



# The Enigmatic Influence of Video-Internet Gaming: Liabilities and Assets over the Lifespan

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## Abstract

Against an ever-increasing background of sedentary lifestyles and the over-indulgence of unsuitable food/drink intake, the advent of video/internet games may be viewed as commodity defined by opposing assets and liabilities. The latter emanate from the aggressiveness, violence, desensitization, criminality and loss of impulse control associated with violent action video games and may eventually culminate in the internet gaming disorder condition whereas the former are linked to educational opportunities and interventions to promote physical activity in the sedentary, improved visuomotor and cognitive skills in both healthy volunteers, young and aged, and those individuals diagnosed with neurologic disorders. Several brain regions have been found to be affected by video game-play in apparently beneficial and non-beneficial directions, sometimes hemisphere-specific, including regions of the frontal and parietal lobes, hippocampus, thalamus and hypothalamic-pituitary-adrenal axis, with accompanying alterations in functional connectivity. Nevertheless, despite the plethora of available for and against the utility of video/internet games across the lifespan, the net worth of the commodity seems yet to be assessed, and more essentially, properly understood.

**Keywords:** Video/internet games; Violent; Interactive; Children; Adolescents; Adults; Elderly; Brain regions; Exercise; Interventions; Assets; Liabilities

## Introduction

The notion of 'optimal child development' is defined by the coordinated mobilizations of active, purposeful effort, parental/significant others and teacher guidance together with the stimulating influences of environment and culture that contribute to the child's social and psychological ecosystem Baumrind et al. [1], Scarr et al. [2]. Whereas most children respond favorably to organized educational computer programs and 'gaming' tasks that enhance hand-eye coordination, the reverse side of the coin is associated with by real or apparent aggression, violence and criminal behavior that may induce traumatic experiences and anxiety in the child's world encompassed by news, film and television shows, or not Aragon Neely et al. [3], Coker et al. [4], Ferguson et al [5]. Partly due to low-cost availability and partly due to enjoyability, video games achieved a high degree of popularity Tseng and Hsieh et al. [6], and have induced both positive, i.e. learning and visuomotor skills, and negative, i.e. aggression and desensitization, influences upon children Andrew and Przybylski et al [7]. In the latter context, excessive violent, action video gaming is responsible for academic Aguilar et al. Peiró-Velert et al. [8], although not consistently Drummond and Sauer et al [9], social interaction Krantz et al. [10], Männikkö et al. [11], addictive behaviors Lemmens and Hendriks et al. [12], and sleep problems Dworak et al. [13], Kevitiyagala et al. [14]. In middle school pupils, the "Problematic use of video games" relates to substance abuse and other high-risk behaviors Gallimberti et al. [15], Yao et al. [16]. The ongoing debate regarding the psychological and delinquency outcomes of repetitive exposures to virtual violence and aggressive behavior among children/juveniles in the average North American and Western European home continues to rage Freedman et al. [17], Greitemeyer and Mugge et al. [18]. It ought to be borne in mind that video games, independent of specific form and physical property, have been designed with two basic aims in view, i.e. to instigate enjoyment and to sustain player engagement Anguera and Gazzaley et al. [19].

The associations between violent video games and expressions of violence/aggression among

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children have obtained some degree of support Anderson et al. [20], Anderson et al. [21], Ferguson et al. [22,23], Sherry et al. [24], albeit circumstantial. Taking the difference aspects of evidence together, there appears to be a consensus that violent media consumption, consisting of TV news, drama and action films and violent video games, are related positively with several parameters of poor developmental outcomes Boxer et al. [25]. It has been observed that adolescents indulging in video play that exceeds one hour of console or Internet video games are liable to present a greater number of symptoms and/or more intensive symptoms of attention-deficit hyperactivity disorder or inattentiveness than those not presenting higher levels of video game indulgence Chan and Rabinowitz et al. [26]. Furthermore, given the reality that more than 90% of children/ juveniles indulge in video games, some sufficiency and necessity of comprehending the psychological mechanisms through which these games may modulate children's behaviors seems important for parents, research psychologists, teachers and pediatricians as well as for the design and application of preventional and interventional efforts to enhance or mitigate these effects. Media violence exposure exerts detrimental effects upon psychological adjustment with outcomes not uncommonly expressing aggression-related attitudes and behaviors Patton et al. [27]. The notion of "Screen-time" is defined as the amount of time spent each day on activities related to video games, computers and television. In adolescent girls, screen-time was inversely related to psychological well-being Straatmann et al. [28], although there is evidence too that computer-gaming affected positively the stress system and the perceptual-cognitive system Aliyari et al. [29].

