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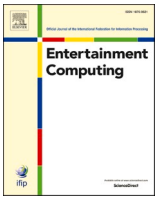

# Relationship between Gaming and other game related activities: Italian validation of the Screening Test for Problematic Gaming (STPG)

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ABSTRACT

*Introduction:* Gaming is a common leisure activity among adolescents which may have risky implications. The aim of the present study is to validate the Italian version of a short screening instrument, the Screening Test for Problematic Gaming (STPG), which is composed of three items and it is able to distinguish between problematic and non-problematic gamers in a non-clinical population.
*Methods:* Data were collected through the ESPAD (European School Survey Project on Alcohol and Other Drugs) questionnaire. It is a cross-sectional school survey that investigates risky behaviours in a representative sample of Italian high-school students (N = 12,237; 50.8% girls) aged between 15 and 19 years (mean = 17.02 years).
*Results:* After the STPG was translated and adapted for Italian use, Principal Component Analysis and Multiple Correspondence Analysis were performed to investigate psychometric properties of STPG and calculate the optimal scaling for each item. Cronbach's alpha was good (0.769).
Finally, confirmatory factor analysis using Structural Equation Modelling was performed, showing a correlation between STPG score and time/money spent gaming ($\beta = 0.467$ and $\beta = 0.238$, respectively), places where students played ($\beta = 0.142$) and gaming apparatus ($\beta = 0.165$).
*Conclusions:* The STPG could be a short and useful instrument for school surveys, to detect problematic gaming among adolescents early on.

## 1. Introduction

Gaming and online gaming are common leisure activities among adolescents, which provide an easy access source of fun. Specifically, these kinds of activities involve the use of several devices such as consoles, computers, tablets and smartphones; therefore, they permit young people to play in different places, including public transports and schools.

In particular, in 2019, 59% of European high-school students aged 16 reported playing a digital game during a typical school day in the past month, while 68% did the same during non-school days. Concerning the Italian context, around 62% and 71% of the students played videogames during a school day and a non-school day, respectively [1].

Moderate gaming activity may positively impact well-being and, compared with adolescents who have never played videogames, it is associated with higher levels of self-esteem, less depressive symptoms, having better relationships with family and friends, and less risky behaviours [2–4]. Moreover, some studies have emphasised the possible positive effect of gaming on cognitive and visual-spatial functions [5,6]. Anyway, during the last decades, gaming gained more and more attention for the associated risks. Indeed, it may be associated with problematic gambling behaviours and, especially when the time spent gaming is excessive, it is associated with poor school performance and a low psychosocial functioning [7,8]. Moreover, gaming has a potentially addictive nature which can result in problematic gaming, defined as excessive and risky video game use [9]. More than just playing video games, problematic gaming is associated with several risks such as substance use, lower psychosocial well-being, aggressive/oppositional behaviour or hostility, and psychosocial problems [10]. In this regard, the scientific literature has also highlighted several predisposing factors for developing problem behaviour such as personality traits, being male, gaming features such as loot boxes or other gaming microtransaction,

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and certain gaming motivations (e. g. social, escapism, and competition motives and coping with negative emotions) [10–12]. More in detail, both loot boxes and gambling involve a person betting money on the result of a chance event in the hopes of winning a prize of considerable worth. Opening loot boxes is frequently accompanied by thrilling sounds and visuals, similar to what happens in a live gabling context. These characteristics of games can provide feelings of reward, especially if they involve real money. They can therefore be addictive in nature and encourage the development of a problem gaming pattern [12].

In 2013, the American Psychiatric Association (APA) considered the *Internet Gaming Disorder (IGD)* in the fifth revision of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5), even if not* as a formal diagnosis [13]. More in detail, the DSM-5 states nine diagnostic criteria that have to be present over a 12-month period: excessive preoccupation with Internet gaming; symptoms of discomfort when not playing games or when unable to play (withdrawal); tolerance, i.e. a need to increase the time spent playing games; several and unsuccessful attempts to reduce Internet gaming; loss of interest in performing previously enjoyable activities; excessive use of games despite awareness of the psychosocial problems involved; using deception about the amount of time spent gaming; using gaming to ward off a negative mood; putting relationships, work and educational opportunities at risk because of Internet gaming [13].

Moreover, *Gaming Disorder* has also been included in the 11th edition of the *International Classification of Diseases (ICD-11)*. It is described as a condition where a person displays a persistent or repetitive pattern of gaming behaviour, either online or offline. This pattern is characterized by impaired control over gaming, prioritizing gaming over other daily activities and interests, and continuing to game despite negative consequences. It may occur regularly or sporadically and can result in significant distress or impairment in various areas of a person's life. The diagnosis of gaming disorder requires that these symptoms are present for at least 12 months, but the duration may be shorter if all diagnostic criteria are met and symptoms are severe [14]. For all these reasons, it could be particularly useful to easily differentiate between non-problematic and problematic gaming profiles and to detect early signs of frailty.

