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Gaming as psychologically nutritious: Does need satisfaction in video games contribute to daily well-being beyond need satisfaction in the real world?

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by

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The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this dissertation. The Graduate College will ensure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

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ABSTRACT

Research on self-determination theory has demonstrated that the satisfaction of basic psychological needs improves well-being and can thus be considered psychologically nutritious. Most of this work has focused on need satisfaction in the real world, but some studies have shown that need satisfaction experienced during video game play also leads to short-term improvements in well-being. It is not yet clear, however, how need satisfaction derived from video games compares to need satisfaction derived from real-world experiences. Can video game need satisfaction improve well-being beyond real-world need satisfaction? The present study addressed this and related questions using a two-week daily-diary study with a sample of 133 undergraduates who regularly played video games.

Multilevel models revealed that well-being was higher on days with (a) above-average levels of video game playtime (without considering need satisfaction or frustration), and (b) above-average levels of video game need satisfaction (after controlling for the satisfaction and frustration of needs in the real world). The effect of real-world need satisfaction on well-being was nearly 10 times the size of the effect of video game need satisfaction, however. This suggests that video games are psychologically nutritious, but less nutritious than need-satisfying real-world experiences. People with an obsessive passion for gaming and those with IGD symptoms also had poorer daily well-being. Separate models revealed that video game playtime was lower on days with above-average levels of real-world need frustration. People with a harmonious passion for gaming and those with IGD symptoms spent more time playing across the two weeks.

CHAPTER 1. INTRODUCTION

Consider, for a moment, a day in the lives of Haley and Ollie—two young adults with a passion for video games. Hayley, an undergraduate student, has had a good day. She got a 98% on her social psychology exam and got to listen—with great interest—to her favorite professor talk about persuasion (Hayley's favorite topic). After class, she had a great time chatting with one of her best friends over coffee. Later in the day, Hayley enjoys some well-earned leisure time by going online to play *World of Warcraft* with one of her old high school friends. The two of them explore an exciting new dungeon and, surprisingly, succeed on the first try. Although she felt great before, Hayley feels even better after playing. In contrast, Ollie, a delivery driver, has had a bad day. During his shift, he delivered food to the wrong location *twice*, and one of the customers yelled at him for showing up late. That same customer complained to Ollie's manager, who punished him by making him work an extra two hours to cover for a sick co-worker. When he finally finishes his shift, Ollie feels terrible. He goes home and spends a few hours playing *Cuphead* with his roommate—a treat he has looked forward to all day. Although *Cuphead* is notoriously difficult, practice has paid off, and the two finally manage to beat the game. After excited disbelief and high-fives, Ollie finds himself feeling much better.

According to self-determination theory (SDT), people have three basic psychological needs—for competence, autonomy, and relatedness—which serve as essential nutriments for optimal functioning and psychological well-being (Deci & Ryan, 2000; Ryan & Deci, 2000; Vansteenkiste & Ryan, 2013). The satisfaction of these needs in everyday life (as experienced by Hayley) improves well-being but the frustration of these needs (as experienced by Ollie) impairs it. Thus, it is unsurprising that, before their gaming sessions, Hayley had a good day and Ollie had a bad one. But Hayley and Ollie both experienced need satisfaction while gaming and both

felt better after playing. Research has shown that need satisfaction during gameplay leads to short-term improvements in well-being (e.g., Ryan, Rigby, & Przybylski, 2006), but it is not yet clear how this compares to need satisfaction derived from other contexts. If need satisfaction in everyday life is psychologically nutritious, then is need satisfaction in video games equally nutritious? Can gaming contribute to daily well-being over and above "real-world" need satisfaction? Or is video game play closer to "the mental equivalent of sugared soft drinks" (Rigby & Ryan, 2016, p. 35)—an enjoyable but non-nutritious pastime?

The proposed study addressed these and related questions using a daily-diary study lasting two weeks. A sample of undergraduates who regularly played video games completed daily measures of need satisfaction and frustration in everyday life (outside of video games), need satisfaction and frustration during gameplay, video game play time, and well-being. Multilevel modeling was used to determine whether daily experiences of need satisfaction and frustration in video games predict daily levels of well-being after controlling for daily experiences of need satisfaction and frustration in the real world.[1] Additionally, separate models tested (a) whether daily need satisfaction and frustration in the real world predict daily video game playtime, and (b) whether daily video game playtime predicts daily well-being. Multilevel models also considered the effects of relevant person-level characteristics as predictors of daily playtime and well-being, as well as potential moderators of daily relations. These variables included (a) harmonious and obsessive passion for gaming, (b) symptoms of Internet Gaming Disorder (IGD), and (c) trait need satisfaction and frustration.

[1] I use "real world" throughout the manuscript to indicate experiences in everyday life outside of video games. This usage is not meant to imply that the satisfaction and frustration of basic psychological needs in video games is any less authentic than the real-world counterparts.

CHAPTER 2. A BRIEF OVERVIEW OF RESEARCH ON VIDEO GAMES

Although playing video games may have been a niche activity in the early days of *Pong* and *Pac Man*, this is certainly not the case today. Video games have become an extremely popular form of entertainment and they continue to rise in prominence. According to the Entertainment Software Association, 65% of households in the United States (US) include at least one person who plays video games for three hours or more each week and these game-playing households have an average of 1.7 gamers (Entertainment Software Association, 2017). Who are these gamers? Although there are more males than females, the distribution is close to equal, with 41% of gamers in the US being female and 59% being male. Gamers are 35 years old, on average, but age distributions vary slightly by sex. For males, 18% are under 18 years old, 17% are 18-35, 11% are 36-49, and 13% are 50 or older. For females, 11% are under 18 years old, 10% are 18-35, 8% are 36-49, and 13% are 50 or older. Thus, gaming appeals to men and women of all ages.

In recent years the amount of money spent on video game content in the US has steadily increased from 17.6 billion dollars in 2011 to 24.5 billion dollars in 2016 (Entertainment Software Association, 2017). Beyond money spent on content in 2016, 3.7 billion dollars were spent on video game hardware and 2.2 billion dollars were spent on gaming accessories, including virtual reality equipment. In addition to spending substantial amounts of money on video games, people are also spending substantial amounts of time playing. One recent study with a massive, representative sample of adolescents from the United Kingdom found that males spent approximately 1.8 hours playing games on weekdays and 3.0 hours on weekend days (Przybylski & Weinstein, 2017). In contrast, females spent approximately 0.2 hours playing games on weekdays and 0.5 hours on weekend days. Thus, males spent roughly 15 hours each

week playing video games and females spent roughly two hours each week playing video games. Other studies have found high weekly playtimes for large samples of youth in America (*M* = 13.2 hours, *SD* = 13.1) and in Singapore (*M* = 21.33 hours, *SD* = 16.0) (Gentile, 2009; Gentile et al., 2011). It is also not uncommon to find high weekly playtimes in older samples. For example, in a large sample of massively multiplayer online (MMO) gamers—most of whom were adults—people played an average of 22.71 hours per week (*SD* = 14.98) (Yee, 2006). Recent studies with university students found average weekly playtimes of 8.61 hours (*SD* = 8.83) and 12.73 hours (*SD* = 11.36) when non-gamers were included (Mills, Milyavskaya, Mettler, Heath, et al., 2018) and 20.55 hours (*SD* = 16.18) when non-gamers were excluded (Allen & Anderson, 2018). Thus, considerable amounts of time and money are being spent on video games, making it critically important to understand the role that games play in people's lives.

Historically, much of the research on video games has focused on the effects of violent video game content (C. Plante et al., 2019). The largest meta-analysis of this area—including 136 papers and 381 independent effect sizes—provided compelling evidence that violent video game play increases the likelihood of aggressive thoughts, feelings, and behaviors while also reducing empathy and prosocial behavior (Anderson et al., 2010). Relations between violent video game exposure and these important outcomes were small-to-moderate in magnitude, appeared in experimental, cross-sectional, and longitudinal studies, and varied little across sex and culture. The effects of video game play are not always negative, however, and depend on content. For example, longitudinal studies have shown that nonviolent prosocial game play leads to increases in prosocial behavior whereas violent game play leads to increases in aggressive behavior (Gentile et al., 2009). A more recent meta-analysis of 98 studies provided further support for the link between violent video game play and aggressive outcomes, but also

demonstrated that prosocial video game play is associated with decreased aggressive thoughts, feelings, and behaviors, and increased prosocial thoughts, feelings, and behaviors (Greitemeyer & Mügge, 2014). Again, the relations between video game play and aggressive and prosocial outcomes were small-to-moderate in magnitude. Thus, video game play can promote aggressive or prosocial behavior depending on the content.

Some recent video game research has focused less on content effects and more on motivation for gaming and the consequences of gaming for well-being. This line of work has once again demonstrated the promise and peril of video game play. Work guided by SDT shows that video game play can satisfy our basic psychological needs, yielding high levels of motivation and short-term improvements in well-being (e.g., Ryan et al., 2006). Work guided by the Dualistic Model of Passion (DMP) shows that people can have a healthy or unhealthy passion for video games with the former linked to better well-being and the latter linked to poorer well-being (e.g., Przybylski, Weinstein, Ryan, & Rigby, 2009). And, finally, work on IGD has shown that some people become *too* motivated to play video games and develop excessive patterns of play that interfere with life and impair well-being (e.g., Gentile et al., 2017). These three areas of research are discussed in detail in the following sections.

CHAPTER 3. SELF-DETERMINATION THEORY

Basic Theoretical Propositions

SDT is a theory of human motivation that identifies three basic psychological needs, which are innate, universal, and essential for optimal functioning and well-being (Deci & Ryan, 2000; Ryan & Deci, 2000, 2017; Vansteenkiste & Ryan, 2013). These are the needs for *competence* (to be good at what we do), *autonomy* (to act volitionally), and *relatedness* (to have meaningful social connections). SDT also proposes three distinct types of motivation and six distinct types of self-regulation associated with these motivations—all of which fall along a continuum ranging from nonself-determined (or controlled) behaviors to self-determined (or autonomous) behaviors. The most autonomous form of motivation is *intrinsic motivation*, which occurs when people freely choose interesting activities without consideration of consequences outside those activities. Intrinsically-motivated behaviors are governed by *intrinsic regulation*—the person chooses the activity simply because it is satisfying. A less autonomous (and more controlled) form of motivation is *extrinsic motivation*, which occurs when people choose behaviors based on associated consequences. Extrinsic motivation is associated with four types of regulation that range from relatively autonomous to relatively controlled. The most autonomous form is *integrated regulation*, where the behavior has been thoroughly internalized through integration with one's identity and values, making it congruent with the self. The next-most autonomous form is *identified regulation*, where a behavior is enacted because the person acknowledges its value, making it partially internalized. The next, relatively controlled form is *introjected regulation*, where behaviors are contingent on internally-administered consequences such as shame, guilt, and pride. The most controlled form is *external regulation*, which occurs when behavior depends entirely on external consequences, such as the rewards and punishments

of others. The final form of motivation—*amotivation*—occurs when a person is not motivated to engage in an activity at all. Amotivation is associated with *non-regulation* of the behavior—a person may still enact the behavior but will do so with little volition or interest.

To illustrate these different forms of behavioral regulation and their associated types of motivation, let us consider how they apply to gaming (Lafrenière et al., 2012). Someone who is intrinsically motivated to play games may play because they find games stimulating, feel competent while playing, and enjoy trying out new game experiences. Someone with integrated regulation may play because gaming feels like an extension of the self—an activity that is aligned with personal values and has become an important part of life. Someone with identified regulation may find gaming personally significant and believe it a good way to develop social skills, intellectual skills, or other aspects of the self. Someone with introjected regulation may feel compelled to play regularly to feel good about themselves or to avoid feeling bad about themselves. Someone with external regulation may play to gain in-game rewards (such as high-quality equipment or virtual currency), to gain in-game awards (such as trophies, achievement points, or character levels), or to be respected by other gamers. Finally, someone who is amotivated may still play but question whether it is good for them or no longer feel that they have good reasons for playing.

How do the three basic psychological needs relate to motivation and well-being? Contexts that support the satisfaction of the needs for competence, autonomy, and relatedness maintain or enhance intrinsic motivation which is associated with many positive outcomes, including positive affect, high-quality performance, healthy behavioral changes, and better mental health (Deci & Ryan, 2000; Ryan & Deci, 2000, 2017; Vansteenkiste & Ryan, 2013). Additionally, need-supportive contexts promote the internalization and integration of extrinsic

motivation, which makes the self-regulation of behavior more autonomous. In contrast, need-thwarting contexts are associated with less intrinsic motivation and more controlled regulation and amotivation, which in turn impairs experiences, performance, and well-being. Thus, according to SDT, need satisfaction is psychologically nutritious and need frustration is psychologically poisonous.

Day-to-Day Need Satisfaction, Need Frustration, and Well-Being

There are several studies demonstrating the connection between daily fluctuations in need satisfaction and well-being. For example, in a two-week, daily-diary study with a sample of undergraduates, daily variations in the satisfaction of competence and autonomy needs positively predicted daily variations in a composite measure of well-being based on positive affect, negative affect, vitality, and physical symptoms (Sheldon et al., 1996). Person-level, trait measures of competence and autonomy satisfaction also predicted higher daily well-being. Another two-week, daily-diary study with an undergraduate sample replicated and extended these findings (Reis et al., 2000). Here, daily variations in the satisfaction of competence, autonomy, *and* relatedness needs positively predicted daily variations in a composite measure of well-being (using the same indicators as the last study). This time, at the person-level, only trait competence satisfaction predicted higher daily well-being, but there were three interactions between need satisfaction at the trait and daily levels. Trait and daily competence satisfaction interacted to predict positive affect; trait and daily autonomy satisfaction interacted to predict vitality; and trait and daily relatedness satisfaction interacted to predict negative affect *and* composite well-being. In all cases, the relation between daily need satisfaction and the outcome was stronger for those high in trait need satisfaction, suggesting that high levels of general need satisfaction may sensitize people to daily need satisfaction, giving them bigger boosts to well-being.

More recent research has produced similar results. In a daily-diary study of undergraduate students lasting 16 days, daily self-concealment (i.e., keeping distressing personal information secret) predicted lower levels of daily well-being (based on life satisfaction, perceived stress, subjective vitality, positive affect, negative affect, and physical symptoms), and this occurred in part through reduced daily satisfaction of needs (Uysal et al., 2010). Finally, in a five-day, daily-diary study with a sample of Belgian children, daily well-being (based on positive affect) was positively predicted by daily need satisfaction and negatively predicted by daily need frustration (van der Kaap-Deeder et al., 2017). Daily autonomy support from mothers and siblings were also indirectly associated with daily well-being through increased need satisfaction. In contrast, daily ill-being (based on negative affect) was positively predicted by daily need frustration and negatively predicted by daily need satisfaction. Daily perceived control from mothers and teachers were also indirectly associated with daily ill-being through increased need frustration. Thus, well-being is highest on days that basic psychological needs are satisfied and lowest on days that they are frustrated.

Applying Self-Determination Theory to Video Games

A growing body of research has focused on understanding the motivation to play video games and the consequences of gameplay through the lens of SDT (Adachi & Willoughby, 2017; Rigby & Ryan, 2011, 2016; Ryan et al., 2006; Uysal & Yildirim, 2016). As a medium focused primarily on entertaining players, video games have the power to intensely satisfy all three of our basic psychological needs (often simultaneously), and thus inspire intrinsic motivation and long-lasting engagement. Games can satisfy the need for competence by allowing players to select difficulty levels that provide an optimal challenge and by giving them consistent feedback on performance. For example, if you grow tired of failing a specific mission you can simply open the settings menu and decrease the difficulty—an option obviously lacking in the real world.

