Test for episodic memory (data are means±SD; *$P<0.001$, Mann-Whitney U test).

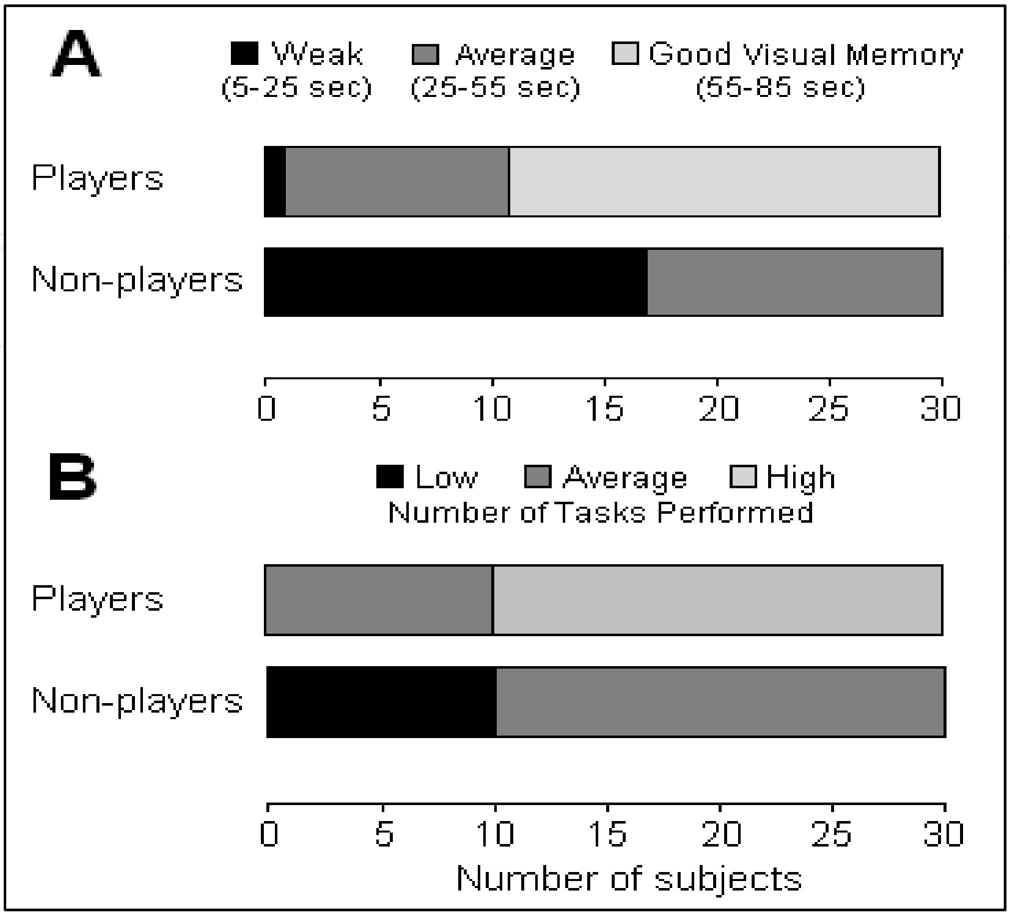

Figure 2. Panel A - Visual working memory of video games players *vs.* non-players assessed with a RehCom BILD Test (χ^2=30.5; P<0.001); Panel B - Logical reasoning assessed with a RehaCom LODE Test (data distributed on 3-degree Likert scale, χ^2=33.3; P<0.001).