## Violence-aggression Desensitization

The 'desensitization' to violent behaviors/incidents/situation may alter the manner in which these perceptions are handled in the brain and CNS Carnagey et al. [30]. Exposing individuals, particularly children and adolescent, to violent video games evokes aggressive thoughts, angry feelings, negative affect, physiological arousal and aggressive behaviors, and reduces helpful/empathic behaviors thereby desensitizing them to real-life violence. Certain other expressions of disequilibrium/pro-equilibrium in impulse control functioning and affective status seem implicated in violence-observation to behavior development links: for example, the watching of violent-aggressive television-programs and indulging in these types of video games are in each case linked to the elevated attentional deficits outcome observed in exposed children with similar associations among television, video games, and attention problems expressed later during adolescence and early adulthood Swing et al. [31]. There has emerged recently a plethora of studies aimed at ascertaining whether or not the intervening cognitive and/or affective processes mediating the influences of violent video game-playing on aggressiveness may be identified and whether or not these effects may be moderated by factors such as age, gender, prior incidence of aggressiveness, or the pressures of parental monitoring. Affective expression, achieved through the processing of positive emotion related to facial expressions may be altered by video game violence Sauer et al. [32]. Thus, it has been found that there were transient modulations of the event-related potentials in brain regions related to selective attentional-orientations and sustained alterations of the event-related potentials associated with appraisal and evaluational functions that were sensitive to video game violence exposures Bailey et al. [33]. In a longitudinal study of adolescents, it was observed among those participants exposed to action, risk-glorifying games that the incidence of behavioral deviation, including

alcohol use, cigarette smoking, aggression, delinquency, and risky sex as a consequence of its effects on personality, attitudes, and affiliations indicative of increased tolerance of deviance, was markedly increased Hull et al. [34]. Similarly, the "virtual threat effect", e.g. the stereotyped African American type-of-character, negatively construed, would have been constructed to induce stereotyped conclusions among White (European) American players since the mere exposure to the threatening stereotype would be sufficient, i.e. negative affective response to the threatening stimulus predicts stereotyping thereby evoking the negative affectivity of objectifying a racially stereotyped video game character on players' race-related perceptions/predispositions Behm-Morawitz et al. [35].

The psychological consequences of video game-play may depend upon multiple factors determining the perception and cognitive setting under which these behavior are allowed to proceed, and not least the child's own particular neuropsychological point of departure. There is the likelihood that video games presenting reward outcomes for violent actions may increase aggressive behavior by increasing 'aggressive cognition' Carnagey and Anderson et al. [36]. Contrastingly, it has been shown that the 'prosocial', neutral or violent nature of the video games in question will mediate the expression of 'helpful' or 'hurtful' behaviors among 9-to-14-year-old children Saleem et al. [37]: thus, prosocial games were found to promote helpful behavior concomitant with and reducing hurtful behaviors while, in contrast violent games promoted hurtful behavior and reduced helpful behavior. Certainly, marked longitudinal effects pertaining to both prosocial-video-game and violent-video-game applications upon prosocial behaviors mediated through empathy have been forthcoming Prot et al. [38]. Interestingly, from the Singapore video-game longitudinal study, it appears that the influence of violent video games is mediated by 'aggressive cognitions' rather than the effects of gender, prior incidences of aggressiveness or the pressures of parental monitoring Gentile et al. [39], the younger children expressed a greater increase in initial 'aggressive cognition' in relation to initial violent game-play at the initiation of this study than did the older children. Nevertheless, prosocial reduced 'aggressive cognitions': (i) through reducing the "hostile expectation bias" and (ii) inhibiting the accessibility of antisocial thoughts Greitemeyer and Osswald et al. [40]. Adachi and Willoughby et al. [41] in a four-year longitudinal study of young adults ( $N = 1,132$ ;  $M_{age} = 19$  years), compared with results from a 4-year longitudinal study of adolescents ( $N = 1,492$ ;  $M_{age} = 13$  years), regarding associations between video game play and aggression obtained a lasting link between competitive video game play and aggressive behavior among both age groups. The participants' competitive video game play predicted higher levels of aggressive affect over time; the video game prediction concurred with higher levels of aggressive behavior over time, implying that aggressive affect contributed a mechanism mediating the relationship. There is something approaching a consensus that the long-lasting relationship between the playing of violent video games and aggressive behavioral expressions, and the specific game characteristics (e.g., violence content, competitiveness, pace of action, etc) may underlie the dynamics of their causal 'reciprocity' Willoughby et al. [42].

