Psychological Test and Assessment Modeling, Volume 59, 2017 (3), 297-315

Theoretical framework, factorial structure and measurement invariance of the Video Game Playing Motives Questionnaire (VGPM-Q) for preadolescents

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Abstract

The video game playing motives questionnaire for preadolescents (VGPM-Q) was developed and tested regarding construct validity and measurement invariance. The VGPM-Q is theoretically based on a combination of uses and gratifications theory and mood-management theory. Based on these theoretical frameworks, two distinct motive systems were distinguished, (1) motives oriented towards the satisfaction of needs and (2) motives oriented towards the regulation of mood states. Construct validity and measurement invariance across gender were tested in 1297 preadolescents (42 % girls; *M*age = 11.57). The theoretical two-factor structure fit the data well, yielding the two correlated factors "uses and gratifications motives" and "mood management motives". Partial strong measurement invariance across gender was obtained. Theoretical and methodological implications for research on video game playing motives are discussed.

Key words: measurement invariance, construct validity, video game playing motives

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Introduction

Playing video games has become a normative leisure activity for youth (Beentjes, Koolstra, Marseille, & van der Voort, 2001; Rideout, Foehr, & Roberts, 2010), and peaks during early adolescence (Beentjes et al., 2001; Durkin, 2006; Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010, Olds et al., 2009). A huge body of research has investigated the links between video game playing and health outcomes, academic achievement, cognitive skills or aggression (e.g. Gentile, Lynch, Linder, & Walsh, 2004; Mößle, Kleimann, Rehbein, & Pfeiffer, 2010; Okagaki & Frensch, 1994; Vandewater, Shim, & Caplovitz, 2004; Willoughby, Adachi, & Good, 2011). Comparably little attention has been given to the question of *why* adolescents play video games. Thus, it is still unclear what motives drive (pre)adolescents to play video games. Depending on these motives, it is reasonable to assume that the socialization impact of video game playing could either be harmful, developmentally beneficial, or of no relevance (Wallenius, Rimpelä, Punamäki, & Lintonen, 2009). Furthermore, motives for playing video games might also have a crucial role in selection processes of certain (e.g. violent) video games.

To study how adolescents' motives drive video game use (and to study the effects of this), we must be able to measure their motives adequately. Thus, an instrument that measures video game playing motives should comply with the following requirements: The instrument should (1) be theoretically based and (2) meet high methodological standards with respect to construct validity and measurement invariance. It should (3) be appropriate for the target group (e.g., preadolescents) and (4) be able to measure motives for a broad range of games. However, in existing studies on video game playing motives, those four aspects have not been considered simultaneously indicating that further research is required. Thus, the aim of the present research was to develop an instrument to measure video game playing motives addressing all aforementioned aspects.

Uses & gratifications theory and mood management theory as theoretical frameworks

Many studies on video game playing motives are exploratory or qualitative in nature, not relying on a distinct theory (e.g. Barnett et al., 1997; Bijvank, Konijn, & Bushman, 2012; *Motives for Online Gaming Questionnaire*, Demetrovics et al., 2011; Griffiths, 1997; Hellström, Nilsson, Leppert, & Åslund, 2011; Olson et al., 2007; Olson, Kutner, & Warner, 2008; Phillips, Rolls, Rouse, & Griffiths, 1995). Some are theoretically based, but used measures referred to different theories[4]. With regard to theory, prior research on video game playing motives was mostly based on *Uses and Gratifications Theory* (UGT; Rubin, 1994, 2002; Ruggiero, 2000). The UGT postulates that people are active agents who use media, because they want to satisfy their needs, goals and interests (Rubin,

[4] Our presentation of theories on video game playing motives is not exhaustive. There are also other theories which have been reported in literature in the context of video game playing motives, e.g. Self Determination Theory (Przybylski, Rigby, & Ryan, 2010; Ryan, Rigby, & Przybylski, 2006).