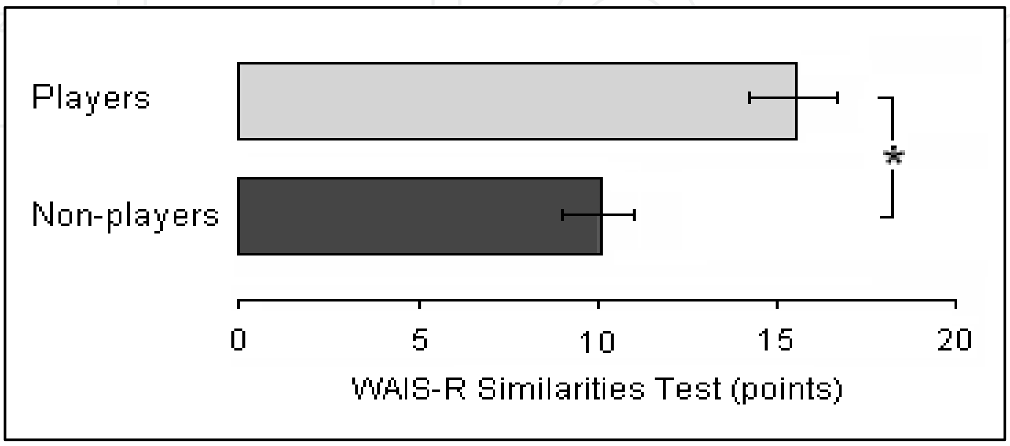

Figure 3. Differences between the video games players and non-players in the WAIS-R Similarities Test for conceptual thinking (data are means±SD; *P<0.001, ANOVA).

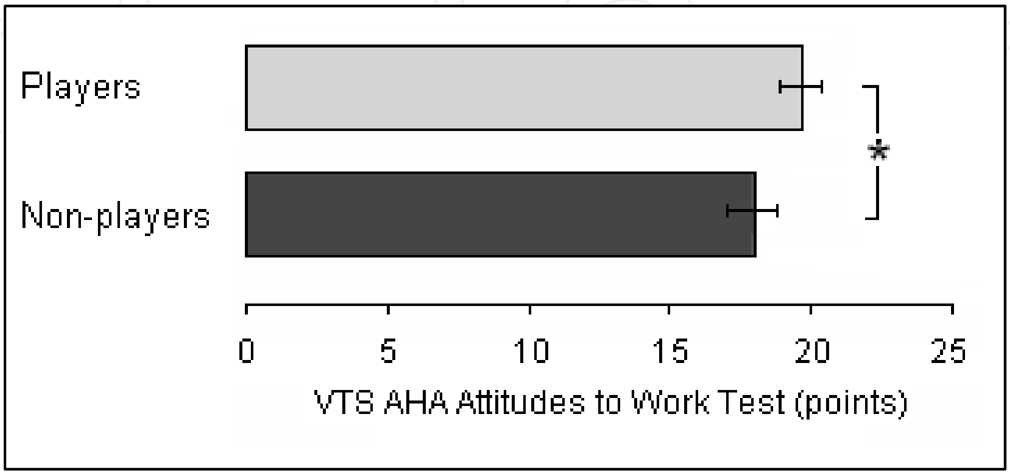

Figure 4. Differences between players and non-players in VTS AHA Attitudes Test for impulsiveness (data are means±SD; *P<0.001, ANOVA).

