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Assessing Video Game Habits and Pathological Behaviour in Children through a New Scale: Psychometric Properties of the Video-Gaming Scale—For Children (VGS-C)

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Abstract

The purpose of this study was to develop an instrument to assess video-gaming habits and pathological behavior in children. The *Video Game Scale—For Children* (VGS-C) was developed by adapting the *VGS—For Adolescents* (VGS-A). The final scale was composed of two sections: Section A, with unscored items, assessing a wide series of video-gaming habits, and Section B, with scored items, measuring pathological use of video games by adapting the DSM—5 criteria for Internet Gaming Disorder. Participants were 201 children attending primary school in Italy (47% males; mean age = 8.7 years). Concerning Section A, preferred video games, daily frequency of video-gaming, used devices, amount of time spent on video game sessions, gaming on Internet, preferred online video games, and social partners in playing video games, were analyzed. Regarding Section B, Confirmatory Factor Analysis attested the hypothesized one-factor structure, and an adequate reliability was found. The association of video-gaming habits with pathological video-gaming attested the validity of the scale. Tolerance and escape were the pathological symptoms more frequently experienced by children. Findings suggest that the VGS-C could be a valuable instrument to assess video-gaming habits and pathological behavior in children.

Keywords

Children, VGS-C, Video-Gaming Habits, Pathological Behavior

1. Introduction

In the 21st century, video games are one of the most appreciated activities for

entertainment of all age groups, with youth particularly involved in the video game phenomenon (e.g., Donati, Ammannato, Chiesi, & Primi, 2015; Patriarca, Di Giuseppe, Albano, Marinelli, & Angelillo, 2009; Tejeiro Salguero & Morán, 2002). In the juvenile population, children have been found to be largely and increasingly involved in video games (e.g., Cummings & Vandewater, 2007; Gentile, 2009; Gentile et al., 2011; Greenberg et al., 2010; Hamlen, 2010; Lui, Szeto, & Jones, 2011; Nogueira, Faria, Vitorino, Silva, & Neto, 2019; Rideout, Foehr, & Roberts, 2010), even starting from the early age of 6 years (Hastings et al., 2009; Kovess-Masfety et al., 2016).

Video-gaming has been found to be very popular among children, with research attesting that 97.5% of children are gamers (Lui et al., 2011), and 83% play video games at least occasionally (Gentile et al., 2011). Adventure and Action games resulted the preferred video games in this age group (Nogueira et al., 2019). Concerning the frequency of video-gaming, children play about eight play-sessions per week (Lobel, Engels, Stone, Burk, & Granic, 2017). In another study, Gentile (2009) found that the frequency of video-game play appeared to be relatively steady in the 8 to 13 age group, and decreasing thereafter, while the amount of playing time per session seemed to increase as children grow older. Regarding the used devices to play, Rideout and colleagues (2010) found that children aged 8 - 10 years played with consoles and smartphones less than 11 - 14 years old youths, whereas the use of handheld consoles did not show differences. The preferred devices to play resulted to be computer and mobile phone (Lui et al., 2011). Concerning time spent on gaming, 19% of children play 2 - 3 hours per week and 10% more than 4 hours per week (Nogueira et al., 2019), while the average time playing video games was found to be about four hours per week (Hastings et al., 2009; Lobel et al., 2017). Taking into account younger children (6 - 11 years old), they spend 3.4 hours per week on average playing video games (Hastings et al., 2009), with 20% who spend more than 5 hours a week playing video games, and 40% who game from 1 to 5 hours a week (Kovess-Masfety et al., 2016). Children also use the Internet to play (Lui et al., 2011; Nogueira et al., 2019), with Multiplayer resulting the most widespread online game (Nogueira et al., 2019). Finally, children used to play video games alone, or together with friends, siblings (Hastings et al., 2009; Nogueira et al., 2019), or parents (Hastings et al., 2009).

Even if video games are a common leisure activity, children who play excessively may experience negative effects with regard to the psychosocial development. With regard to children aged 7 to 11 years, Lobel et al. (2017) found that excessive video-gaming was longitudinally associated with increases in emotional problems one year later, in particular internalizing problems. Moreover, in children playing approximately 8 hours or more per week, frequent competitive video-gaming was a risk factor for decreasing prosocial behavior. Scholastic achievement and externalizing problems were also found to be positively associated with the amount of video game playing in male children aged to 10 (Hastings at al., 2009). As video-gaming can lead to negative consequences even

at an early age, some scholars have analyzed the presence of signs of pathological gaming in children. For this purpose, they referred to the *American Psychiatric Association* (APA, 2013) criteria for addictions (Gentile et al., 2011) (i.e., salience, tolerance, mood modification, withdrawal, relapse, conflict, and problems) or to the Brown's criteria (Brown, 1991) for video-gaming addiction (Skoric, Teo, & Neo, 2009) (i.e., tolerance, euphoria, and cognitive salience), by adapting them to children. By applying these criteria, studies found that 9% of participants aged 8 to 14 years exhibited pathological video-gaming and that the number of symptoms endorsed were positively correlated with the amount of playing time (Gentile et al., 2011), and negatively associated with scholastic achievement in children aged 8 to 12 years (Skoric et al., 2009).