1994, 2002; Ruggiero, 2000). The UGT was originally applied to traditional media like newspaper or television (Greenberg et al., 2010). Starting with Selnow (1984), UGT has also been applied to studies on video games motives. In studies relying on UGT, empirical support has been found for several motives, e. g. playing for social interaction, playing to pass the time or to avoid boredom as well as playing for fun (Greenberg et al., 2010; Sherry, Lucas, Greenberg, & Lachlan, 2006; Wallenius et al., 2009). Moreover, playing for the challenge (also described as mastery or control) was an important motive in almost every study as well as playing to experience success and to compete with others (e.g. Greenberg et al., 2010; Sherry et al., 2006; Wallenius et al., 2009).

A second important theory in media research that has been frequently applied for traditional media is *Mood Management Theory* (MMT; also known as *theory of affect-dependent stimulus arrangement*; Oliver, 2003; Zillmann, 1988). MMT postulates that people use media to regulate negative mood states provoked by high physiological arousal and negative emotions or understimulation (Oliver, 2003; Zillmann, 1988). Accordingly, negative mood states are aimed to be reduced, whereas positive mood states are aimed to be maintained via media use (Zillmann, 1988).

Compared to UGT, MMT is rarely referred to in studies on video game motives (exceptions are e.g. Bowman & Tamborini, 2012; Colwell, 2007; Reinecke et al., 2012). In general, motives related to mood management have been underrepresented in existing scales (e.g., *Sport Video Game Playing Motivation Scale*, Kim & Ross, 2006; *Gaming Motivation Scale*, Lafréniere, Verner-Filion, & Vallerand, 2012; *Motivation to Play in Online Games Questionnaire*, Yee, 2006). It is assumed that mood management motives are not always conscious when choosing media (Zillmann, 1988). However, qualitative studies demonstrated that adolescents mention these mood management motives (e.g., Colwell, 2007; Olson et al., 2008). Playing video games obviously facilitates changes in mood states through interrupting negative thoughts (Bryant & Davies, 2006), redirecting attention from negative emotions, or distancing oneself from problems (von Salisch & Bretz, 2003). Evidence has shown that adolescents indicated to play video games to obtain relief from stress, to recover, relax, forget problems, cheer oneself up, cope with anger or to escape from reality (Colwell, 2007; Olson et al., 2008; Olson, 2010; Phillips et al., 1995; von Salisch & Bretz, 2003; Wallenius et al., 2009). Finally, Bijvank et al. (2012) identified releasing aggression and venting anger as strongest motives for video game use in adolescent boys. Consequently, video game playing might serve as a tool for emotional self-regulation (Bryant & Davies, 2006; von Salisch, Oppl, & Kristen, 2006). With regard to prior evidence, mood management motives should be conceptually integrated in measures on video game motives.

To summarize, combining UGT and MMT is useful for gaining a more comprehensive understanding of *why* preadolescents play video games. In the present research, we used both theories as theoretical frameworks to develop the video game playing motives questionnaire (VGPM-Q) for preadolescents. Based on these two theories, we proposed two motive factors: The *uses and gratifications motives* factor, based on UGT, assumes that preadolescents play video games because they want to satisfy their needs, goals and interests. The *mood management motives* factor, based on MMT assumes that preadolescents play video games to regulate their mood states.

Construct validity and measurement invariance: Defining methodological standards

Construct validity has usually been tested in prior studies, but the methodological procedures differed. Heterogeneous results regarding the dimensionality of scales (i.e. number of factors) have been reported, reaching from four (e.g. Colwell, 2007) to ten motive factors (e.g. Yee, 2006). Probably different methodological procedures for exploratory factor analysis are responsible for those heterogeneous numbers of factors. Different methodological procedures are related to the analysis method, extraction method and rotation method. In most cases, principal component analysis has been conducted, instead of principal axis analyses. A principal component analysis aims to reduce data and "accounts for variance in measured variables" (Fabrigar, Wegener, Mac Callum, & Strahan, 1999, p. 275), whereas principal axis analysis aims to "identify latent constructs underlying measured variables" (Fabrigar et al., 1999, p. 276) by explaining correlations among measured variables. Conducting principal component analysis instead of principal axis analysis may yield different results, especially when only few items are associated with one factor.