Games can satisfy the need for autonomy by giving players interesting choices and many ways to play, thus maximizing volitional engagement. For example, players may choose which path to take to a new destination or which kind of character to play (e.g., a brawny warrior vs. a brilliant wizard). Finally, games can satisfy the need for relatedness through virtual interactions with characters controlled by the computer or by other players. For example, multiplayer games allow people to cooperate or compete, and some games simulate deep social connections with computer-controlled characters.

A foundational set of four studies with samples of undergraduates and gamers demonstrated that need satisfaction experienced during video game play predicts greater game enjoyment, a feeling of being present in the game while playing, increased motivation to play, and increased well-being after playing—based on subjective vitality, self-esteem, and mood (Ryan et al., 2006). From these promising beginnings, a new realm of research has bloomed. This research is discussed below in three general categories: motivation for gaming, the effects of video game need satisfaction and frustration on well-being, and gaming as a compensatory response to real-world need deprivation.

Motivation for Gaming

Several studies have linked video game need satisfaction to the enjoyment of video games and motivation to play. In one experimental study, undergraduates were randomly assigned to play a bowling game with a traditional controller or a motion controller made to look like a bowling ball and also randomly assigned to play the game with a computer-controlled partner or a human partner (Tamborini et al., 2010). Competence satisfaction was predicted by feeling that the game controls were natural, autonomy satisfaction was predicted by perceived game skill, and relatedness satisfaction was predicted by playing with a human partner (compared to a computer partner). Enjoyment was positively predicted by the satisfaction of all

three needs; and the model explained 51% of its variance. A similar set of studies compared the explanatory power of hedonic needs (for arousal and absorption) to non-hedonic needs (for competence and autonomy) for predicting video game enjoyment (Tamborini et al., 2011). In the first study, 54% of the variance in enjoyment of a boxing game was explained by hedonic needs for arousal and absorption, and an additional 13% of the variance was explained by non-hedonic needs for competence and autonomy.

In the second study, undergraduates were randomly assigned to play a flight simulation game under conditions of low, medium, or high interactivity. Across the three conditions, hedonic needs explained 20% of the variance in enjoyment and nonhedonic needs explained 34% of the variance. When conditions were tested separately, however, it was found that as interactivity increased, the explanatory power of non-hedonic needs increased while the explanatory power of hedonic needs decreased. Thus, it seems that basic psychological need satisfaction is especially influential for the enjoyment of interactive media such as video games.

Another experimental study allowed undergraduates to play a flight simulation game under conditions of low, medium, and high user demand, then asked them to complete a filler task (Reinecke et al., 2012). Participants randomly received positive or negative false feedback on their task performance and then selected one of the three game conditions to play again. The negative (compared to positive) feedback produced lower competence and autonomy satisfaction which predicted lower positive affect. Competence satisfaction and positive affect negatively predicted self-selected user demand, but autonomy satisfaction positively predicted it. Those who selected more demanding conditions felt greater competence and autonomy satisfaction during that play session, which in turn predicted greater enjoyment. Taken together, this suggests that basic psychological need satisfaction (or frustration) can influence choice of video game

exposure directly and indirectly through mood. Additionally, demanding video game play seems to be better at satisfying competence and autonomy needs and repairing negative moods through enjoyment.

Other research has explored the potential for games to satisfy a need for insight, defined as a need for "contemplating, introspecting, and experiencing greater understanding of essential values, fundamental beliefs, and important life lessons" (Oliver et al., 2016, p. 393). In an online, experimental study, gamers were randomly assigned to report about a game they found fun or a game they found meaningful. Those who answered questions about a meaningful game reported higher in-game narrative quality than those who answered questions about a fun game, but there were no differences in the reported quality of game control mechanics. Higher narrative quality predicted greater autonomy, relatedness, and insight satisfaction and higher quality of game controls predicted greater competence, autonomy, and insight satisfaction. Insight satisfaction was also directly predicted by recalling a meaningful (vs. fun) game, suggesting the presence of other, non-story avenues responsible for insight satisfaction. Finally, quality of game controls, competence satisfaction, and autonomy satisfaction predicted greater enjoyment, but relatedness satisfaction and insight satisfaction predicted greater appreciation. Thus, need satisfaction varied by game type but always predicted more positive experiences with games.

In addition to predicting enjoyment and appreciation, video game need satisfaction also predicts weekly playtime. In a cross-sectional study of gamers (most of whom were university students), the satisfaction of competence, autonomy, and relatedness needs in one's current favorite video game each independently predicted higher weekly playtimes for that game, even after controlling for many other potential predictors (Johnson et al., 2016). Another cross-sectional study with undergraduate gamers found moderate, positive correlations between

weekly playtime and the game-based satisfaction of all three basic psychological needs (Allen & Anderson, 2018). Another recent cross-sectional study of gamers found a moderate positive correlation between a composite measure of video game need satisfaction (based on all three needs) and weekly playtime (Mills, Milyavskaya, Mettler, & Heath, 2018).

A set of two, two-week, daily-diary studies with undergraduate students yielded mixed evidence for a relation between daily need satisfaction (in general) and daily video game playtime (Quist, 2016). The first study found a significant positive relation between these two variables, but the second study found a non-significant, negative relation. Both studies *did* find positive relations between daily need satisfaction and two other measures of daily gaming experiences: perceived success during gameplay and satisfaction with gaming sessions. However, because the measure of need satisfaction was open-ended, it is unclear whether responses reflect need satisfaction during video game play or during the rest of the day, thus the meaning of these findings is ambiguous.

A separate set of studies have examined video game motivations across the spectrum of self-determination, ranging from controlled to autonomous motivations. One early cross-sectional study found—in a sample of gamers—that problematic gamers (i.e., those who spent so much time playing that it created problems for them) had greater extrinsic motivation and amotivation for playing video games (King & Delfabbro, 2009). This suggests that problematic gamers were more controlled by gaming than other gamers, but also that they began to question the meaningfulness of gaming (here, amotivation was conceptualized as playing games to alleviate boredom but without purpose). Similar patterns have been observed in more recent research (Mills & Allen, 2020).

Another cross-sectional study with gamers developed a measure of motivations for gaming that closely reflects the spectrum of self-determination (Lafrenière et al., 2012). This study found that the satisfaction of basic psychological needs in video games was more strongly related to motivations on the autonomous end of the spectrum (i.e., intrinsic motivation, integrated regulation, and identified regulation) compared to the controlled/amotivated end of the spectrum (i.e., introjected regulation, external regulation, and amotivation). This provides further evidence that video game need satisfaction fuels intrinsic motivation to play. The same measure of gaming motivations was used in another cross-sectional study with Italian online gamers (Ballabio et al., 2017). In this study, the SDT-based motivations were assessed along with another measure of seven distinct motives for gaming: escape, coping, fantasy, skill development, recreation, competition, and social. Strong positive relations were found between identified regulation and the skill development motive, introjected regulation and the escape motive, and external regulation and the competition motive. Strong positive relations were also found between relatedness satisfaction and the social motive as well as competence satisfaction and the competition motive. A third cross-sectional study using the same measure of gaming motivations explored relations among gaming motivation, need frustration (in general), and problematic gaming in a large sample of gamers (Mills et al., 2017). This study found that problematic gaming was positively predicted by integrated-identified motivation (a combination of two forms), introjected motivation, external motivation, and amotivation as well as the frustration of autonomy needs. Introjected motivation and amotivation also indirectly predicted greater problematic gaming through increased autonomy frustration. Overall, this suggests that controlled and autonomous motivations both contribute to problematic gaming and that controlled motivations do so in part through increased frustration of the need for autonomy.

Finally, research has also explored how meta-game reward systems affect player motivation. Such systems grant players trophies or achievements for completing in-game goals, and these "badges" are usually publicly displayed on the player's profile. In a qualitative study, several focus groups of gamers discussed these badge systems (Cruz et al., 2017). Attitudes toward badges ranged from indifference to extreme positivity. Some players viewed badges as rewards for in-game tasks that provided information about the player's progress (a perception likely to foster intrinsic motivation). Others, however, viewed badges as chores to complete and found them controlling (a perception likely to foster extrinsic motivation or amotivation). Some players identified as "completionists" and were highly motivated to earn *all* available badges for the games they played. These completionists found it very satisfying to earn all possible rewards, but they were also sometimes frustrated by badges that were difficult to attain and confessed to playing games that were no longer fun just to earn badges. Thus, badge systems seem to foster intrinsic motivation and contribute to enjoyment for some but foster extrinsic motivation and detract from enjoyment for others.

The Effects of Video Game Need Satisfaction and Frustration on Well-Being

Other research has focused on how the satisfaction and frustration of needs in video games affects well-being. In one repeated-measures study, undergraduates were frustrated with a stressful math task and then played *Mario Kart* (Rieger et al., 2014). Measures of angriness, depression, fatigue, happiness, and relaxation were completed before and after gameplay. After playing, participants had reduced angriness, depression, and fatigue, but increased happiness and relaxation. This suggests that game play improved well-being, but the study had no non-gaming control group, so other factors (such as the passage of time) may also be responsible. The mood benefits were driven by in-game success rather than the satisfaction of competence and autonomy needs, but the latter two variables did predict game enjoyment. However, because in-

game success likely predicted competence satisfaction, it is not clear that it is appropriate to include actual success as a predictor of mood changes alongside need satisfaction. Other research has focused on need frustration. A set of seven studies with diverse methods demonstrated that the frustration of the need for competence during video game play produces greater aggressive thoughts, feelings, and behaviors (Przybylski et al., 2014).

The set of two, two-week daily-dairy studies described in the previous section also provided mixed evidence for a link between daily video game play and daily well-being (Quist, 2016). In the first study, daily levels of (a) perceived success in video games, (b) satisfaction with video game play, and (c) video game playtime all predicted better daily well-being through increased need satisfaction. Again, however, this measure of need satisfaction was open-ended, so it is unclear whether this reflects the satisfaction of needs inside or outside of video games. In the second study, there was no evidence for these relations, but this may be attributable to an experimental manipulation added to this study—specifically, using a traditional or gamified approach to goal accomplishment.

Finally, a cross-sectional study with a sample of undergraduate gamers explored relations among well-being and the satisfaction and frustration of needs in the real world and in video games (Allen & Anderson, 2018). Complex, interactive relations were found for video game competence satisfaction and real-world competence satisfaction as predictors of a composite measure of well-being based on life satisfaction, loneliness, self-esteem, and measures of psychological, physical, and relational well-being. Generally, competence satisfaction in the real world was more strongly (positively) related to well-being than competence satisfaction in video games. At the lowest levels of real-world competence satisfaction, video game competence satisfaction was positively related to well-being up to the scale midpoint, but negatively related

to well-being above the midpoint. At higher levels of real-world competence satisfaction, video game competence satisfaction was essentially unrelated to well-being. Similarly-complex interactive relations were also observed for autonomy satisfaction. Once again, real-world autonomy satisfaction was generally more strongly (positively) related to well-being than the video game equivalent. The relation between video game autonomy satisfaction and well-being was negative at the lowest levels of real-world autonomy satisfaction, positive at the highest levels, and near zero for moderate levels. For relatedness satisfaction, real-world relatedness satisfaction was positively related to well-being, but video game relatedness satisfaction was unrelated to well-being. Similar patterns were observed for competence and relatedness frustration, with the real-world variable negatively predicting well-being and the video game variable not predicting well-being. For autonomy frustration, both real-world and video game autonomy frustration negatively predicted well-being, but the real-world variable was a stronger predictor. Thus, at this macroscopic level, the relations between well-being and video game need satisfaction are complicated and depend on levels of real-world need satisfaction. Video game need frustration, on the other hand, was unrelated or weakly related to well-being after controlling for need frustration in the real world.

Gaming as a Compensatory Response to Real-World Need Deprivation

Thus far, the research discussed has emphasized the effects of need satisfaction and frustration experienced during video game play. There is also research, however, examining relations between gaming and the satisfaction and frustration of needs in everyday life. Much of this research focuses on excessive (or problematic) gaming. Several studies suggest that excessive gaming may be an attempt to compensate for a lack of need satisfaction in other contexts. According to SDT, if needs are continually frustrated, people are likely to develop need substitutes or other compensatory behaviors in an effort to satisfy their neglected psychological

needs (Vansteenkiste & Ryan, 2013). Gaming seems to serve these functions for some. According to the need density hypothesis, for some people video games are simply better than everyday life at satisfying needs and this discrepancy between real-world and video game need satisfaction may lead to overuse (Rigby & Ryan, 2011, 2016). Thus, for some, "video games become an escape, and a substitution for basic need satisfaction they are not receiving in their everyday lives" (Rigby & Ryan, 2016, p. 39).

Early evidence for the need density hypothesis came from qualitative interview studies with gamers who struggled with overuse. These interviews suggested that problematic gaming is most likely when need satisfaction is low in the real-world but high in video games (Rigby & Ryan, 2011; Wan & Chiou, 2006b). Since then, several quantitative studies have provided additional support. In one cross-sectional study with adult, Chinese gamers, low satisfaction of competence and relatedness needs in the real world predicted less purpose in life which in turn predicted more problematic gaming (Wu et al., 2013). Low relatedness satisfaction also directly predicted more problematic gaming. Another, two-year longitudinal study with Chinese high school students found that autonomy support from teachers in the 7th grade predicted greater real-world need satisfaction in the 8th grade. That need satisfaction predicted greater school engagement in the 9th grade which in turn predicted less problematic gaming in the 9th grade (after controlling for problematic gaming in the 7th grade) (Yu et al., 2015). Thus, problematic gaming decreased over time for those whose needs were satisfied but increased for those whose needs were unsatisfied.

A systematic review of epidemiological studies of IGD highlighted several SDT-relevant risk and protective factors for IGD that have emerged in longitudinal research (Mihara & Higuchi, 2017). Risk factors include loneliness and low social competence (relevant to

relatedness need frustration), and protective factors include social competence, social integration in the classroom (both relevant to relatedness need satisfaction), and teacher autonomy support (as previously described). Research conducted after this review has provided additional support. In a two-wave, six-month longitudinal study with a large sample of American adults who played online games, low initial need satisfaction predicted increases in IGD over time and high initial IGD predicted decreases in need satisfaction over time (N. Weinstein et al., 2017). This suggests a possible downward spiral, where real-world deficits in need satisfaction exacerbate IGD which in turn further impairs real-world need satisfaction. However, it also suggests that high real-world need satisfaction protects against IGD.

Although most studies have focused on the satisfaction and frustration of needs in the real world or in video games alone, two of the most recent quantitative studies in this area considered both real-world and video game contexts. One cross-sectional study with a sample of undergraduate gamers found nonlinear, interactive relations between real-world and video game need satisfaction (Allen & Anderson, 2018). Specifically, IGD increased as need satisfaction in video games surpassed need satisfaction in the real world, suggesting that it is the discrepancy in need satisfaction between the two contexts that matters most for predicting IGD. Surprisingly, need frustration in the real world *and* in video games uniquely, positively predicted IGD, suggesting that excessive gameplay can continue even when video games frustrate needs as well as satisfy them. Another cross-sectional study with a large sample of gamers found similar results (Mills, Milyavskaya, Mettler, & Heath, 2018). Specifically, real-world need frustration interacted with video game need satisfaction to predict weekly playtime and IGD symptoms, such that the positive relations between video game need satisfaction and both outcomes were

stronger when real-world need frustration was high. This suggests that people with frustrated needs are especially drawn to video games for their need-satisfying potential.