Attention has also been paid to the correlates of pathological behavior and the motivations to play video games in children. In this regard, in their longitudinal study, Gentile et al. (2011) showed that greater amounts of video-gaming, lower social competence, and greater impulsivity acted as risk factors for becoming pathological video gamers, whereas depression, anxiety, social phobias, and lower school performance seemed to act as outcomes of pathological video-gaming. Moreover, Skoric et al. (2009) found that both time spent playing video games (as reported by Hastings et al., 2009), and the addiction tendencies characterizing video game playing, were negatively correlated with scholastic achievement. Furthermore, Nogueira and colleagues (2019) found that children with a risky video game use showed a shorter sleep duration. Concerning the motivations to play video games, the main reasons are to relax, to forget problems, and to the challenge of the game (Nogueira et al., 2019).

Following these premises, the purpose of this study was to develop a measurement tool able to assess video-gaming habits and pathological gaming behavior in children. Indeed, despite the interest in video-gaming in children (e.g., Gentile, 2009; Gentile et al., 2011; Hastings et al., 2009; Kovess-Masfety et al., 2016; Lobel et al., 2017; Nogueira et al., 2019; Rideout et al., 2010; Skoric et al., 2009), measurement represents a very critical issue. In fact, in some cases (e.g., Kovess-Masfety et al., 2016; Lobel et al., 2017) parental perceptions of children's behavior have been collected rather than the children's self-reported evaluation, which, instead, allows to shed light on personal feelings and thoughts hardly noticeable by others. In other studies, the measures seem to be more a set of items rather than stand-alone measurement tools. The only scales traceable in literature are the *Scale of Game Addiction for Children* (SGAC), developed by Horzum, Aras, & Çakır Balta (2008) and composed of 21 items and 4 factors, and the nine items adapted for children aged 10 - 14 years old from the *Diagnostic and Statistical Manual for Mental Disorders—Fifth Edition* (DSM-5, APA, 2013) criteria for Gambling Disorder by Nogueira et al. (2019). However, these instruments have not been extensively analyzed in their psychometric properties. Another identifiable limitation is that the age range of children with whom pathological video-gaming has been studied starts from 8 years. Rather, considering also younger children is fundamental since it has been found that most

children receive their first electronic devise between 6 and 10 years of age, with some children who start to play videogames before the age of 4 years old (Nogueira et al., 2019). Finally, all these measures do not take into account the last indications of the APA (2013) concerning Internet Gaming Disorder (IGD). In detail, the DSM-5 defines IGD as a persistent and recurrent use of the Internet to engage in games, leading to clinically significant impairment or distress as indicated by five (or more) symptoms in a 12-month period. The symptoms include preoccupation with games, withdrawal when video-gaming is taken away, tolerance, unsuccessful attempts to control the participation in games, loss of interests in previous activities because of gaming, continued excessive use of games despite knowledge of psychosocial problems, lying regarding the amount of gaming, use of games to escape or relieve a negative mood, and compromise of relationships, job, or educational and career opportunities because of the participation in videogames.

To summarize, a psychometrically adequate instrument assessing video game habits and pathological use of video-gaming based on the IGD criteria in children aged from 6 to 11 years old is still lacking. Among the scales assessing pathological use of video games in the juvenile population by referring to the criteria set by the DSM-5 for the IGD, there are the *Internet Gaming Disorder Test* (IGD-20; Pontes, Király, Demetrovics, & Griffiths 2014), the *Video Game Dependency Scale* (CSAS; Rehbein, Kliem, Baier, Mößle, & Petry, 2015), and the *Video-Gaming Scale—For Adolescents* (VGS-A; Primi, Donati, & Chiesi, 2017). Among these scales, the VGS-A is the only one that allows the evaluation of both behavioral habits and pathological symptoms through two sections. The first section consists of unscored items investigating video game habits. In detail, it investigates the preferred game genres, the frequency of play at the different video game genres during the last year (through which respondents can be classified into non-gamers—i.e., absence of gaming for each genre—and gamers—i.e., presence of gaming in at least one genre), time spent on video games (days per week multiplied by hours per day reported for each device), and use of the Internet to game. The second section is composed of nine scored items, each one developed in order to relieve one of the nine DSM-5 diagnostic criteria of pathological gaming among adolescents. All the items have a three-response format, i.e., 0 = never, 1 = sometimes, 2 = often.