For factor extraction, the Kaiser-Guttmann-Criterion has been frequently used. However, the Kaiser-Guttmann-Criterion is susceptible to overestimate the number of factors (Fabrigar et al., 1999) by providing eigenvalues marginally greater than 1. The *Scree-Test* (Cattell, 1966) and *Parallel Analysis* based on minimum rank factor analysis (Timmerman & Lorenzo-Seva, 2011) are two more advantageous alternatives with respect to factor extraction. Furthermore, orthogonal rotation (Varimax) has often been applied, although motive factors have been reported to be correlated (e.g., Colwell, 2007; Wallenius et al., 2009; Yee, 2006). Thus, oblique rotation (e.g. Promax) should be used (Fabrigar et al., 1999). Applying consistent methodological standards would add to research on video game playing motives.

In contrast to tests of construct validity, prior studies neglected measurement invariance issues on video game playing motives, even in existing scales. However, invariant measures ensure a good methodological standard also in media psychological research (Kühne, 2013). According to Kühne (2013), measurement invariant instruments are essential for research, because they are capable to measure the same constructs across different populations. Only measurement invariant instruments allow group differences to be attributed to true group differences, instead of to variabilities in the measurement instrument itself (Van de Schoot, Lugtig, & Hox , 2012; Wicherts, Dolan, & Hessen 2005).

Group differences which have been routinely addressed in video game research refer to gender differences. Gender is found to be a strong predictor for video game playing with respect to frequency (Trainor, Delfabbro, Anderson, & Winefield, 2010), duration (Marshall, Gorely, & Biddle, 2006), and preferences (Homer, Hayward, Frye, & Plass, 2012; Hust & Brown, 2008). Also gender differences have been reported for video game playing motives (Wallenius et al., 2009). Studies have shown that boys indicate stronger motives for video game playing than girls, especially with respect to social interaction, enjoyment, challenge and competition (e.g. Greenberg et al., 2010; Olson, 2010). Boys

also indicate stronger emotional motives in video game playing than girls (Olson et al., 2007; Olson, 2010). Despite these gender differences, existing scales on video game playing motives have never been tested regarding measurement invariance across gender. To evaluate findings on gender differences adequately, research on video game playing motives would essentially profit from invariant measures.

Appropriateness for preadolescents

Video game playing peaks during early adolescence (Beentjes et al., 2001; Durkin, 2006; Greenberg et al., 2010, Olds et al., 2009). However, most instruments have measured video game playing motives in adults using items adapted to them in terms of content, length and language (e.g. *Gaming Motivation Scale*, Lafréniere et al., 2012). In contrast, short and simple instruments that are appropriate for preadolescents are rare. But, from a developmental perspective, the question of why preadolescents play video games is highly important. During preadolescence, youth get more autonomy in deciding their media use behavior (Bryant & Davis, 2006). Thus, preadolescents can use video game playing to get along with personal, peer-related and school-related demands that accumulates during this developmental period (Simmons, Burgeson, Carlton-Ford, & Blyth, 1987; Steinberg & Morris, 2001). Insofar, video game playing motives could play a moderating role in selection processes of certain games and in socialization processes of video game playing. A strong need for appropriate instruments for this age group can be stated.

Appropriateness for a broad range of games

Finally, the appropriateness of the VGPM-Q for a broad range of games deserves further investigation. Instead of covering a broad range of games, most of existing instruments predominately focus on motives for specific game genres (e.g. *Motives for Online Gaming Questionnaire*, Demetrovics et al., 2011; *Sport Video Game Playing Motivation Scale*, Kim & Ross, 2006; *Motivation to Play in Online Games Questionnaire*, Yee, 2006;) or specific games (e.g. SIMS2, Jansz, Avis, & Vosmeer, 2010). Consequently, items are formulated quite specifically. The development of an instrument capturing motives for a broad range of games is a precondition to test future research questions.

The present study

The general goal of the present study was to develop a theory-based and methodologically sound questionnaire to measure motives for a broad range of games in preadolescents. The specific goals were threefold: (1) for questionnaire development, we selected and modified motive items from prior studies that were related to UGT as well as to MMT. Applying a theory-based procedure, two motive factors were assumed (factor 1: uses and gratifications motives; factor 2: mood management motives). (2) We investigated the construct validity of the proposed measure by analyzing its factorial structure. (3) We examined measurement invariance across gender.