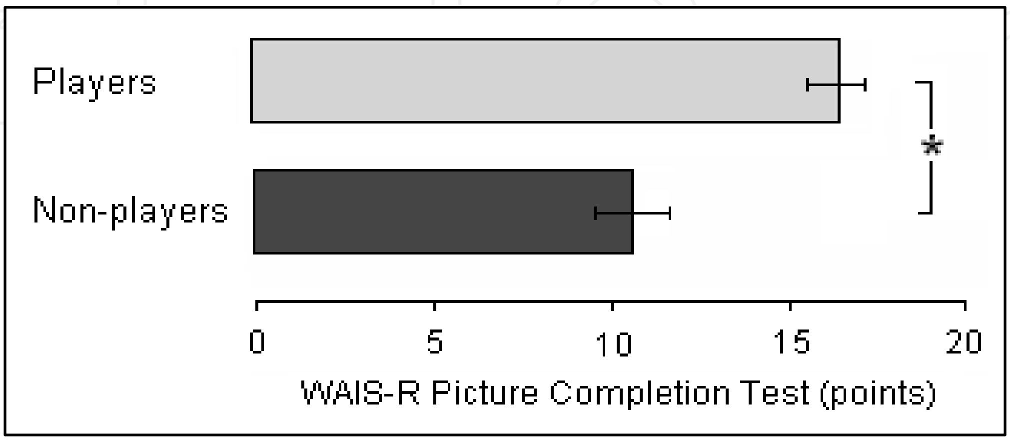

Figure 5. Difference between players and non-players in WAIS-R Picture Completion Test for perception of details (data are means±SD; *P<0.001, Mann-Whitney U test).

2.2. Emotional enhancement of video game players

When we compared emotional stability between the video game players and non-players, as expressed by the level of neuroticism, it turned out that the players were appreciably less neurotic and more emotionally stable. The two populations of subjects not only significantly differed concerning the level of neuroticism, but the players also had characteristically different personality traits. This is shown in Fig. 6 which demonstrates the profiles of the introversion-extroversion continuum, expressed in stens. Extroversion appeared a clearly predominating personality trait in the majority of players (23 subjects), with but one subject scoring in the lowest sten division corresponding to introversion. This profile contrasted with that present in the non-players, where ambiversion predominated (15 subjects), followed by introversion in 10 subjects.

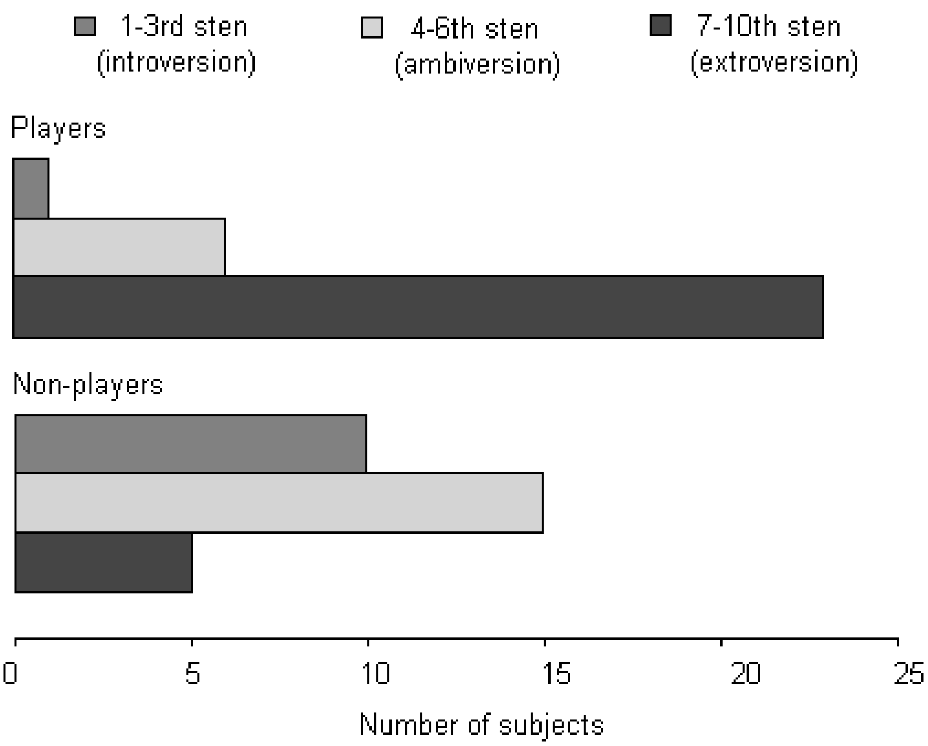

Figure 6. Personality traits in video game players and non-players surveyed with EPQ-R questionnaire (χ^2=22.8, P<0.001; reproduced with permission from Borecki et al., 2011).