Moreover, only for the VGS-A, items assessing pathological behaviors have been developed by applying Item Response Theory (IRT). IRT allows us considerable advantages in terms of assessment given that, inside this framework, one of the item characteristics is the location, which can be conceptualized as the "severity" of the symptom described by the item. Moreover, by applying an IRT-based scoring procedure, the VGS-A allows to measure the pathological use of videogames taking into account the relative weight (i.e., the severity) of each symptom described by the items of the scale. Finally, the scale shows good psychometric properties since the second section was proved to be unidimensional, and the Test Information Function (TIF), which is used to evaluate the precision

of the test at different levels of the measured construct, showed that the instrument was highly informative for mid to high levels of severity of pathological gaming (Primi et al., 2017).

Given the advantages of the VGS-A, the goal of the present study was to develop an adapted version of the scale which would be suitable for children, namely the *VGS—For Children* (VGS-C). In this way, it will be possible to measure video-gaming habits and pathological signs of excessive and maladaptive behavior in children through a self-report measure. To fulfill that aim, we adapted a non-scored first section (Section A) investigating video-gaming habits, and a second scored section referred to maladaptive moods, thoughts, and behaviors related to video-gaming (Section B). After having developed the adapted version of the scale, we aimed at enlarging the existing knowledge about children's video-gaming habits by analyzing information collected through Section A. We also aimed at providing evidence for the psychometric adequacy of the Section B items in terms of dimensionality, reliability, and validity. In detail, we predicted to confirm the unidimensionality of the original scale for adolescents, consistent with the DSM-5 definition of IGD (APA, 2013), and the good internal consistency found for the original scale. Concerning the validity, our hypothesis was that the VGS-C score would be predicted by the video-gaming frequency (Gentile et al., 2011) and the use of Internet to play (Nogueira et al., 2019). Finally, we were interested in analyzing the most common pathological behaviors among video game players, in order to understand the most frequent signs of maladaptive consequences of video-gaming among children.

2. Methods

2.1. Video Game Scale—For Children (VGS-C) Adaptation

The adaptation of the VGS-C concerned with the need to make the scale more suitable for children. Indeed, vocabulary and reading demands for this age group were considered as a priority to maximize the comprehensibility of the scale (Ganley & McGraw, 2016). To that aim, with respect to the original VGS-A items, new items were added in order to measure some aspects of video-gaming behavior relevant to be understood with children, and some of the existing items were modified to improve their suitability with children. In particular, items with a very simple sentence structure were formulated in order to be appropriate for the reading level of younger children, and, in some cases, open-ended items were preferred with respect to pre-coded items, in order to increase the possibility for children to give individualized answers (Colfax & Allen, 1967).

Looking specifically at Section A, it was aimed at investigating various aspects of video-gaming habits which have been analyzed predominantly in a separate way in the previous studies, i.e., the prevalence of video game players (Gentile et al., 2011; Lui et al., 2011), the preferred video games (Nogueira et al., 2019), video-gaming frequency (Gentile, 2009; Lobel et al., 2017; Rideout et al., 2010), the devices used to game (Lui et al., 2011), the amount of time spent on video games

(Hastings et al., 2009; Kovess-Masfety et al., 2016; Nogueira et al., 2019), the use of the Internet to game (Lui et al., 2011; Nogueira et al., 2019), and the social partners of video-gaming (Hastings et al., 2009; Nogueira et al., 2019).

In detail, the following changes on the original VGS-A were realized. First, the time frame was referred to recent times, in order to facilitate children's information retrieval. Then, in order to further simplify data collection with this specific age group, we included a preliminary question, asking the children if they have played video games recently. To assess preferred video game genres, children were asked—through an open-ended question—to nominate the top three games they liked the most. The classification into the different game genres—in line with Donati et al.'s (2015) classification—was conducted in the scoring procedure, in order to clarify children's answers, basing on the assumption that children are not reasonably able to recognize similarities and differences between video game genres. To investigate the frequency of playing, we deemed it necessary to ask children to refer to their overall video-gaming in order to favor a more reliable answer. Moreover, to help children in contextualizing the question, we operationalized the frequency of video-gaming in terms of the number of the moments per day during which they play video games. We referred to seven prototypical moments of the day: After waking up, during the breakfast/before the school lessons, during the morning, after lunch, after the homework/during the middle part of the afternoon, before dinner, and before falling asleep. Children were asked to report in which of these moments they used to play both on school days and on weekend days (**Appendix**).