Method

Sample

Data stem from a sample of 1,593 preadolescents between 10 -15 years old (47 % female; *M*age = 11.67; *SD*=.85) who took part in a longitudinal intervention study conducted in Austria. Data were collected in 100 classes in 18 secondary schools in 2009. Schools applied to participate in the study. Participants attended the 5th (n = 805) and 6th (n = 788) grade. Only pre-test data were used in this study.

Construct validity and measurement invariance were analyzed in 1,297 preadolescents (87 % of the original sample), who indicated to play video games. Thirteen percent (n= 207; 77 % girls) denied playing video games. Forty-two percent of the sample were female (n= 547; *M*age = 11.57, *SD* = .78), 58 % (n= 750; *M*age = 11.75, *SD* = .86) were male.

Procedure

During a regular school lesson, an online-based questionnaire was administered in the schools' computer labs under supervision of trained research assistants. The study was approved by the ministry of education and by the local school council. Active parental consent was obtained.

Development of the Video Game Playing Motives Questionnaire (VGPM-Q*)*

For the *VGPM-Q,* all items were adopted and slightly modified from previous research (Colwell, 2007; Jansz & Martens, 2005; Olson, et al. 2007; Sherry et al., 2006; Wallenius et al., 2009). See the *Appendix*, for a detailed overview.

After the introductory question "When do you play video- and computer games? I usually play video games…", 14 items consisting of a motive statement and a 4-point scale ranging from *strongly agree* (3) to *strongly disagree* (0) were presented (see Table 1). The first scale on uses and gratifications motives contained seven items. Among them, three items measured challenge ("if I want to master the game", "if I want to improve my skills", "if I want to advance the game"), and one item measured social interaction ("if I want to play with my friends"), competition ("if I want to win"), enjoyment ("if I want to have fun"), as well as passing time ("When I don't know what else to do"). The second scale on mood management motives included seven items. The items measured stress relief ("when I am stressed"), coping with anger ("if I want to vent my anger", "when I am angry", "when I am furious"), understimulation ("when I feel empty"), and escapism ("if I want to forget about something", "if I want to be someone else"), respectively. The ordering of the items was individually randomized to avoid order-effects.

Statistical analyses

We analyzed the questionnaire in two steps. *In the first step,*we tested the questionnaire for construct validity. For this purpose, the sample was divided into two, randomly composed subsamples. In *subsample 1*, we performed an exploratory factor analysis (EFA); in *subsample 2* we ran a *confirmatory factor analysis (CFA)*. In this way, the questionnaire was cross-validated.

EFA in subsample 1. Extending previous research, we conducted an EFA in SPSS following methodological standards proposed by Fabrigar and colleagues (1999). Accordingly, we conducted a principal axis analysis. For factor extraction, we used the *Scree-Test* (Cattell, 1966). Further, we used *Parallel Analysis* based on minimum rank factor analysis (Timmerman & Lorenzo-Seva, 2011) in R (package psych). This procedure is based on polychoric instead of Pearson correlation which is most appropriate in the case of polytomous items, because otherwise the number of factors may easily be overestimated (Bernstein & Teng, 1989). As a result of moderate correlations between factors in previous studies (e.g., Colwell, 2007; Wallenius et al., 2009; Yee, 2006), we used oblique rotation which allows the factors to be correlated (Fabrigar et al., 1999).

CFA in subsample 2. We ran a CFA in Mplus (CFA; Muthén & Muthén, 2010) using a robust maximum likelihood estimator (Satorra & Bentler, 2001). To evaluate model fit, we used the chi-square index. Non-significant chi-square values indicate good model fit. However, because the chi-square statistic is known to be sensitive to sample size, we additionally used the Comparative Fit Index (CFI; Bentler, 1990) and the root mean squared error of approximation (RMSEA; Steiger, 1990). The CFI ranges from 0 to 1.00, where a value above 0.95 indicates good fit, and for the RMSEA a value of below 0.05 indicates good fit (Hu & Bentler, 1990). In subsample 1, we repeated the CFA. Subsequently, we conducted a reliability analysis for subsample 1 and subsample 2.

