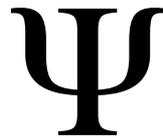




DET PSYKOLOGISKE FAKULTET



***Video Game Addiction among High School Students in Hordaland;
Prevalence and Correlates***

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VIDEO GAME ADDICTION AMONG HIGH SCHOOL STUDENTS IN HORDALAND;
PREVALENCE AND CORRELATES¹

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Summary.—The aim of this study was to estimate the prevalence and correlates of video game addiction among high school students ($N = 531$) in Hordaland county, Norway. Video game addiction measured by the Game Addiction Scale for Adolescents was estimated both by a monothetic and a polythetic format. The prevalence was found to be 2.5% and 12.5%, respectively. Regression analyses were conducted where video game addiction comprised the dependent variable. Demographic variables, depression, anxiety, loneliness, aggression, smoking, and alcohol consumption comprised the independent variables. Video game addiction was positively associated with male gender, depression, anxiety, loneliness, aggression and smoking, and negatively associated with both higher paternal education and alcohol consumption. Little research has been conducted on video game addiction and there is no consensus concerning its operationalization. Still, the results of our study are fairly consistent with previous findings and contribute to the construct validity of video game addiction.

Sammendrag.—Formålet med denne studien var å estimere prevalens av, og korrelater til dataspillavhengighet blant elever på videregående skole (N=531) i Hordaland, Norge. Dataspillavhengighet, målt med Game Addiction Scale for Adolescents, ble estimert både med et monotetisk og et polytetisk format som gav prevalensestimater på henholdsvis 2.5 % og 12.5 %. Regresjonsanalyser ble utført med dataspillavhengighet som avhengig variabel, og hvor kjønn, alder, foreldres utdanning, bosted, depresjon, angst, ensomhet, aggresjon, røyking og alkoholforbruk utgjorde de uavhengige variablene. Resultatene viste positive sammenhenger mellom dataspillavhengighet og mannlig kjønn, depresjon, angst, ensomhet, aggresjon og røyking. Negative sammenhenger ble funnet mellom dataspillavhengighet og fars høyere utdanning, og med alkoholforbruk. Det er foreløpig gjort lite forskning på feltet og der foreligger ikke konsensus når det gjelder operasjonalisering av dataspillavhengighet. Resultatene av studien er i hovedsak konsistente med tidligere funn, og bidrar på denne måten til begrepsvaliditeten av dataspillavhengighet.

1 Major technological development has taken place in recent decades. Various types of
2 video games have been a part of this development, and video game playing is a popular
3 activity among young people. Between 75% and 90% of children and young people report
4 that they play video games (Wallenius, Rimpela, Punamaki & Lintonen, 2009).

5 Some individuals display excessive use of video games. It has been argued that this is
6 addictive behavior, and it has also been argued that video game addiction should be included
7 as a diagnosis in the DSM-V (Lemmens, Valkenburg & Peter, 2009). According to
8 Mendelson and Mello (1986), addictive behavior is excessive, compulsive and uncontrollable
9 behavior that can lead to harmful consequences, both psychologically and physically. Like
10 pathological gambling, video game addiction is considered to be a behavior-based or non-
11 chemical dependency (Gentile, Choo, Liau, Sim, Li, Fung *et al.*, 2011). Griffiths (2005) and
12 Johansson and Götestam (2004) argue that gambling and video game addiction seem to share
13 common features. Lemmens *et al.* (2009) define video game addiction as excessive and
14 obsessive video game playing resulting in social or emotional problems, while the player is
15 unable to control his/her use.

16 According to Salguero and Morán (2002), it is a problem in many studies in this field
17 that video game addiction is not rooted in official diagnostic manuals. Thus, validated
18 diagnostic criteria do not exist. Several instruments have been developed to define and
19 measure video game addiction, and these are mainly based on the criteria for pathological
20 gambling taken from different editions of the Diagnostic and Statistical Manual of Mental
21 Disorders (DSM-III-R; DSM-IV, American Psychiatric Association, 1987; 1994) (Wenzel,
22 Bakken, Johansson, Götestam & Øren, 2009). Griffiths (1991) and Fisher (1994), among
23 others, developed instruments measuring video game addiction based on the criteria for
24 gambling addiction found in the DSM-III-R (American Psychiatric Association, 1987) and
25 DSM-IV (American Psychiatric Association, 1994), respectively. Other researchers have

1 developed instruments based on the criteria for pathological gambling in the International
2 Classification of Disorders (ICD, World Health Organization, 1992), or based on other
3 criteria for defining the term (Lemmens *et al.* 2009). As a result, there is no consensus on the
4 definition of video game addiction (Wenzel *et al.*, 2009).

5 Lemmens *et al.* (2009) have recently developed a 21-item instrument for measuring
6 video game addiction, the Game Addiction Scale for Adolescents (GASA). This instrument,
7 and a shortened corresponding seven-item version, displayed good reliability and validity.
8 The two versions were found to be coherent in terms of correlations regarding measures of
9 loneliness, life satisfaction, social competence, and aggression. The 21 items are based on
10 seven underlying criteria: salience, tolerance, mood modification, relapse, withdrawal,
11 conflict, and problems, which are regarded as common elements of all kinds of addiction
12 (Brown, 1993; Griffiths, 1996).

13 In the field of addiction research in general, there has been a tradition of using a
14 categorical diagnostic approach. In contrast, addiction, including video game addiction, can
15 also be considered along a continuum (Lemmens, Valkenburg & Peter, 2011). The estimation
16 of prevalence is influenced by whether game addiction is perceived as a dichotomous or
17 continuous variable. Choosing a dichotomous or continuous variable also affects the degree of
18 coherence with other relevant variables, such as measures of mental health.

19 Previously, different prevalence estimates of video game addiction have been found to
20 vary from 1.9% to 19.9% (Skouverøe, Berntsen, Mentzoni, Brunborg, Molde, Myrseth,
21 Bjorvatn & Pallesen, submitted). This variation could be due to differences in measuring, e.g.
22 different instruments and samples. Mentzoni, Brunborg, Molde, Myrseth, Skouverøe, and
23 Pallesen (in press) examined video game addiction among Norwegians aged 16 to 40 years.
24 The estimated prevalence was 0.6% and 4.1%, depending on the operationalization. Age and
25 gender predicted video game addiction and younger boys were the most vulnerable group. In

1 general, research shows that boys play both more often and for longer periods of time than
2 girls do (Buchman & Funk, 1996).

