The immediate and long-term effects of time perspective on Internet gaming disorder

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Backgrounds and aims: This study focuses on the role of time perspective (TP) in Internet gaming disorder (IGD). An inventory-based study on 377 massive multiplayer online role playing game players was conducted, followed by a 3-year-follow-up in which 48 active players from the original sample participated. We proposed that TP factors (negative TP and future positive TP) will influence either the current presence of IGD symptoms or the further development of IGD over time. In other words, the effect of TP is stable. Finally, game usage patterns were analyzed in the sense of changes in playing time and IGD symptoms in gamers after 3 years. *Methods:* To access the variables, two scales were administered through online inventory, the Zimbardo Time Perspective Inventory-short, and Charlton and Danforths' Core Addiction Scale, both in 2012 ($N = 377$) and 2015 ($N = 48$). The amount of time that gamers usually spent playing were obtained through self-reports. *Results:* The study's primary presumptions were confirmed. Both negative TP and future positive TP were confirmed as significant predictors of the presence of IGD symptoms, either immediately or in the following 3 years. Data on game usage showed a significant decrease in playing time and IGD symptoms between year 0 and year 3 of the study.

Keywords: Internet gaming disorder, time perspective, massive multiplayer role-playing games, longitudinal

INTRODUCTION

Online gaming is an activity that is very easy to engage in excessively. A growing body of research emphasizes positive outcomes that gamers may obtain via playing – e.g., experiencing competence, making social connections, decreasing negative feelings, exploring new roles and identities, and learning new skills (Barnett & Coulson, 2010; Yee, 2006). In contrast, many studies note the negative effects of gaming, such as physical problems, personal life problems (i.e., conflicts with friends or family), professional/academic problems (i.e., work or school absence and deteriorated performance), and so on (Kuss & Grifiths, 2012). These outcomes are usually signs of gaming disorder (GD). The ability to predict whether a gamer will or will not develop GD is very important, especially in online gamers, that are the most prone to problematic usage (Cole & Hooley, 2013; Kuss & Griffiths, 2012; Ng & Wiemer-Hastings, 2005; Smyth, 2007). Many scholars suggest a specific diagnostic category for problematic online gaming. Internet gaming disorder (IGD) is a relatively new but intensively researched concept that is currently placed in the "Emerging Measures and Models" section of the fifth edition of *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) (American Psychiatric Association [APA], 2013; Griffiths, King, & Demetrovics, 2014). The reason for treating online games separately is that compared with offline gaming, online gaming usually has a strong social aspect (Allison, von Wahlde, Shockley, & Gabbard, 2006; Kim & Kim, 2010) and usually requires a substantial time commitment – e.g., the average massive multiplayer online role playing game (MMORPG) player spends 25–40 hr per week gaming (Castronova, 2005; Yee, 2006); in other words, among online gamers, excessive gaming is often the norm. Although it has been repeatedly documented in Internet users that light users are less likely to develop problematic usage symptoms than heavy users (Dowling & Quirk, 2009; Fu, Chan, Wong, & Yip, 2010; Young, 1998), excessive gaming, and problematic gaming are not the same thing. It is broadly agreed that problematic gaming is the persistent inability to control excessive gaming habits, despite the problems caused by such habits (Griffiths, 2010; Lemmens, Valkenburg, & Peter, 2009). The inability to control one's gaming usage thus seems to be the important etiological factor in IGD (LaRose, Lin, & Eastin, 2003).

Negative time perspective (TP) and IGD

According to the operant conditioning model of media addiction (Marks, 1990; Marlatt, Baer, Donovan, &

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Kivlahan, 1988), the inability to control media usage develops when the usage functions as the main tool for relieving negative feelings, such as anxiety, stress, loneliness, and depression. Humans do not experience these feelings to the same extent: some are more prone to them than others and some can handle them better than others. The ability to shift one's attentional focus to different aspects (both positive and negative) of one's past, present, and future is known as the TP. Zimbardo and Boyd (1999) proposed five different temporal categories that are used both in encoding, storing, and recalling experienced events and in forming expectations, goals, contingencies, and imaginative scenarios. These frames are past negative, past positive, present fatalistic, present hedonistic, and future (positive). Later, a sixth frame – future negative – was included by TP researchers (Carelli, Wiberg, & Wiberg, 2011). All temporal frames have both a positive and a negative aspect, meaning that we may focus on either positive or negative experiences from the past, the present, and the anticipated future.