Since action video/internet/ computer games employ incremental levels of realist episodes and violence, in addition to portraying gender-based roles and stereotypes, it is likely that these expressions of aggressive personality traits may attract individuals to aggressive, action-filled, risk-glorifying video games rather than more women who are constrained not to play computer games in view of their

socialization pressures to be non-aggressive. In a survey, it was found that female responders who played computer games perceived their online environments as less friendly but experienced also less sexual harassment online Norris et al. [43]. They experienced more aggressiveness themselves and did not differ in gender identity, degree of sex role stereotyping, or acceptance of sexual violence when compared to women who used the computer but did not participate in video games. It was shown too computer gaming was linked with decreased participation in computer-related employment although female participants expressing high masculine gender identities were more likely to use computers at work. In participants, identifying with dominant and aggressive male game characters, that were randomly assigned to play a violent-sexist game, a violent-only game, or a non-violent game, Gabbiadini et al. [44], studied how exposure to “sexist” video games may reduce the expressions of empathy for female violence victims in media circumstances. They obtained results showing that participants’ gender and their identification with the violent male video game characteristics influenced the effects of the exposure to “sexist-violent” video games on masculine beliefs thereby supporting the prediction that playing violent-sexist video games increasing masculine beliefs, which occurred for the male participants, but not female participants who were identified to a high degree with the particular game character. Furthermore, masculine beliefs predicted negatively empathic feelings for female violence victims. Contrastingly, even violent video games may improve intergroup attitudes under circumstances of cooperative playing with an outgroup Adachi et al. [45], whereby cooperative (vs. solo) play improved markedly outgroup attitudes and pro-outgroup participant behavior, thus illustrating an engaging and pragmatic solution to the pervasive issue of setting up and negotiating opportunities for successful intergroup cooperation. Taken together, the findings of this analysis imply the special characteristics of those individuals most affected by the exposure to the sexist-violent video games as well as to some extent the underlying causes for the occurrence of these observations.

## Regional Expressions of Gaming Disorder

Neuroimaging studies have implicated aggression-oriented brain regions in violent video games Klasen et al. [46], Martinez et al. [47], Mathiak et al. [48], Zvyagintsev et al. [49], although it has been observed also that violent video game participation does not necessarily lead to desensitization Szycik et al. [50], and may even affect positively the hypothalamic-pituitary-adrenal stress system and the perceptual-cognitive system Aliyari et al. [29], see above. Among individuals presenting depression there was shown to be a failure to suppress default mode network activity during a task that demanded high levels of attention in comparison with individuals not presenting depression, even taking into account comparison groups with and without a history of compulsive video gaming Han et al. [51]. The incidence of internet gaming disorder Müller et al. [52], Tsitsika et al. [53], which involves ‘predisposing factors’, including neurobiological and psychological factors, ‘moderators’, as exemplified by coping styles/strategies and Internet-related cognitive biases, and ‘mediators’, involving the affective and cognitive responses to situational triggers in combination with disruptions of executive functioning, which describes a non-substance addictive-compulsive syndrome King et al. [54], Petry et al. [55], may contribute to the more threatening aspects of video game violence Brand et al. [56]. Using the internet and/or on-line video/internet game-playing activates the corticostriatal- limbic circuitry among healthy control volunteers and individuals

presenting Internet gaming disorder. In MRI studies, these latter individuals showed elevated fractional anisotropy values within several regions including the forceps minor, right anterior thalamic radiation, right corticospinal tract, right inferior longitudinal fasciculus, right cingulum to hippocampus and right inferior fronto-occipital fasciculus concurrent with parallel reductions in radial diffusivity values within forceps minor, right anterior thalamic radiation and the fronto-occipital fasciculus in comparison with the former Jeong et al. [57].