Children were also asked to indicate if they played or not (by indicating *yes* or *no*) video games using home console (e.g., PlayStation, Xbox, Wii), handled console (e.g., Nintendo 3DS, Play Station Portable/Vita), computer, smartphone, and tablet. To have a measure of the amount of time spent on a video game session, we included one item with an ordinal scale: *Less than* 1 *hour per day*, *between* 1 *and* 2 *hours per day*, *between* 2 *and* 4 *hours per day*, *more than* 4 *hours per day*.

Finally, we asked children to indicate if they have ever used the Internet to play. Moreover, preferred online video games were investigated by asking children—through an open question—the names of the three online games they liked the most. A final item asks children to indicate with whom they used to play videogames, by using an open question. The classification into the different game genres—making reference to Donati et al. (2015)'s classification—was conducted in the scoring procedure.

Concerning the adaptation of Section B, the nine items of the original version were made more adequate to children's lives in their contents and simplified in phrasing to improve children's understanding. An example of item revision was "*Have you ever lied regarding the amount of time spent gaming*?" modified in "*Have you ever told lies about how much you play video games*?" Responses were collected using a 3-point Likert scale—*never*, *few times*, *many times*—in

order to make the temporal scale more adequate to children (Spirito, Stark, & Williams, 1988). Before the administration, the revised items were tested to verify their comprehensibility and adequacy.

In order to maximize the potential of the VGS-C, we also adapted its administration procedure. In detail, since children begin to be relatively autonomous and independent in doing tasks at around 8 years (Youell, 2009), we thought to different ways of scale administration for the two age groups in the school context: A structured interview individually administered by a trained interviewer for the younger children (6 - 7 years old), and a collective administration in the classroom through a paper and pencil format for the older children (8 - 11 years old), in the presence of a small group of researchers. Furthermore, with regard to the item investigating the daily frequency of gaming, in order to make it as simple as possible for the younger children, two figurative representations of seven everyday life moments (one for school days and one for weekend days; **Appendix**), were added.

The developed scale was then analyzed by four experts (three clinical psychologists with expertise in the field of juvenile video-gaming and one psychometrician), and a pilot study with a small sample of children (n = 20) was conducted in order to review the adequacy of the items in terms of content and grammar. As a result of this phase, some items were modified in phrasing, and the final version of the VGS-C was obtained.

2.2. Participants

The sample size was defined based on indications that a minimum of 100 participants is necessary to conduct factor analysis (Hatcher, 1994) and that at least 10 subjects are needed for each item (Kass & Tinsley, 1979). Moreover, an a-priori power analysis was conducted using G*Power analysis software to estimate the sample size needed to achieve statistical power = .95 for the linear multiple regression analysis conducted to test the validity of the VGS-C. It was calculated that a sample size of N = 44 would be sufficient to detect a medium effect size ($R^2 = .30$) with a statistical power of 95% ($\alpha = .05$).

Participants were 201 children (47% males) ranging from 6 to 12 years in age (mean age = 8.7, SD = 1.53 years). The sample included 19% ($n = 38$) first year students (34% males; $M_{age} = 6.5$, $SD = .44$), 18% ($n = 36$) second year students (47% boys; $M_{age} = 7.70$, $SD = .53$), 20% ($n = 40$) third year students (37% boys; $M_{age} = 8.45$; $SD = .30$), 15% ($n = 31$) fourth year students (54% boys; $M_{age} = 9.53$, $SD = .45$), and 28% ($n = 56$) fifth year students (46% boys; $M_{age} = 10.57$, $SD = .41$).

From the available schools in the area, four schools were randomly selected. Subsequently, the schools' principals were contacted, apprised of the issue of video-gaming in children to generate support for the research, and presented with the project. Once the schools agreed to participate (two declined to participate because they were already involved in other projects), the detailed study

protocol in accordance with the criteria of the Declaration of Helsinki was reviewed and approved by the institutional review boards at each school. Written informed consent was requested from the children's parents, assuring them that the data would be handled confidentially; only children who had both parents consent were allowed to participate. The research was conducted during school time and all the parents gave the consent for their children.

2.3. Instrument and Procedure

The final version of the VGS-C is composed of two sections. After the investigation of the presence of video-gaming behavior, in Section A several aspects related to video-gaming use were asked, namely preferred video games, daily frequency of video-gaming, the devices used to play video games, the amount of time spent on a video game session, the use of the Internet to play, the preferred online video games, and the social partners in video-gaming. Section B contains nine items aimed at the screening for behaviors related to a pathological use of video games. Responses were collected using a 3-point Likert scale—never, few times, many times—scored respectively 0, 1, and 2.