3 Several studies find correlations between video game addiction and impaired mental
4 and physical health, such as positive correlations between video game addiction and anxiety
5 and depression (Mentzoni *et al.*, in press), physical complaints (Wallenius *et al.*, 2009),
6 loneliness, and aggression (Lemmens *et al.*, 2009). Wenzel *et al.* (2009) found that video
7 game addiction was positively correlated with sleep problems, suicidal thoughts, obsessions,
8 compulsions and alcohol and drug abuse. A positive correlation has also been found between
9 video game addiction and smoking (Desay, Krishnan-Sarin, Cavallo & Potenza, 2010).
10 Negative correlations have been found between video game addiction and social competence
11 (Lemmens *et al.*, 2009), school achievement (Gentile, 2009), life satisfaction, and other health
12 indicators (Mentzoni *et al.*, in press).

13 A recent meta-study concluded that exposure to violent video games was significantly
14 positively related to aggressive behavior and aggressive cognition, and that playing violent
15 video games over time may be a risk factor in relation to increasing aggressive thinking.
16 Playing violent video games was found to predict increased aggressive affect, and to be
17 associated with reduced prosocial behavior. Both of these effects appeared to be stronger in
18 experimental studies than in longitudinal studies. Exposure to violent video games was also
19 found significantly related to less empathy (Anderson, Shibuya, Ihori, Swing, Bushman,
20 Sakamoto *et al.*, 2010). Gackenbach (2006), however, argues that different cognitive skills
21 can be improved by the use of video games.

22 At present, there is a lack of studies concerning prevalence and correlates of video
23 game addiction in Norway. Such studies are therefore needed, ideally studies that make use of
24 a validated measurement instrument. The purpose of our study was to examine the prevalence
25 of video game addiction among students aged 16 to 19 years in Hordaland county, Norway.

1 Moreover, we aimed to investigate whether video game addiction is related to the following
2 demographic variables: gender, age, urban or rural areas of living, parental education, and the
3 following psychosocial variables: anxiety, depression, loneliness, physical and verbal
4 aggression, smoking, and alcohol consumption. Based on previous research, we expected to
5 find that video game addiction is higher among boys, and that video game addiction is
6 positively associated with all of the psychosocial variables mentioned above.

7 Method

8 *Participants*

9 The original sample included students from a total of 208 randomly chosen classes
10 (from 36 of 44 high schools) in Hordaland. A cluster sample procedure was used. As several
11 schools and classes could not participate the survey sample was reduced to 824 students (58
12 classes, 22 high schools). In all, 293 respondents were excluded due to incomplete answers.
13 The final sample consisted of 531 students aged from 16 to 19 years: 215 aged 16, 183 aged
14 17, 93 aged 18, and 40 respondents aged 19 years. The response rate was 64.4%. The mean
15 age was 16.9 years (SD = 0.94). The sample included 290 boys and 241 girls. The survey was
16 carried out in spring 2010.

17 *Measures*

18 *Demographics.*— The demographic questions included gender, age, urban or rural area
19 of living and parental education (primary, vocational, secondary, or higher education).

20 *Video game addiction.*— The seven-item version of GASA (Lemmens *et al.*, 2009)
21 was used to measure video game addiction. This version consists of seven questions based on
22 key symptoms of video game addiction present during the last six months. The items are
23 scored on a five-point scale with the following response options: “never (1)”, “rarely (2)”,
24 “sometimes (3)”, “often (4)” and “very often (5)”. The Norwegian version was based on a
25 standard-translation-back translation procedure (Beaton, Bombardier, Guillemin & Ferraz,

1 2000). Video game addiction was operationalized according to both a monothetic and a
2 polythetic format. Using a monothetic format, all items must be rated above 3 in order to meet
3 the criteria for video game addiction, while, in a polythetic format, at least four of the seven
4 items must be rated above 3. In our study, the Cronbach's alpha for GASA was .85. In
5 addition, the questionnaire included a question on how many hours the respondent spent on
6 video games during the week and on weekends.

7 *Anxiety and depression.*— Anxiety and depression were measured using the Hospital
8 Anxiety and Depression Scale (HADS: Zigmond & Snaith, 1983). HADS consists of two
9 subscales, each consisting of seven items, measuring the symptoms of anxiety and depression,
10 respectively. The items are rated from 0 to 3. In our study, the Cronbach's alphas for the
11 subscales of anxiety and depression were .80 and .74, respectively.

12 *Loneliness.*— Loneliness was measured using the Revised UCLA Loneliness Scale
13 (RULS-8; Roberts, Lewinsohn & Seeley, 1993). The scale consists of eight items rated from
14 never (0) to often (3). The third item of the RULS-8 was removed from the final analyses due
15 to double negation in the wording of the question, leading to inconsistent responses (corrected
16 item-total correlation < 0.1). The Cronbach's alphas in our study were .72 and .80 before and
17 after the item exclusion, respectively.

18 *Aggression.*— The Short-Form Buss-Perry Aggression Questionnaire (BAPQ-SF)
19 subscales of verbal (three items), and physical aggression (four items) were used. The items
20 were rated from “extremely uncharacteristic of me (1)” to “extremely characteristic of me (5)”
21 (Bryant & Smith, 2001; Diamond & Magaletta, 2006). The Cronbach's alphas for verbal and
22 physical aggression in our study were .77 and .83, respectively.

23 *Smoking and alcohol consumption.*— Smoking was assessed by the question “do you
24 smoke?” The options “never” and “occasional or party smoking” were scored as a non-
25 smoker, while “every day” was scored as a smoker.