Many tools for evaluating problematic gaming may be found in the scientific. Concerning the Italian context, the Video-Gaming Scale - For Adolescents (VGS-A; [15]) and he Internet Gaming Disorder Scale – Short-Form (IGDS9-SF; [16,17]) are available to assess problem gaming in adolescents while the Video-Gaming Scale - For Children (VGS-C; [18]) is suitable for assessment in young people of primary school age. The VGS-A and the VGS-C are composed by two section. The first section is aimed at the evaluation of the gaming habits (such as preferred game genres and time spent on video games) while the second section, which is composed by nine items, is about problematic gaming. The IGDS9-SF is validated on a sample of high schools and university school students and it is composed by nine items too. Therefore, to our knowledge, the available screening tests for problematic gaming are composed by nine item or more. Anyway, using particularly brief screening tests can be valuable in settings where time and resources are limited, as they allow for efficient identification of individuals who may require further evaluation or treatment. Moreover, brief and ultra-brief scales can be valid and reliable as shown by Kroenke and colleagues [19] in the context of anxiety and depression.

In 2014, Holstein and colleagues developed a non-clinical tool for assessing perceived problems concerning Internet use and gaming. Our study is focused on the three items of the questionnaire developed to assess perceived problem with computer gaming. It is a very brief assessment tools, developed for students, which showed a good reliability and validity. In our opinion, it could be particularly useful in school survey because it is easy to administer and time-saving.

For these reasons, the article aims to validate the Italian version of the three-item of the questionnaire in a representative sample of Italian high-school students (15–19 years-old). To evaluate the criterion validity, variables that are expected to be correlated with problematic gaming are considered. To this purpose, the number of hours spent playing video games and the duration of a single gaming session have been studied extensively in relation to problematic gaming [20–25]. Money expenditure is also an included variable, as it can be a risk factor for gaming problem [12,26]. Finally, other gaming characteristics such as the device used and the place in which students played, are also analysed to provide a more comprehensive understanding of the relationship between the STPG and gaming behaviours. By analysing these variables, it could be possible to create a useful tool for estimating the presence of self-perceived gaming problems, which can help identify individuals who may need support or intervention to address their gaming problems.

## 2. Methods

### 2.1. Design and participants

The present study uses data from ESPAD®Italia 2021 (European School Survey Project on Alcohol and Other Drugs), a self-administered school survey conducted annually, since 1999. The survey aims to monitor risk behaviours among the Italian high-school student population.

The ESPAD methodology [27] allows for the collection of data from a representative sample of high-school students, aged 15–19 years. The questionnaires were administered during lesson teaching hours, in a controlled setting with the presence of a teacher.

All the students were informed that participation was anonymous and voluntary. The participation rate was 99% of the students present on the day of data collection: the final sample of our study was composed of 12,237 high-school students and 50.8% of the students were female. Participants were between 15 and 19 years old (mean = 17.02 years; sd = 1.42). The descriptive analysis divided participants into two age groups: 15–17 years-old (59.0%) and 18–19 years old (41.0%). The present analyses were restricted to 6,710 students who reported any gaming activity in the last 12 months and fully completed the STPG questionnaire.

### 2.2. Measure

#### 2.2.1. Gaming questionnaire

The questionnaire used to screen problematic gaming is composed of three items.

1. I think I spend way too much time on gaming;
2. I get in bad mood when I cannot spend time on gaming;
3. My parents tell me, I spend way too much time on gaming.

The items were based on Holstein and colleagues' [23] questionnaire. The response options were a five-point Likert scale (strongly agree, partially agree, neither agree/nor disagree, partially disagree, strongly disagree).

#### 2.2.2. Translation and adaptation

Cross-cultural adaptation of the STPG items has been carried out according to international guidelines [28]: (a) two independent Italian translations were obtained from two independent translators who were native Italian speakers with proficiency in English. The Italian adaptation was achieved during a consensus meeting; (b) back-translation from Italian to English was carried out by a native speaker, not involved in developing the initial version; (c) the original and back-translated English versions were compared to assure that there were no differences in the meaning of the questions in the questionnaire; (d) any inconsistencies between versions were discussed and resolved among the translators until a final version was reconciled.

### 2.2.3. Gaming characteristics

The ESPAD®Italia questionnaire allow for obtaining information about gaming activities. Students were asked if they have played videogames during their life or during the last year. Students who played during the previous year were asked which types of game they played (strategy, simulation, adventure, sports, role-playing games, action games, multiplayer role-play games), distinguishing between online and offline games. They were also asked how many hours they spent gaming during the last 30 days, distinguishing between school days from non-school days. The answer options were: Not having gamed, Less than 30 min-1 h, 1–4 h, More than 4 h. Moreover, students were asked how many hours they spent gaming without interruptions during the last 30 days, again distinguishing between school days from non-school day; the possible answers were: Not having gamed, Less than 30 min-1 h, 1–4 h, More than 4 h. Monthly expenditure on internet videogame during last year was assessed with the following answer options: 0 euros, Less than 10 euros, About 11–50 euros, More than 51 euros. Finally, the ESPAD®Italia questionnaire assessed which devices were used (computer, tablet, console, smartphone or TV) and where students played videogames (school, home, friend's home, public places or public transports).