On the basis of the children's age, two different administration procedures were planned. For 6 - 7 years old children the way of administration was individual, managed by an expert interviewer, and facilitated by the figurative representations of the daily moments, while for children from 8 to 11 years old a collective administration without any graphical support was used. Participants were recruited in schools, during school-time. For children aged 6 - 7 years old, data collection took about 15 minutes for each child, while those aged 8 - 11 years old completed the scale in approximately 20 minutes, due to different administration procedure (hetero-administered for younger children and self-administered for the older ones).

3. Results

3.1. Video-Gaming Habits from VGS-C—Section A

The results indicated that 87% of the children (n = 174, 51% males, mean age = 8.80, SD = 1.51) used to play video games. The preferred video game genres resulted to be Sandbox, Sport, and Action-Adventure games. The time of the day in which children played most was after the homework or during the middle part of the afternoon, followed by the after-lunch time. It must be noted that 35% of the children game before falling asleep. As expected, the moments in which children played less were during the breakfast and during the morning. On average, children played video games twice a day (M = 2.10, SD = 1.36, range: 1 - 6). The most used type of device was tablet, followed by home console, smartphone, computer, and handheld console. Regarding time spent on a video game session, 47% of the children played less than one hour, 24% between one and two hours, 10% between two and four hours, and 19% more than four hours per day. Furthermore, 65% of the participants used an Internet connection to

play video games at least once, and the video game genres most used online were Sandbox, Management, and Action-Adventure games. Finally, concerning the social aspects linked with video games, children reported playing both alone and with others. Specifically, 36% used to play alone, 27% with brothers or sisters, 20% with friends, and 8% with parents. All the descriptive results are reported in Table 1.

3.2. Psychometric Properties of the VGS-C—Section B

To analyze the psychometric properties of the items measuring pathological behaviors related to video-gaming, analyses were conducted by considering only those children that used to play video games, i.e., 174 children. No missing data were found in the responses to Section B of the VGS-C.

Table 1. Video-game habits derivable from the Section A of the Video Gaming Scale—for Children (VGS-C).

Favoured video game genre	
Video game genres	*Players*
Sandbox (e.g., *Minecraft*, *Terraria*)	18%
Management (e.g., *The Sims*, *Sim City*)	10%
Sport (e.g., *FIFA*, *Pro Evolution Soccer*)	17%
Action-Adventure (e.g., *Lego Star Wars*: *The Video Game*, *Assassin's Creed*)	14%
Strategy (e.g., *Clash Royale*, *Age of Empire*)	3%
Platform (e.g., *Subway Surfers*, *Rayman Legends*)	7%
Casual (e.g., *Angry Bird*, *Ruzzle*)	7%
Shooter (e.g., *Call of Duty*, *Fortnite*)	5%
Racing (e.g., *Forza Horizon*, *Mario Kart*)	11%
Fighting (e.g., *Street Fighter*, *Tekken*)	2%
Dance games (e.g., *Just Dance*)	2%
Board games (e.g., *Monopoly Family Fun Pack*, *Pure Chess*)	2%
Party (e.g., *Mario Party*, *Wii Party*)	1%
Role playing (e.g., *Miitopia*, *Final Fantasy*)	1%
Daily frequency of video-gaming	
Moments of the day	*Players*
After waking up	18%
At breakfast	16%
During school lessons	6%
After school	41%
In the afternoon	96%
Before dinner	36%
Before falling asleep	35%

Continued

Devices used to play video games	
Devices	*Players*
Home console	66%
Handheld console	32%
Computer	50%
Smartphone	65%
Tablet	80%
Amount of time spent on video game sessions	
Hours per day	*Players*
<1 hour	47%
1 - 2 hours	24%
2 - 4 hours	10%
>4 hours	19%
Favoured online video game genre	
Video game genres	*Players*
Sandbox (e.g., *Minecraft*, *Terraria*)	23%
Management (e.g., *The Sims*, *Sim City*)	13%
Sport (e.g., *FIFA*, *Pro Evolution Soccer*)	9%
Action-Adventure (e.g., *Lego Star Wars*: *The Video Game*, *Assassin's Creed*)	12%
Strategy (e.g., *Clash Royale*, *Age of Empire*)	10%
Platform (e.g., *Subway Surfers*, *Rayman Legends*)	5%
Casual (e.g., *Angry Bird*, *Ruzzle*)	11%
Shooter (e.g., *Call of Duty*, *Fortnite*)	10%
Racing (e.g., *Forza Horizon*, *Mario Kart*)	7%
Fighting (e.g., *Street Fighter*, *Tekken*)	0%
Dance games (e.g., *Just Dance*)	0%
Board games (e.g., *Monopoly Family Fun Pack*, *Pure Chess*)	0%
Party (e.g., *Mario Party*, *Wii Party*)	0%
Role playing (e.g., *Miitopia*, *Final Fantasy*)	0%
Social partners of video-gaming	
Social partners	*Players*
Alone	36%
Brothers/sisters	27%
Friends	20%
Parents	8%
Online friends	4%
Relatives	2%

n = 174.