The notion of functional connectivity implies that connectivity observed between brain regions that share functional properties and may be described as the temporal correlation (contingent) between spatially remote neurophysiological events, expressed as deviation from statistical independence across these events in distributed neuronal groups and brain regions Archer and Abedini et al. [58], submitted). For example, the tendency to indulge in reward-oriented behaviors by adolescents was linked to enhanced reinforcement learning combined with stronger links between reinforcement learning and episodic memory for rewarding outcomes associated with greater BOLD activity in the hippocampus and markedly elevated functional connectivity between the hippocampus and the striatum contingent upon the reinforcement episode Davidow et al. [59]. Zvyagintsev et al. [49], have shown that functional connectivity network patterns identified a reduction in connectivity within six brain regions concurrent with violence-related video game-play comprising: (i) three sensory-motor networks, (ii) the default mode network, (iii) the brain reward network, and (iv) the right-lateralized frontoparietal network. The authors emphasize the short-term elevations of aggressive affect and related cognitive-emotional expressions associated with violent video game-play. Internet game disorder (also “video game addiction”) implies the excessive and/or compulsive usage of computer/video games to the extent that it interferes with individuals’ everyday life and functioning. In this context, individuals presenting “internet game disorder” showed a markedly reduced regional resting-state functional connectivity between the ventral tegmental area and right nucleus accumbens Zhang et al. [60], resting-state functional connectivity levels between the ventral tegmental area and the right hemisphere nucleus accumbens were correlated negatively with the participants self-reported subjective craving for the Internet as compared with the healthy control group.

The symptom profiles of internet gaming disorder are characterized by high levels of ‘behavioral-craving’ for online gaming and related cues to the degree that addiction-related cues may evoke increased activation in those limbic brain regions involved in motivational and reward processing thereby engendering gaming behaviors or triggering relapse behavior. The presence an internet gaming disorder is implicated in observations of functional network dysregulation, such as those seen in deficits of executive control and emotional management, whereas enhancements of coordination among visual, sensorimotor, auditory and visuospatial systems may be obtained Wang et al. [61]. Thus, Zhang et al. [62], have shown that a craving behavioral interventional group therapy reduced internet gaming disorder severity and cue-induced craving, and enhanced activation in the anterior insula and decreased insular connectivity with the lingual gyrus and precuneus. To some extent, the expressions of video-game violence-aggression seem associated with individuals’ affective ‘make-up’ with trait-level hostility, interface types and character identification influencing aggressiveness and overall



game experience following the experience of violent video games by reducing potentially negative outcomes. Low-level trait hostility players reported greater positive game experience under a condition of mapping interface whereas the high-level trait hostility players reported greater negative game experience Jung et al. [63]. It was concluded that character identification moderated the effects upon aggression activation and mediated the influence upon overall game experience.

## Cognitive Plasticity Promotion

There has accumulated a remarkable degree of evidence to support the notion the video game playing expertise is associated with high levels of cognitive plasticity as expressed through primary and higher level functioning Green and Bavelier et al [64], West et al. [65], selective and specific attentional processes Cain et al. [66] and working memory Blacker et al. [67], Colzato et al. [68]. It may well be the case that “action video games” experience/accomplishment is associated with an integrational relationship between the Saliency Network and the Central Executive Network that underlies enhanced attentional and working memory prowess Menon and Uddin et al. [69]. In this context, it has been found that expert action video game players showed enhanced intra- and inter-network functional integrational performances in comparison with “amateur-players” Gong et al. [70], even to the extent that the earlier the debut of video game-players to the activity, the later the ‘age-of-onset’ for cognitive ageing thereby buttressing against age-related cognitive decline in healthy adults Ballesteros et al. [71,72], Hartanto et al. [73], another marker for the maintenance and integrity of older brain plasticity. The issue of whether or video game training may improve the performance of visuospatial working memory and episodic memory in nineteen healthy older adults (intervention group: 69.95 years; control group: 73.20 years) was examined by Toril et al. [74]. Their results indicated that the intervention (video game training) group improved markedly over all the practiced video games; both groups attended a variety of cultural and educational activities at the senior centre. Remarkably, marked performance enhancements were obtained in the intervention group on visuospatial working memory, i.e. the Corsi Blocks task and the Jigsaw Puzzle task, and for episodic memory and short-term memory. All these performance enhancements were maintained over the three-month follow-up, an encouragingly positive expression of the plasticity of the ageing brain, at least in healthy individuals. Interestingly, these above findings compare favorably with those of Stern et al. [75], who observed that video game training intervention, dependent upon duration and intensity of the training, improved executive control process performance by healthy older adults. Nevertheless, dependent upon situation, video gaming may be detrimental to performance: the “angry birds” video games were found to affect working memory performance negatively over time when played in between different learning tasks Kuschpel et al. [76].