1 Alcohol consumption was measured using Alcohol Use Disorders Identification Test -
2 Consumption (AUDIT-C) (Saunders, Aasland, Babor, De La Fuente & Grant, 1993). AUDIT
3 was developed by the World Health Organization to enable screening for problematic alcohol
4 consumption. AUDIT-C is argued to be a valid screening instrument measuring excessive
5 alcohol consumption and dependence (Bush, Kivlahan, McDonell, Fihn & Bradley, 1998).
6 The instrument includes three questions: "How often do you consume alcohol?" rated from 1
7 "never" to 5 "four times a week or more"; "How many units of alcohol do you consume on a
8 'typical' day of drinking?" rated from 1 "1-2" to 5 "10 or more"; and "How often do you
9 consume six or more units of alcohol?" rated from 1 "never" to 5 "daily or almost daily ". The
10 Cronbach's alpha for AUDIT-C in our study was .85.

11 *Procedure*

12 The students gave online informed consent to participation. Parental consent was not
13 obtained due to the respondents being 16 years or older, and because the questions were not
14 considered to be sensitive. The principals, teachers and students involved, received an
15 orientation of the purpose and scope of the study via e-mail prior to participation.

16 The survey was conducted online, using SurveyXact. Each student received an e-mail
17 containing a link to the questionnaire. De-identification of the data was achieved by
18 numbering each e-mail address in SurveyXact. The link between students' e-mail addresses
19 and the corresponding numbers was kept under high security conditions, and separated from
20 the file containing the respondents' answers. The data are thus de-identified. The link between
21 the respondent number and e-mail address was used to send reminders about unanswered
22 requests. The project was approved by the Regional Committee for Medical Research Ethics,
23 Helse Vest.

24 *Analysis*

25 To calculate prevalence estimates, correlations and regressions, Stata Statistical

1 Software was used (StataCorp., 2003). Stata was the preferred software for analyzing the data,
2 as it allows controlling for the design effect, i.e. the problem of responses potentially
3 correlating within clusters / classes (Kish, 1987).

4 Pearson product-moment correlation analysis was used to calculate correlations
5 between the continuous variables of age, depression, anxiety, loneliness, physical and verbal
6 aggression and alcohol consumption.

7 Video game addiction as a continuous dependent variable was analyzed using
8 hierarchical multiple regression analysis with two blocks. Block 1 consisted of the predictor
9 variables: gender, age, urban or rural area of living, and maternal and paternal education.
10 Block 2 consisted of the predictor variables: depression, anxiety, loneliness, physical and
11 verbal aggression, smoking, and alcohol consumption.

12 Video game addiction as a categorical dependent variable was analyzed using
13 bivariate and multivariate logistic regression analysis. Both the monothetic and the polythetic
14 operationalizations of video game addiction were used as dependent variables in these
15 analyses.

16 Results

17 *Descriptive analysis*

18 Of the 531 respondents, 415 report to play video games. On average, the respondents
19 play 1.86 (SD = 2.56) hours on weekdays, and 2.89 (SD = 3.84) daily hours in weekends. A
20 total of 2.5% (95% CI = 1.13 -3.77) of the 531 respondents can be characterized as video
21 game addicted using the monothetic format. A total of 12.5% (95% CI = 9.63 to 15.27) of the
22 respondents can be characterized as video game addicted using the polythetic format.

23 *Correlation Analysis*

24 Table 1 presents the Pearson product-moment correlation coefficients of the
25 continuous variables of age, depression, anxiety, loneliness, physical and verbal aggression,

1 and alcohol (insert Table 1 here). Depression, anxiety, loneliness, and physical and verbal
2 aggression are all significantly and positively interrelated. In addition, age is significantly and
3 negatively correlated with depression and loneliness, and significantly and positively
4 correlated with alcohol use. Furthermore, alcohol is significantly and positively correlated
5 with physical and verbal aggression.

6 *T-test*

7 Table 2 and 3 presents the differences in the number of hours spent on video games
8 between the group that meets the criteria for video game addiction and the group that does not
9 (insert Table 2 and 3 here). The groups that meet the criteria for video game addiction with
10 either the monothetic or polythetic format show a significantly higher number of hours spent
11 on video games on weekdays and weekends than the non-video game addiction group.

12 *Regression Analysis*

13 *Hierarchical regression analysis.*— Table 4 presents the results of the hierarchical
14 regression analysis, with the continuous score on GASA as the dependent variable (insert
15 Table 4 here). Block 1 explains 17% of the variance. Block 2 explains an additional 15% of
16 the variance. In total, the two blocks explain 32% of the variance, $F(18, 40) = 23.5$.

17 The hierarchical regression analysis shows that gender, paternal university or college
18 education, depression, anxiety, loneliness, and alcohol consumption are significant predictors
19 of video game addiction. Compared to girls, boys are more likely to meet the criteria for video
20 game addiction. Paternal university or college education is negatively related to video game
21 addiction, and may thus be a protective factor in relation to the development of video game
22 addiction. In addition, alcohol consumption is negatively related to video game addiction,
23 while depression, anxiety, and loneliness are positively related to video game addiction.

24 *Logistic regression analysis.*— Table 5 presents the bivariate and multivariate
25 analyses of the monothetic operationalization of video game addiction (insert Table 5 here).

1 Physical aggression is a significant predictor of video game addiction in the multivariate
2 analysis. Depression, anxiety, loneliness, physical and verbal aggression, and smoking are
3 significant predictors of video game addiction in the bivariate analyses.

4 Table 6 presents the bivariate and multivariate analyses for the polythetic
5 operationalization (insert Table 6 here). Male gender and verbal aggression are significant
6 predictors of video game addiction in the multivariate analysis. Male gender, depression,
7 anxiety, loneliness, physical and verbal aggression, and smoking are significant predictors of
8 video game addiction in the bivariate analyses.

9 Discussion

10 Individuals classified as video game addicts in our study, were found to spend
11 significantly more time playing, both in weekends and weekdays, compared to non-addicted.
12 These findings attest to the convergent validity of the GASA (Lemmens *et al.*, 2009).