The manner in which we use temporal frames influences many actions, decisions, and judgments. According to Zimbardo and Boyd (1999), people usually develop a preference for one or more frames under various circumstances (e.g., experiencing success or failure, stressful life situations, family discourse, religiosity, and cultural and educational background), eventually leading to the habitual overuse of some frames at the expense of others. This temporal bias (time orientation) is learned, largely unconscious, and relatively stable.

Time orientation has been proven to relate significantly to various personality characteristics, such as consciousness, impulse control, consideration of future consequences, ego control, novelty seeking and reward dependence, self-esteem, aggression, depression, anxiety, and so on (Zimbardo & Boyd, 1999), along with various harmful or risky behaviors, such as substance use and abuse (Apostolidis, Fieulaine, & Soulé, 2006; Barnett et al., 2013; Hall et al., 2012; Keough, Zimbardo, & Boyd, 1999; Sansone et al., 2013), gambling (Hodgins & Engel, 2002), online gaming (Lukavska, 2012), and Internet addiction (Przepiorka & Blachnio, 2016).

The majority of studies on substance use and abuse consider only the role of future time perspective (FTP) on consumption behavior. All the studies that were carried out confirmed the FTP to be a protective factor against various substance use (Apostolidis et al., 2006; Barnett et al., 2013; Keough et al., 1999; Sansone et al., 2013), but Keough et al. (1999) revealed that the present time perspective – which, unlike the FTP, relates positively to substance use – accounts for more variance than FTP. Hall et al. (2012) investigated the relationship between FTP and attempts to quit smoking in a large sample of 8,845 adult smokers and found that respondents with higher FTP were more likely to attempt to quit. However, they did not find a significant relationship between FTP and the maintenance of smoking cessation (i.e., abstinence from smoking for at least a month). It must be noted that both in Hall et al. (2012) and Sansone et al. (2013), the FTP was measured very simply, using only one item.

Only three studies that we examined measured all temporal frames using a standard or shortened version of the Zimbardo Time Perspective Inventory (ZTPI). Hodgins and Engel (2002) compared pathological gamblers, social (non-pathological)

gamblers, and a control group of psychiatric patients and found significant differences in the groups' mean ZTPI scores. Surprisingly, the most pronounced differences between pathological and social gamblers were found in the positive–negative dimension of past factor (pathological gamblers scored significantly higher on the past negative scale than social gamblers; the situation was opposite for the past positive scale). No significant difference was found for the future scale between the two groups of gamblers, and in both the present factors (hedonistic and fatalistic), pathological gamblers scored higher than social gamblers.

Przepiorka and Blachnio (2016), using a shortened version of ZTPI on Facebook users, also emphasized the role of negative time frames (past negative and present fatalistic) as predictors of Internet addiction. Future positive orientation, however, proved to be a significant negative predictor of addiction.

According to a study focused on TP in MMORPG players (Lukavska, 2012), game usage (i.e., weekly time spent playing) was primarily influenced by the present fatalistic frame. In other words, the stronger the present fatalistic orientation, the more time was spent gaming.

It has repeatedly been documented that time frames are not completely independent. Very often, an orientation toward one frame is correlated with an orientation toward others, creating certain settings. This is recognized in the concept of the optimal or balanced TP (Boniwell & Zimbardo, 2004), which consists of high orientation toward the future positive and past positive frames and low orientation toward the past negative and present fatalistic frames. In empirical studies using ZTPI, the strongest connections are usually found among the negative frames of past negative, present fatalistic, and future negative (Košťál, Klicperová-Baker, Lukavská, & Lukavský, 2016). Therefore, we can define negative TP as the average score of the three aforementioned frames.

Negative TP is characterized by negative feelings, such as sadness, anxiety, hopelessness, and helplessness. It is theoretically plausible that people with negative TP would be more prone to addictive gaming, as they are more likely than other people to cope with negative emotions. When gaming brings them relief, it can easily become habitual. Other ways of coping with negative emotions are gradually eliminated for the sake of gaming and a shift to addictive gaming occurs.