In the context of video game training and cognitive performance enhancement among ageing populations the notion of a “cognitive reserve” may be entertained: this notion postulates the distinction between an existing ‘brain reserve’, which refers to individual differences in the neuroanatomic substrate, as opposed to an expressed ‘cognitive reserve’, which refers to observed differences in the flexibility or adaptability of cognitive networks Stern et al. [77]. Possibly, this above distinction between a brain-structure as opposed to a cognitive reserve may contribute to the idea that video

game-playing as a training procedure optimizes alterations of basic mechanisms underlying visuospatial attention thereby rendering video game trainees an improved ability to shift attentional processes more rapidly than those individuals non-exposed to video game training. In a spatial cuing task with varying cue-lead times to estimate attentional shifts in 36 non-video gamestrained and 62 video game trained participants, it was found that the latter exhibited higher peak and mean performance than the latter Mack et al. [78]. Nevertheless, no differences between the two groups with regard to the speed of covert attention shifts, as estimated through cue-lead times, was observed implying that in the absence of faster attention shifts by the video game trained individuals an enhanced efficacy of attention and/or responding (i.e. visuomotor control processes) ought to be considered. This theme focusing upon the influence of video gaming upon visuomotor control efficacy and visual functioning has been implicated from the findings of several different avenues, including contrast sensitivity Li et al. [79], motion-direction discrimination Green et al. [80], visuospatial attention Feng et al. [81], and aboveand ‘top-down’ guidance in visual search Wu and Spence et al. [82]. Li et al. [83], observed, in a group of participants (aged 18-35 years) assigned to action/non-action video game conditions, that video action gamers showed superior ‘lane-keeping’ and visuomotor control skills than non-action gamers; they then trained the non-action gamers with either action or non-action video games. Among the action gamers, training/playing involving driving or shooter video games improved visuomotor control markedly who was not observed among the non-action video game group see also Beveridge et al. [84]. Whether or not active video gaming influences upon exercise propensity in ADHD is real or apparent, physical exercise provides benefits for symptom profiles, executive function, and motor abilities, as well as social, emotional, cognitive and behavioral characteristics and outcomes Hoza et al. [85], Tan et al. [86].

## Video Gaming as Intervention

It is entirely possible that beneficial or pernicious aspect of video games is determined by circumstance and other conditions, such as age, maturity, personal attributes, etc. As a training exercise for cognitive flexibility through repetitive usage (see above), the utility of video-gaming has provided benefits for the speed of psychological processing in tests of reaction time and attention, but also with higher-level cognitive functions, such as working memory De Giglio et al. [87], Melby-Lervåg and Hulme et al. [88], Nikolaidis et al. [89], with or without concurrent brain regional improvements, although the intervention may be detrimental under certain conditions Clemenson and Stark et al. [90], Unsworth et al. [91]. Thus, the present status regarding the putative benefits of video games as interventional constructs for brain plasticity and/or cognitive flexibility, independent of position along the lifespan gradient, remains to be established on grounds of empirical reliability and validity. Pujol et al. [92], studied associations between weekly video game uses (1 hour/week), selected cognitive functions/abilities and conduct-related problems in 2442 children aged between 7 and 11 years. Video game training was linked with faster and more consistent responding to visual stimulation although further training (> 2 hours/week) did not induce further increments in motor speed. In a study of young children (mean age: 5.8 years) presenting developmental delays, the intervention of ‘interactive video games Hsieh et al. [93], was shown to provide marked improvements in physical functioning in all the children involved during the periods of intervention but no improvements in psychosocial health, functional performances or family impact. In

some sense, contrastingly, but in another, confirmatory, the amount of time spent each week on video gaming was related to the extent of observed conduct problems, as indicated when the behavior reached and extended over 9 hours/week. A sub-group of 260 children were subjected to fMRI examination in order to ascertain eventual alterations in structure and function Adachi and Willoughby et al. [94]. Among these children, it was observed that basal ganglia white matter and functional connectivity were increased among the “low-users” (1-8 hours/week) and “high-users” (9->9 hours/week) of video game usage. Thus, the likely ‘two-edged’ aspect of video gaming as an intervention ought to be considered in any assessment of the positive benefits and negative dangers involved, as a function of intensity and duration of game-usage. Taking into account the enormous numbers of children indulging in video games (many millions worldwide), the observation that strategic video games indulgence promoted self-reported problem solving skills and thereby indirectly giving rise to higher academic grades Adachi and Willoughby et al. [94], prompts the conclusion also that educational purposes as yet remain an almost unexplored potential Ledoux et al. [95].