As a first step, item distributions and descriptives were analyzed in order to assess for normality (**Table 2**). Skewness values ranged from −.01 to 1.29, while Kurtosis indices ranged from −1.43 to .40, indicating a slightly platykurtic distribution for the majority of the items. However, all the items evidenced a normal distribution (Curran, West, & Finch, 1996).

Then, a Confirmative Factor Analysis (CFA) was carried out, employing the maximum likelihood (ML) method using AMOS (Arbuckle, 2003), and testing the one-factor model. To verify the model's fit, the following indices were taken into account: the ratio of chi-square to its degrees of freedom (χ^2/df); the comparative fit index (CFI; Bentler, 1990); the Tucker-Lewis index (TLI; Tucker & Lewis, 1973); and the root mean square error of approximation (RMSEA; Steiger & Lind, 1980). In the case of χ^2/df, values below or equal to two are considered good, while values between two and three are considered acceptable (Schermelleh-Engel, Mossbrugger, & Müller, 2003). For the TLI and CFI indices, values above .90 are indicative of acceptable fit, while values above .95 are indicative of excellent fit (Hu & Bentler, 1999). The RMSEA value is considered acceptable when it is below .08 and good when it is below .05 (Kline, 2010).

The CFA attested that the items of the VGS-C Section B measured one dimension (χ^2/df = 1.26, CFI = .958, TLI = .944, and RMSEA = .039 [CI = .000 - .075]). All factor loadings were significant ($p < .001$), ranging from .37 to .57 (**Figure 1**).

Cronbach's alpha was .71 for the total scale. Following the cut-offs proposed by the European Federation of Psychologists' Association (EFPA; Evers et al., 2013), the internal consistency value was adequate. All corrected item-total correlations were equal or above .30.

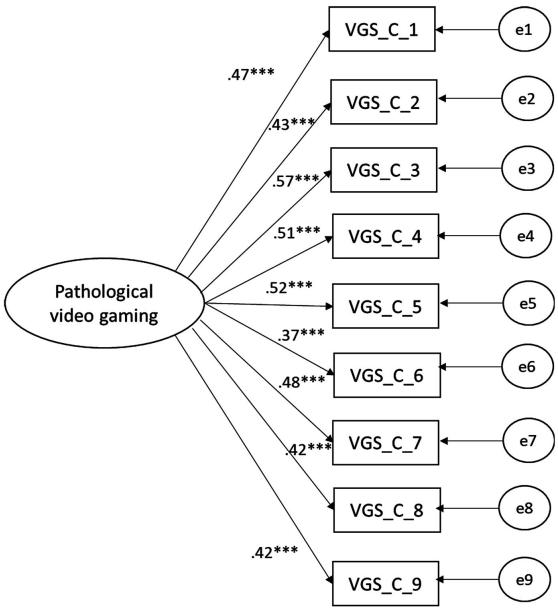

Figure 1. The one-factor model of the Video-Gaming Scale—for Children (VGS-C). Note: standardized parameters, all significant at .001, n = 174.

Table 2. Means, standard deviations, skewness, and kurtosis of the nine items of the Video Gaming Scale—for Children (VGS-C).

Item	M	SD	Skewness	Kurtosis
1	.85	.69	.20	−.88
2	.95	.80	.09	−1.43
3	.43	.67	1.29	.40
4	.94	.74	.09	−1.17
5	.84	.80	.30	−1.39
6	.95	.76	.09	−1.27
7	1.01	.76	−.01	−1.28
8	.48	.69	1.12	−.05
9	.88	.79	.22	−1.37

n = 174.