After testing the construct validity in the first step, in the second step, we analyzed measurement invariance in the total sample across gender. For this purpose, we ran a multiple-group CFA in a stepwise fashion, using increasingly restrictive measurement models (Gregorich, 2006; Kühne, 2013; Van de Schoot et al., 2012). First, we ran a CFA with identical number of factors and factor structure for boys and girls to test for *configural invariance*. Configural invariance means both factors are associated with the same items in boys and girls. Second, we tested for *metric invariance* assuming equal factor loadings in each group, i.e., both factors have the same meaning between boys and girls. Third, we tested for *equal residuals invariance* assuming equal factor loadings and equal residuals in each group. Fourth, we ran a model for *scalar invariance (*or *strong invariance).* Scalar invariance means equal factor loadings and equal intercepts in each group. Finally, we tested for *full uniqueness measurement invariance* (or *strict invariance*) assuming equal factor loadings, equal intercepts and equal residual variances, that is to say "that the explained variance for every item is the same" between boys and girls (Van de Schoot et al. 2012, p. 490). Then, we analyzed differences in latent mean scores in video game motives between boys and girls. We used the effect sizes (*ES*) for latent mean comparisons developed by Hancock (2001), which is similar to Cohen's *d*. Latent means were fixed to zero in the male group for comparison purposes.

Results

Testing for construct validity

Exploratory factor analysis. In subsample 1 (N = 649; 44.5% female) we performed an EFA (principal axis analysis; *KMO* = 0.906; Promax rotation). The scree test as well as the parallel analysis suggested two factors. The first factor on uses and gratifications motives comprised seven items with factor loadings from .40 to .71 (see Table 1). This factor measures video game playing for mastery/challenge, competition, social interaction, passing time and enjoyment, which is directed either to the game itself or to others. The second factor on mood management motives consisted of seven items with factor loadings from .43 to .83 . This factor measures video game playing to cope with one's own anger and stress, as well as to escape from reality.

Confirmatory factor analysis. In subsample 2, we test the factor structure that was suggested in subsample 1 using EFA. Computed CFA showed a good model fit (χ^2 (76) = 190.42, $p < .01$, *CFI* = 0.96, *RMSEA* = .05).We repeated a CFA also in subsample 1 showing also a good model fit (χ^2 (76) =181.20, $p < .01$, *CFI* = 0.96, *RMSEA* = .05).

We received an acceptable reliability for the uses and gratifications motives scale (Subsample 1: Cronbach's α = .77; Subsample 2: Cronbach's α = .78) and the mood management motives scale (both subsamples: Cronbach's α = .85). Both factors correlated moderately with each other (in subsample 1, r = 0.39; in subsample 2, r = 0.43).

Testing for measurement invariance

As shown in Table 2, the configural invariance model showed an acceptable fit (χ^2 (152) = 326.454; *CFI* = 0.964; *RMSEA* = 0.043), as did the metric invariance model (χ^2 (164) = 346.048; *CFI* = 0.962; *RMSEA* = 0.042) and the equal residuals model (χ^2 (178) = 396.742; *CFI* = 0.954; *RMSEA* = 0.044). The strong invariance model exhibited a drop in model fit (χ^2 (178) = 476.259; *CFI* = 0.938; *RMSEA* = 0.052). We also tested for partial invariance to analyze which loadings or intercepts are distinct for boys and girls (Kühne, 2013; Van de Schoot et al., 2012). In order to conduct latent mean comparisons between groups, constraining two factor loadings and intercepts to be equal across groups is sufficient (Byrne, Shavelson, & Muthén, 1989). Due to high modification indices for three items (item 4, 5 and 7), we released equality constraints for these items. The partial strong I invariance model showed an acceptable fit (χ^2 (173) = 360.620; CFI = 0.961; RMSEA = 0.042). Then, we set equality constraints for items 4, 5, and 7 and for latent means of both factors. This resulted in a substantial drop in model fit (χ^2 (175) = 426.262; CFI = 0.948; RMSEA = 0.048), also indicating substantial differences in latent means between boys and girls. The strict measurement invariance model was not tenable (χ^2 (192) = 525.099; *CFI* = 0.930; *RMSEA* = 0.053).

We conducted latent mean comparisons in the partial strong I measurement invariance model (4a, see Table 2) to examine gender differences. As shown in Table 3, girls showed substantially lower latent means on both factors, the difference between groups

was especially striking with respect to uses and gratifications motives (*ES* = 0.55; medium effect), but also notable with respect to mood management motives (*ES* = 0.35; small effect).