Finally, it is worth noting that similar results have been observed for the use of other media. In one cross-sectional study with Chinese elementary school students, weekly time spent on the Internet was positively predicted by need satisfaction experienced online but negatively predicted by real-world need satisfaction (Shen et al., 2013). Additionally, a cross-sectional study with a sample of German Facebook users found that low levels of competence, autonomy, and relatedness satisfaction predicted higher levels of social networking site addiction, and these relations were partially mediated by compensatory motives for self-presentation, escapism, information-seeking, and meeting new people (Masur et al., 2014).

Summary

Overall, research applying SDT to video games has shown that need satisfaction during gameplay predicts greater enjoyment, greater motivation to play, and greater time spent playing. The ability of video games to satisfy basic psychological needs means that many players are intrinsically motivated to play—but some gamers are also driven by extrinsic motivations and these are associated with problematic gameplay. Need satisfaction during gameplay is associated with short-term improvements in well-being but need frustration during gameplay is associated with short-term decreases in well-being. It is less clear how video game need satisfaction and frustration relate to well-being in long-term contexts, or in short-term contexts after controlling for real-world need satisfaction and frustration. Finally, there are several studies suggesting that people are more drawn to video games if their needs are unsatisfied in the real world, suggesting that excessive gameplay may be an attempt to compensate for real-world need deprivation.

CHAPTER 4. THE DUALISTIC MODEL OF PASSION

Basic Theoretical Propositions

The Dualistic Model of Passion (DMP) proposes two related but distinct types of passion that coexist when people are passionate about an activity (Vallerand, 2010; Vallerand et al., 2003). Within the DMP, passion is defined as "a strong inclination toward a self-defining activity that one loves, values (finds important), and devotes a significant amount of time and energy to" (Vallerand, 2010, p. 183). Passion can be primarily harmonious or obsessive. Harmonious passion "originates from an autonomous internalization in identity and entails control over the activity and a harmonious coexistence of the passionate activity with other activities in the self" (Vallerand, 2010, p. 183). In contrast, obsessive passion "follows a controlled internalization and entails a relative lack of control over the passionate activity, rigid persistence, and conflict with other activities in one's life" (Vallerand, 2010, p. 184). Thus, both harmonious and obsessive passion involve high engagement and treating the passion as an important part of the self, but they differ in how much control the person has over the activity. When harmonious passion dominates, the person volitionally engages in the activity in a manner that does not conflict with other parts of life. When obsessive passion dominates, the person is controlled by their passion and they feel compelled to engage even when it conflicts with other life activities. Generally, harmonious passion is associated with adaptive outcomes and obsessive passion is associated with maladaptive outcomes.

The DMP was originally proposed with four studies supporting the model (Vallerand et al., 2003). The first of these was cross-sectional, with a large sample of college students reporting their experiences with an activity they were passionate about. Harmonious passion was associated with more flow, positive emotions, concentration, and less shame during activity

engagement as well as more positive emotions after activity engagement. In contrast, obsessive passion was associated with more shame during activity engagement and more negative affect and cognition when prevented from engaging in the activity. Obsessive passion also predicted greater conflict between the passion activity and other life activities. Both forms of passion were positively associated with inclusion of the activity in the self. In a second, two-wave longitudinal study, male intercollegiate football players completed measures approximately four months apart. Harmonious passion for football was associated with increases in general positive affect over the course of the football season, but obsessive passion for football was associated with increases in general negative affect during the same time frame. In another two-wave longitudinal study, recreational cyclists completed measures in the summer and winter. Only 30% of the sample continued cycling under dangerous winter weather conditions and these people had higher obsessive passion for cycling than the non-winter cyclists, suggesting that obsessive passion can lead to rigid persistence in passion activities even when they are potentially harmful. Finally, a fourth, cross-sectional study, compared the passions of two groups of gamblers. One group had excluded themselves from a local casino, asking to be banned for one year (to help curtail excessive gambling). The other group had not excluded themselves. The self-exclusion gamblers had significantly higher obsessive passion for gambling than the other gamblers, but the two groups did not differ in harmonious passion for gambling. Additionally, self-exclusion gamblers had obsessive passion that was significantly greater than their harmonious passion, but the other gamblers had harmonious passion that was significantly greater than their obsessive passion. Thus, these studies provided initial support for the proposition that harmonious passion is beneficial and obsessive passion is harmful.

Since the introduction of the DMP, a great deal of research has provided additional support for the model. This relatively new literature is summarized nicely in one meta-analysis spanning a full decade of passion research and including 94 studies with a total of 1,308 independent effect sizes for relations between passion and intrapersonal outcomes (Curran et al., 2015). Because harmonious and obsessive passion are nearly always examined simultaneously, the authors were able to calculate weighted partial correlations between intrapersonal outcomes and each type of passion after controlling for the other type (see Table 1). These partial correlations give an excellent overview of how each passion uniquely relates to several outcomes of interest. Ignoring partial correlations between -.09 and .09, we see that for well-being (and ill-being), high harmonious passion predicts higher levels of positive affect, life satisfaction, vitality, and cognitive-emotional engagement, as well as lower levels of negative affect and burnout. In contrast, high obsessive passion predicts higher levels of negative affect and burnout. For motivational factors, high harmonious passion predicts higher levels of intrinsic motivation, identified regulation, mastery approach goals, and psychological need satisfaction, as well as lower levels of amotivation. In contrast, high obsessive passion predicts higher levels of introjected regulation, external regulation, amotivation, mastery approach goals, performance approach goals, and performance avoidance goals. For cognitive outcomes, high harmonious passion predicts higher levels of concentration, flow, and self-esteem, as well as lower levels of anxiety and activity/life conflict. In contrast, high obsessive passion predicts higher levels of anxiety, rumination, and activity/life conflict, as well as lower self-esteem. Finally, for behavior and performance, high harmonious passion predicts higher levels of deliberate practice and subjective performance whereas high obsessive passion predicts higher levels of deliberate practice, hours per week, and activity dependence. Overall, harmonious passion is associated

with a wide variety of positive outcomes and obsessive passion is associated with a few positive outcomes, but many negative outcomes. Thus, harmonious passion involves healthy activity engagement that generally enhances well-being and obsessive passion involves less-healthy activity engagement that generally detracts from well-being.

Before discussing how the DMP has been applied to video games, it is worth discussing a few non-gaming studies that are especially relevant to the present research. First, is a two-week daily-diary study with a sample of undergraduates with passions for a variety of activities (Mageau & Vallerand, 2007). Across the two weeks, obsessively passionate people engaged more frequently in their passion activity but not for longer sessions whereas harmoniously passionate people engaged less frequently but for longer sessions. Additionally, passion moderated the relation between activity engagement and positive affect. When people *did* engage in their passion activity, those with harmonious passion had higher positive affect than those with obsessive passion. When people *did not* engage in their passion activity, those with obsessive passion had lower positive affect than those with harmonious passion. Thus, it seems that harmoniously passionate people feel especially good when they engage with their passion, but obsessively passionate people feel especially bad when they cannot engage with their passion.

Another set of four studies explored how the two passion types relate to the satisfaction of basic psychological needs inside and outside the passion activity (Lalande et al., 2017). The first of these was cross-sectional with a sample of people who played a musical instrument as a hobby. Need satisfaction in music positively predicted both harmonious and obsessive passion for the instrument but need satisfaction at work did not predict harmonious passion and negatively predicted obsessive passion. Life satisfaction, in turn, was positively predicted by

harmonious passion but negatively predicted by obsessive passion. The second study involved an experimental manipulation of general need satisfaction (to produce high vs. low satisfaction) with a sample of people who had passions for various activities. Need satisfaction within the passion activity once again positively predicted both types of passion, but the experimental manipulation of need satisfaction outside the passion activity only predicted obsessive passion, which was higher when general need satisfaction was low. Negative affect, in turn, was negatively predicted by harmonious passion and positively predicted by obsessive passion. The third, cross-sectional study replicated these patterns with a sample of people who played basketball as a hobby. As before, need satisfaction in basketball positively predicted both passions, but general need satisfaction did not predict harmonious passion for basketball and negatively predicted obsessive passion for basketball. Additionally, harmonious passion positively predicted life satisfaction and obsessive passion positively predicted burnout. The final study, involving government workers in Quebec, was longitudinal, with two waves separated by a six-month gap. High initial levels of need satisfaction at work predicted increases in both harmonious and obsessive passion for work over time, but high initial levels of general need satisfaction predicted decreases in obsessive passion over time.

Overall, all four studies suggest that harmonious and obsessive passion are both fueled by the satisfaction of needs within the passion activity, but that obsessive passion is also fueled by low satisfaction of needs outside the passion activity. In other words, it seems that obsessive passion may be a compensatory response to unsatisfied needs—the person becomes more obsessed with their passion if it is the only place where their needs are satisfied. This can lead to conflict with other life activities and negative outcomes such as reduced life satisfaction and increased negative affect and burnout. This finding lends further support to the hypothesis that

excessive video game play—which suggests an obsessive passion for gaming—may be an attempt to compensate for real-world need deficits, as discussed in prior sections.

Applying the Dualistic Model of Passion to Video Games

A small body of work has applied the DMP to video games to better understand the motivations for and consequences of gaming. Several of these studies have demonstrated a strong positive relation between obsessive passion for gaming and various measures of video game addiction. For example, in a cross-sectional study with a large sample of Taiwanese gamers, harmonious passion for gaming was not a predictor of online game addiction, but obsessive passion for gaming was a very strong, positive predictor (C.-C. Wang & Chu, 2007). Additionally, those with high (vs. low) levels of harmonious passion did not differ in the frequency or length of online game usage, but those with high (vs. low) obsessive passion played online games more frequently and for longer periods of time. In another cross-sectional study with massively multiplayer online (MMO) gamers, high harmonious passion for gaming was associated with higher levels of positive affect, life satisfaction, and self-realization, but high obsessive passion for gaming was associated with higher levels of positive *and* negative affect, more problematic gaming, more physical symptoms, more hours per week playing, and less self-realization (Lafrenière et al., 2009). A third cross-sectional study with a small sample of male, German gamers also found a strong positive relation between obsessive passion for gaming and problematic gameplay (Kneer & Rieger, 2015). Moreover, after controlling for weekly playtime, obsessive passion for gaming and motivation for immersion were both positive predictors of problematic gameplay, but harmonious passion was not a predictor. Based on these studies, it seems that measures of problematic video game play are capturing a construct very similar to obsessive passion for gaming.

In addition to the relations just discussed, other studies have demonstrated that harmonious passion for gaming is associated with positive outcomes and obsessive passion for gaming is associated with negative outcomes. In a cross-sectional study with Singaporean adolescents, harmonious passion for gaming, compared to obsessive passion for gaming, was more strongly, positively related to intrinsic regulation, identified regulation, flow, and positive affect (C. K. J. Wang et al., 2008). In contrast, obsessive passion, compared to harmonious passion, was more strongly, positively related to external regulation, weekday playtime, and weekend playtime. Both forms of passion had similar, positive relations with introjected regulation.

Another cross-sectional study with a very large sample of gamers showed that trait need satisfaction was positively related to harmonious passion but negatively related to obsessive passion for gaming (Przybylski et al., 2009). When trait need satisfaction was used as a predictor of gaming experiences alongside the two passions, trait need satisfaction positively predicted game enjoyment and post-play energy but negatively predicted post-play tension. Harmonious passion positively predicted game enjoyment and post-play energy, but obsessive passion negatively predicted game enjoyment and positively predicted post-play tension and amount of play. Trait need satisfaction and the two passions were also used as predictors of general well-being. Trait need satisfaction positively predicted life satisfaction, mental health, and physical health. Harmonious passion also positively predicted life satisfaction and obsessive passion negatively predicted physical health. Finally, obsessive passion—but not harmonious passion—moderated the relations between weekly playtime and three of the well-being variables: post-play energy, life satisfaction, and mental health. In all cases, the relation between weekly playtime and well-being was positive for those with low levels of obsessive passion, but negative for those

with high levels of obsessive passion. Controlling for trait need satisfaction eliminated the interactions for life satisfaction and mental health, but because low need satisfaction contributes to the development of obsessive passion (Lalande et al., 2017), it is not clear that it is appropriate to include it as a control variable. Thus, people with harmonious passion had more energy after playing and had higher life satisfaction but people with obsessive passion spent more time playing, felt tenser after playing, and had poorer physical health. Additionally, people with low obsessive passion had higher post-play energy, life satisfaction, and mental health as weekly playtime increased, but people with high obsessive passion had lower post-play energy, life satisfaction, and mental health as weekly playtime increased.

Another cross-sectional study with a sample of MMO gamers showed that, when controlling for obsessive passion for one's favored MMO game, harmonious passion for the game was positively related to general positive affect, positive affect while playing, and craving for gameplay (Stoeber et al., 2011). In contrast, when controlling for harmonious passion, obsessive passion was positively related to general negative affect, negative affect while playing, negative affect when prevented from playing, and craving for gameplay. In a cross-sectional study with a sample of massively multiplayer online role-playing game (MMORPG) players, harmonious and obsessive passion for gaming were used as predictors of the number of friends and quality of friendships in online and offline contexts, after controlling for age, sex, time spent online, and time spent gaming (Utz et al., 2012). Obsessive passion negatively predicted both the number of offline friends and the quality of offline friendships. Harmonious and obsessive passion both positively predicted the number of online friends, but only harmonious passion predicted higher-quality online friendships. Thus, obsessive passion was linked to poorer social outcomes and harmonious passion was linked to better social outcomes.

Finally, a five-wave longitudinal study spanning approximately 2.5 months explored relations among real-world need frustration, time spent gaming, and passion for gaming in a sample of university students (Mills, Milyavskaya, Mettler, Heath, et al., 2018). A multilevel model explored relations at the within- and between-person levels. At the within-person level, need frustration at a given wave did not predict time spent gaming at the same wave. At the between-person level, need frustration was positively predicted by obsessive passion and negatively predicted by harmonious passion, and both passion types positively predicted time spent gaming. Additionally, need frustration was not significantly related to time spent gaming at this level, either, but this relation was moderated by gender and obsessive passion. For gender, the relation was weak and positive for females but slightly stronger and negative for males, suggesting that women spend a little more time on gaming when their needs are frustrated but men spend less time on gaming when their needs are frustrated. For obsessive passion, the relation was nearly flat for those with high obsessive passion, but negative for those with low obsessive passion, suggesting that people with high obsessive passion do not play any more (or less) when their needs are frustrated but people with low obsessive passion play less when their needs are frustrated. The non-relation for obsessively passionate players may be due to a ceiling effect—these gamers may already be playing as much as they can, leaving little room for variation. Thus, both harmoniously and obsessively passionate people spent more time playing compared to their less passionate counterparts but need frustration was unrelated to playtime for those high in obsessive passion and high need frustration predicted lower playtime for those low in obsessive passion.