In order to analyze the criterion validity of the VGS-C, we investigated its associations with time spent playing video games and online gaming. Results showed that the VGS-C total score was significantly and positively correlated with daily frequency of playing video games ($r = .54$, $p < .001$), indicating an excellent validity (Evers et al., 2013). Moreover, there were statistically significant differences in the VGS-C total score between children who played video games online (M = 8.2, SD = 3.7) and those who did not (M = 5.9, SD = 3.4 (t (166) = 3.98, $p < .001$, Cohen's $d = .65$; Cohen, 1988). As a final step, a multiple linear regression was conducted using daily frequency of playing video games and online gaming as independent variables and the VGS-C total score as the dependent variable. Results showed that the model was statistically significant (F (2,163) = 36.07, $p < .001$) and the two independent variables accounted for 30% of the total variance of VGS-C score ($AdjR^2 = .31$). Specifically, daily frequency of playing video games had a statistically significant, positive and moderate predictive power on pathological video-gaming ($\beta = .50$, $p < .001$), as online gaming had ($\beta = .16$, $p < .001$).

3.3. Pathological Behavior

The percentage of item endorsement for each response option was calculated for the nine items of Section B (Table 3). Overall, results showed higher percentages of "many times" responses for the items reflecting tolerance, i.e., wanting to play even more with video games, and escape, i.e., getting to play to feel better, while the items with the lowest percentages of "many times" responses were those reflecting compromised relationships because of gaming, i.e., preferring to play video games rather than playing with friends, and lying, i.e., telling lies regarding the amount of gaming.

4. Discussion

In the current days, video games are a very popular activity among children

Table 3. Percentages of item endorsement for each response option on the Video Gaming Scale—for Children (VGS-C).

Item	Never	Few times	Many times
1	42%	33%	25%
2	32%	51%	17%
3	29%	42%	29%
4	38%	36%	26%
5	32%	42%	26%
6	30%	45%	25%
7	67%	23%	10%
8	35%	36%	29%
9	63%	26%	11%

n = 174.

(Cummings & Vandewater, 2007; Gentile, 2009; Gentile et al., 2011; Greenberg et al., 2010; Hamlen, 2010; Hastings et al., 2009; Kovess-Masfety et al., 2016; Lui et al., 2011; Rideout et al., 2010). Due to excessive video-gaming, children may experience negative effects, as emotional and behavioral problems (Lobel et al., 2017), as well as school and externalizing problems (Hastings et al., 2009). By applying the APA criteria for addiction or pathological gambling to define and assess the negative consequences related to gaming in children, the signs of pathological gaming have been identified (Gentile et al., 2011; Nogueira et al., 2019; Skoric et al., 2009). However, the measures used till now seem to be more a set of items rather than stand-alone measurement tools, and do not take into account the last indications given by the APA in 2013 concerning IGD. Moreover, they have not been used with children with an age starting from 6 years old, and their psychometric properties with this age group have not been analyzed yet.

Following these premises, the purpose of this study was to develop a measurement tool able to measure video-gaming habits and pathological behaviors related to video games in children. In detail, our aim was to develop a children-adapted version of the VGS-A Primi et al. (2017), a scale devoted to assess video-gaming behavior and pathological use of video games among adolescents based on the DSM-5 definition of IGD. Consistent with the original version, we developed two sections. The first section (Section A) consisted in a set of non-scored questions about video games use, preferred video games, daily frequency of video-gaming, the devices used to play video games, the amount of time spent on video-game sessions, the use of the Internet to play video games, the preferred online video games, and the social partners in playing video games. The second section (Section B) was composed of scored items regarding a series of pathological behaviors related to video games, based on the DSM-5 criteria for IGD.

Concerning video-gaming habits, the main findings consist of the fact that the vast majority of children played video games, in line with international studies (Gentile et al., 2011; Lui et al., 2011). The favored video game genres resulted to be Sandbox, Sport, and Action games, and this result is partially in line with a previous study in which children's preferred video game genres were Action and Adventure (Nogueira et al., 2019). Children played video games twice a day, in line with a previous study in which children played about eight sessions *per* week (Lobel et al., 2017). In increasing existing knowledge, this study showed that children used to play mostly in the afternoon, but there was a considerable portion of children who played video games in the evening, before falling asleep. It must be noted that the negative effects of electronic media on children's sleep quality have been widely documented (Cain & Gradisar, 2010), and using video games before bedtime has been linked to poor sleep outcomes for adolescents (Weaver, Gradisar, Dohnt, Lovato, & Douglas, 2010). Concerning this issue, it has been also found that children with risk behaviors for their video-gaming habits showed a shorter sleep duration (Nogueira et al., 2019).