Table 1:
Factor loadings of the two-factor model and descriptives (mean, standard deviation) by gender

When do you play video- and computer games? I usually play video games	Factor loadings		*M (SD)*		
	Factor I Uses and Gratifications	Factor 2 Mood management	Total	Boys	Girls
1. … if I want to master the game.	.69	-.08	2.27 (1.05)	2.44 (.95)	2.03 (1.14)
2. … if I want to improve my skills.	.71	.01	1.98 (1.16)	2.17 (1.09)	1.72 (1.20)
3. … if I want to advance the game.	.53	.20	1.41 (1.26)	1.60 (1.26)	1.14 (1.21)
4. … if I want to play with my friends.	.53	.01	2.23 (1.09)	2.41 (1.00)	1.97 (1.17)
5. … if I want to win.	.59	.02	1.56 (1.29)	1.84 (1.25)	1.17 (1.23)
6. … if I want to have fun.	.46	-.05	2.67 (0.72)	1.95 (1.14)	2.63 (0.72)
7. … when I don't know what else to do.	.40	.07	2.04 (1.16)	2.07 (1.17)	2.01 (1.15)
8. … if I want to be someone else.	.17	.43	0.92 (1.21)	1.02 (1.25)	0.77 (1.13)
9. … if I want to forget about something.	.08	.59	1.39 (1.27)	1.46 (1.28)	1.31 (1.25)
10. … when I feel empty.	.08	.51	0.91 (1.18)	0.99 (1.21)	0.78 (1.14)
11. … if I want to vent my anger.	-.04	.76	1.15 (1.27)	1.29 (1.29)	0.95 (1.21)
12. … when I am angry.	-.10	.83	0.95 (1.19)	1.08 (1.22)	0.76 (1.13)
13. … when I am furious.	-.10	.83	0.85 (1.17)	0.99 (1.22)	0.65 (1.06)
14. … when I am stressed.	.07	.64	0.95 (1.18)	1.09 (1.21)	0.75 (1.10)

Table 2:
Test of measurement invariance across gender

Model		EQC	$SB\chi^2$	df	Compare	Δd	Δ $SB\chi^2$	*CFI*	*TLI*	*RMSEA*	95% CI	*BIC*	*AIC*	*p*
1	Configural	--	326.454	152	-	-	-	0.964	0.956	0.043	0.036 - 0.049	49596.588	49155.262	-
2	Metric	**Λ**	346.048	164	2 vs. 1	12	19.10	0.962	0.958	0.042	0.036 - 0.048	49530.480	49150.734	0.086
3	Equal Residuals	**Λ,Θ**	396.742	178	3 vs. 2	14	39.60	0.954	0.953	0.044	0.038 - 0.050	49492.099	49184.197	0.000
4	Strong	**Λ ,ν**	476.259	178	4 vs. 2	14	130.17	0.938	0.936	0.052	0.046 - 0.057	49570.558	49262.656	0.000
4a	Partial Strong I	**Λ ,ν** **M4, M5, M7**	360.620	173	4a vs. 2	9	14.49	0.961	0.959	0.042	0.036 - 0.048	49480.771	49147.210	0.106
4b	Partial Strong II	**Λ ,ν** **M4, M5, M7, f1, f2**	426.262	175	4b vs. 2	11	79.69	0.948	0.945	0.048	0.042 - 0.054	49537.878	49214.581	0.000
5	Strict	**Λ, Θ, ν**	525.099	192	5 vs. 3	14	127.56	0.930	0.934	0.053	0.047 - 0.058	49295.285	49531.343	0.000

Note. EQC = Equality constraints across groups; **Λ** = matrix of factor loadings, **Θ** = matrix of error (co)variances, **ν** = vector of latent intercepts; $SB\chi^2$ = Satorra-Bentler Estimator (Satorra & Bentler, 2001); *CFI*= Comparative Fit Index; *TLI* = Tucker-Lewis Index; *RMSEA* = Root Mean Square Error of Approximation; 95% CI = 95% confidence interval of *RMSEA* estimate, *BIC* = Bayesian information criterion, AIC = Akaike Information Criterion; M4= item 4 "if I want to play with friends"; M5 = item 5 "if I want to win"; M7 = item 7 ("when I don't know what else to do"); f1 = latent mean of factor 1; f2 = latent mean of factor 2