Many studies identified the protective influence of the future positive time orientation on various forms of addictive or otherwise potentially harming behavior. Therefore, we presumed that this orientation would also function protectively against IGD.

We expect that the effects of TP on IGD will be small to moderate, given to the rather small size of previously found effects of TP on substance use and given to the fact, that IGD seemed to be influenced by various factors, e.g., identification with avatar (Smahel, Blinka, & Ledabyl, 2008), habits related to starting and ending the gaming sessions (Lukavská, Hrabec, & Chrz, 2016), and psychiatric symptoms (Király, Tóth, Urbán, Demetrovics, & Maraz, 2017).

Little is known about the development of time orientation, IGD, and their interaction in time. Therefore, this study's primary goal was to provide and analyze longitudinal data from online gamers.

METHODS

Data collection and sample

Participants were recruited on Czech Internet forums on MMORPGs and a website for gaming fans (http://games.tiscali.cz). Forum posts and an article briefly describing the research focus and linking to the online inventory were posted.

The final data set consisted of 377 respondents (340 males, 30 females, and 7 respondents who did not indicate their gender) ranging in age from 12 to 67 years ($M = 24.1$, $SD = 6.8$). All respondents claimed to be active MMORPG players. The data set mainly consists of Czech (277) and Slovak (39) people but includes people of other nationalities (17 Americans; 7 British; 4 Australians; 3 Germans; 2 Greeks, Dutch, Vietnamese, and Portuguese; and 1 Austrian, Belgian, Canadian, Caucasian, Polish, Swede, and Swiss). Fifteen respondents did not state their nationality. The data were collected in September 2012.

In June 2015, 276 respondents from the original sample who had provided e-mail addresses were sent an e-mail and asked to complete an inventory that was much the same as the one they had completed three years earlier. Seventy-six respondents completed the follow-up survey (69 males and 7 females), 48 of whom were still active players of MMORPGs. The age of respondents ranged from 13 to 37, mean = 22.4, $SD = 4.7$. This follow-up group was compared in some key characteristics (age, playing time, IGD symptoms, and TP) with the rest of the respondents, with no significant differences found except for age, as described in "Results" section.

Measures

Playing time. The amount of time a gamer usually spends playing was accessed using three self-report variables: hours per week (HpW), in which a gamer indicated the number of HpW he or she usually spends playing; hours per session (HpS), in which a gamer indicated how long his or her usual gaming session lasts; and free-time ratio (FTR), in which a respondent indicated how much of his or her free time was spent gaming on a scale from 0% to 100%.

IGD symptoms. Charlton and Danforth's (2007) Core Addiction Scale (CAS) was used to assess IGD. The scale consists of seven items that shows various symptoms that may indicate IGD, e.g., "Arguments have sometimes arisen at home because of the time I spend on MMORPGs." Respondents were asked to express their level of agreement with each statement on a 1–5 scale. The average score was computed for each respondent. None of the respondents fulfilled all of the criteria for IGD, although most fulfilled at least some of them ($N = 242$). It must be noted that CAS does not cover all the nine IGD criteria as proposed in DSM-5 (APA, 2013). CAS measures behavioral salience (item nos. 1 and 6), interpersonal conflict (no. 3), conflict with other activities (nos. 2 and 4), withdrawal symptoms (no. 7), and relapse and reinstatement (no. 5) (Charlton & Danforth, 2007).

TP. Two TP factors were measured via the ZTPI-short scale (Košťál et al., 2016):

Future positive TP factor, measured by three items (5, 12, and 14), reflects the tendency to regulate behavior according to future goals or anticipated outcomes. It consists of items such as "I am able to resist temptations when I know that there is work to be done" and "Before making a decision, I weight the costs against the benefits."

Negative TP factor, measured by nine items (2, 10, 17; 6, 11, 18; 4, 9, 15), reflects the negative aspects of each time frame: the problematic perception of one's own past (items such as "I think about the bad things that happened to me in the past"); a fatalistic, helpless, and hopeless attitude toward present life (e.g., "My life path is controlled by forces I cannot influence"); anxiety and worries about one's future (e.g., "I feel pressure not to be finished with different projects on time").