## 2.3. Statistical analysis

Statistical analysis was performed using software SPSS (version 23.0) and STATA (version 13.0). Categorical variables are expressed as percentages, and the continuous variables are expressed as mean ± standard deviation.

To explore the dimensionality of STPG, the Principal Component Analysis (PCA) was performed. The number of dimensions and the item loading structure of the PCA was conducted on the correlation matrix of the three items. Two classical criteria from PCA were used: a) eigenvalue rule (number of factors with eigenvalue of $> 1$) and b) Scree plot (number of factors before the break in the Scree plot). When the scale uni-dimensionality was supported, we recoded the Likert points of SPCGQ items by an "optimal scaling method" via the Multiple Correspondence Analysis (MCA) [29,30].

The MCA method uses the Likert points as nominal categories responses, and enables optimal grading for each category response of the Likert questions (called "optimal weights"); consequently, an "optimal score" for each subject may be obtained. The optimal score of a subject is the sum of the optimal weights of the item options chosen. Additionally, internal consistency of STPG items was computed by Cronbach Index (α) reliability coefficient. To validate the stability of PCA and MCA results, we performed a split-half cross-validation procedure [31] applied to discrimination measures such as eigenvalue, factor loadings, Cronbach's alpha, and MCA results. We randomly selected samples from each group, balancing for geographical area, gender, and age (Group 1: n° 3,364, Group 2: n° 3,346).

Finally, confirmatory factor analysis (CFA) using Structural equation modelling (SEM) by Stata/SE 13.1 software, used to test the proposed model (Fig. 1) with Robust maximum likelihood (RML) estimation method. The path analysis technique used measures to the extent that the model fit a data set and allowed testing of interrelationships between a range of variables simultaneously. The proposed model included four latent variables (Components): Screening Test for Problematic Gaming