More adaptive emotional characteristics of video game players were also reflected in their tackling of stressful situations. The majority of them presented the advantageous task-oriented strategy of coping with stress. Other less adaptive styles of coping were present in a fewer number of players than in non-players; avoidance-oriented 0 *vs.* 8 subjects, distraction 2 *vs.* 13 subjects, social diversion 0 *vs.* 8 subjects, respectively. The only exception here was the emotion-oriented style of coping which appeared in eight players as opposed to one non-player. All these differences between the players and non-players were significant as depicted in detail in Fig. 7.

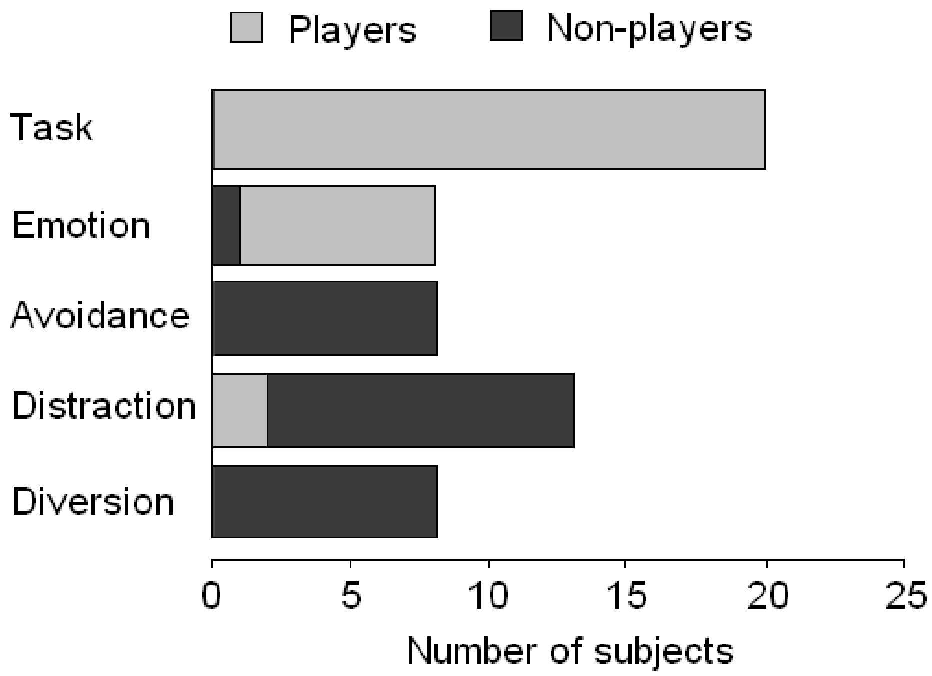

Figure 7. Styles of coping with stress in video game players and non-players assessed with CISS questionnaire (χ^2=49.5, P<0.001; reproduced with permission from Borecki et al., 2011).

3. Psychological agility of video game players

3.1. Cognition

Video games have become a kind of appeasement genre. The games seem limitless in terms of technological progress which turns them into ever greater enjoyable experience for players. The popularity of games spurred research on their potential psychological effects. However, the influence of long-term repetitive video gaming on cognitive fitness is not full well clear. Our research above outlined demonstrates that spontaneous, uncontrolled video gaming activity, performed on a regular basis, increases cognitive fitness. Regular, avid video game players perform better on tests of episodic and visual working memory, decision making, perceptive processing, and conceptual and logical thinking than never-users of video games. Thus, game playing enhances mental agility in young adult players compared with that of non-players. These results are in accord with those of other studies which show the overall positive effects of heavy use of video games on attention, memory, and other executive-controlled brain functions (Boot et al., 2008, Maclin et al., 2011).

That video game players' perceptual and cognitive skills extend far beyond those demonstrated by never-players seems to have a sound neurophysiological foundation. Research shows that neuronal networks used regularly for a given multitask set will be recruited to a fuller extent or alternative networks will come into play. There will be more flexibility in problem solving (Stern, 2002; Green & Bavelier, 2003). A habitual 'trained' game user might be able to use redundant neuronal pathways to accomplish the task or, in other words, approach the task from different angles.