Table 3:
Latent mean comparisons across gender

	Boys		Girls		
Factor	*M*	*Var*	*M*	*Var*	*ES*[1]
Uses and gratifications motives	0.00	0.53	-0.41	0.58	0.55
Mood management motives	0.00	0.97	-0.33	0.76	0.35

Note. Latent mean comparisons refer to the partial strong measurement invariance model (see model 4a, Table 2).
[1]Effect size measure according to Hancock (2001); *M* =latent mean, fixed to Zero in male group, *Var* = Variance

Discussion

The goal of the present study was to develop and rigorously test the VGPM-Q for preadolescents. The VGPM-Q fulfills four important requirements that have not been addressed simultaneously in prior studies: *To begin with*, UGT and MMT have been combined to serve as a theoretical framework for item selection. *Second*, measurement invariance across gender has been tested. Also high methodological standards regarding factor analysis have been complied. *Third*, the appropriateness of the VGPM-Q for preadolescents as well as *fourth* for measuring motives for a broad range of games have been considered. Thus, the present study contributes to existing literature on video game playing motives in theoretical and methodological ways.

Theoretical implications for measuring video game playing motives

Considering mood management theory in addition to uses and gratifications theory contributes to a better understanding of video game playing motives among youth. Whereas in existing instruments, uses and gratifications motives have usually been captured, mood management motives are often underrepresented (e.g. Kim & Ross, 2006; Lafréniere et al., 2012; Yee, 2006). However, those motives should also be emphasized. As reason can be argued that during early adolescence, the importance of video game playing for emotional self-regulation (Bryant & Davies, 2006; von Salisch et al., 2006) might become especially relevant. In this developmental period profound changes regarding school, peers and family occur, and lead to an increase of stress and negative emotions (Petersen, Kennedy, & Sullivan, 1991; Simmons et al., 1987; Steinberg & Morris, 2001). Playing video games can give support for coping with them. Therefore, adding mood management motives in future studies in preadolescents could be insightful to better understand socialization and selection effects of video game playing.

Methodological implications for measuring video game playing motives

The present study has also methodological implications regarding construct validity and measurement invariance for future studies on video game playing motives.

We tested the construct validity of our instrument by analyzing the factorial structure according to methodological standards proposed by Fabrigar et al. (1999) for the analysis method, extraction method and rotation method. Concordant with underlying theories, the results of principal axis analysis revealed two factors, when oblique rotation, Scree test as well as parallel analysis were applied. The two-factor structure has also been shown in CFA. Due to our theoretically based item selection based on UGT and MMT, the expected two-factor structure has been successfully cross-validated. In contrast, in other studies more factors have been found (Colwell, 2007; Yee, 2006), but those results could be partly attributed to differences in methodological procedure. In line with other studies, we found our motive factors to be moderately correlated (Colwell, 2007; Wallenius et al., 2009; Yee, 2006).

Because invariant measures are required for media psychological research (Kühne, 2013), the present study contributes to research in analyzing measurement invariance for an instrument on video game playing motives applying high methodological standards (Gregorich, 2006; Kühne, 2013; Van de Schoot et al., 2012). The present study can be seen as example for further studies on measurement invariance for other scales. The instrument presented in this study fulfills the methodological requirements to make appropriate comparisons between boys and girls. Providing a partial invariant questionnaire, our analyses revealed striking group differences between males and females in video game playing motives. Consistent with the literature (e.g. Greenberg et al., 2010; Olson, 2010; Olson et al., 2007), stronger motives for game playing were found in boys regarding both, uses and gratifications motives and mood management motives. This finding supports the interpretation that playing video games represents more a stereotypical masculine activity complying more with boy's motives (Durkin, 2006; Lucas & Sherry, 2004).

Limitations

This study has some limitations that require further investigations. First, although the consideration of mood management motives is important, preadolescents agreed less with those motives than with uses and gratifications motives. Because self reports were used, it remains unclear whether mood management motives for playing video games actually occur less frequently, or whether preadolescents were less aware about their mood management motives due to restricted conscious availability (Zillmann, 1988). This issue should be addressed in future research.