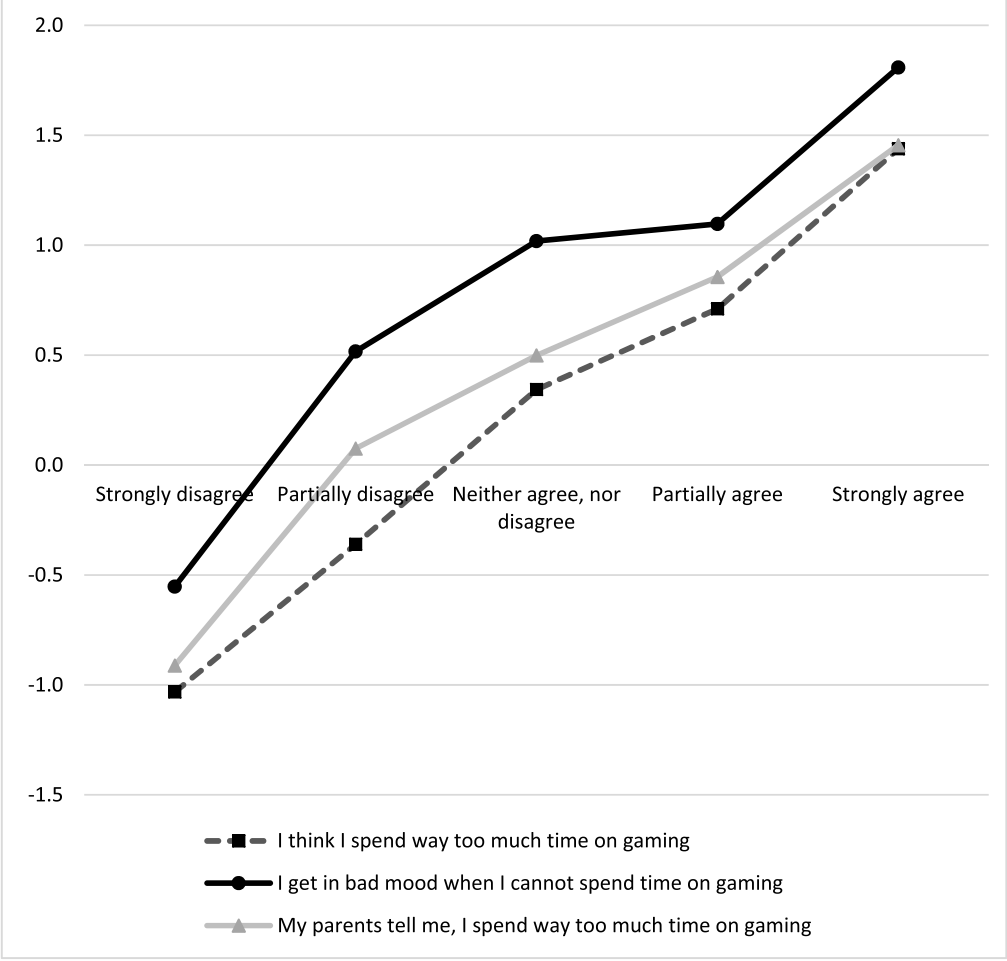


**Fig. 1.** Optimal weights recording of the SPTG Likert format items.

(STPG) and other game related activities such as time spent playing, gaming apparatus, monthly expenditure during last year, and gaming places. The overall model fit was assessed using Root Mean Square Error of Approximation (RMSEA) (values between 0.05 and 0.08 indicate acceptable fit, and values < 0.05 a good fit), Comparative Fit Index (CFI) (values > 0.90 indicate reasonable fit, >0.95 good fit), and Standardised Root Mean Square Residual (SRMR) (values < 0.10 indicate good fit) [32].

## 3. Result

90.4% of students have gamed in their life, while 68.1% during the last year. In general, higher percentages refer to male students compared to females. With respect to having gamed during the last year, minor students reported a higher percentage (71.0%) compared to students older than 18 years old (63.6%; $p < 0.001$) and male students reported a higher percentage (88.7%) compared to female (46.9%; $p < 0.001$) (Table1).

Concerning offline videogame type, 47.2% of the students who gaming during the last year played action games, 44.9% adventure games, 40.5% sport games, 40.2% multiplayer role-play games, 35.8% strategy games, 30.0% simulation games, and 24.5% role-play games. Among students who played online during the last year, 52.0% played action games, 50.1% multiplayer role-play games, 40.8% adventure games, 38.3% strategy games, 35.4% sport games, 31.2% simulation games and 26.5% role-play games.

A higher percentage of males played all game types both offline and online, comparing to females. Moreover, boys preferred action online/offline games while females preferred adventures games. There weren't any age differences, excluding the offline strategy games, preferred by students aged 18–19 years.

In the last 30 days, the majority of the last year gamers spent from 30 min to 1 h playing during schooldays 1–4 h during non-schooldays (respectively 36.1% and 37.1%). males played more than females ($p < 0.001$) and minors played more than students over 18 years old ($p < 0.001$).

As reported by gamer students, each gaming session lasts from 30 min to 1 h during schooldays (49.8%) and from 1 to 4 h during non-schooldays (47.8%). In general, minors and males played longer gaming sessions both in schooldays and non-schooldays ($p < 0.001$).

36.1% of last year gamer students spent money for Internet gaming, especially males ($p < 0.001$) and minors ($p = 0.004$).

Among gamer, the most used devices were the console (68.8%) and the smartphone (49.8%). Males used computer (36.0%) and console (75.9%) more than females (computer = 29.0%, $p < 0.001$; console = 55.2%, $p < 0.001$) while the other devices were especially used by females.

Finally, the majority of the gamer students reported to have gamed at home (94.4%) and at friends' house (33.0%). A higher percentage of males played in each considered setting ($p < 0.001$) and students over 18 years played at schools more than minors (Table 2).

**Table 1**
Sampling descriptive statistics.

| | | Age classes (%) | | | | Total (%) |
|---|---|---|---|---|---|---|
| | | 15–17 | | 18–19 | | |
| **Sex** | Male | 48,5 | | 50,2 | | 49,2 |
| | Female | 41,5 | | 49,8 | | 50,8 |
| | | **Age classes (%)** | | **Sex (%)** | | **Total (%)** |
| | | **15–17** | **18–19** | **Male** | **Female** | |
| **Lifetime gaming** | Yes | 91.0 | 89.5 | 96.5 | 83.9 | 90.4 |
| **Last Year gaming** | Yes | 71.0 | 63.6 | 88.7 | 46.9 | 68.1 |

### 3.1. Dimensionality analysis and optimal scaling

The PCA identified one Principal Component (PC) for SPTG items with eigenvalue of >1 (2.052) that explained for 68.4% of the observed total variance. The uni-dimensionality of SPTG items was also supported. Given the successful uni-dimensionality testing of SPTG scale, optimal scaling via MCA was performed. The descriptive indices calculated are shown in Table 3. The first column of the table represented the "factor loadings" (the square root of the discrimination coefficients). For example, the correlation of the optimal recoded SPTG item 1 "I think I spend way too much time gaming" and the first dimension is 0.838 and explains the $(0.838)^2 = 70.2\%$ of the score variability. For the recoded SPTG item 2 "I get in a bad mood when I cannot spend time gaming" the correlation is 0.776 and explains the $(0.776)^2 = 60.2\%$ of the score variability. While for the SPTG item 3 the correlation is 0.865 and explains the $(0.865)^2 = 74.0\%$. For the three SPTG statements the Cronbach Index is 0.769 (95% CI:0.759–0.778).