The school periods associated with physical activity-exercise describe a favorable relationship with the development of motor skills Wrotniak et al. beneficial cardio-metabolic profiles Stamatakis et al., Ekelund et al., positive health behavior change Poultney et al. [96], improved affect and perceived exertion Lison et al. [97], and higher levels of academic performance Borgonovi et al. [98], Kafai and Burke et al. [99], whereas a sedentary pupil existence relates to reduced health profiles Garriguet et al. [100], Suchert et al., and psychosocial well-being Cruickshank et al. [101], deteriorated body composition Diouf et al. [102], Zhang et al. [103], and academic performance Kawada et al. [104]. In a large meta-analytic study concerning the usage of action video games as an intervention to activate children for sports and exercises in school settings (2016), it was observed that although motor skills were markedly improved, none of the 14 studies relating to physical found any improvements, compared with controls, pertaining to greater propensity for physical exercise. The authors concluded that there was insufficient evidence to support the notion that action video games offered an effective intervention in the school context; similar negative findings for hip-worn and wrist-worn accelerometers in children (aged 10-12 years) have been obtained Howie et al. [105]. Tarakci et al. [106], showed that children presenting mild cerebral palsy using wii-fit balance-based video games that were aimed at the improvement of both static- and performance-related balance parameters in combination with neurodevelopmental therapy treatment induced marked benefits. It was observed also that active video games combined with narratives induced higher levels of physical activity in overweight and obese 8- to 11-year-old children Lu et al. [107]. Despite the encouraging nature of these studies for fitness, obesity and academic achievement, independent of socioeconomic and behavioral backgrounds Morita et al. [108], the paucity of available evidence renders it premature to conclude other than that there appears only meagre support, however necessary, for the preventative/interventional use of active video games as substitutes for traditional forms of active play and health-enhancing physical activity Thivel and O’Malley et al [109].

Nevertheless, some evidence does suggest that children playing interactive video games expended markedly more energy than those children restricted to sedentary video games Adachi and Willoughby et al. [110], Graves et al. [111]. Regular physical exercise is essential not only for the young but just as important for the elderly (> 65

years) for both health and function. There are exercise-based active video games that provide an alternative to the traditional exercise programs that are available for both healthy and disorder-diagnosed older individuals Guzman and Lopez-Garcia et al. [112], Thivel and O’Malley et al. [109]. Interestingly, it was evident that active video games assigned by themselves or in combination with exercise-programs, improved estimations of mobility and balance in the elderly Taylor et al. [113], see also Peng et al. [114]. Exercise self-efficacy predicts the propensity and compliance for physical exercise. In a study of “overweight” and “healthy weight” children (aged 6 to 12 years) assigned to a seven-week program of exercise video games and exercise self-efficacy training, it was observed that there were positive alterations for exercise self-efficacy by the “overweight” group whereas the “healthy weight” group maintained their level of self-efficacy at both the 12-month and 24-month follow-ups Dos Santos et al. [115]. Several studies reinforce the notion the active video games not only ameliorate overweight/obesity in children and adults Allsop et al. [116], Höchsmann et al. [117], but provide an optimistic prognosis for other condition, including child cancer Sabel et al., as well as, in adults, expediting patient rehabilitation in a variety of pathological conditions such as stroke, cerebral palsy, and Parkinson’s disease Bonnechere et al. [118]. As a major component modulating the influence of ‘intervention’ individuals’ lifestyle may arise as the deciding-factor for efficacy: Rivera et al. [119], examined the efficacy of a media literacy program for altering adolescents’ attitudes to violent video game playing and observed that the efficacy of intervention was dependent upon lifestyle. Adolescents expressing communicative relational lifestyles displayed fewer intentions to indulge in and consume violent video games whereas a “boomerang” effect was observed among adolescents with a problematic lifestyle.

## Conclusion

Suffice it to say, the influences of video/internet game playing present intricate and wide-ranging scenarios with an often decisive reliance upon age and maturity, violent or empathic themes, social context and interactive quality, guidance from responsible others, the preventive or interactive relation, and not the family background and lifestyle of proponents. The “problematic use of video games”, associated with aggressiveness, substance abuse and other high-risk behaviors in adolescents, requires analysis in relation to affective status, impulsiveness, temperament and character, and the disempowering influences of this behavior. Finally, the educational applications, not least for the pursuance of physical exercise programs, were pertaining to video/internet gaming offers much, as yet untapped, potential.

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