13 *Prevalence*

14 The estimates of prevalence of video game addiction of 2.5% and 12.5% that we
15 found, lie within the range of 1.9% -19.9% that has previously been found across studies
16 (Skouverøe *et al.*, submitted). The large variation in estimations reported in previous studies
17 could partly be due to the use of various approaches in relation to operationalization,
18 measurement and sample selection. The year of publication combined with the technical
19 advances made during recent decades may also add to our understanding of differences in the
20 prevalence of video game addiction.

21 Previous studies of video game addiction among teenage samples that include the age
22 group 16-19 years have found prevalence estimates of 8.5% (Gentile, 2009), 1.9%
23 (monothetic) and 9.4% (polythetic) (Lemmens *et al.*, 2009), 11.9 % (Grüsser, Thaleman &
24 Griffiths, 2007), and, in Norway, 2.7% (Johansson & Götestam, 2004). Our results are
25 comparable with the estimates of 1.9% and 9.4% found by Lemmens *et al.* (2009), as we used

1 the same operationalizations. The prevalence of video game addiction appears to be somewhat
2 higher in Norway than in the Netherlands. However, the Dutch sample, which was aged 12-18
3 years, represents a somewhat broader and younger age group than our sample. Gentile (2009)
4 used an even broader age group of 8-18 years. Overall, this could indicate that young people
5 aged 16-19 years have a higher prevalence of video game addiction than younger adolescents.
6 The fact that we used such a narrow age group may explain why age was not a significant
7 predictor in our study. The differences could also reflect differences in culture between
8 Norway, the Netherlands and the USA. It should also be noted that different results across
9 cultures may reflect inadequacies in the adaptation/translation process of the assessment
10 instruments such as lack of conceptual equivalence, linguistic equivalence and measurement
11 unit equivalence (Lonner & Ibrahim, 2008).

12 The prevalence estimate of 11.9% (Grüsser *et al.*, 2007) is close to our finding of
13 12.5% (polythetic format). However, the sample selection of Grüsser *et al.* (2007) was based
14 on an online gaming magazine, thus representing a population likely to have a higher
15 prevalence of video game addiction than the general population. Johansson and Götestam
16 (2004) estimated the prevalence of video game addiction among Norwegian teenagers aged
17 12-18 years to be 2.7%. This is close to our estimate of 2.5 % (monothetic format), despite the
18 fact that their estimate was based on Young's (1998) Diagnostic Questionnaire for Internet
19 Addiction. This instrument is based on the criteria for pathological gambling in DSM-IV and
20 measures internet addiction. Since the DSM-IV (American Psychiatric Association, 1994)
21 uses a polythetic approach, we might expect that studies with operationalizations based on
22 criteria from the DSM would result in estimates closer to our estimate in polythetic format
23 than in monothetic format, which however does not seem to be the case in the study of
24 Johansson and Götestam (2004).

1 Among younger age groups (ranging from 8-16 years), prevalence estimates of 7.6% -
2 9.9% (Gentile *et al.*, 2011), 5.7% (Phillips, Rolls, Rouse & Griffiths, 1995), and 19.9%
3 (Griffiths & Hunt, 1998) have been found. The first two studies suggest that these age groups
4 have a lower prevalence than the age group in our sample (with use of a polythetic format),
5 with an apparent increase in prevalence from 1995 to 2011. The estimate of 19.9% deviates
6 strongly from the other findings. It is based on a sample aged 12-16 years, using a customized
7 version of the criteria for pathological gambling by DSM-III-R (American Psychiatric
8 Association, 1987).

9 Studies investigating video game addiction among young adults (20-30 years) have
10 found prevalence estimates of 8%, (Griffiths & Dancaster, 1995; Porter, Starcevic, Berle &
11 Fenech, 2010), both among British psychology students and in an international sample of
12 mostly Western men younger than 30 years old. These estimates are somewhat lower than our
13 estimate in polythetic format. These findings combined further supports the hypothesis that
14 young people aged 16-19 years are a particularly vulnerable group in relation to video game
15 addiction, with a higher prevalence than both younger and older age groups. This is also in
16 accordance with previous findings that the age group 16-21 years had higher levels of video
17 game addiction than older age groups (Mentzoni *et al.*, in press).

18 Video game addiction has also been investigated among broader age groups in
19 Norway. For video game addiction operationalized as playing video games for four hours or
20 more per day, Wenzel *et al.* (2009) found prevalence estimates of 2.2% among Norwegian
21 16-74-year-olds (2009). Prevalence estimates of 0.6% (monothetic format) and 4.1%
22 (polythetic format) were found among 16-40-year-olds in a recent Norwegian study
23 (Mentzoni *et al.*, in press). This study used the same operationalization as in our study, and
24 showed a lower prevalence in a sample consisting of a broader age group. Overall, this
25 supports the hypothesis that the prevalence of video game addiction is significantly lower

1 among broader age groups (16-40, 16-74) that include people of higher age than in our
2 sample.

3 The prevalence studies mentioned above used various instruments for
4 operationalization and measurement, e.g. based on the criteria for pathological gambling in
5 DSM-III-R (American Psychiatric Association, 1987), or DSM-IV (American Psychiatric
6 Association, 1994). This makes it difficult to compare prevalence estimates across studies.
7 Consensus on operationalization is of great importance if we are to expand our knowledge of
8 the concept of video game addiction. Like Lemmens *et al.* (2009), and Mentzoni *et al.* (in
9 press), we used GASA, with a cut-off of 3, and we used both a polythetic and monothetic
10 format. Mentzoni *et al.* (in press) chose a monothetic format for the operationalization of
11 video game addiction, while a polythetic format was used for the operationalization of
12 problematic use of video games. Lemmens *et al.* (2009) argue that video game addiction
13 should be operationalized using a monothetic format, which means that all criteria must be
14 met, even though the DSM-IV diagnostic manual presents a polythetic format for diagnosing
15 gambling addiction. According to Lemmens *et al.* (2009), several researchers advocate the
16 use of a monothetic format as the preferred operationalization of video game addiction. It is
17 argued that a monothetic format helps to avoid overestimation of video game addiction, as
18 well as assuring the presence of the criterion of negative life consequences, a criterion
19 considered to be essential in video game addiction (Lemmens *et al.*, 2009).