Following the split-half cross-validation procedure, PCA and MCA were performed for each group. In the group 1, the PCA identified one PC for SPTG items with eigenvalue of >1 (2.043) that explained for 68.1% of the observed total variance. Similarly, in the group 2, a PC was identified with eigenvalue of > 1 (2.061) that explained for 68.7% of the observed total variance.

A more detailed description of the results is available in Table 4.

The transformation plots of the optimal weights for STPG Likert scale are summarised in Table 3 and displayed in Fig. 1. STPG items describe a Likert scale, so the relationship between the scoring system could be considered as a linear transformation from continuous to ordinal scale.

The equidistance assumption of STPG items was respected but some response options in some items had different weights. For example, if the subject response pattern is: partially agree (item 1), partially disagree (item 2), strongly agreed (item 3), the recoded response subjects score is: $2.8 + 1.8 + 4.0 = 8.6$.

Computing a score using the recoded format, the full range of item responses yielded a total score ranging from 0 to 12.

The STPG score greater than or equal to the 75th percentile was equal to 7.0 points; score greater than or equal to the 80th percentile was equal to 7.4 points; score greater than or equal to the 85th percentile was equal to 8.0 points; and score greater than or equal to the 90th percentile was equal to 8.6 points. Overall, the mean score of STPG in our sample is 4.16 (sd = 3.47; median = 4.00). The STPG score was significantly lower in females (mean = 2.87; sd = 3.33; median = 1.60) than in male (mean = 4.82; sd = 3.33; median = 5.10) ($p < 0.001$).

The standardised paths of all the four components to their respective variables were specified in Fig. 2. The Structural Model Fit indices indicated that the proposed model fits the data adequately (RMSEA = 0.056; SRMR = 0.060; CFI = 0.924; TLI = 0.907) [33]. STPG latent variable was positively associated with hours spent playing ($\beta = 0.467$; SE = 0.012; $p < 0.001$), with monthly expenditure during last year ($\beta = 0.238$; SE = 0.014; $p < 0.001$), with gaming places ($\beta = 0.142$; SE = 0.017; $p < 0.001$), and with gaming apparatus ($\beta = 0.165$; SE = 0.025; $p < 0.001$). Monthly expenditure during last year was positively associated with gaming places ($\beta = 0.125$; SE = 0.015; $p < 0.001$) and positively associated with hours spent playing ($\beta = 0.447$; SE = 0.010; $p < 0.001$). Finally, gaming apparatus was positively associated with gaming places ($\beta = 0.555$; SE = 0.026; $p < 0.001$).

## 4. Discussion

Gaming is a common leisure activity among high-school students, and they spend several hours gaming both on non-schooldays and schooldays. In line with data from other European countries, boys spend more hours gaming [1] and they play for longer sessions. According to scientific literature [34], action games are the most popular among boys, while girls prefer adventure games. Consoles and smartphones are the