A structural equation model with measures at Baseline, Wave 2, and Wave 5 was also constructed to explore the direction of relations among these variables. This model showed that

high baseline obsessive passion predicted increased need frustration at Wave 2 which in turn predicted increased obsessive passion at Wave 5, suggesting a downward spiral where obsessive passion exacerbates real-world need frustration which in turn strengthens obsessive passion. This is similar to findings concerning real-world need satisfaction and IGD (N. Weinstein et al., 2017). Additionally, baseline need frustration did not predict changes in gaming playtime at Wave 2, but high need frustration at Wave 2 did predict greater gaming playtime at Wave 5, suggesting that real-world need frustration may lead people to spend more time playing games.

Summary

Overall, research applying the DMP to video games shows that harmonious and obsessive passion both predict greater engagement with video games, but obsessive passion is the more reliable predictor of weekly playtime. Additionally, as in other passion research, harmonious passion for video games is associated with many positive outcomes such as positive affect, life satisfaction, self-realization, flow, greater post-play energy, reduced post-play tension, a greater number of online friends, and higher-quality online friendships. Obsessive passion, in contrast, is associated with many negative outcomes such as negative affect, less self-realization, physical symptoms, poorer physical health, post-play tension, fewer offline friends, and lower-quality offline friendships. There is also evidence that obsessive passion moderates the relation between weekly playtime and well-being, with obsessively passionate people having *poorer* well-being with greater weekly playtimes, but people low in obsessive passion having *better* well-being with greater weekly playtimes. Obsessive passion also seems to moderate the relation between need frustration and weekly playtime, with obsessively passionate people having high weekly playtimes regardless of need frustration and people low in obsessive passion playing less when need frustration is high. It is not clear whether these patterns will emerge on a daily basis, however. Finally, obsessive passion is very strongly related to measures of problematic video

game play, suggesting that obsessive passion for video games is very similar to IGD. Harmonious passion, in contrast, seems to be unrelated to problematic gameplay.

CHAPTER 5. INTERNET GAMING DISORDER

Basic Characteristics

IGD has been studied under many different labels (including video game addiction, problematic game play, pathological gaming, excessive gaming, and more), but the premise behind the many conceptualizations remains the same—some people find themselves so entranced by video games that it interferes with the rest of their lives. IGD was included in the fifth edition of the *Diagnostic and Statistical Manual for Mental Disorders* (*DSM-5*) as a condition warranting further research that is currently conceptualized as a behavioral addiction sharing characteristics with both gambling and substance use disorders (Gentile et al., 2017; Lemmens et al., 2015; Petry et al., 2014a). The *DSM-5* outlines nine symptoms of IGD and recommends diagnosis if five or more symptoms are experienced in a 12-month period. These symptoms include: (a) pre-occupation (i.e., spending lots of time thinking about games, even when not playing), (b) withdrawal (i.e., feeling bad when unable to play or when trying to play less), (c) tolerance (i.e., needing to play for longer or in more exciting ways to get the same satisfaction as before), (d) unsuccessful attempts to reduce or stop playing, (e) giving up other activities—such as other hobbies or socializing—to allow for more gaming, (f) continuing to play despite awareness of problems—such as insufficient sleep, spending too much money, or neglecting important tasks, (g) deceiving others about time spent gaming, (h) playing games to forget about personal problems or escape bad moods (e.g., guilt, anxiety, or depression), and (i) risking or losing significant relationships or opportunities (e.g., educational or career opportunities). Importantly, despite being called *Internet* Gaming Disorder, IGD applies to offline games as well (Petry et al., 2014b).[2] Thus, Gaming Disorder (GD) may be a clearer label,

[2] "Internet Gaming Disorder" was selected over "Gaming Disorder" for two reasons: (1) because people seem to be

and, in fact, the World Health Organization (WHO) recently included GD in the final draft of the 11th revision of the *International Classification of Diseases* (*ICD-11*) as a disorder sharing many of the symptoms of IGD outlined in the *DSM-5* (Sarkar, 2018). However, most of the research thus far has used measures that align more closely with the *DSM-5* version of IGD than the *ICD-11* version of GD, so research on IGD is emphasized here.

Although the inclusion of IGD in the *DSM-5* has given a disorganized field some much-needed common ground for researching the condition, the current conceptualization remains controversial, with researchers disagreeing about optimal definitions and measurement (Carbonell, 2017; Dowling, 2014; Goudriaan, 2014; Griffiths et al., 2015; Ko & Yen, 2014; Krossbakken et al., 2017; Kuss et al., 2017a, 2017b; Petry et al., 2014a, 2014a, 2015; Quandt, 2017; Starcevic, 2017; Subramaniam, 2014; van Rooij & Kardefelt-Winther, 2017). Unsurprisingly, the inclusion of GD in the ICD-11 has been controversial as well, with scholars disagreeing about whether we understand GD well enough to warrant its formalization as a disorder (Aarseth et al., 2017; Bean et al., 2017; Billieux et al., 2017; Griffiths et al., 2017; Higuchi et al., 2017; James & Tunney, 2017; Király & Demetrovics, 2017; Lee et al., 2017; Müller & Wölfling, 2017; Saunders et al., 2017; Shadloo et al., 2017; van den Brink, 2017; van Rooij et al., 2018). Despite the controversies, however, most scholars seem to agree that this is a condition deserving additional research, even if the current conceptualizations are imperfect. The following sections provide an overview of what is currently known about IGD.

Prevalence

Because of the many different measures for IGD and disagreements about appropriate diagnostic thresholds, estimates of prevalence vary widely. A recent systematic review of cross-

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most likely to develop difficulties with online compared to offline games, and (2) to help distinguish the disorder more clearly from gambling disorder (Petry et al., 2014b).

sectional, epidemiological studies of IGD reported 41 prevalence estimates[3] from 37 studies (Mihara & Higuchi, 2017). These estimates ranged from 0.2% to 27.5%, although the latter estimate was a clear outlier. The median prevalence was 4.6%, and half of the estimates fell between 1.7% and 9.25%. Prevalence was higher among males compared to females and among younger compared to older people, but geographical region had little effect on prevalence in these studies.

Factors Associated with IGD

Along with estimates of prevalence, the same systematic review identified many factors associated with IGD in cross-sectional studies (Mihara & Higuchi, 2017). Factors related to gaming included greater time spent playing games, preferring online to offline games, preferring certain genres of games (i.e., MMORPGs, first-person shooters, fighting games, and real-time strategy games), low involvement in non-gaming activities, and using gaming as a form of coping. Demographic and familial factors included being male, being younger, and having family or marital difficulties. Interpersonal relationship factors included peer problems, being bullied, being a bully, having friends with IGD, poorer social skills, and poorer social integration. School factors included worse grades, lower educational attainment, skipped classes, and truancy. Personality factors included impulsivity, neuroticism, introversion, disagreeableness, aggressive tendencies, acceptance of aggression and violence, and actual aggression. Mental health factors included loneliness, and low levels of self-esteem, self-efficacy, and life satisfaction. IGD was also frequently comorbid with attention deficit and/or

[3] The values discussed here are based on the total prevalence rates reported in tables by Mihara and Higuchi (2017), collapsing across sex. Separate samples within studies were treated as separate prevalence estimates. A weighted (vs. unweighted) prevalence estimate was used for one study and the prevalence of computer game addiction (vs. video game arcade addiction) was used in another study that included estimates for both across three samples.

hyperactivity disorder (ADHD), depression, anxiety, sleep issues, and substance use. Finally, IGD was sometimes associated with physical pain.

Other research has identified additional factors associated with IGD. These include attachment to in-game characters (Lewis et al., 2008), low conscientiousness (Peters & Malesky, 2008), playing MMORPGs to (a) seek novelty, (b) be aggressive and anti-social, or (c) be social and competitive (Hussain et al., 2015), and motivation to play for (a) entertainment and achievement, (b) social reasons, or (c) escapism (Männikkö et al., 2017). Neuroscientific studies of IGD have also shown that the neural mechanisms underlying the condition are similar to those of drug addiction; and IGD is associated with changes in brain regions responsible for emotional regulation, attention and control, impulse control, motor function, and sensory-motor coordination (A. Weinstein et al., 2017). Additionally, video game play is associated with changes in the brain's reward systems.

Risk and Protective Factors for IGD

Although cross-sectional studies are useful for determining which factors are associated with IGD, they cannot determine the direction of the association. For example, loneliness may lead to IGD or IGD may lead to loneliness. It may also be that both are true, and a reciprocal relation exists. Finally, it may be that a third variable produces changes in both loneliness and IGD, creating a spurious relation between the two variables. Longitudinal studies are valuable because they can help us determine which of these possibilities is most likely. Thankfully, longitudinal research on IGD is becoming more common.

The systematic review of epidemiological studies of IGD also included 13 longitudinal studies which identified several risk factors that predicted increases in IGD over time (Mihara & Higuchi, 2017). These factors included high current levels of pathological gaming, more time spent gaming, intentions to play too much, positive attitudes toward gaming, being male, coming

from a single-parent family, low social competence, loneliness, high impulsivity, conduct problems, and low levels of sport and exercise. The same 13 longitudinal studies also identified several protective factors that predicted decreases in IGD over time. These factors included self-esteem, perceived behavioral control, social competence, social integration in the classroom, teacher autonomy support, school-related well-being, and academic achievement. It is important to note that, in many cases, a risk factor can also be considered a protective factor if the direction is reversed. For example, low social competence predicts increases in IGD, but high social competence predicts decreases. The same is true for protective factors. For example, high self-esteem protects, but low self-esteem is a risk.

Additional risk factors identified in other longitudinal research include low life satisfaction (Lemmens et al., 2011) and maladaptive gaming cognitions such as perfectionism toward gameplay, being unable to focus on other tasks due to thinking about gaming, and regret about playing too much (Forrest et al., 2017). Additional protective factors include high perceived success relative to peers (Scharkow et al., 2014) and high levels of basic psychological need satisfaction (N. Weinstein et al., 2017).

Consequences of IGD

In the same way that longitudinal research identifies which factors predict changes in IGD over time, it can also determine if IGD predicts changes in other factors over time. The 13 longitudinal studies included in the systematic review discussed above also identified several consequences of IGD (Mihara & Higuchi, 2017). These consequences included poorer academic performance, physical aggression, conduct problems, lower levels of sport and exercise, and higher levels of depression, anxiety, and social phobia.

Consequences identified in other longitudinal research include greater loneliness (Lemmens et al., 2011), lower life satisfaction, lower perceived success relative to peers

(Scharkow et al., 2014), lower basic psychological need satisfaction (N. Weinstein et al., 2017), and higher anxiety, shyness, depression, aggression, and problematic cell phone use (Coyne et al., 2020).

Internet Gaming Disorder and Well-Being

Reviewing the factors associated with IGD in cross-sectional and longitudinal studies makes it clear that IGD is often accompanied by lower levels of well-being, but this link is worth additional elaboration given the goals of the present research. Relevant studies are discussed in more detail below, organized by design.

Cross-Sectional Studies

In a combined survey and interview study with *World of Warcraft* (*WoW*) players (a very popular MMORPG), many believed that playing *WoW* increased their happiness, helped them relax, and added to their life satisfaction, but many also believed that *WoW* increased their stress, felt addicted to *WoW*, and experienced symptoms of addiction (Snodgrass et al., 2011). Thus, even people who feel addicted may still believe that gaming contributes to well-being. In a separate study with a large, nationally-representative sample of Norwegian 8th graders, addicted gamers were compared to problem gamers (who had fewer symptoms of addiction), highly engaged gamers, and a control group of non-addicted, non-problem, non-engaged gamers (Brunborg et al., 2013). Compared to the control group, both addicted and problem gamers were more likely to report nervousness, irritability or bad mood, feeling low, and feeling tired and exhausted, but highly engaged gamers did not differ from the control group on these variables, suggesting that addiction is associated with poorer psychological well-being, but high engagement is not.

A more recent study used latent class analysis to identify problematic gamers and normative participants (who did not have high gaming or social media use) in a massive sample

of adolescents from the Netherlands (Colder Carras et al., 2017). For males, the problematic gamers (compared to normative participants) had higher depression and were more likely to have high-quality online friendships but low-quality offline friendships. Additionally, at-risk gamers (compared to normative participants) had higher loneliness, depression, and social anxiety, and were more likely to have high-quality friendships online and offline. For females, at-risk gamers (compared to normative participants) had higher depression. In another study with French online gamers, those with IGD compared to those without had much higher depressive symptoms and much lower self-esteem (Laconi et al., 2017). Similarly, a study with a large sample of adolescent-caregiver pairs from Germany showed that IGD was associated with elevated emotional distress, self-esteem problems, hyperactivity/inattention, anger control problems, antisocial behavior, and parent anxiety (Wartberg et al., 2017).

Finally, to eliminate potential sociodemographic confounds, a recent study compared a sample of young adults with IGD to a sample of young adults without IGD after matching the two samples on geographical location, age, sex, ethnicity, and marital status (Stockdale & Coyne, 2018). Compared to those without IGD, those with IGD had significantly poorer well-being across a wide variety of measures. For mental health, they had more severe ADHD symptoms, worse cognitive functioning, and poorer global mental health. For physical health, they had worse sleep difficulties but did not differ on a global measure of physical health or body mass index (BMI). For emotional health, they had higher anxiety, depression, and aggression, as well as lower positive affect and psychological well-being. For social health, they felt more socially isolated but did not differ in companionship or emotional support. Additionally, those with IGD had higher levels of problematic pornography use.

Longitudinal Studies

In a two-wave, longitudinal study with a large sample of Dutch adolescents, loneliness, low life satisfaction, low social competence, and low self-esteem all predicted increased pathological gaming six months later (Lemmens et al., 2011). Additionally, high initial levels of pathological gaming predicted increased loneliness six months later but did not predict changes in the other variables. Thus, these findings suggest that poor psychosocial well-being causes pathological gaming but also that pathological gaming causes loneliness.

In a three-wave, two-year longitudinal study with a very large sample of children and adolescents in Singapore, initial levels of pathological gaming were positively predicted by initial levels of weekly playtime and impulsivity; and increases in pathological gaming over time were predicted by low initial social competence and high initial impulsivity (Gentile et al., 2011). Both initial levels of pathological gaming and increases in pathological gaming over time predicted greater depression, anxiety, and social phobia as well as poorer grades at the final wave. Thus, pathological gaming reduced well-being over time.

In a three-wave, annual longitudinal study with a large sample of German computer game players, problematic gaming was inconsistently related to measures of psychosocial well-being (Scharkow et al., 2014). Gaming addiction predicted decreases in life satisfaction over time for older adults (aged 40 or older), but not for adolescents (aged 14-18) or young adults (aged 19-39). Life satisfaction did not predict changes in gaming addiction over time for any of the age groups. Gaming addiction also predicted decreases over time in perceived success compared to peers for older adults and young adults, but not for adolescents. Additionally, high perceived success compared to peers predicted decreases in gaming addiction over time for young adults but not for other age groups. Longitudinal relations among social capital, social support, and gaming addiction were also examined but gaming addiction did not predict changes in social

capital or social support and neither of those variables predicted changes in gaming addiction. Thus, in this sample, the relations between gaming addiction and well-being differed across age groups, with poor well-being serving as a consequence of IGD for some and a cause of IGD for others.

In a two-wave, longitudinal study with a very large sample of American adults, initial levels of IGD did not predict changes in a composite measure of health (based on social, mental, and physical health) over six months, but high initial levels of basic psychological need satisfaction did predict increases in health over six months (N. Weinstein et al., 2017). Additionally, high initial levels of IGD predicted decreases in need satisfaction, suggesting that IGD may impair health indirectly through the frustration of basic psychological needs. In fact, mediation analyses (which assumed that observed relations would replicate in additional waves) found a significant effect of IGD on health through need satisfaction.