This study also demonstrated that tablet has rapidly become the most used device by children, even if consoles and smartphones are largely spread (Lui et al., 2011; Rideout et al., 2010). The majority of children that participated in this study played video games for less than one hour per day, but there were 19% of them who played more than four hours per day. Overall, this data confirmed a considerable involvement of children in video-gaming in terms of hours devoted to gaming (Hastings et al., 2009; Kovess-Masfety et al., 2016; Lobel, et al., 2017; Nogueira et al., 2019). The current study also showed that more than half of the sample used Internet to play, with Sandbox, Simulation, and Shooter games as the most favored online video games, confirming an early interest in playing online games among children (Hamlen, 2010; Lui et al., 2011; Nogueira et al., 2019). Finally, the majority of children reported to play alone, even if a considerable proportion of them gamed with brothers/sisters or with friends. This result confirms previous studies in which most children resulted to play alone or with friends (Hastings et al., 2009; Nogueira et al., 2019).

Regarding the scored items of the VGS-C, unidimensionality has been confirmed. This property represents a desirable characteristic that makes the scale suitable to be used as a population screen of video-gaming problems. Moreover, the scale showed to have a good internal consistency. Criterion validity was also demonstrated finding that daily frequency of playing video games and the use of the Internet to game were significant and positive predictors of the total score, confirming previous results with children (Gentile et al., 2011; Nogueira et al., 2019) and adolescents (Wang et al., 2014). Furthermore, we also verified that the pathological gaming symptoms more frequently experienced by children were tolerance and escape, in line with a previous study that found that the main reasons why children like playing video games are to relax, to forget problems, and for the challenge of the game (Nogueira et al., 2019).

5. Conclusion

Some limitations should be considered during the interpretation of the present findings. Our sample had a moderate size and was formed by children that came from the same city in Italy; therefore, the interpretation of findings should be cautious in terms of generalizability. Future studies should replicate the present results with a larger sample of the Italian population, by involving children attending schools in different geographical areas. Given the potentials of the IRT, useful to weight the specific severity of each symptom in children, wider samples of children would also be useful to apply these models in order to more deeply analyze the psychometric properties of the VGS-C. In addition, it would be also useful to conduct longitudinal studies in order to obtain more robust evidence about the predictive validity of the scale, by means of some external validity measures too, as life satisfaction and psychosocial problems (Hastings et al., 2009; Lobel et al., 2017).

As indications for future research, it would be interesting to investigate the cross-cultural invariance of the scale by translating and validating the VGS-C in other languages, and also to verify if the VGS-C is invariant across genders, by using a larger sample of children, in order to test if the scale measures pathological gaming in the same way both in males and females. Furthermore, studies with clinical samples are needed in order to extend knowledge about the diagnostic sensitivity of the scale. Since it has been stated that even preschool children do use video games (Downing, Hinkley, & Hesketh, 2015), a further development of the present work could concern the employment of the Section A of the VGS-C in order to better understand video-gaming habits in 4 - 5 years old children. Finally, given that multi-informant assessment is recommended for the screening and diagnosis of clinical problems in the developmental age (e.g., De Los Reyes et al., 2015; Gizer et al., 2008; Hughes & Gullone, 2010; Hunsley & Mash, 2007; Izzo, Donati, & Primi, 2019), it should be desirable to develop a VGS-C form for parents in order to have the possibility to collect an hetero-evaluation of the children's video-gaming habits, thus having a more comprehensive assessment of the riskiness of this behavior for children.

Despite the limitations, our study has several important implications for clinical and research purposes. Indeed, the VGS-C can help clinicians not only for the diagnosis of IGD but also for the assessment of a wide array of characteristics in the early developmental age. For example, previous papers (Falbe et al., 2015; Gentile et al., 2011) documented that video games use can lead to the development of anxiety, depression, social phobia, and sleep problems. The VGS-C can also be used by scholars to deepen the pathological gaming construct and its related aspects in primary school children. For example, the VGS-C could be a useful instrument for researchers who want to study the correlates of the excessive use of video games in children, such as school outcomes (Hastings et al., 2009; Skoric et al., 2009) and psychosocial health (Lobel et al., 2017).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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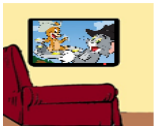
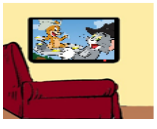
Appendix

Figurative representation of daily moment in school and weekend days.

SCHOOL DAYS

M1	M2	M3	M4	M5	M6	M7
						
AFTER WAKING UP	DURING THE BREAKFAST	DURING THE MORNING	AFTER LUNCH	IN THE AFTERNOON	BEFORE DINNER	BEFORE FALLING ASLEEP

WEEKEND DAYS

M1	M2	M3	M4	M5	M6	M7
						
AFTER WAKING UP	AT BREAKFAST	DURING THE MORNING	AFTER LUNCH	IN THE AFTERNOON	BEFORE DINNER	BEFORE FALLING ASLEEP