20 *Demographic variables*

21 In line with previous research (Wenzel *et al.*, 2009), we found that it is primarily boys
22 who are affected by video game addiction. This trend has been found in numerous studies,
23 e.g., Buchman & Funk (1996). However, the effect of gender was not significant in the
24 logistic regression analysis in the monothetic format. This exception may be due to the low

1 number of individuals classified as video game addicted, which reduces the statistical power
2 in this analysis.

3 One can imagine several reasons for the effect of gender. Several studies have found
4 that men have a higher risk of developing other types of addiction, such as alcohol
5 dependence and pathological gambling. Kringlen, Torgersen and Cramer (2001) found that
6 men are about twice as likely to develop both alcohol and drug addiction in a lifetime
7 perspective. Blanco, Hasin, Petry, Stinson and Grant (2006) found that whereas men had a
8 lifetime prevalence rate of 0.64% (95% CI 0.50-0.78) for pathological gambling as defined in
9 DSM-IV, the lifetime prevalence rate for women was 0.23% (95% CI 0.17-0.29). Based on
10 findings like this, it is possible to envisage an underlying vulnerability among boys to
11 developing different kinds of addictions, both chemical and non-chemical.

12 Greenberg, Sherry, Lachlan, Lucas and Holmstrom (2010) argue that most video
13 games today are aimed at male users and designed by men, and that these may be reasons for
14 the gender differences in video game playing. Furthermore, they found that, to a greater
15 extent than girls, boys use video games to achieve activation and social interaction. Phillips *et*
16 *al.* (1995) found that boys more often report feeling better after playing than girls do. This
17 may indicate that video game playing has a different function for boys than it has for girls,
18 and it is conceivable that girls meet needs, such as social needs, in different ways, e.g., it was
19 found that girls spent more time talking on the phone (Hunley, Evans, Delgado-Hachey,
20 Krise, Rich & Schell, 2005). It is also possible that boys achieve feelings of mastery when
21 playing video games, while girls to a greater extent achieve this through other activities, e.g.,
22 Augner and Hacker (in press) found that girls are more likely to develop mobile phone
23 addiction than boys.

24 We found that higher paternal education may be a protective factor in relation to video
25 game addiction as a continuous variable. To our knowledge, our study is the first to look at

1 the relationship between video game addiction and socio-economic status. This finding is
2 interesting considering the previously found association between low socio-economic status
3 and other forms of addiction, such as alcohol addiction (Bränström & Andréasson, 2008).
4 Thus, low socio-economic status might represent a vulnerability also to developing video
5 game addiction.

6 *Psychosocial Variables*

7 Overall, we found positive associations between video game addiction and anxiety,
8 depression, loneliness, physical and verbal aggression, and smoking, and a negative
9 association between video game addiction and alcohol consumption. These findings
10 correspond to previous findings that video game addiction is positively correlated with
11 depression (Mentzoni *et al.*, in press), loneliness (Lemmens *et al.*, 2009), aggression
12 (Anderson *et al.*, 2010), anxiety, (Wenzel *et al.*, 2009), and smoking (Desay *et al.*, 2010).
13 However, in contrast to our findings, Wenzel *et al.* (2009) found a positive correlation
14 between video game addiction and alcohol. Video game addiction is also found to correlate
15 with other psychosocial variables that are not examined in our study. They include ADHD
16 (Bioulac, Arfi & Bouvard, 2008), sleep problems, obsessions, compulsions, and drug use
17 (Wenzel *et al.*, 2009). In addition, the personality traits of impulsivity, poor social
18 competence, low levels of empathy, and poor emotional regulation are found to increase the
19 risk of developing video game addiction (Gentile *et al.* 2011). In other words, video game
20 addiction appears to be related to a variety of mental disorders.

21 *Anxiety, depression and loneliness.*— Anxiety and depression were found to be
22 significant predictors of video game addiction, both as a continuous variable, and with both
23 monothetic and polythetic operationalization. Wenzel *et al.* (2009) found that the prevalence
24 of self-reported anxiety and depression was positively correlated with time spent on video
25 game playing among Norwegians aged 16 to 74 years. Mentzoni *et al.* (in press) found that

1 players who met the criteria for video game addiction in the polythetic format scored higher
2 on anxiety and depression measured using HADS, compared to both players and non-players.
3 The fact that our findings are consistent with previous Norwegian studies strengthens the
4 assumption that anxiety and depression are related to video game addiction in Norway.

5 We also found that loneliness is a significant predictor of video game addiction, both
6 as a continuous variable and with monothetic and polythetic operationalization. Lemmens *et*
7 *al.* (2009) found that the respondent's average score on GASA was positively correlated with
8 scores on a sample of questions from the UCLA loneliness scale, and the relationship between
9 video game addiction and loneliness was confirmed in two different samples. It was also
10 investigated whether the time spent playing video games was positively correlated with
11 loneliness. In one of the two samples, a low but positive correlation was found, while, in the
12 second sample, time spent playing video games was not significantly correlated with
13 loneliness (Lemmens *et al.*, 2009). It seems that video game addiction is more strongly related
14 to loneliness than the amount of video game playing per se. This finding is relevant to the
15 debate on video game addiction as a mental disorder and on whether one can identify general
16 characteristics across different addictions.

17 Few studies have examined whether video game addiction leads to depression,
18 anxiety, and loneliness, or whether the opposite is true. Excessive video game playing could
19 possibly lead to social isolation, which in turn can give rise to symptoms of depression,
20 anxiety, and loneliness. Moreover, it is conceivable that symptoms of depression, anxiety and
21 loneliness increase the probability of choosing indoor activities, including video game
22 playing, and avoiding or missing out on more traditional social interaction. A number of other
23 causal relationships can be envisaged, and video game playing could also be seen as a
24 mediating factor, as a coping strategy for anxiety, depression and loneliness, or as a
25 maintaining factor.