Finally, in a six-wave longitudinal study with a large sample of American adolescents, male gender predicted a pattern of increasing or moderate symptoms of IGD over the course of six years (compared to low symptoms), but measures of well-being (depression, shyness, and anxiety), prosocial traits (prosocial behavior and empathy), and antisocial traits (delinquency and aggression) did not predict the course of IGD symptoms (Coyne et al., 2020). Additionally, at the end of the six years, patterns of moderate and increasing symptoms were associated with poorer well-being (i.e., higher depression, shyness, and anxiety), whereas patterns of increasing symptoms were also associated with higher aggression and problematic cell phone use.

Meta-Analyses

An early meta-analysis of 30 published journal articles and 3 doctoral dissertations with 37 independent effect sizes found weak-to-moderate relations between pathological gaming and (a) mental health problems (r = .19), (b) social problems (r = .25), and (c) academic problems (r

= .12), but these relations differed based on the measurement approach used, the age of the sample, and the geographic region (Ferguson, 2011). Relations with mental health and social outcomes tended to be stronger when measures of pathological gaming emphasized interference with the rest of life over criteria based on problematic gambling or the amount of exposure alone, but relations with academic outcomes were weaker with the interference approach compared to the other two approaches. Additionally, relations with social outcomes tended to be stronger for children compared to adults and relations for all three outcomes were generally stronger in Asian compared to Western countries.

A more recent meta-analysis of 11 studies assessed the size of the relation between IGD and response inhibition—a neurocognitive indicator of self-regulation (Argyriou et al., 2017). The average effect size was moderate in magnitude (d = 0.56) and indicated that IGD is associated with poorer response inhibition. There was also little evidence for heterogeneity in the effect size, suggesting an absence of moderators (although the effect size did differ slightly depending on the measure of response inhibition).

Internet Gaming Disorder as a Compensatory Coping Strategy

It has been proposed that IGD may be best understood as a rational—but potentially maladaptive—attempt to cope with or compensate for real-world problems (Kardefelt-Winther, 2017; Kardefelt-Winther, 2014a, 2014b, 2014b). In fact, research reviewed in previous sections has already provided support for this proposition, with problematic gaming and obsessive passions generally both being more likely when needs are unsatisfied in the real world but satisfied by gaming (or other passion activities). This section describes additional research relevant to the compensatory coping framework.

Early evidence was provided by two cross-sectional studies with Taiwanese adolescents. In the first study, frequent MMORPG players reported how well online games satisfied needs for

safety, love and belonging, self-esteem, and self-actualization as well as how dissatisfied these needs were in their real lives (Wan & Chiou, 2006a). Those classified as addicted had real-world dissatisfaction that was higher than online satisfaction, but this pattern was reversed for non-addicted participants. This suggests that addicted gamers played games to combat dissatisfaction with their real lives. An interview study with a small number of gaming addicts provided further support for these observations by examining motivations for play (Wan & Chiou, 2006b). These gamers reported playing for entertainment and leisure, for emotional coping (i.e., to combat loneliness, isolation, boredom, stress, anger, and frustration), to escape from reality, and to satisfy needs for socialization, achievement, power, and excitement or challenge.

In a cross-sectional study with a large sample of *WoW* players, social anxiety, loneliness, and stress were all positively related to negative outcomes due to *WoW* (e.g., losing sleep, skipping meals, and neglecting relationships), but after controlling for sex and age, only sex and stress predicted negative outcomes (Kardefelt-Winther, 2014a). Additionally, when motivations for escapism, achievement, and social interaction were added to the model, only being male and motivations for escapism and achievement predicted more negative outcomes. Thus, although social anxiety, loneliness, and stress were all associated with more problematic play (as evidenced by negative outcomes), it was the motivation to escape or to achieve that mattered most. This suggests that motivations may mediate the relation between poor psychosocial well-being and negative outcomes due to gameplay. A similar cross-sectional study with another sample of *WoW* players found that the relation between escapism and negative outcomes due to *WoW* was moderated by psychosocial well-being, but only for players with high levels of negative outcomes (Kardefelt-Winther, 2014b). Specifically, the relation between escapism and negative outcomes was stronger (i.e., more positive) as stress increased and self-esteem

decreased, but the relation was weaker (i.e., more negative) as stress decreased and self-esteem increased. Thus, escapism was more strongly related to negative outcomes due to gameplay for those with poor psychosocial well-being. This was not the case, however, for players who experienced few negative outcomes. Together, these two cross-sectional studies suggest that people with poor psychosocial well-being are motivated to play games to escape and this is associated with more problematic gaming (as evidenced by game-related negative outcomes).

Two studies discussed in the previous section are also relevant here. In a cross-sectional study with Italian online gamers, a mediation model tested whether gaming motivations mediated relations between psychiatric symptoms and problematic online gaming (Ballabio et al., 2017). Psychiatric symptoms—which were based on somatization, obsession-compulsion, interpersonal sensitivity, depression, hostility, anxiety, phobia, psychoticism, and paranoia—weakly positively predicted coping and fantasy motives and moderately positively predicted escapism motives and problematic online gaming. Problematic online gaming was also weakly positively predicted by escapism, fantasy and competition motives. Thus, psychiatric symptoms predicted problematic gaming directly and indirectly through increased motivations for escape (i.e., avoidance of reality and real-world problems) and fantasy (i.e., a desire to experience things not possible in real life). In another cross-sectional study with a very large sample of adolescents from the Netherlands, problematic male gamers were more likely than normative male gamers to be depressed and to have high-quality online friendships but low-quality offline friendships, suggesting that problematic gameplay may be motivated in part by compensating for mood problems or deficits in real-world friendships (Colder Carras et al., 2017).

Additional research has emphasized the role of gaming motivations in explaining IGD. In a cross-sectional study with French, online gamers, those classified as having IGD, compared to

those who did not, had moderately higher social motives, and much higher escape motives, coping motives, and depressive symptoms as well as much lower self-esteem (Laconi et al., 2017). Another cross-sectional study with Finnish gamers demonstrated that problematic gaming was weakly positively predicted by entertainment-achievement and social motivations, and moderately positively predicted by escapism motivations (Männikkö et al., 2017). Another cross-sectional study with a small sample of French-speaking *WoW* players explored playing *WoW* as a way to cope with schizotypal personality traits (Schimmenti et al., 2017). Three types of schizotypal traits were assessed: cognitive-perceptual (e.g., magical thinking, ideas of references, and paranoid ideation), interpersonal deficits (e.g., lack of close friends, constrained affect, and social anxiety), and disorganization (e.g., odd speech and beliefs). Participants reported significantly fewer interpersonal and disorganized schizotypal traits during *WoW* gameplay compared to everyday life, but there were no differences for cognitive-perceptual schizotypal traits. Additionally, cognitive-perceptual traits positively predicted achievement and immersion motivations and interpersonal traits negatively predicted social motivation. Schizotypy, achievement motivation, and immersion motivation all positively predicted IGD after controlling for gender and age. Thus, schizotypal traits were reduced during *WoW* play, but these traits predicted more problematic gameplay as well as increased motivations associated with problematic play.

Another cross-sectional survey study with MMORPG players tested a mediation model with social phobia symptoms predicting IGD symptoms directly and through identification with the player's avatar (Sioni et al., 2017). Social phobia strongly positively predicted avatar identification which in turn moderately positively predicted IGD symptoms. Social phobia also moderately positively predicted IGD symptoms, but this relation was weaker after controlling for

avatar identification. Thus, these findings suggest that MMORPG players with social phobia may be more susceptible to IGD, due in part to stronger identification with in-game avatars.

Finally, a recent set of two cross-sectional studies with large samples of undergraduates tested the hypothesis that high levels of anxiety encourage the use of video games as a coping mechanism which in turn contributes to video game addiction (C. N. Plante et al., 2018). In the first study, a serial mediation model was tested with four different measures of mental illness: bipolar disorder, depression, obsessive compulsive disorder, and ADHD. For all four measures, greater mental illness predicted higher trait anxiety which in turn predicted greater use of video games to cope. Greater use of video games to cope also predicted greater video game addiction. These findings were replicated in the second study. Thus, the models suggest that mental illness can contribute to video game addiction through increased anxiety and increased reliance on video games for coping. It is important to note, however, that the true direction of effects cannot be determined in cross-sectional research such as this. In fact, another cross-sectional study found support for a mediation model in the opposite direction with a large sample of adult gamers (Loton et al., 2016). Here, video game addiction predicted higher levels of stress, anxiety, and depression directly and indirectly through increased resignation and withdrawal coping. Video game addiction also indirectly predicted anxiety and depression through reduced approach coping. Thus, there is evidence that poor mental health can increase problematic gaming through increased use of games to cope, but there is also evidence that problematic gaming can worsen mental health through altered coping strategies. Because these studies were cross-sectional and did not test alternative mediation models, the direction of influence remains unclear.

Overall, there is growing evidence that IGD may be usefully understood as a compensatory coping strategy, with people using video games to escape from or compensate for real-world problems. It is worth noting, however, that viewing IGD in this way is not necessarily incompatible with viewing IGD as an addiction—in fact, most addictions could be considered maladaptive coping strategies that people ultimately lose control over (Kuss et al., 2017b).

Summary

IGD is currently conceptualized as an addiction and is characterized by excessive video game play that interferes with the rest of a person's life. Although there is controversy surrounding the definition and measurement of IGD, there is a great deal of research demonstrating that the condition is associated with poorer well-being across a wide range of indicators, including many mental health problems (e.g., anxiety, depression, ADHD), social problems (e.g., loneliness, social isolation, low-quality friendships), and even some physical health problems (e.g., physical pain, sleep difficulties). Longitudinal studies have shown that poor well-being can be both a cause and a consequence of IGD. For example, loneliness, low life satisfaction, low social competence, low self-esteem, and low perceived success relative to peers all lead to increases in IGD over time. In contrast, IGD leads to decreases in life satisfaction, perceived success relative to peers, and school grades as well as increases in loneliness, depression, anxiety, and social phobia over time. Finally, there is mounting evidence that IGD may develop as individuals attempt to compensate for or cope with real-life struggles, and this proposition fits very well with research guided by SDT and the DMP.

CHAPTER 6. THE PRESENT RESEARCH

Primary Hypotheses

The primary goal of the present research was to determine how daily video game play relates to daily well-being for gamers. This was accomplished using a two-week daily diary study. In short, a sample of gamers completed baseline questionnaires and then two weeks of daily diary measures. Multilevel modeling was used to test primary hypotheses, with daily measurements nested within person. Key person-level variables (measured at baseline) included (1) harmonious and obsessive passion for gaming, (2) IGD symptoms, and (3) trait need satisfaction and frustration. Key day-level variables included (1) real-world need satisfaction and frustration, (2) video game playtime, (3) video game need satisfaction and frustration, and (4) well-being, based on positive affect, negative affect, vitality, physical symptoms, life satisfaction, and stress.

First, analyses tested whether daily real-world need satisfaction and frustration predict daily video game playtime, after controlling for harmonious and obsessive passion in one model and IGD in a second model[4] (see Figure 1). Because some gamers seem to use video games to compensate for unsatisfied, or frustrated needs in the real-world, I predicted that daily real-world need satisfaction would be negatively related to daily video game playtime and that daily real-world need frustration would be positively related to daily video game playtime. Additionally, because harmonious and obsessive passion both predict high levels of engagement, I predicted that harmonious and obsessive passion (at the person level) would both be positively related to the average daily video game playtime across the two weeks—although I expected obsessive

[4] Because IGD seems to be capturing a construct very much like obsessive passion for gaming it was not included in models with harmonious and obsessive passion.

passion to be a stronger predictor. Similarly, because IGD reflects excessive video game play, I predicted that IGD symptoms would be positively related to the average daily video game playtime across the two weeks. Finally, because obsessive passion and IGD both seem to reflect a compensatory response to unsatisfied needs, I predicted that the daily relations between the satisfaction and frustration of needs in the real world and video game playtime would be stronger as obsessive passion and IGD increased. In other words, I expected obsessively passionate and disordered gamers to be especially drawn to video games when their needs were frustrated. It was unclear whether harmonious passion would also serve as a moderator, but this possibility was tested.

Second, analyses tested whether daily video game playtime predicts well-being after controlling for harmonious and obsessive passion in one model, IGD in a second model, and trait need satisfaction and frustration in a third model[5] (see Figure 2). Because gamers usually find video game play to be enjoyable and satisfying, I predicted that daily video game playtime would be positively related to daily well-being. Additionally, because harmonious passion is generally associated with adaptive outcomes and obsessive passion is generally associated with maladaptive outcomes, I predicted that, at the person level, harmonious passion would be positively related to the average daily well-being and that obsessive passion would be negatively related to the average daily well-being. For the same reasons, I predicted that the positive relation between daily video game playtime and daily well-being would increase as harmonious passion increased but decrease as obsessive passion increased. In other words, I expected playing video games to be more beneficial for harmoniously passionate gamers and less beneficial—perhaps even harmful—for obsessively passionate gamers. Similarly, because IGD is associated

[5] Because obsessive passion and IGD are both associated with low need satisfaction and high need frustration, trait need satisfaction and frustration were examined separately from obsessive passion and IGD.

with poorer well-being and unhealthy engagement with video games, I predicted that IGD would be negatively related to the average daily well-being and that the positive relation between daily video game playtime and daily well-being would decrease as IGD increased. Finally, because need satisfaction fosters well-being and need frustration impairs it, I predicted that trait need satisfaction would be positively related to the average daily well-being and trait need frustration would be negatively related to the average daily well-being. It was unclear whether trait need satisfaction and frustration would moderate the relations between daily video game playtime and daily well-being, but this possibility was examined.

Finally, analyses tested whether daily video game need satisfaction and frustration predicts daily well-being above and beyond daily real-world need satisfaction and frustration, after controlling for harmonious and obsessive passion in one model, IGD in a second model, and trait need satisfaction and frustration in a third model (see Figure 3). Because need satisfaction fosters well-being and need frustration impairs it, I predicted that, at the daily level, real-world need satisfaction and video game need satisfaction would be positively related to well-being and that real-world need frustration and video game need frustration would be negatively related to well-being. Once again, at the person level, I expected harmonious passion and trait need satisfaction to be positively related to the average daily well-being and I expected obsessive passion, IGD, and trait need frustration to be negatively related to the average daily well-being. It was unclear whether the person-level variables would serve as moderators in these models, so no formal predictions were made, but these possibilities were tested.

Secondary Hypotheses

A secondary goal of this research was to replicate and extend previous cross-sectional findings in gaming research using baseline measures. I predicted that harmonious passion for gaming would be positively related to autonomous forms of motivation and regulation (i.e.,

intrinsic, integrated, and identified) and less positively (perhaps negatively) related to controlled forms of motivation and regulation (i.e., introjected, external, and amotivated). In contrast, I expected obsessive passion for gaming to be positively related to controlled forms of motivation and regulation and less positively (perhaps negatively) related to autonomous forms of motivation and regulation. Additionally, I expected harmonious passion to be positively related to well-being (i.e., positive affect, subjective vitality, and life satisfaction) and negatively related to ill-being (i.e., negative affect, physical symptoms, and perceived stress), but I predicted the opposite pattern for obsessive passion. Like obsessive passion, I expected IGD to be positively related to controlled forms of motivation and regulation (i.e., introjected, external, and amotivated) and less positively related to autonomous forms of motivation and regulation (intrinsic, integrated, and identified). I also expected IGD to relate negatively to well-being and positively to ill-being.