3.2. Personality and emotion

Our work demonstrates the presence of a specific game-related psychological pattern developed as a result of repetitive gaming sessions. The on-line games require an active interaction and cooperation with other players. This is congruous with the more outgoing, more approachable, and socially interactive personality trait of extroversion present in the players. Players are better emotionally equipped. They employ emotionally superior task-oriented strategy of coping with stress and are, in general, more emotionally stable. Gaming acquaints with a highly competitive, i.e., stressful circumstances. Such circumstances may actually help the players adapt to other real-life stressful situations and make them feel more secure and of higher self-esteem, which is reflected in taking on the more adaptive task-oriented strategy of coping with stress. The players would then be less vulnerable to stress in the longer-run.

Choosing a more adaptive style of coping with stress is in correspondence with disconfirmation of less-adaptive styles by video game players, as seen in our results. Unexpectedly, the emotion-oriented style of coping was up in this group. Possibly, there were persons among the players who were inherently predisposed to the feelings of anger or sadness. Such feelings may have been mitigated during the gaming sessions, but came to light between the sessions.

The overall advantageous psychological pattern in video game players may likely have to do with more efficient and less susceptible to disruption use of neuronal networks. Emotional stability would then go in harmony with enhanced cognitive functions due possibly to coordinated interaction of neurons in wider spread areas as a result of repetitive 'training' sessions (Uhlhaas & Singer, 2006).

3.3. Piagetian aspects

Repetitive, training-like binding of perceptive signals in the context of previously acquired experience and knowledge while using video games fits well into Jean Piaget's cognitive theory known as 'cognitive constructivism'. The theory was originally created to understand the successive stages of intellectual development from the neonatal to childhood age (Piaget, 1977). On the premise, however, that cognitive development does not end at the age of physical maturity and rather represents a sort of continuum throughout the life cycle (Commons & Richards, 1984; Demetriou et al., 2010), we submit that the process of cognitive improvement in young adults due to video gaming may be seen extensional to this theory. One can find in the cognitive enhancement due to video gaming the basic tenets of Piaget's ideas. Games help classify or group subjects together on the basis of common features, which seems obvious in case of a battlefield or other action games. They help a person take new material into his mind from the fictitious fable and from the real environment pertaining to the interaction with other players. Games thus play on the senses to make one's mind pliable to accommodate concepts and to adapt to changing situations. This adaptation also has to do with playing back on the memories of prior experiences, which should be fostered by improved memory processing in the game users shown in the present study. Furthermore, gaming facilitates the thinking process by trying to work things out in the head on the basis of the representation in the mind of the actions contained in the game. Enhanced conceptual thinking and logical reasoning in the gamers go hand in hand with the overall improved thinking process. The multitask games develop a mind frame for taking into account multiple aspects of a problem to solve it; a feature named decentering in the Piagetian classification of mental operations. Finally, games enhance the ability to shift away from one action to another, all of which takes place under pressure of time and interaction with other players, which forces out decisiveness in action, an additional element liable to drive cognitive enhancement. Put it in another way, the video game players are called upon using earlier learned abilities and upon performing concrete operations which they would not have undertaken otherwise, which brings to light the players' untapped cognitive potential. Video gaming enhances what, in general terms, is called psychological maturity.