1 A longitudinal study of video game addiction was recently conducted and it indicated
2 that video game addiction seems to contribute to development of other psychological
3 problems, and thus cannot solely be regarded as a symptom of underlying difficulties. It was
4 also found that anxiety, depression, and social phobia improved if video game addiction
5 ceased, and that these disorders, as well as impulsivity, were aggravated if video game
6 addiction developed (Gentile *et al.*, 2011). According to Gentile *et al.* (2011), a clinical
7 perspective on video game playing conceive of it as a coping strategy for young people
8 suffering from depression or anxiety. Wurmser (1987) regarded addiction as a way of self-
9 medicating, and of escaping from problems. Freud and Ferenczi viewed alcohol addiction as a
10 way of escaping into a form of narcosis (Brabant, Falzeder & Giampieri-Deutsch, 1993). A
11 possible motive for video game playing could be the need to escape other activities, concerns
12 and negative emotions (Wallenius *et al.*, 2009). In line with this it was recently found that
13 some video game players are motivated by the need to escape everyday problems (Stetina,
14 Kothgassner, Lehenbauer and Kryspin-Exner, 2010). Video game playing is also described as
15 a form of "self-treatment" or coping strategy in relation to ADHD (Han, Lee, Na, Ahn,
16 Chung, Daniels, *et al.*, 2009).

17 Even though players seem to use video game playing as a coping strategy when
18 experiencing psychological difficulties, Gentile *et al.* (2011) argue that video game playing
19 cannot be regarded solely as a symptom of other psychological difficulties. Their longitudinal
20 study shows that video game addiction is not just correlated with other psychological
21 problems, but can even predict them. The authors assume that there is a reciprocal
22 relationship between video game addiction and other mental disorders (Gentile *et al.*, 2011).

23 *Physical and verbal aggression.*— We found a positive correlation between video
24 game addiction and physical and verbal aggression, such as threatening others and getting into
25 fights. Previously, it has been argued both for and against a causal link between violent video

1 games and aggressive behavior. There have been major technological developments in recent
2 years. This has led to both easier access to and a larger selection of video games with better
3 graphics (Gentile and Anderson, 2006). Thus, video games are assumed to be more realistic,
4 which in turn makes it easier to engage and identify with the characters. It seems reasonable
5 to assume that a stronger identification with the characters and involvement in the game in
6 general will lead to an increased influence on and higher risk of aggressive behavior. Albert
7 Bandura's social learning theory of aggression (1978), postulates that aggressive models in the
8 media can be both a source of, and a tutor of aggressive behavior. A stronger identification
9 could potentially increase this effect of model learning. Furthermore, it is conceivable that
10 increased exposure to aggressive behavior over time can contribute to a change in norms, as
11 well as a risk of becoming desensitized in relation to aggressive behavior.

12 Innovations in the video game industry have also led to increased awareness about the
13 possible effects of violent video games. Several studies show that there is an association
14 between the use of violent video games and aggression (Gentile and Anderson, 2006). Hauge
15 and Gentile (2003) found that adolescents with video game addiction were more involved in
16 aggressive behavior such as arguing and fighting, and reported higher levels of hostile
17 attribution than adolescents not suffering from video game addiction. Neither Hauge and
18 Gentile's (2003) study nor ours distinguishes between type of game. It would be interesting,
19 therefore, to investigate whether video game addiction is related to aggression per se, or
20 whether it is the violent and aggressive content of the games that can explain the relationship
21 between video game addiction and physical and verbal aggression. Experimental and
22 longitudinal studies indicate a causal relationship in which exposure to violent video games
23 leads to higher levels of aggressive behavior, aggressive cognition, and aggressive affect
24 (Anderson *et al.*, 2010). Our findings are consistent with these findings. However, due to the
25 research design, we cannot say anything about causality.

1 *Smoking and alcohol consumption.*— Our results show a positive correlation between
2 video game addiction and smoking. Previous findings indicate that boys who play video
3 games are less likely to be smokers, while boys with a video game addiction are more likely
4 to be smokers, compared to boys who do not play video games (Desay *et al.*, 2010). It is not
5 known whether this is due to an underlying general vulnerability to addiction. Weinstein
6 (2010) has found that playing video games can have a long-lasting effect on the brain's reward
7 system in the same way as drug use.

8 Contrary to what we expected, a negative relationship between video game addiction
9 and alcohol consumption was found. Alcohol is often used in a social context in the age group
10 in our study, such as at parties, while video game playing is often seen as being a less social
11 activity. Alcohol may have a social function, while video game addiction is found to relate to
12 loneliness. This was also the case in our study. This may explain the negative relationship
13 between alcohol consumption and video game addiction in our study. Although smoking can
14 take place in social settings as well, smoking in our study is operationalized as daily smoking,
15 which most likely includes smoking outside social contexts. Consequently, in our study,
16 smoking is assumed to be an activity characterized more by loneliness and addiction than
17 alcohol use. It is uncertain however, whether a measure of alcohol addiction would be
18 positively or negatively related to video game addiction.

19 *Strengths and Limitations*

20 A response rate of 64.4% is acceptable, and it can be considered to be an asset of the
21 study and increase the generalizability of the results.

22 A second strength of the study is the sampling process. The sample consisted of
23 randomly selected classes from randomly selected schools. Previously, several prevalence
24 studies have been based on populations of players (Grüsser *et al.* 2007; Porter *et al.*, 2010) or
25 other non-representative samples (Griffiths & Dancaster, 1995). However, using randomly

1 selected schools allows us to estimate the prevalence among high school students in general.
2 The same, using randomly selected samples, also applies to the studies by Wenzel *et al.*
3 (2009) and Mentzoni *et al.* (in press), which increases the possibility of making relevant
4 comparisons with these studies.

5 Moreover, the sample represents an age group previously found to have a high
6 prevalence of computer game addiction, and it is thus a relevant population (Mentzoni *et al.*,
7 in press). To the best of our knowledge, our study is the first to examine video game addiction
8 among a sample limited to 16 to 19-year-olds. A thorough examination of the relationship
9 between video game addiction and correlates such as anxiety, depression, loneliness, and
10 aggression could presumably be facilitated by the fact that our sample is thought to involve a
11 higher proportion of people with video game addiction than the general population of
12 Norway. Overall, the high response rate, the use of random sampling, as well as a relevant
13 and specific age group, are factors thought to increase the generalizability of the results to
14 other high schools in Norway.