I expected trait need satisfaction to be positively related to harmonious passion and negatively related to obsessive passion and IGD but expected these patterns to be reversed for trait need frustration. Finally, I expected IGD to be strongly positively related to obsessive passion but unrelated to harmonious passion. When considered simultaneously, I expected IGD to increase as obsessive passion surpassed harmonious passion.

The pre-registered hypotheses and methods for this study can be found online at https://osf.io/jb4pr with more extensive details at https://osf.io/peytj/. Please note that the phrasing of hypotheses and the design of Figures 1-3 have changed slightly to improve clarity, but the predictions themselves remain unchanged.

CHAPTER 7. METHOD

Participants

A total of 143 undergraduate students[6] participated in exchange for partial course credit. Participants earned more credit for higher levels of participation in the daily diary phase of the study to incentivize study completion. Participants were required (a) to be at least 18 years old, (b) to have consistent Internet access—via computer or smartphone—to complete daily diary measures electronically, and (c) to play video games at least once a week. The study was titled "Daily Activities and Well-Being for People Who Play Video Games" and participants were informed that the study examined relations between daily activities, well-being, video game play, and academic performance.

From the initial sample, eight participants were excluded for completing less than half of the daily surveys, one was excluded for reporting typically playing games for less than once a week, and one was excluded for failing both attention checks in the baseline survey and submitting daily surveys early (before 7:00 pm) on seven days. Thus, the final sample consisted of 133 participants with 103 males, 28 females, one who preferred to self-describe as neutral and one who preferred not to say. The average age was 19.32 years (*SD* = 1.45) and ranged from 18 to 26. Most of the sample self-identified as White (85.0%) followed by Latino/Hispanic (6.0%), Asian / Pacific Islander (3.8%), Multi-Racial (3.0%), African American (1.5%) and Other (0.8%). English was a native language for most of the sample (91.7%). On a 13-point scale (1 = *F*, 13 = *A*+), the average grade was 10 (*SD* = 1.86), corresponding to a B+. The average GPA was 3.31/4.00 (*SD* = 0.53). Regarding educational level, 1.5% reported having completed

[6] Two of these participants completed baseline measures twice, yielding 145 completed baseline surveys. The second completed survey was excluded for each participant.

college, 49.6% reported having completed some college, and 48.9% reported having completed high school. For the educational level of participants' mothers, 22.6% had completed graduate or professional school, 46.6% had completed college, 18.8% had completed some college, 10.5% had completed high school, and 1.5% had completed some high school. For the educational level of participants' fathers, 22.3% had completed graduate or professional school, 43.1% had completed college, 17.7% had completed some college, 15.4% had completed high school, and 1.5% had completed some high school.

On average, participants had been playing video games for 11.29 years (*SD* = 3.62), and currently played games regularly: 44.4% almost every day, 32.3% about four or five times a week, 21.0% about two or three times a week, and 2.3% about once a week. Typical gaming sessions lasted 105.29 minutes on average (*SD* = 49.47), and the average weekly playtime was 23.09 hours (*SD* = 13.29). On a 6-point scale measuring frequency of play (1 = *Never*, 6 = *Very Frequently*) the most popular video game genre was shooter (*M* = 4.26, *SD* = 1.61), followed by role-playing (*M* = 3.60, *SD* = 1.70), action-adventure (*M* = 3.53, *SD* = 1.67), strategy (*M* = 3.14, *SD* = 1.77), massively-multiplayer online (*M* = 3.09, *SD* = 1.87), racing (*M* = 2.96, *SD* = 1.45), sports (*M* = 2.98, *SD* = 1.94), platformer (*M* = 2.70, *SD* = 1.49) and simulation (*M* = 2.70, *SD* = 1.63), puzzle (*M* = 2.60, *SD* = 1.50), fighting (*M* = 2.34, *SD* = 1.60) and finally, music and dance (*M* = 2.02, *SD* = 1.32) games.

The target sample size was 125 which was selected to provide enough statistical power to detect hypothesized effects, even if up to 20% were lost to attrition. Prior SDT research using two-week daily-diary designs have demonstrated sufficient power using sample sizes ranging from 60 to 127 (Quist, 2016; Reis et al., 2000; Sheldon et al., 1996; Uysal et al., 2010). Additionally, power analyses using the Power in Two-Level Designs (PINT) software (Snijders

& Bosker, 1993), suggested that a sample of 100 would provide a power of at least .90 to detect small (d = 0.20) individual day-level, person-level, and cross-level effects in the most complicated model. However, these power analyses required estimates for several parameters that were very difficult to estimate a priori (e.g., the covariance matrix for random slopes and intercept), so they should be treated as a rough guideline.

Procedure

This study had two phases. In Phase One, participants came to the lab to complete an initial set of questionnaires (see person-level measures). Once these baseline measures were completed, the participant verified their understanding of how to complete Phase Two of the study and developed an action plan and a contingency plan for completing their daily surveys. All new participants who completed Phase One in each week were grouped into a cohort that completed daily diary measures for the next two weeks, beginning on the following Monday. Each cohort was emailed a link to a new Qualtrics survey each day at noon (see day-level measures). Participants were asked to complete this survey before going to bed each night—even if they stayed up past midnight. They received reminder emails at 7 PM on each day. Participants could complete measures for each day as late as noon the next day if they forgot to complete before sleeping. An additional reminder email was sent at 7 AM the next day for participants who had not yet completed a day's measures.

Phase One: Person-Level Measures

All person-level measures were completed in the lab as a Qualtrics survey in the week prior to the two weeks of daily diary measures. Participants also reported their email address so that Phase One and Phase Two responses could be matched. Unless otherwise noted, all scale scores were calculated by averaging the relevant items (after reverse coding as necessary). The

descriptive statistics and internal consistencies for these baseline variables (except those already reported in the "Participants" section) are shown in Table 2.

Demographics and Academic History

Participants reported their age, gender, race, average school grade and GPA (from high school if they were currently a freshman in college or current GPA if they were a sophomore or higher), highest level of education completed by self, mother (or stepmother), and father (or stepfather), and whether English was their native language.

Gaming Habits

Participants completed an adaptation of the General Media Habits Questionnaire (Gentile et al., 2004), reporting how often they play video games, how many years they have played video games, and how long they usually play in one sitting. They also reported how many hours they play video games on a typical weekday (Monday-Friday) during four blocks of time: 6 am to Noon, Noon to 6 pm, 6 pm to Midnight, and Midnight to 6 am. This was repeated for typical weekend days (Saturday and Sunday). Average weekly playtime was calculated by: (1) summing the weekday responses then multiplying by five, (2) summing the weekend responses then multiplying by two, and (3) summing these products.

Video Game Genre Preferences

Participants were asked how often they play 12 different genres of video games using a 6-point scale (*Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently*). These 12 genres were the most common to appear in both the literature on video game addiction and on popular gaming websites (Lemmens & Hendriks, 2016). The 12 genres were: action/adventure, sports, role-playing, strategy, simulation, puzzle, shooter, racing, fighting, massively-multiplayer online, platformer, and music & dance. Three, recent, popular, and representative examples were provided in parentheses after each genre (e.g., *Horizon: Zero Dawn*, *Assassin's Creed Origins*,

and *God of War* for action/adventure games). These examples were selected to have as little overlap as possible with other genres.

Motivation for Playing Video Games

Participants completed the 18-item Gaming Motivation Scale, using a response scale ranging from 1 = *Do not agree at all* to 7 = *Very strongly agree* (Lafrenière et al., 2012). This scale was designed to assess six distinct forms of motivation identified by self-determination theory. These different types of motivation fall on a continuum ranging from intrinsic motivation (one type) to extrinsic motivation (four types) to amotivation (one type). There are three items for each motivation and all items provide possible answers for why people play video games. The six motivations (with example items) are as follows: intrinsic motivation ("For the feeling of efficacy I experience when I play"), integrated regulation ("Because it is an integral part of my life"), identified regulation ("Because it has personal significance to me"), introjected regulation ("Because I must play to feel good about myself"), external regulation ("To gain in-game awards and trophies or character/avatar's levels and experience points"), and amotivation ("I used to have good reasons, but now I am asking myself if I should continue"). An attention check was also added to this scale ("To show that you're paying attention, pick five for this statement").

Passion for Gaming

Participants completed an adaptation of the 16-item passion scale using a response scale ranging from 1 = *Do not agree at all* to 7 = *Very strongly agree* (Vallerand, 2010; Vallerand et al., 2003). Items were re-phrased to reference playing video games (or gaming). Four items assessed general passion for gaming (e.g., "I spend a lot of time playing video games"), and six items each assessed harmonious passion (e.g., "Playing video games is in harmony with the other activities in my life") and obsessive passion (e.g., "I have difficulties controlling my urge to play video games").

Internet Gaming Disorder Symptoms

Participants completed the nine-item version of the Internet Gaming Disorder Scale, which assessed how frequently participants had experienced each of the nine, *DSM-V*-proposed criteria for Internet Gaming Disorder in the last year (Lemmens et al., 2015). The six-point polytomous response format was used (*Never, 1-4 times in the last year, 5-11 times in the last year, About 1-3 times a month, Once or more a week, Every day or almost every day*).

Positive and Negative Gaming Engagement

Participants completed eight items adapted from the Fantasy Engagement Scale (C. N. Plante et al., 2017), using a response scale ranging from 1 = *Strongly disagree* to 7 = *Strongly agree*. Four items assessed positive engagement (e.g., "Playing video games has had a positive effect on my life") and four items assessed negative engagement (e.g., "Playing video games has been the source of a lot of problems in my life").

Trait Need Satisfaction and Frustration

Participants completed the 24-item Basic Psychological Need Satisfaction and Frustration scale, using a response scale ranging from 1 = *Not true at all* to 5 = *Completely true* (Chen et al., 2015). This scale had four items assessing the satisfaction of each of the three basic psychological needs and four items assessing the frustration of the same three needs. This yielded six subscales: competence satisfaction (e.g., "I feel confident that I can do things well"), autonomy satisfaction (e.g., "I feel a sense of choice and freedom in the things I undertake"), relatedness satisfaction (e.g., "I feel that the people I care about also care about me"), competence frustration (e.g., "I feel disappointed with many of my performances"), autonomy frustration (e.g., "I feel forced to do many things I wouldn't choose to do"), and relatedness frustration (e.g., "I have the impression that people I spend time with dislike me"). Composite

measures of trait need satisfaction and, separately, trait need frustration were created by averaging across the three needs.

Big-Five Personality Traits

Participants completed the Ten Item Personality Inventory, using a response scale ranging from 1 = *Disagree strongly* to 7 = *Agree strongly* (Gosling et al., 2003). This scale has two items for each of the Big-Five personality traits. All items began with "I see myself as:" and example items for the five traits included: "extraverted, enthusiastic" (extraversion), "sympathetic, warm" (agreeableness), "dependable, self-disciplined" (conscientiousness), "calm, emotionally stable" (emotional stability), and "open to new experiences, complex" (openness to experience).

Past-Month Positive and Negative Affect

Participants completed a nine-item mood checklist, assessing the extent to which they had felt four positive emotions (e.g., joyful, happy) and five negative emotions (e.g., worried/anxious, unhappy) in the past month (Diener & Emmons, 1984). The response scale ranged from 1 = *Not at all* to 7 = *Extremely*, and positive and negative affect items were averaged separately.

Trait Vitality

Participants completed the individual-difference-level version of the seven-item vitality scale, using a response scale with anchors at 1 = *Not true at all*, 4 = *Somewhat true*, and 7 = *Very true* (Ryan & Frederick, 1997). Example items include "I feel alive and vital," and "I look forward to each new day."

Past-Month Physical Symptoms

Participants completed an adaptation of the physical symptoms checklist to assess the frequency of experiencing nine different physical symptoms (e.g., headaches, stiff/sore muscles)

during the past month (Emmons, 1991). A six-point response scale was used (*Never, Very Rarely, Rarely, Occasionally, Frequently, Very Frequently*).

General Life Satisfaction

Participants completed the five-item Satisfaction With Life Scale to measure general life satisfaction (Diener et al., 1985). A response scale ranging from 1 = *Strongly disagree* to 7 = *Strongly agree* was used. Example items included "I am satisfied with my life," and "The conditions of my life are excellent."

Past-Month Perceived Stress

Participants completed an adaptation of the 14-item Perceived Stress Scale to assess stress during the past month (Cohen et al., 1983). A five-point response scale was used (*Never, Almost Never, Sometimes, Fairly Often, Very Often*). Example items included "In the last month, how often have you been upset because of something that happened unexpectedly?" and "In the last month, how often have you felt nervous and 'stressed'?"

Well-Being (Composite)

A composite measure of well-being was created by standardizing and summing past-month positive affect, past-month negative affect (scoring reversed), trait vitality, past-month physical symptoms (scoring reversed), general life satisfaction, and past-month perceived stress (scoring reversed). This new measure was then standardized.

Coping Strategies

Participants completed an adapted 64-item version of the Children's Coping Strategies Checklist, which assessed four general types of coping strategies: active coping, distraction, avoidance, and support-seeking (Ayers et al., 1996). For each item, participants rated how frequently (*Never, Sometimes, Often, Most of the time*) they behave a certain way when faced with a problem (e.g., "Think about what I could do before I do something"). Four items assessed

using video games to cope (e.g., “Play video games alone”). Participants also rated how well their strategies work (a) to make the situation better and (b) to make them feel better (*Do not work at all, Work a little, Work pretty well, Work very well*).

Because the original scoring scheme could not be located, an exploratory factor analysis was conducted to determine how to calculate subscale scores. In short, the analyses suggested extracting four correlated factors aligned with the original measurement approach: active coping (13 items, e.g., “Think about what I could do before I do something.”), avoidance coping (15 items, e.g., “Try to stay away from the problem.”), support-seeking (6 items, e.g., “Talk to someone who might understand how I feel.”), and distraction coping (6 items, e.g., “Go for a walk or a run.”). The four items assessing video game coping did not load on any of these factors and did not emerge as a distinct factor in the exploratory factor analyses. However, given their conceptual clarity, a measure of video game coping was also calculated with these four items.

Action and Contingency Plans

At the end of the survey, participants read a description of how to complete Phase Two of the study and then confirmed that they understood the important aspects of Phase Two by checking boxes next to several statements. Next, they typed and submitted action and contingency plans. The action plan instructions were:

> Before we conclude the study, there are two more things to do. To help you remember to complete your daily surveys during Phase Two, it is useful to create an action plan. An action plan specifies the when, where, and how of an activity. When creating action plans, it is very useful to pick a cue that is consistent across days. For example, for this study, your action plan might be: "Every night, before I go to sleep, I will check my email one last time and complete my daily survey." Please take some time to develop an action plan that will help you successfully complete Phase Two of this study and type out

> your action plan in the box below (you may use the example action plan if you think it will work for you).

The contingency plan instructions were:

> Finally, it is also useful to create a contingency plan to go with your action plan. A contingency plan specifies what you will do if your action plan goes wrong. For example, for this study, your contingency plan might be: "If I forget to complete my daily survey before going to sleep, I will complete it as soon as I get up in the morning." Please take some time to develop a contingency plan that will help you successfully complete Phase Two of this study and type out your contingency plan in the box below (you may use the example contingency plan if you think it will work for you).
>
> Please remember, though, that it is very important for you to do your best to complete your daily surveys at the end of each day before you go to sleep.