3.4. Neural processing

Contemporary neurophysiological research, unavailable at the time of Piaget, lends credence to the functional brain changes above outlined. Cognitive fitness has to do with coordinated synchronization of neural activity in different, often anatomically remote, brain areas. The better the temporal and spatial neuronal integration the better is the cognitive performance (for a review see Singer, 1999; Varela et al., 2001; Uhlhaas & Singer, 2006). Although neurophysiological data are discordant, for instance, attentional processing occurring with complex task training is ascribed alternately to lower frequency alpha (Maclin et al., 2011) or higher frequency beta range (Singer, 1999) in EEG recordings, the necessity for a large-scale synchronization of neural activity to accomplish the task is beyond a question. The multitask actions, typical for the video game, like the one presented in this article, require a parallel processing of multisensory inputs. Repetitive use of video games is thus bound to increase the attention and task-dependent correlates of cognition, such as conscious and purposeful stimulus selection and processing or operative memory. These processes, in turn, enhance 'cognitive reserve', the term coined for the ability to optimize performance of currently functioning neuronal substrate when coping with excessive task demands in healthy individuals or to recruit alternate 'reserve' substrate not normally used in case of diseased individuals with brain damage (Stern, 2002). The applicability of the notion of 'cognitive reserve' to video games' effects has practical implications, such as the game training might help brain impaired persons cope with the handicap.

3.5. Uncertainties

Research on psychological role of video games is subject to frequent methodological flaws and the presented work is no exception. The participants were cross-sectional. The gamers did not play games while surveyed. They did the psychometric tests once at the time free of gaming. Nor was the crucial issue tackled of whether the video games enhanced cognitive fitness concerning the specific mental tasks used in game training or the enhancement held true for other unrelated tasks. However, there is evidence from other studies that video games, particularly those exerting a high action-related and heterogeneous demand on mental functions, have a globally improving effect on one's cognition and psychological functioning (Frostling-Henningsson, 2009; Papastergiou, 2009).

The cause-and-effect relation is difficult to prove in the design of the presented work. It is possible that expert players fared better on the tests squarely because it takes better cognitive skills to be a good gamer in the first place. Thus, gamers would have had an inherent advantage over never-gamers when tested. However, both groups of subjects were fairly well matched regarding age, gender, educational status, etc. Although the matching obviously does not preclude inter-group differences having a genetic or environmental background, any such differences would seem random rather than systematic in view of a substantial number of subjects tested. There is no reason to assume the never-gamers are *a priori* inferior in cognitive or intellectual skills compared with gamers due to the sheer fact that they do not like playing the games. The major criterion of gamers selection was the long-term, for months, habitual use of video games. That criterion made it unworkable, for practical reasons, to carry out a longitudinal training study of the pre-post test type or tracing the cognitive gamers' history in their pre-habitual period. We purposefully chose a long-term habituation to gaming on the premise that it will enable us to bring out contrasts between gamers and never-gamers, which may not be the case in shorter time training protocols. Despite these limitations, we believe we have demonstrated that video gaming enhances cognitive and emotional fitness in young adult players.

4. Concluding remarks

This article describes the associations between playing the video games and psychological health. Commercial video games apparently offer an unintentional cognitive training, which makes them a psychomotor rehabilitation tool. Video games may supplement rehabilitative strategies in pathological conditions that affect adults, such as psychiatric and psychological disorders, including depression and neurodegenerative conditions in which cognitive performance and memory suffer or which may be accompanied by disordered thinking and decision-making (Gleichgerrcht et al., 2010). To this end, video games may also counter a natural cognitive decline of aging (Foos & Sarno, 1998). Future research should explore the best ratio of regularity, time and effort put into playing the games to achieve the maximum effectiveness of cognitive self-training. Finding the right proportions will enable the rehabilitators to advocate natural or prescribed use of video games for cognitive enhancement.

Video games are often degraded to unwise activity and loss of time from the intellectual standpoint. We submit that negative attitudes toward the video games are not substantiated or are due to parental overreactions. Young persons should be motivated to start gaming activity and not to overuse it. The use of video games also may become part of educational adolescent activity. It seems hardly achievable to make young persons stop playing the games, and in the light of the presented research it may actually be undesirable to do so. To the contrary, when appropriately used, widely popular games can be utilized as a valuable tool for cognitive training. The positive effects of playing the games stand in opposition to an often held view by the lay public that games, particularly those of aggressive genre, are maleficent. Instead, playing the video games should be knowledgeably used to effectively support psychological health

The authors have no conflicts of interest to declare in relation to this article.

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