15 The psychometric properties of the instruments used in our study are found to be good
16 (GASA; Lemmens *et al.* 2009; HADS: Zigmond & Snaith, 1983; RULS-8: Roberts, *et al.*
17 1993; BAPQ-SF; Diamond & Magaletta, 2006; AUDIT -C, Reinert & Allen, 2007). To our
18 knowledge, our study of video game addiction prevalence is the second in Norway to use
19 GASA as a measuring device. Currently, there is no consensus on the operationalization of
20 video game addiction. By using the operationalization recommended by Lemmens *et al.*
21 (2009), this study contributes to generating knowledge about video game addiction and a
22 shared understanding of the phenomenon. Such a shared understanding could enable
23 comparison across prevalence studies.

24 Due to the fact that our study is of cross-sectional design, we cannot draw any
25 conclusions about the causal relationships underlying the various correlates in our study.

1 Several possible causal explanations exist. There is thus a need for studies in this field that
2 address causality.

3 There is a difference between the logistic and hierarchical regression analyses, as
4 some findings are constrained to the hierarchical analysis only. This may be due to the use of
5 video game addiction as a continuous variable in the latter analysis, and that the results from
6 the hierarchical analyses to a higher degree reflect variance within the normal range
7 concerning video game activity.

8 Our study is based exclusively on self-reporting and subjective experience, which
9 could potentially give rise to common method variance. In common method variance, the
10 variance is due to covariance between variables caused by the measurement method, and is
11 not related to the constructs one wishes to measure (Podsakoff, MacKenzie, Lee & Podsakoff,
12 2003). It can be difficult to separate the variance of the phenomenon one wishes to investigate
13 from the qualities of the measuring instrument. By exclusively using instruments based on
14 self-reporting, it is probable that the results may not necessarily reflect reality. Social
15 desirability, mood at the time of completion, context effects from items, and demand
16 characteristics are examples of factors that can affect the respondents' responses (Podsakoff *et*
17 *al.*, 2003).

18 *Further Research*

19 The American Psychiatric Association has considered incorporating video game
20 addiction into the DSM system, but it concluded that there is insufficient research on this
21 phenomenon (Gentile *et al.*, 2011). Gentile *et al.* (2011) presents some issues in the field to be
22 addressed. These are questions such as: What is the etiology of video game addiction? What
23 risk and protective factors exist? What patterns of comorbidity exist? How does the problem
24 evolve? What is the expected outcome? How can these difficulties be overcome?
25 Longitudinal, experimental and treatment studies are required in order to gain an

1 understanding of these issues. There are few longitudinal studies on video game addiction at
2 present, and it is longitudinal studies in particular that can contribute to answering the many
3 questions about video game addiction and causality. There is a need for large surveys of these
4 types. Potential causal mechanisms could be examined, such as whether different personality
5 traits can predict the risk of developing video game addiction, whether mental illness exists
6 prior to the development of addiction, or whether video game addiction is a risk factor in
7 relation to the development of other mental disorders. The study conducted by Gentile *et al.*
8 (2011) has contributed to some understanding of these relationships. Longitudinal studies can
9 also be used as a tool in research on how video game addiction evolves over time.

10 To our knowledge, few experimental studies have been conducted of video game
11 addiction. There is a need for experimental studies if we are to achieve a more detailed
12 understanding of the phenomenon, e.g., an experimental design could be used to explore the
13 physiological manifestations of addiction by examining whether there are any differences in
14 physiological measures in boys and girls who play video games. Alternatively, one could
15 investigate the differences in physiological measurements between players and individuals
16 displaying an addiction to video games.

17 Individuals with an alcohol addiction have been tested using the Stroop paradigm.
18 Alcohol stimuli were found to significantly increase distraction during testing among
19 individuals with an alcohol addiction in whom treatment proved not to be successful (Cox,
20 Hogan, Kristian and Race, 2002). Similarly, future studies could examine whether video game
21 addicts have attention bias to game relevant stimuli. Knowledge about this is important as
22 such biases have been related to treatment outcome and relapse in other kinds of addicts
23 (Marissen, Franken, Waters, Blanken, van den Brink & Hendriks, 2006; Waters, Shiffman,
24 Sayette, Paty, Gwaltney & Balabanis, 2003).

25 Treatment studies are also needed in this area (Griffiths & Meredith, 2009). As far as

1 we know, no treatment studies on video game addiction have yet been conducted. However,
2 randomized clinical treatment studies of other forms of addiction exist, such as alcohol
3 addiction (Cox *et al.* 2002), and these could give some indications of important factors in the
4 successful treatment of video game addiction.

5 Finally, more studies are needed that investigate video game addiction in relation to
6 prevalence and correlates in order to further support video game addiction as an evidence-
7 based concept.

8 *Conclusions*

9 Although there is still a lack of consensus on how to assess video game addiction there
10 seems to be a growing consensus regarding the construct validity of the phenomenon, e.g.,
11 variables that seem to co-occur with addiction in general, such as poorer school performance,
12 a higher degree of hostility, and comorbid conditions such as depression have consistently
13 been found to co-occur in a similar manner with video game addiction (Gentile *et al.*, 2011).

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Tables

TABLE 1

CORRELATION COEFFICIENTS BETWEEN THE INDEPENDENT INTERVAL/RATIO VARIABLES

	Age	Depression	Anxiety	Loneliness	Physical Aggression	Verbal Aggression	Alcohol Consumption
Age	—						
Depression	-.10*	—					
Anxiety	.03	.53**	—				
Loneliness	-.10*	.57**	.49**	—			
Physical Aggression	-.05	.39**	.34**	.26**	—		
Verbal Aggression	.01	.34**	.40**	.31**	.67**	—	
Alcohol Consumption	.21**	.06	.07	-.08	.28**	.17**	—

* $p < .05$. ** $p < .01$.