Each respondent was asked to express his level of agreement with each statement on the 1–5 scale. An average score was computed for each respondent.

Data analysis

Linear regression analysis and partial least squares path modeling (PLS-PM) were conducted using the statistical program R (R Core Team, 2014), including the PLS-PM package (Sanchez, 2013). PLS-PM is the special case of structural equation modeling (SEM), which is based on variance rather than covariance, as is usual in SEM, e.g., LISREL (Haenlein & Kaplan, 2004). PLS-PM quantifies the relationships between variables by considering the network as a system of multiple interconnected linear regressions (Sanchez, 2013). The use of PLS-PM (instead of covariance-based SEM) is especially recommended for models with collinear predictors (Haenlein & Kaplan, 2004). PLS-PM enables researchers to measure the weight of both direct and indirect relationships between variables. This is useful for models in which we expect that relationships between predictors and the dependent variable are mediated by other variables. PLS-PM is also more appropriate than covariance-based SEM in areas that are not yet widely explored and theorized because the weights developed for each construct in PLS-PM consider only those neighboring constructs that are structurally connected (Chin, 2010).

Longitudinal data were paired via the respondents' e-mail addresses; therefore, all comparisons of year 0 and year 3 variables were conducted by paired *t*-tests.

Hypotheses

We expected the positive effect of negative TP on the presence of IGD symptoms – the higher the negative TP, the more IGD symptoms will be present (H1), with the opposite effect of future positive TP on IGD – the higher the future positive TP, the fewer IGD symptoms will be present (H2).

We presumed that the effects of TP on IGD will be quite stable and therefore both negative TP (H3) and future positive TP (H4), as measured in year 0, will be significant predictors of IGD symptoms measured after 3 years (IGD symptoms year 3), even when controlling for IGD symptoms in year 0.

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board of the Charles University approved the study. All subjects were informed about the study and all provided informed consent.

RESULTS

Measured variables, their reliability, and development in time

The obtained values for measured variables for the entire year 0 data set are summarized in Table 1. Table 2 shows the results of respondents who also participated in the year 3 follow-up study and their average results in both years, including the mean of the differences between 2 years and the *t*-test results.

The differences between the both-years group and the rest of the data set were measured by Welsch's independent sample *t*-tests. We found significant differences in age: $t(165) = 3.24$, $p < .01$. Gamers who participated in the follow-up study were, on average, younger ($M = 22.3$, $SD = 4.7$) than the rest of the data set ($M = 24.6$, $SD = 7.2$). The follow-up group showed no difference from the rest of the data set in either playing time variables (HpW, HpS, and FTR; all *t*'s < 0.8, all *p*'s > .4) or IGD symptoms [$t(13.75) = 0.1$, $p = .917$]. With respect to the TP factors, no differences between the follow-up group and the rest of data set were found (all *t*'s < 0.4; all *p*'s > .6).

Playing time. All playing time variables (HpW, HpS, and FTR) were significantly correlated with each other, both in

year 0 (Pearson's coefficients from 0.65 to 0.72, $p < .001$) and in year 3 (Pearson's coefficients from 0.47 to 0.59, $p < .001$).

All playing time variables showed significant decrease between year 0 and year 3 (Table 2).

IGD symptoms. The internal consistency of the CAS was rather low (Cronbach's $\alpha = .69$, $N = 377$), but still acceptable, whereas the obtained value approached the social sciences-accepted value of 0.7 (Tavakol & Dennick, 2011). The reliability of the scale in the 3-year period was high (Pearson's correlation between IGD-year 0 and IGD-year 3 was strong, $r = .70$, $p < .001$). On average, gamers showed a significant decrease in IGD symptoms between year 0 and year 3 [$MD = -0.26$, $t(46) = 2.59$, $p < .05$].

TP. The internal consistency was acceptable both in the case of negative TP (Cronbach's $\alpha = .71$, $N = 377$) and in the case of future positive TP (Cronbach's $\alpha = .67$, $N = 377$). Negative TP and future positive TP showed a significant negative correlation to each other (Pearson's $r = -.29$, $p < .001$).