Second, a further limitation is that we did not consider other possible motives for video game playing, like identification with avatars (Klimmt, Hefner, Vorderer, Roth, & Blake, 2010; Trepte & Reinecke, 2010) or role play, fantasy, and identity play (Sherry et al., 2006; Yee, 2006). Therefore, it could be criticized that our item selection is still limited and incomplete. However, having the goal in mind of developing a questionnaire that is

applicable to a broad range of games, we selected quite general motives considered as most central for our study.

Third, unfortunately we could not consider other existing instruments in our study. Most of them were developed for measuring video game motives in adult samples or for distinct game genres. Moreover, most of them have been published after our data collection. Doubtless, existing scales would also substantially profit from analyses concerning construct validity and measurement invariance, like it is proposed in the present paper.

Conclusion

In presenting the Video Game Playing Motives Questionnaire for preadolescents, this study offers a theoretical and methodological contribution to the existing literature. In addition to using the uses and gratifications theory, mood management theory was also emphasized for item selection. Furthermore, the main methodological contribution of this work is the rigorous tests on construct validity and measurement invariance across gender, which have been absent from prior measures.

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Appendix:
Adopted/modified items of the Video Game Playing Questionnaire and original items from previous studies

Video Game Playing Motives Questionnaire	Original items from previous studies	References from previous studies
I usually play video games		
1. … if I want to master the game.	"I play computer games because I like a challenge"	Colwell (2007 , p. 2078)
	"I feel proud, when I master an aspect of a game."	Sherry et al. (2006, p. 219)
	"I play electronic games, because I like the challenge figuring the game out"	Olson et al. (2007, p. 81)
2. … if I want to improve my skills.	"I go to a LAN event to improve my score and skills."	Jansz & Martens (2005, p. 343)
	"In games, I can use and develop my game skills, speed and smartness."	Wallenius et al. (2009, p. 466)
3. … if I want to advance the game.	"I find it very rewarding to get to the next level."	Sherry et al. (2006, p. 219)
4. … if I want to play with my friends.	"I go to LAN events to meet friends/ acquaintances."	Jansz & Martens (2005, p. 343)
	"I play electronic games, because my friends like to play."	Olson et al. (2007, p. 81)
	"My friends and I use video games as a reason to get together."	Sherry et al. (2006, p. 219)
	"Often, a group of friends and I will spend time playing video games."	Sherry et al. (2006, p. 219)
	"Games are a uniting interest and common topic to discuss with friends."	Wallenius et al. (2009, p. 466)
5. … if I want to win.	"I go to a LAN event to win games."	Jansz & Martens (2005, p. 343)
	"I play electronic games, because to compete and win."	Olson et al. (2007, p. 81)
	"I like to play to prove my friends that I am the best."	Sherry et al. (2006, p. 219)
6. … if I want to have fun.	"I like computer games because they are fun."	Colwell (2007 , p. 2078)
	"I go to a LAN event for fun."	Jansz & Martens (2005, p. 343)
	"I play electronic games, because it's just fun."	Olson et al. (2007, p. 81)
	"For me gaming is a pastime or entertainment."	Wallenius et al. (2009, p. 466)

7.	… when I don't know what else to do.	"I play electronic games, because nothing else to do." "For me gaming is a pastime or entertainment."	Olson et al. (2007, p. 81) Wallenius et al. (2009, p. 466)
8.	… if I want to be someone else.	"Video games allow me to pretend I am someone else."	Sherry et al. (2006, p. 219)
9.	… if I want to forget about something.	"I play to get away from everyday life, to forget troubles and worries."	Wallenius et al. (2009, p. 466)
10.	… when I feel empty.*	*	*
11.	… if I want to vent my anger.	"Playing computer games lets your anger out."	Colwell (2007 , p. 2078)
12.	… when I am angry.	"I play electronic games, because to get my anger out."	Olson et al. (2007, p. 81)
13.	… when I am furious.		
14.	… when I am stressed.	"I play to recover and to relax." "Playing computer games gets everything off my shoulders"	Wallenius et al. (2009, p. 466) Colwell (2007 , p. 2078)

Note. * We added an item "I usually play video games, when I feel empty" to measure feelings of understimulation.