TABLE 2

DIFFERENCES BETWEEN GROUPS WITH AND WITHOUT VIDEO GAME ADDICTION, MONOTHETIC FORMAT

Daily Playing Hours	Video Game Addiction		No Addiction		$t(530)$	p
	M	SD	M	SD		
Weekdays	5.77	4.21	1.76	2.44	- 5.73	.00
Weekend	10.77	6.75	2.69	3.54	- 7.90	.00

TABLE 3

DIFFERENCES BETWEEN GROUPS WITH AND WITHOUT VIDEO GAME ADDICTION, POLYTHETIC FORMAT

Daily Playing Hours	Video Game Addiction		No Addiction		$t(530)$	p
	M	SD	M	SD		
Weekdays	4.76	4.41	1.45	1.85	-10.83	.00
Weekend	7.71	5.92	2.21	2.87	-12.33	.00

TABLE 4

HIERARCHICAL REGRESSION ANALYSIS SUMMARY FOR VARIABLES PREDICTING VIDEO GAME ADDICTION IN HIGH SCHOOL CLASSES (N=58)

	Predictor Variable	$R^2 / \Delta R^2$	β
Step 1		.17	
	Gender		-.38***
	Age		-.08*
	Urban/Rural		-.04
	Maternal Education ^a		
	Elementary School		.03
	Vocational Education		.01
	High School		-.02
	College/University		.01
	Paternal Education ^a		
	Elementary School		.04
	Vocational Education		-.07
	High School		-.08
	College/University		-.12*
Step 2		.32 / .15	
	Gender		-.40***
	Age		-.04
	Urban/Rural		-.01
	Maternal Education ^a		
	Elementary School		.03
	Vocational Education		.02
	High School		-.02
	College/University		.06
	Paternal Education ^a		
	Elementary School		.02
	Vocational Education		-.04
	High School		-.04
	College/University		-.10*
	Depression		.12*
	Anxiety		.11*
	Loneliness		.15**
	Physical Aggression		.08
	Verbal Aggression		.05
	Smoking		.04
	Alcohol Consumption		-.03*

^a “Unknown” was used as the reference group. * $p < .05$. ** $p < .01$. *** $p < .001$.

TABLE 5

LOGISTIC REGRESSION ANALYSIS PREDICTING VIDEO GAME ADDICTION,
MONOTHETIC FORMAT

	Bivariate		Multivariate	
	OR	95 % CI	OR	95 % CI
Male	1.00		1.00	
Female	0.74	(0.19-2.89)	1.06	(0.13-8.72)
Age	0.66	(0.31-1.43)	0.49	(0.11-2.27)
Urban	1.00		1.00	
Rural	1.08	(0.34-3.39)	0.67	(0.13-3.35)
Maternal Education				
Unknown	1.00		1.00	
Elementary School	0.88	(0.85-9.10)	0.36	(0.01-16.6)
Vocational Education	0.75	(0.13-4.48)	1.27	(0.08-20.6)
High School	0.45	(0.07-2.80)	0.29	(0.00-21.3)
College/University	0.58	(0.15-2.32)	1.29	(0.11-15.1)
Paternal Education				
Unknown	1.00		1.00	
Elementary School	3.00	(0.51-17.5)	10.1	(0.26-386)
Vocational Education	0.34	(0.05-2.22)	0.78	(0.07-8.68)
High School	0.49	(0.04- 5.61)	1.34	(0.14-12.9)
College/University	0.79	(0.18-3.53)	1.27	(0.09-18.9)
Depression	1.28	(1.15-1.42)	0.97	(0.79-1.19)
Anxiety	1.28	(1.14-1.44)	1.05	(0.83-1.34)
Loneliness	1.28	(1.12-1.45)	1.13	(0.86-1.48)
Physical Aggression	1.42	(1.21-1.68)	1.27	(1.05-1.54)
Verbal Aggression	1.60	(1.31-1.96)	1.21	(0.88-1.66)
Non-Smoking	1.00		1.00	
Smoking	4.78	(1.68-13.7)	1.81	(0.35-9.40)
Alcohol Consumption	1.15	(0.90-1.46)	0.91	(0.69-1.20)

Note. CI = confidence interval for odds ratio (OR).

TABLE 6

LOGISTIC REGRESSION ANALYSIS PREDICTING VIDEO GAME ADDICTION,
POLYTHETIC FORMAT

	Bivariate		Multivariate	
	<i>OR</i>	95 % CI	<i>OR</i>	95 % CI
Male	1.00		1.00	
Female	0.31	(0.15-0.62)	0.22	(0.10-0.49)
Age	0.82	(0.58-1.15)	0.88	(0.59-1.31)
Urban	1.00		1.00	
Rural	1.04	(0.62-1.75)	0.83	(0.45-1.52)
Maternal Education				
Unknown	1.00		1.00	
Elementary School	0.82	(0.29-2.31)	1.01	(0.30-3.38)
Vocational Education	0.79	(0.36-1.74)	1.10	(0.34-3.58)
High School	0.99	(0.51-1.93)	1.82	(0.67-4.92)
College/University	0.62	(0.32-1.20)	1.04	(0.43-2.55)
Paternal Education				
Unknown	1.00		1.00	
Elementary School	1.69	(0.60-4.79)	1.49	(0.44-5.03)
Vocational Education	0.94	(0.52-1.67)	1.04	(0.48-2.25)
High School	0.68	(0.23-2.01)	0.88	(0.22-3.43)
College/University	0.79	(0.35-1.76)	0.77	(0.29-2.06)
Depression	1.19	(1.11-1.27)	1.10	(0.99-1.21)
Anxiety	1.14	(1.06-1.22)	1.06	(0.96-1.18)
Loneliness	1.14	(1.08-1.21)	1.05	(0.96-1.13)
Physical Aggression	1.15	(1.08-1.22)	0.99	(0.90-1.09)
Verbal Aggression	1.25	(1.17-1.34)	1.16	(1.04-1.30)
Non-Smoking	1.00		1.00	
Smoking	2.25	(1.16-4.34)	1.63	(0.62-4.26)
Alcohol Consumption	0.99	(0.88-1.11)	0.93	(0.84-1.04)

Note. CI = confidence interval for odds ratio (OR).