The reliability of negative TP was high (Pearson's correlation between negative TP-year 0 and negative TP-year 3 was strong, $r = .74$, $p < .001$). On average, the negative TP of respondents decreased significantly between year 0 and year 3 [$MD = -0.18$, $t(43) = 2.37$, $p < .05$].

The reliability of future positive TP was moderate (Pearson's correlation between future positive-year 0 and future positive-year 3 was moderately strong, $r = .56$, $p < .001$). The mean difference between future positive-year 0 ($M = 3.29$, $SD = 1.03$) and future positive-year 3 ($M = 3.52$, $SD = 0.78$) was not significant [$MD = 0.11$, $t(46) = 0.92$, $p = .36$], which suggests that future positive TP is less stable and predictable than negative TP.

Table 1. Obtained values for playing time, IGD, and TP in year 0 sample ($N = 377$)

	Year 0 sample				
	Mean	SD	Minimum	Maximum	N
Hours per week	23.16	16.73	2.00	100.00	377
Hours per session	3.79	2.21	0.50	17.00	377
Free time ratio	41.26	22.89	5.00	95.00	377
IGD symptoms	2.21	0.72	1.00	4.29	377
Negative TP	2.55	0.69	1.00	4.78	377
Future positive TP	3.27	0.89	1.00	5.00	377

Note. SD: standard deviation; IGD: Internet gaming disorder; TP: time perspective.

Table 2. Obtained values for playing time, IGD, and TP in follow-up sample

	Year 0 (2012)			Year 3 (2015)			Difference			
	Mean	SD	n	Mean	SD	n	Mean	t	df	p
Hours per week	23.44	17.90	48	16.89	11.22	47	−6.89	−2.80	46	.007
Hours per session	6.20	2.17	48	3.17	1.62	48	−3.05	−8.60	45	<.001
Free time ratio	41.88	20.85	48	34.58	19.35	48	−7.29	−2.39	47	.021
IGD symptoms	2.54	0.83	47	2.31	0.91	48	−0.26	−2.59	46	.013
Negative TP	2.54	0.71	46	2.33	0.78	46	−0.18	−2.37	43	.022
Future positive TP	3.44	1.00	48	3.52	0.78	47	0.11	0.92	46	.363

Note. Means, standard deviations, and mean differences between year 0 and year 3 of playing time, IGD, and TP are represented in this table. *SD*: standard deviation; IGD: Internet gaming disorder; TP: time perspective.
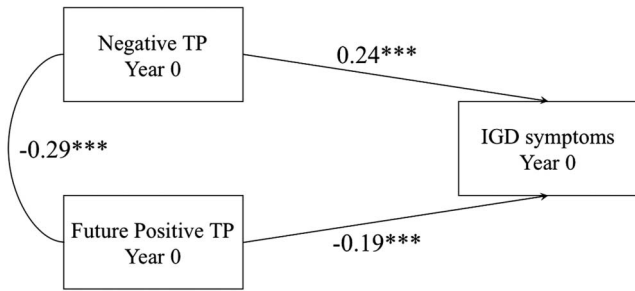
Figure 1. Model 1 with negative TP and future positive TP as predictors of IGD symptoms. Path coefficients and their statistical significance are shown. $N = 377$. ***$p < .001$

Figure 2. Model 2 with negative TP and future positive TP as predictors of immediate and long-term IGD symptoms. Path coefficients and their statistical significance are shown. $N = 48$. *$p < .05$. **$p < .01$. ***$p < .001$

Relationship between TP and IGD symptoms: Immediate effects

Hypotheses 1 and 2 were tested via PLS-PM. Model 1, with negative TP and future positive TP as the only predictors of IGD symptoms (all year 0), was tested (Figure 1). Both hypotheses were proven, whereas negative TP showed a significant positive effect on IGD symptoms (the more a person is negatively oriented, the more IGD symptoms he or she shows), and future positive TP has a significant negative effect (the more a person is oriented toward positive future, the fewer IGD symptoms he or she shows). However, the coefficient of determination shows that both TP factors together have relatively low predictive power, explaining 12% of the variance (Table 3).