**Table 2**
Gaming characteristics among gamer students (in the last year).

| | | Age classes (%) | | | Sex (%) | | | Total (%) |
|---|---|---|---|---|---|---|---|---|
| | | 15–17 | 18–19 | X2 | Male | Female | X2 | |
| **Type of games played offline** | Strategy | 35.1 | 37.5 | 0.049 | 40.4 | 26.9 | <0.001 | 35.8 |
| | Simulation | 29.8 | 30.9 | n.s. | 31.8 | 26.6 | <0.001 | 30.0 |
| | Adventure | 44.8 | 45.6 | n.s. | 44.6 | 45.5 | <0.001 | 44.9 |
| | Sport | 39.7 | 41.4 | n.s. | 50.0 | 22.6 | <0.001 | 40.5 |
| | Role-play | 24.3 | 25.6 | n.s. | 27.1 | 19.5 | <0.001 | 24.5 |
| | Action | 46.8 | 47.9 | n.s. | 53.3 | 35.8 | <0.001 | 47.2 |
| | Multiplayer role-play | 40.9 | 39.7 | n.s. | 46.4 | 28.2 | <0.001 | 40.2 |
| **Type of games played online** | Strategy | 38.2 | 38.9 | n.s. | 44.7 | 25.8 | <0.001 | 38.3 |
| | Simulation | 30.5 | 32.7 | n.s. | 33.9 | 25.8 | <0.001 | 31.2 |
| | Adventure | 41.3 | 40.4 | n.s. | 42.9 | 36.6 | 0.001 | 40.8 |
| | Sport | 34.2 | 37.0 | n.s. | 47.2 | 12.2 | <0.001 | 35.4 |
| | Role-play | 26.9 | 26.6 | n.s. | 31.4 | 16.9 | <0.001 | 26.5 |
| | Action | 52.2 | 51.9 | n.s. | 61.7 | 33.2 | <0.001 | 52.0 |
| | Multiplayer role-play | 50.5 | 49.7 | n.s. | 59.3 | 32.0 | <0.001 | 50.1 |
| **Time spent on gaming during schooldays in the last 30 days** | Not having gamed | 23.9 | 27.3 | <0.001 | 16.5 | 42.0 | <0.001 | 25.2 |
| | 30 min-1 h | 35.9 | 36.4 | | 33.8 | 41.1 | | 36.1 |
| | 1–4 h | 30.6 | 29.3 | | 39.0 | 13.3 | | 30.1 |
| | More than 4 h | 9.5 | 7.0 | | 10.7 | 3.6 | | 8.5 |
| **Time spent on gaming during non-schooldays in the last 30 days** | Not having gamed | 17.2 | 19.7 | <0.001 | 10.9 | 31.8 | <0.001 | 18.1 |
| | 30 min-1 h | 27.7 | 31.4 | | 23.4 | 40.5 | | 29.1 |
| | 1–4 h | 38.0 | 35.5 | | 46.1 | 20.2 | | 37.1 |
| | More than 4 h | 17.1 | 13.3 | | 19.6 | 7.5 | | 15.7 |
| **Time spent gaming for a single session during schooldays** | 30 min-1 h | 47.4 | 52.8 | <0.001 | 40.0 | 73.3 | <0.001 | 49.8 |
| | 1–4 h | 43.1 | 41.0 | | 50.0 | 23.4 | | 42.1 |
| | More than 4 h | 9.5 | 6.2 | | 10.1 | 3.3 | | 8.1 |
| **Time spent gaming for a single session during non-schooldays** | 30 min-1 h | 33.8 | 38.1 | <0.001 | 23.8 | 60.6 | <0.001 | 35.5 |
| | 1–4 h | 47.6 | 47.8 | | 55.9 | 30.4 | | 47.8 |
| | More than 4 h | 18.7 | 14.1 | | 20.3 | 9.0 | | 16.7 |
| **Monthly expenditure during last year** | 0 euros | 62.3 | 66.5 | 0.004 | 54.7 | 84.0 | <0.001 | 63.9 |
| | 5–10 euros | 14.2 | 11.7 | | 16.1 | 7.1 | | 13.2 |
| | 11–50 euros | 13.8 | 12.4 | | 16.6 | 6.2 | | 13.2 |
| | More than 51 euros | 9.7 | 9.5 | | 12.7 | 2.7 | | 9.6 |
| **Gaming apparatus** | Smartphone | 49.7 | 50 | n.s. | 46.5 | 56.2 | <0.001 | 49.8 |
| | Tablet | 10.2 | 8.5 | 0.019 | 6.8 | 14.3 | <0.001 | 9.5 |
| | Computer | 33.9 | 33.8 | n.s. | 36.0 | 29.0 | <0.001 | 33.9 |
| | Tv | 10.7 | 9.3 | n.s. | 8.6 | 12.8 | <0.001 | 10.2 |
| | Console | 68.1 | 69.9 | n.s. | 75.9 | 55.2 | <0.001 | 68.8 |
| **Gaming places** | School | 6.0 | 9.5 | <0.001 | 8.6 | 4.7 | <0.001 | 7.4 |
| | Home | 94.6 | 94.1 | n.s. | 97.0 | 90.0 | <0.001 | 94.4 |
| | Friends' house | 30.9 | 36.3 | n.s. | 33.0 | 32.5 | <0.001 | 33.0 |
| | Closed public places | 3.3 | 3.6 | n.s. | 3.9 | 2.3 | <0.001 | 3.4 |
| | Opened public places | 4.3 | 4.9 | n.s. | 5.1 | 3.2 | <0.001 | 4.5 |
| | Public transports | 9.6 | 9.1 | n.s. | 9.3 | 9.0 | <0.001 | 9.4 |

Note: n.s. not statistically significant.

most commonly used devices and students mainly play at their own home.

This study explores the psychometric properties of the Italian validation of the Screening Test for Problematic Gaming (STPG), a three-item questionnaire adapted form Holstein and colleagues [23]. Specifically, the questionnaire provides a short, easy and self-report instrument to discriminate between problematic and not problematic gaming profiles in a non-clinical sample. Therefore, it is useful to evaluate the proportion of adolescents who report self-perceived gaming problems, from a non-pathological perspective. Holstein and colleagues [23] developed the items starting from the student's perspective and experience and, after a pilot test, they validated the questionnaire in a sample composed of 2,100 Danish students (11; 13 and 15 years old).