Phase Two: Day-Level Measures

Day-level measures were completed at the end of each day. Before completing measures, participants also reported the date and entered their university email address to allow for the accurate tracking of responses across time. The order of measures was randomized on each day. Unless otherwise noted, all scale scores were calculated by averaging the relevant items (after reverse coding as necessary). The intraclass correlations and the averages and standard deviations of the descriptive statistics and internal consistencies for the primary daily variables are shown in Table 3.

Daily Real-World Need Satisfaction and Frustration

Participants completed the 12-item daily version of the Basic Psychological Need Satisfaction and Frustration scale in reference to the experiences they had that day *in their everyday life (outside of video games)* (Chen et al., 2015; van der Kaap-Deeder et al., 2017). This

scale included two items assessing the satisfaction and frustration of each of the three needs. Items were re-phrased to reflect daily experiences, and each began with "Today, in my everyday life…" Aside from this, the content of the items was the same as the person-level measure (with fewer items). An example item was "Today, in my everyday life, I felt a sense of choice and freedom in the things I undertook." The response scale once again ranged from 1 = *Not true at all* to 5 = *Completely true*. Because there were so few items, composite measures of need satisfaction and need frustration were created using the six relevant satisfaction and frustration items.

Daily Video Game Play

Participants reported whether they played video games that day (*yes* or *no*). If they selected no, then they did not answer any further questions about video games that day. If they select yes, they reported how many *minutes* they spent playing video games during four time blocks: 6 am – Noon, Noon – 6 pm, 6 pm – Midnight, and Midnight – 6 am (of the next day) (based on the General Media Habits Questionnaire; Gentile et al., 2004). The time spent playing was summed across the four time-blocks to create the measure of video game playtime. This measure was then divided by 60 to translate playtime into hours instead of minutes. Participants who did not play video games on a given day were given a zero for playtime. Participants also reported the names of up to three video games that they played that day, ranging from 1st-most-played to 3rd-most-played.

Daily Video Game Need Satisfaction and Frustration

Participants once again completed the 12-item daily version of the Basic Psychological Need Satisfaction and Frustration scale, but this time in reference to the experiences they had that day *while playing video games* (Chen et al., 2015; van der Kaap-Deeder et al., 2017). This time, all items began with "Today, while playing video games…" Aside from this change,

however, the items were identical to those assessing real-world need satisfaction and frustration, and the same response scale was used. An example item was "Today, while playing video games, I felt confident that I could do things well." As with the real-world version, composite measures of need satisfaction and frustration were created based on the six relevant satisfaction and frustration items. Participants who did not play video games on a given day were given the lowest possible scores (1.00) for video game need satisfaction and video game need frustration, to indicate the absence of satisfaction and frustration.

Daily Positive and Negative Affect

Participants rated the extent to which they felt four positive and five negative emotions that day, using a scale ranging from 1 = *Not at all* to 7 = *Extremely* (Diener & Emmons, 1984). These items were the same as those used for person-level positive and negative affect.

Daily Vitality

Participants completed a version of the State Vitality Scale, modified to assess feelings of vitality during that day (e.g., "Today, I felt alive and vital") (Ryan & Frederick, 1997). Aside from these changes, the items were the same as those used for person-level trait vitality.

Daily Physical Symptoms

Participants completed a version of the physical symptoms checklist, modified to assess the degree to which each symptom was experienced that day, using a scale with anchors at 1 = *Not at all*, 4 = *Moderately*¸ and 7 = *Extremely* (Emmons, 1991). The items were the same as those for person-level physical symptoms.

Daily Life Satisfaction

Participants completed four items from the Satisfaction With Life Scale, modified to assess feelings during that day (e.g., "Today, I felt that… In most ways my life is close to my

ideal") (Diener et al., 1985). A response scale ranging from 1 = *Strongly disagree* to 7 = *Strongly agree* was used.

Daily Perceived Stress

Participants completed a short, four-item version of the Perceived Stress Scale, focused on their experiences during that day (e.g., "Today, I felt that things were going my way.") (Cohen et al., 1983). A response scale ranging from 1 = *Strongly disagree* to 7 = *Strongly agree* was used.

Daily Well-Being (Composite)

As with the baseline version of well-being, a composite measure of daily well-being was created by standardizing and then summing the daily measures for positive affect, negative affect (scoring reversed), vitality, physical symptoms (scoring reversed), life satisfaction, and perceived stress (scoring reversed). This new variable was then standardized.

Bedtime and Unusual Day Check

At the end of the survey, participants reported what time they went to bed last night and whether the day was unusual in a major way. If the day was unusual, they were asked to describe why.

Analytic Strategy

Primary hypotheses (see Figures 1-3) were tested using multilevel modeling. All day-level predictors were person-centered so that zero reflected the average value across the 14 days for that person during Phase Two. All intercepts were allowed to vary randomly across persons, and, unless otherwise specified, all day-level slopes were allowed to vary randomly across persons. All person-level variables were standardized (i.e., grand-mean centered) so that zero reflects the average value across all persons in the sample. To illustrate, Model 1a in Figure 1 was tested with the following equations:

Level 1 (day): $VGP_{it} = \pi_{0i} + \pi_{1i}(RWNS_{it}) + \pi_{2i}(RWNF_{it}) + \varepsilon_{it}$

Level 2 (person): $\pi_{0i} = \beta_{00} + \beta_{01}(HP_i) + \beta_{02}(OP_i) + r_{0i}$

$\pi_{1i} = \beta_{10} + \beta_{11}(HP_i) + \beta_{12}(OP_i) + r_{1i}$

$\pi_{2i} = \beta_{20} + \beta_{21}(HP_i) + \beta_{22}(OP_i) + r_{2i}$

At the day level, VGP_{it} is the video game playtime for person *i* on day *t*, and π_{0i} is the intercept for person *i*, reflecting the video game playtime for that person on a day with average levels of real-world need satisfaction and real-world need frustration (for that person). π_{1i} and π_{2i} reflect the slopes for real-world need satisfaction and real-world need frustration, respectively, for person *i*, averaged across the 14 days, and ε_{it} reflects the day-level error term. At the person level, β_{00} is the intercept reflecting the average video game playtime across all days for all persons, assuming average levels of harmonious and obsessive passion. β_{01} and β_{02} are slopes reflecting the effect of harmonious and obsessive passion, respectively, on daily video game playtime, and r_{0i} reflects the random variation of the intercept across persons. β_{10} reflects the average slope for real-world need satisfaction across persons and β_{11} and β_{12} are slopes reflecting the effect of harmonious and obsessive passion, respectively, on those slopes. r_{1i} reflects the random variation of the slope for real-world need satisfaction across persons. β_{20} reflects the average slope for real-world need frustration across persons and β_{21} and β_{22} are slopes reflecting the effect of harmonious and obsessive passion, respectively, on those slopes. r_{2i} reflects the random variation of the slope for real-world need frustration across persons. Combining the Level 1 and 2 equation yields the full model: $VGP_{it} = \beta_{00} + \beta_{01}(HP_i) + \beta_{02}(OP_i) + \beta_{10}(RWNS_{it}) + \beta_{11}(RWNS_{it})(HP_i) + \beta_{12}(RWNS_{it})(OP_i) + \beta_{20}(RWNF_{it}) + \beta_{21}(RWNF_{it})(HP_i) + \beta_{22}(RWNF_{it})(OP_i) + r_{0i} + r_{1i} + r_{2i} + \varepsilon_{it}$.

All multilevel analyses were conducted using R (version 3.6.1) and the “lme4,” “lmerTest,” “optimx,” and “sjstats” packages. All models used restricted maximum likelihood estimation. The importance of including each random effect (i.e., slopes and intercept) was assessed by comparing models with and without each random effect. Likelihood Ratio Tests (LRTs) were conducted based on the difference in log-likelihood values to determine whether removing a random effect significantly decreased model fit. Random intercepts were evaluated by comparing null models (i.e., with no predictors) with random versus fixed intercepts. Random slopes were evaluated by dropping each random slope from the final model. Thus, significant LRTs suggest that there is significant variability in the intercept or slope across persons.

Secondary hypotheses were tested using bivariate correlations and exploratory polynomial regression (for hypotheses concerning obsessive and harmonious passion as predictors of Internet Gaming Disorder).

CHAPTER 8. RESULTS

Data Diagnostics

Before analyses, the data were checked for missingness. As part of this process, 38 cases of participants failing to follow instructions and submitting daily surveys before 7:00 PM were identified. Of these, 13 people submitted early once, four people submitted early twice, and one person each submitted early three times, four times, five times, and six times. Because this was limited to a small subset of possible days, all early submissions were coded as missing rather than excluding additional participants. After this, the average number of daily surveys completed was 12.38 (*SD* = 1.94) and ranged from 7-14. The average sample size for daily surveys was 117.43 (*SD* = 8.40) and ranged from 99-129. There was no missingness at the level of individual items at baseline, and within completed daily surveys, responses for individual items were missing from 1% of the sample at most. Missingness at the item level was dealt with by averaging available items.

Next, the data were checked for univariate outliers and non-normality, then cleaned as necessary. Outliers were defined as cases flagged as outliers on a boxplot that were also clearly separated from the distribution on a histogram. Non-normality was defined as skewness or kurtosis values greater than one in absolute value. When outliers were present or distributions were non-normal, the following methods were tested sequentially until distributional issues were resolved: (1) a 90% Winsorization,[7] (2) a square root transformation, and (3) a log-10 transformation.

[7] This censors extreme scores at both ends of the distribution which allows outliers to be kept while minimizing their ability to bias parameter estimates. All values below the 5th percentile are set to the 5th percentile value and all values above the 95th percentile are set to the 95th percentile value.

Among the baseline variables, the following were Winsorized: age, length of typical gaming sessions, average weekly playtime, introjected regulation, obsessive passion, IGD, negative gaming engagement, relatedness frustration, conscientiousness, and physical symptoms. The following variables were square root transformed: amotivation, passion criteria, and avoidance coping. A few distributional issues remained after these transformations. There were nine high outliers for relatedness frustration and two high outliers for avoidance coping. However, despite being separated on histograms these cases were not far removed from the distributions, so these variables were not changed further. Aside from this, all baseline variables were normally distributed without any outliers.

For daily variables, the same process was applied except square root transformations and log-10 transformations were not used, even if they might have solved distributional issues. This was necessary to maintain the interpretability of daily variables across the two weeks. For example, a square root transformation on one day would necessitate the same transformation on all days but would interfere with the interpretation of models. Thus, variables were Winsorized when this improved distributional issues even if some issues remained. In cases where Winsorization did not improve distributional issues, the original variable was used. Table 4 provides a summary of which daily variables were Winsorized and which distributional issues remained.

While examining daily video game playtime it became apparent that a substantial number of people reported playtime in hours instead of minutes (as requested). For example, there were many cases where someone reported playing only a minute for a game that could not be reasonably played so quickly. Because participants reported playtime in four, six-hour time-blocks, I identified those who played games on the given day and selected those who reported

playing for six minutes or less in each of the four time-blocks. For each of these cases, I identified the day, the minutes played, and the number of games played (1-3). In the case where one game was played, I also coded for whether that game could be reasonably played in just a few minutes. This ended up being based entirely on whether the game was a mobile game, because many mobile games are designed to be played in short periods of time. Only eight cases of this were identified. Overall, the number of participants misreporting playtimes on a given day ranged from 9-26 with an average of 15.79 (*SD* = 4.68). The average number of misreported playtimes per person was 4.35 (*SD* = 4.32) and ranged from 1-14.

Next, I checked the baseline data for each person to determine the length of their typical gaming sessions (in minutes) and their average weekly playtime (in hours). Aside from one questionable case,[8] the lowest typical session length was 30 minutes. This, paired with the average weekly playtime values, strongly suggested that in all the identified cases the participants erroneously reported in hours instead of minutes. Thus, these values were changed to the correct metric.

To help verify the appropriateness of this corrective measure, correlations were calculated between baseline reports of average weekly playtime and actual amounts of playtime in the first and second weeks of Phase Two. The actual amounts of playtime were calculated by averaging all available daily playtimes within the first week and then multiplying by seven. This approach was then repeated for the second week. Importantly, these measures are likely to be inaccurate because most participants had days where daily surveys were not completed, meaning there are likely days where video games were played that were not included. Before the daily

[8] One person reported a typical gaming session length of three minutes but reported playing every single day with an average weekly playtime of 27 hours. Given this, it seemed safe to assume that this participant meant to report a typical session length of three hours instead of three minutes.

reporting errors were corrected, the baseline report of average weekly playtime correlated at $r(131) = .53$, $p < .001$, with playtime in the first week and at $r(131) = .43$, $p < .001$, with playtime in the second week. After reporting errors were corrected, these correlations increased to $r(131) = .54$, $p < .001$, and $r = (131) = .49$, $p < .001$, respectively. These stronger relations suggest that the corrections appropriately increased the accuracy of the measurement. Thus, the corrected values were used for daily playtime throughout this work.

Preliminary Analyses

Before testing hypotheses, descriptive analyses were conducted to provide a basic understanding of the data. These analyses were not pre-registered.

Baseline Variables

Table 5 shows bivariate correlations among primary person-level variables and select baseline variables (note that relations with gaming motivations are tested later in the "Secondary Hypotheses" section). Harmonious passion was associated with lower levels of agreeableness ($r = -.18$), and higher levels of active coping ($r = .22$), IGD ($r = .32$), average weekly playtime ($r = .38$), obsessive passion ($r = .40$), video game coping ($r = .40$), and positive gaming experiences ($r = .66$). Obsessive passion was associated with lower levels of conscientiousness ($r = -.17$), trait need satisfaction ($r = -.19$), support seeking ($r = -.21$), agreeableness ($r = -.25$), and well-being ($r = -.30$). Obsessive passion was also associated with male (vs. female) gender ($r = .20$) and higher levels of video game coping ($r = .30$), average weekly playtime ($r = .36$), trait need frustration ($r = .39$), positive gaming experiences ($r = .40$), negative gaming experiences ($r = .50$), and IGD ($r = .62$).

Similarly, IGD was associated with lower levels of agreeableness ($r = -.24$) and well-being ($r = -.41$) as well as male (vs. female) gender ($r = .19$) and higher levels of video game coping ($r = .21$), neuroticism ($r = .21$), avoidance coping ($r = .22$), average weekly playtime ($r =$

.25), positive gaming experiences (*r* = .29), trait need frustration (*r* = .49), and negative gaming experiences (*r* = .54).

Trait need satisfaction was associated with lower levels of neuroticism (*r* = -.37) and trait need frustration (*r* = -.59) as well as higher levels of support seeking (*r* = .27), distraction coping (*r* = .28), grade point average (*r* = .28), openness (*r* = .32), conscientiousness (*r* = .36), active coping (*r* = .52), and well-being (*r* = .66). In contrast, trait need frustration was associated with lower levels of support seeking (*r* = -.19), grade point average (*r* = -.20), active coping (*r* = -.25), conscientiousness (*r* = -.34), and well-being (*r* = -.78). Trait need frustration was also associated with higher levels of negative gaming experiences (*r* = .29), avoidance coping (*r* = .31), and neuroticism (*r* = .45).