Relationship between TP and IGD: Long-term effects

Hypotheses 3 and 4 were also tested via PLS-PM. Model 2 (Figure 2) presumed negative TP and future positive TP (as measured in year 0) as the significant predictors of IGD-year 3. IGD-year 0 was included in the analysis as a mediating variable (between TP factors and IGD-year 3) to control for the effect of high correlation between both IGD variables (year 0 and year 3). Future positive TP showed a significant direct negative effect on IGD symptoms (year 3); therefore, hypothesis 4 was confirmed. Negative TP did not show a significant direct effect on IGD symptoms (year 3), and hypothesis 3 was not supported. However, we again found the significant effect of negative TP on IGD-year 0 (Hypothesis 1). The strongest effect was found between IGD-year 0 and IGD-year 3, which was presumed given their strong correlation. The coefficients of determination were moderate in the case of both dependent variables, showing that predictors can explain approximately 30% of the variance in the case of IGD-year 0 and almost 60% of the variance in the case of IGD-year 3 (Table 4). As noted previously, the strongest predictor of IGD-year 3 was IGD-year 0. Therefore,
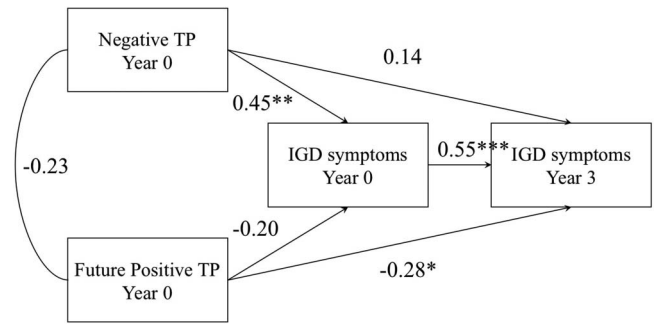
a linear regression model with IGD-year 0 as the only predictor of IGD-year 3 was created. The coefficient of determination was $R^2 = .48$. This means that knowing TP scores improves the prediction of future IGD by 12% (the coefficient of determination for overall model with both IGD-year 0 and TP factors was higher by 0.12, $R^2 = .60$). Sometimes, however, we may want to predict future IGD without measuring current IGD. Therefore, yet another linear regression analysis with negative TP and future positive TP (both year 0) as the only predictors of IGD-year 3 was made. Both TP factors were found to be significant predictors ($p < .01$) with moderate predictive power ($R^2 = .31$).

Gender and age factors

We found no effect of gender on the analyzed variables throughout the sample ($N = 377$, 30 of whom were females): IGD-year 0 [$t(35.068) = 1.01$, $p = .32$], negative TP-year 0 [$t(32.559) = 0.71$, $p = .48$], and future positive TP-year 0 [$t(35.224) = 0.199$, $p = .84$]. It was not possible to analyze the year-3 sample, because there were very few female participants ($n = 7$).

The effect of age was assessed using linear regression analysis in both samples (entire sample, $N = 377$ and follow-up sample, $N = 76$). We did not find a significant effect of age-year 0 on IGD-year 0 in the entire sample [estimate $= -0.01$, standard error $(SE) = 0.006$, $p = .05$, $R^2 = .01$]. We found a significant (although weak) effect of age-year 0 on IGD-year 3 in follow-up sample (estimate $= -0.06$, $SE = 0.028$, $p = .044$, $R^2 = .07$). When testing the possible effect of age on IGD compared with the effects of TP factors, the linear regression analysis was made using age, future positive TP, and negative TP (all three year 0) as explanatory variables. Age was the only insignificant predictor of IGD-year 3 ($p = .12$), whereas both TP factors were significant.

The effects of age on negative TP were very low both in the entire whole sample ($R^2 = .02$) and in the follow-up

Table 3. Path-modeling results for model 1 ($N = 377$)

| Reference variable | Explanatory variables | Estimate | SE | Direct effect | | R^2 |
				value	p	
IGD symptoms (year 0)	Negative TP (year 0)	0.242	0.052	0.242	<.001	.122
	Future positive TP (year 0)	−0.187	0.052	−0.187	<.001	

Note. SE: standard error; IGD: Internet gaming disorder; TP: time perspective.