PCA was conducted to determine STPG dimensionality. It shows only one principal component with eigenvalue $> 1$ (2.075) that explains for 68.4% of the total observed variance. The items analysis showed that all factor loadings coefficients were above 0.50, indicating a robust discrimination ability for each of the three statements. Reliability analysis, performed by MCA, shows a good Cronbach's alpha index (0.778; 95% CI: 0.768–0.786) for the total score of STPG Likert format items recording. According to the criteria proposed by DSM-5 and ICD-11 [13,14], the screening test can evaluate the early warning signs of problematic gaming such as withdrawal symptoms (e.g. irritability and bad mood) when gaming is not possible, or disagreements with family members about time spent playing. The questionnaire summarises the diagnostic criteria in only three items, highlighting the presence of

**Table 3**
Multiple Correspondence Analysis optimal weights recording of the SPTG Likert format items.

| | Factor Loadings | | Strongly disagree | Partially disagree | Neither agree/nor disagree | Partially agree | Strongly agreed | Cronbach's alpha |
|---|---|---|---|---|---|---|---|---|
| *1.*I think I spend way too much time gaming | 0.838 | a | −1.030 | −0.361 | 0.339 | 0.709 | 1.447 | 0.778 (95% CI: 0.768–0.786) |
| | | b | 0.0 | 1.1 | 2.2 | 2.8 | 4.0 | |
| *2.*I get in bad mood when I cannot spend time gaming | 0.776 | a | −0.553 | 0.513 | 1.014 | 1.095 | 1.821 | |
| | | b | 0.0 | 1.8 | 2.6 | 2.8 | 4.0 | |
| *3.*My parents tell me, I spend way too much time gaming | 0.865 | a | −0.910 | 0.072 | 0.493 | 0.853 | 1.463 | |
| | | b | 0.0 | 1.6 | 2.4 | 3.0 | 4.0 | |

a) Optimal weight values. b) Optimal weight values rescaled to the original Likert scale.

**Table 4**
Multiple Correspondence Analysis optimal weights recording of the SPTG Likert format items in Group 1 and Group 2.

| | | Factor Loadings | Strongly disagree | Partially disagree | Neither agree/nor disagree | Partially agree | Strongly agreed | Cronbach's alpha |
|---|---|---|---|---|---|---|---|---|
| *Group 1* | *1.*I think I spend way too much time gaming | 0.837 | −1.054 | −0.393 | 0.378 | 0.669 | 1.444 | 0.778 (95% CI: 0.763–0.789) |
| | *2.*I get in bad mood when I cannot spend time gaming | 0.773 | 0.556 | −0.545 | 1.020 | 1.050 | 1.803 | |
| | *3.*My parents tell me, I spend way too much time gaming | 0.863 | −0.933 | 0.123 | 0.491 | 0.803 | 1.454 | |
| *Group 2* | *1.*I think I spend way too much time gaming | 0.839 | −1.004 | −0.329 | 0.295 | 0.750 | 1.452 | 0.779 (95% CI: 0.764–0.791) |
| | *2.*I get in bad mood when I cannot spend time gaming | 0.778 | −0,549 | 0.479 | 1.007 | 1.142 | 1.846 | |
| | *3.*My parents tell me, I spend way too much time gaming | 0.867 | −0,885 | 0.022 | 0.492 | 0.907 | 1.474 | |

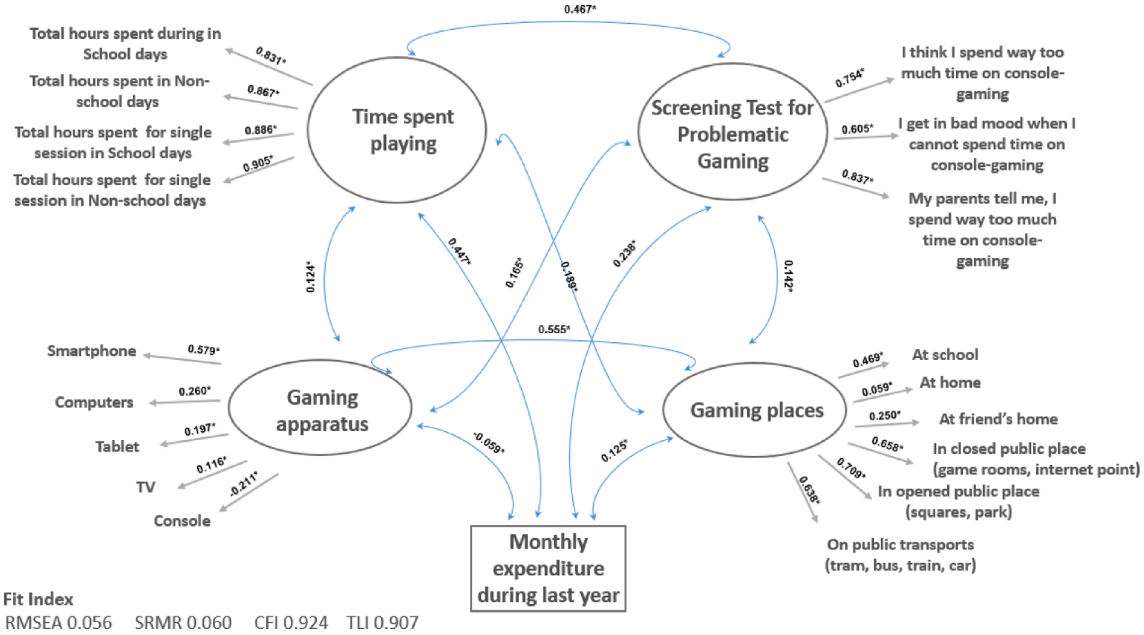


**Fig. 2.** Screening Test for Problematic Gaming (STPG) and other game related activities Model; RMSEA: Root Mean Square Error of Approximation. SRMR: Standardised Root Mean Square Residual; CFI: Comparative Fit Index.

potentially risky characteristics. Additionally, they are formulated to make them simple to understand for adolescents who self-administer them. The study is conducted on a very large sample representative of the Italian high-school students' population; thus, it can provide a robust validation of the STPG. Accordingly, a similar methodology to identify at-risk behaviour in the general population was proposed in other studies concerning problematic internet use and cannabis abuse [35,36].