Table 4. Path-modeling results for model 2 ($N = 48$)

Reference variables	Explanatory variables	Estimate	SE	Direct effect Value	p	Indirect effect	Total effect	R^2
IGD symptoms (year 0)	Negative TP (year 0)	0.453	0.135	0.453	.002	–	0.453	.297
	Future positive TP (year 0)	−0.200	0.135	−0.200	.146	–	−0.200	
IGD symptoms (year 3)	Negative TP (year 0)	0.140	0.117	0.140	.239	0.247	0.386	.595
	Future positive TP (year 0)	−0.279	0.106	−0.279	.012	−0.109	−0.388	
	IGD symptoms (year 0)	0.545	0.119	0.545	<.001	–	0.545	

Note. SE: standard error; IGD: Internet gaming disorder; TP: time perspective.

sample ($R^2 = .01$). Similar results were obtained for the effect of age for FTP ($R^2 = .04$ in the entire sample; $R^2 = .05$ in the follow-up sample).

CONCLUSIONS AND LIMITATIONS

Our major concern was to examine whether TP is a significant and useful predictor of immediate and even future GD symptoms in MMORPG gamers. Although not all of the presumed relationships were confirmed (Hypothesis 3), we may conclude that individual differences in time orientation are important factors in the development of IGD symptoms. Gamers who are more negatively time oriented are more likely to show symptoms of IGD. In contrast, a positive orientation toward one's future seems to prevent the occurrence of IGD symptoms, even in the long term. The obtained coefficients of determination are low-to-moderate, which suggests that TP alone has limited explanatory power and that other factors should be included (e.g., gaming habits – Lukavská et al., 2016, certain gaming motives and psychiatric symptoms – Király et al., 2017) to more precisely predict whether a gamer will exhibit symptoms of IGD.

The high stability of negative TP over 3 years suggests that although TP biases can change (Zimbardo & Boyd, 1999, 2008), biases toward negative frames usually do not vary by much. However, gamers registered a significant decrease in negative TP, which is an interesting finding worthy of further investigation.

The other results are that on average, active gamers showed a significant decrease both in IGD scores and in all measures of playing time within 3 years. It seems that in relatively non-problematic gamers, gaming activity loses its frequency and importance. It should be noted that 28 of the 76 respondents who participated in follow-up study had quit gaming entirely. This conclusion must be treated with caution, especially because of the small number of respondents in the follow-up study; however, it is consistent with recent findings suggesting that online gamers improve their time-management skills because of their gaming activity and therefore they are capable of eventually decreasing their playing time (Majamäki & Hellman, 2016).

The small number of respondents and the self-selecting recruitment procedure are this study's main limitations. The attrition rate was very high, especially in the follow-up group. Although all year 0 respondents willing to further participate ($N = 276$) were sent two e-mails (the second one after 1 week from the first one), only 76 respondents (28%)

participated in the follow-up study. This might cause bias – e.g., relatively responsible, self-organized, or helpful respondents might have completed the inventory. Therefore, we checked for differences between the respondents who participated in the follow-up and those who did not. No significant differences in any analyzed variables (playing time, IGD, or TP) were found between groups. We found a significant difference in age between follow-up participants and non-participants – follow-up participants were significantly younger. However, age did not seem to be an important variable in further analyses.

The measurement of IGD was not ideal. The advantage of Charlton and Danforth's (2007) CAS is that it has been developed for MMORPG users, it appropriately distinguishes between problematic gaming and high engagement (which might simulate preoccupation but is typical in MMORPG players), and it is short and easy to use. The main CAS disadvantage is that unlike more recent tools, it does not include some IGD criteria that are currently being discussed by international researchers (Griffiths et al., 2016).

Nevertheless, we believe that investigating respondents for a longer time period has proven to be a useful approach to IGD, and we encourage other IGD researchers to adopt longitudinal designs. The effect of time orientation on Internet or game usage, as revealed in earlier studies, (Hodgins & Engel, 2002; Lukavska, 2012; Przepiorka & Blachnio, 2016), was also found in this research. More knowledge about the development of time orientation and its relationship with various personality, situational, and psychopathology conditions is needed for a deeper understanding of the role of time orientation in IGD. Finally, the conceptualization and measurement of IGD should be systematically considered to ensure the comparativeness of IGD studies.

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