Optimal weight values rescaled to the original Likert format show that being partially disagree with the item "I get in a bad mood when I cannot spend time gaming" (item 2) has a score of nearly 2 points

(instead 1 point). It is an interesting result and it may suggest that item 2 has more importance in determining the final score of STPG. In fact, item 2 may reflect a more problematic behaviour: while item 1 (I think I spend way too much time gaming) refers to the self-perception and awareness of the time spent playing, and item 3 (My parents tell me I spend way too much time gaming) refers to other one's perception of time spent gaming, item 2 may be related to initial withdrawal symptoms, that, may indicate an at-risk gaming behaviour.

In general, higher scores of the STPG correspond to a higher level of self-perceived problematic gaming and the 75th percentile was equal to 7.0 points; the 80th percentile was equal to 7.4 points, while the 90th percentile was equal to 8.6 points. However, the study is conducted on the non-clinical population; thus, further investigations are needed to explore the clinical population and provide information on a suitable cut-off for different populations.

After testing the reliability of the Screening Test, the structural equation model (SEM) was applied to explore the pathways between STPG and hours spent playing, gaming apparatus, monthly expenditure on videogame during last year, and gaming places.

The SEM pathways shown in Fig. 2 highlighted a positive correlation between the STPG score and the hours spent for gaming both during school and non-school days. Moreover, the STPG score also resulted to be strongly correlated with the time spent during a single gaming session. Our findings are in line with the scientific literature [20–25]. In particular, Holstein and colleagues [23] observed a significant association between time spent for gaming and perceived problems related to this kind of behaviour. As already observed in the literature, we also found a positive association between perceived problematic gaming and money spent on the Internet for gaming (e.g. buy and/or update videogame, pass to the next level) [26]. In a less strong way, a higher level of perceived problematic gaming resulted to be associated with an increase of both the use of devices (smartphone, console and tablet) and places to play, especially public transports, public places (e.g. parks, game rooms, Internet points), and school. In regards to the devices used for gaming, we also observed that students who use consoles tend to not use other devices thus suggesting a potential difference between console-gamer profiles and other types of gamers. These findings are in line with the literature [37] that suggest differences in game-play (e.g. game interfaces) and game usage (game installation, availability, and possibility of customize the game). Furthermore, they are confirmed by the pilot test conducted by Holstein et al. [23] which shows that adolescents distinguish between computer gaming and console gaming.

Lastly, our results showed that boys obtained significantly higher scores in the STPG compared with girls. It is in line with Holstein and colleagues' [23] study and with other literature findings [38–40] and it suggests that boys deserve more attention in regards to gaming behaviour and they may be a target population for preventive interventions.

## 5. Strengths and limitations

The major study strength is that the STPG is validated in a large sample representative of the high-school student population. Therefore, the questionnaire is a reliable, valid, short, and simple screening test, able to evaluate problematic characteristics of gaming behaviours in a non-clinical population. It is important to mention that gaming-related problems may also involve adults, while this article targets a specific adolescent population; further research may focus attention on readapt and validate the STPG in the adult population.

Our study also presents some limitations. We conducted a cross-sectional study, which does not allow us to observe potential cause-effect relationships and we used a self-report questionnaire, which may involve both memory recall biases and social desirability biases. Specifically, the item about the time spent for gaming is related to a self-perceived gaming duration so that there may be a misperception of one's own gaming behaviour. Accordingly, literature findings do not show a linear association between the time spent for gaming and problematic gaming. However, the majority of studies have investigated gaming or problematic gaming using self-report questionnaires that can be affected by the misperception of the subjects about their problematic gaming.

## 6. Conclusion

The Screening Test for Problematic Gaming (STPG) is a valid and reliable screening questionnaire to evaluate problematic gaming in non-clinical populations. It is also short (only three items), self-report, and simple to be understood by adolescents. All these characteristics make the STPG a useful instrument for school surveys, for those about at-risk behaviours and for those about everyday life and adolescents' wellbeing.

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## Data availability statement

The data will be made available on request.

## Ethics approval statement

Parental permission for their children to participate was obtained prior to survey administration. Moreover, the study complies with the European and national ethics rules and had the approval of the Ethics Committee of the Italian CNR.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

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