In addition to the relations already identified, high levels of average weekly playtime were associated with higher levels of positive gaming experiences (*r* = .37) and video game coping (*r* = .38).

Finally, in addition to the relations already identified, good well-being was associated with lower levels of avoidance coping (*r* = -.32) and neuroticism (*r* = -.56) as well as higher levels of openness (*r* = .21), distraction coping (*r* = .29), grade point average (*r* = .29), conscientiousness (*r* = .30) and active coping (*r* = .37).

Daily Variables

Relations among daily variables were examined using averages for each person across the 14 days (see Table 6). Note, however, that this aggregated approach ignores variability at the daily level, so relations should be interpreted cautiously.

Average daily real-world need satisfaction was negatively related to average daily video game need frustration (r = -.51) and average daily real-world need frustration (r = -.71) but positively related to average daily video game need satisfaction (r = .43) and average daily well-being (r = .85). In contrast, average daily real-world need frustration was negatively related to average daily video game need satisfaction (r = -.40) and average daily well-being (r = -.80) but positively related to average daily video game need frustration (r = .63).

Average daily video game need satisfaction was positively related to average daily well-being (r = .38) and average daily video game playtime (r = .66). In contrast, average daily video game need frustration was negatively related to average daily well-being (r = .52).

Next, the intraclass correlation (ICC) values were examined for each daily variable (see Table 3). These values revealed what proportion of the variance in each variable was attributable to the person (i.e., between-person variance), with the remaining variance being attributable to the day (i.e., within-person variance). For real-world need satisfaction, 64% of the variance was between persons and 36% was within persons. For real-world need frustration 60% of the variance was between persons and 40% was within persons. Similarly, for well-being, 67% of the variance was between persons and 33% was within persons.

The values for the gaming variables showed a different pattern where within-person variance dominated between-person variance. For video game need satisfaction, 30% of the variance was between persons and 70% was within persons. For video game need frustration, 40% of the variance was between persons and 60% was within persons. Finally, for video game playtime, 36% of the variance was between persons and 64% was within persons.

Thus, the real-world variables and well-being varied more from person-to-person than from day-to-day, but the opposite was true for the video game variables.

Primary Hypothesis Testing

Do Daily Real-World Need Satisfaction and Frustration Predict Daily Video Game Playtime?

This question was answered with two models (Models 1a and 1b). Predictions are shown in Figure 1 and results are shown in Figure 4 and Tables 7 and 8. In both models, average daily video game playtime varied significantly across persons, $\chi^2(1) = 472.66$, $p < .001$.

Model 1a

The first model (Model 1a) included real-world need satisfaction and frustration as predictors of video game playtime at the day level. Harmonious and obsessive passion were included as predictors of video game playtime at the person level. All possible cross-level interactions between the day-level and person-level predictors were also included. This model explained 7.6% of the variance in video game playtime at the daily level and 10.5% of the variance in video game playtime at the person level.

The intercept was significant and revealed that the predicted video game playtime on a day with average levels of real-world need satisfaction and real-world need frustration for a person with average levels of harmonious and obsessive passion was 1.66 hours. Contrary to predictions, daily real-world need satisfaction was not a significant predictor and daily real-world need frustration was a significant predictor, but not in the expected direction. Each one-unit increase in daily real-world need frustration was associated with a 0.34-hour decrease in predicted video game playtime. At the person level, harmonious passion was a significant positive predictor as expected, but obsessive passion was not. Each one-*SD* increase in harmonious passion was associated with a 0.39-hour increase in average daily video game playtime (across the two weeks). None of the cross-level interactions were significant, meaning

that the observed daily relations did not change as a function of harmonious or obsessive passion for gaming.

Regarding random effects, the slope for real-world need satisfaction varied significantly across persons, $\chi^2(3) = 10.46$, $p = .015$, but the slope for real-world need frustration did not, $\chi^2(3) = 3.26$, $p = .352$. The intercept was negatively related to the slopes for both real-world need satisfaction ($r = -.15$) and real-world need frustration ($r = -.54$), meaning that the effects of these variables on video game playtime were weaker when average video game playtime was high. The slope for real-world need satisfaction was also negatively related to the slope for real-world need frustration ($r = -.37$), meaning that the effect of real-world need frustration became weaker as the effect of real-world need satisfaction increased, and vice versa. In other words, it seems that video game playtime was primarily affected by either real-world need satisfaction or real-world need frustration—not both. Given that the latter effect was significant, and the former effect was not, it seems that real-world need frustration is the dominant predictor of video game playtime.

Model 1b

The second model (Model 1b) was identical to the first at the day level but included IGD symptoms at the person level instead of harmonious and obsessive passion. IGD symptoms were specified as a predictor of video game playtime at the person level and all possible cross-level interactions were included. This model explained 5.0% of the variance in video game playtime at the daily level and 4.1% of the variance in video game playtime at the person level.

The results at the day level were nearly identical to those of Model 1a and thus are not interpreted here. At the person level, IGD was a significant positive predictor, as expected. Each one-*SD* increase in IGD symptoms was associated with a 0.27-hour increase in average daily

video game playtime. Neither of the cross-level interactions were significant, meaning that the observed daily relations did not change as a function of IGD symptoms.

Regarding random effects, as before, the slope for real-world need satisfaction varied significantly across persons, $\chi^2(3) = 10.89$, $p = .012$, but the slope for real-world need frustration did not, $\chi^2(3) = 3.87$, $p = .276$. The correlations among random effects (i.e., the intercept and slopes) were slightly stronger than those found in the previous model, but all in the same direction. Thus, the basic interpretation of these effects remains the same.

Summary

In short, these models indicate that people spent less time playing video games on days with above-average frustration of needs in the real world. This relation was not moderated by harmonious passion, obsessive passion, or IGD symptoms. Additionally, when harmonious and obsessive passion were considered simultaneously, people with greater harmonious passion for gaming spent more time playing across the two weeks, but obsessive passion was unrelated to average playtime. People with higher levels of IGD symptoms also spent more time playing across the two weeks.

Does Daily Video Game Playtime Predict Daily Well-Being?

This question was answered with three models (Models 2a, 2b, and 2c). Predictions are shown in Figure 2 and results are shown in Figure 5 and Tables 9 and 10. Average daily well-being varied significantly across persons in all three models, $\chi^2(1) = 1{,}342.90$, $p < .001$.

Model 2a

The first model in this series (Model 2a) included video game playtime as a predictor of well-being at the day level. Harmonious and obsessive passion were included as predictors of well-being at the person level. All possible cross-level interactions between the day-level and

person-level predictors were also included. This model explained 5.1% of the variance in well-being at the daily level and 5.4% of the variance in well-being at the person level.

The intercept revealed that the predicted well-being on a day with an average level of video game playtime for a person with average levels of harmonious and obsessive passion was -0.04, which was not significantly different from zero. As expected, daily video game playtime was a significant positive predictor. Each one-hour increase in daily video game playtime was associated with a 0.06-*SD* increase in predicted daily well-being. At the person level, obsessive passion was a significant negative predictor, as expected, but harmonious passion was not a significant predictor. Each one-*SD* increase in obsessive passion was associated with a 0.24-*SD* decrease in average daily well-being (across the two weeks). Neither of the cross-level interactions were significant, meaning that the link between daily video game playtime and daily well-being did not vary as a function of harmonious or obsessive passion for gaming.

Regarding random effects, the slope for video game playtime varied significantly across persons, $\chi^2(2) = 6.95$, $p = .031$. The intercept was negatively related to the slope for video game playtime ($r = -.17$), meaning that the effect of video game playtime on well-being was weaker when average daily well-being was high and stronger when average daily well-being was low. In other words, those with poor well-being benefitted more from video game playtime.

Model 2b

The second model in this series (Model 2b) was identical to the first at the day level but included IGD symptoms at the person level instead of harmonious and obsessive passion. IGD symptoms were specified as a predictor of well-being at the person level and a cross-level interaction was included. This model explained 9.1% of the variance in well-being at the daily level and 11.2% of the variance in well-being at the person level.

The results at the day level were nearly identical to those of Model 2a and thus are not interpreted. At the person level, IGD was a significant negative predictor, as expected. Each one-*SD* increase in IGD symptoms was associated with a 0.29-*SD* decrease in average daily well-being. The cross-level interaction was not significant, however, meaning that the daily relations between video game playtime and well-being did not vary as a function of IGD symptoms.

The random effects were similar to those found in Model 2a. Once again, the slope for video game playtime varied significantly across persons, $\chi^2(2) = 8.56$, $p = .014$. The negative correlation between the random intercept and the random slope for video game playtime was nearly twice as strong in this model but in the same direction as before.

Model 2c

The third model in this series (Model 2c) was identical to the other two models (Models 2a & 2b) at the day level but included trait need satisfaction and trait need frustration at the person level instead of harmonious and obsessive passion or IGD symptoms. Trait need satisfaction and trait need frustration were both specified as predictors of well-being at the person level and the two possible cross-level interactions were included. This model explained 37.6% of the variance in well-being at the daily level and 52.3% of the variance in well-being at the person level.

The results at the day level were nearly identical to those of Model 2a and Model 2b and thus are not interpreted. At the person level, trait need satisfaction was a positive predictor of well-being and trait need frustration was a negative predictor of well-being, both as expected. Each one-SD increase in trait need satisfaction was associated with a 0.29-SD increase in average daily well-being. In contrast, each one-SD increase in trait need frustration was associated with a 0.39-SD decrease in average daily well-being. Neither of the cross-level interactions was significant, however, meaning that the daily relation between video game

playtime and well-being did not vary based on levels of trait need satisfaction or trait need frustration.

Finally, the random effects were similar to those found in Model 2a and Model 2b. The slope for video game playtime again varied significantly across persons, $\chi 2(2) = 11.17$, $p = .004$. The negative correlation between the random intercept and the random slope for video game playtime was even stronger in this model, but in the same direction as in previous models.

Summary

In short, these models indicate that people had better well-being on days with above-average video game playtime. This relation did not vary as a function of harmonious or obsessive passion for gaming, IGD symptoms, or trait need satisfaction or frustration. Additionally, when harmonious and obsessive passion were considered simultaneously, people with greater obsessive passion for gaming had poorer well-being across the two weeks, but harmonious passion was unrelated to average daily well-being. People with more severe IGD symptoms also had lower average daily well-being. Finally, when trait need satisfaction and frustration were considered simultaneously people with high need satisfaction experienced better well-being across the two weeks but people with high need frustration experienced poorer well-being in the same time frame.

Do Daily Video Game Need Satisfaction and Frustration Predict Daily Well-Being After Controlling for Real-World Need Satisfaction and Frustration?

This question was answered with three models (Model 3a, 3b, and 3c). Predictions are shown in Figure 3 and results are shown in Figure 6 and Tables 11 and 12. As in the previous models, average daily well-being varied significantly across persons in all three models, $\chi^2(1) = 1{,}342.90$, $p < .001$.

Model 3a

The first model in this series (Model 3a) included real-world need satisfaction, real-world need frustration, video game need satisfaction, and video game need frustration as predictors of well-being at the day level. Harmonious and obsessive passion were included as predictors of well-being at the person level. Cross-level interactions between the passion variables and the video game variables were also included. In this model and in Models 3b and 3c the slope for video game need satisfaction was fixed because models would not converge when this slope was allowed to vary randomly. This model explained 18.2% of the variance in well-being at the daily level and 5.3% of the variance in well-being at the person level.

The intercept revealed that the predicted well-being on a day with average levels of real-world need satisfaction, real-world need frustration, video game need satisfaction, and video game need frustration for a person with average levels of harmonious and obsessive passion was -0.04, which was not significantly different from zero. As expected, real-world need satisfaction was a significant positive predictor and real-world need frustration was a significant negative predictor. Each one-unit increase in daily real-world need satisfaction was associated with a 0.48-*SD* increase in predicted well-being. In contrast, each one-unit increase in daily real-world need frustration was associated with a 0.32-*SD* decrease in predicted well-being. Also as expected, video game need satisfaction was a significant positive predictor, however, video game need frustration was not a significant predictor. Each one-unit increase in daily video game need satisfaction was associated with a 0.05-*SD* increase in predicted well-being. At the person level, obsessive passion was a significant negative predictor as expected, but harmonious passion was not a significant predictor. Each one-*SD* increase in obsessive passion was associated with a 0.24-*SD* decrease in average daily well-being. None of the cross-level interactions were

significant, meaning that the effects of daily video game need satisfaction and frustration on daily well-being did not vary based on harmonious or obsessive passion for gaming.

Regarding random effects, the slopes for real-world need satisfaction, $\chi^2(4) = 15.61$, $p = .004$, and video game need frustration, $\chi^2(4) = 12.94$, $p = .012$, both varied randomly across persons, but the slope for real-world need frustration did not, $\chi^2(4) = 8.22$, $p = .084$. Focusing on correlations ≥ .10 in absolute magnitude, the following relations among random effects were observed. The intercept was negatively related to the slope for video game need frustration ($r = -.28$), meaning that the effect of video game need frustration on well-being was weaker when average daily well-being was high and stronger when average daily well-being was low. Additionally, the slope for real-world need satisfaction was positively related to the slopes for real-world need frustration ($r = .10$) and video game need frustration ($r = .48$). Thus, those who were strongly affected by real-world need satisfaction were also strongly affected by video game need frustration and real-world need frustration.

Model 3b

The second model in this series (Model 3b) was identical to Model 3a at the day level but included IGD symptoms at the person level instead of harmonious and obsessive passion. IGD symptoms were specified as a predictor of well-being at the person level and two cross-level interactions with the daily video game variables were included. This model explained 22.1% of the variance in well-being at the daily level and 11.0% of the variance in well-being at the person level.

The results at the day level were nearly identical to those of Model 3a and thus are not interpreted. At the person level, IGD was a significant negative predictor, as expected. Each one-*SD* increase in IGD symptoms was associated with a 0.29-*SD* decrease in average daily well-being. Neither of the cross-level interactions was significant, meaning that the effects of daily

video game need satisfaction and frustration on daily well-being did not vary as a function of IGD symptoms.

The random effects were very similar to those found in Model 3a. There was significant variability across persons in the slopes for real-world need satisfaction, $\chi^2(4) = 16.61$, $p = .002$, real-world need frustration, $\chi^2(4) = 9.49$, $p = .050$, and video game need frustration, $\chi^2(4) = 14.93$, $p = .005$. The correlations among random effects were stronger in this model. The intercept was positively related to the slopes for real-world need satisfaction ($r = .12$) and real-world need frustration ($r = .13$) but negatively related to the slope for video game need frustration ($r = -.37$). Thus, those with high levels of average daily well-being tended to be less affected by video game need frustration but slightly more affected by real-world need satisfaction and real-world need frustration. The other correlations were similar to those in Model 3a.

Model 3c

The final model in this series (Model 3c) was identical to the other two models (Models 3a and 3b) at the day level but included trait need satisfaction and trait need frustration at the person level instead of harmonious and obsessive passion or IGD symptoms. Trait need satisfaction and trait need frustration were both specified as predictors of well-being at the person level and four possible cross-level interactions were included, with trait need satisfaction interacting with daily need satisfaction variables and trait need frustration interacting with daily need frustration variables. This model explained 50.6% of the variance in well-being at the daily level and 52.3% of the variance in well-being at the person level.

The results at the day level were nearly identical to those of Models 3a and 3b and thus are not interpreted. At the person level, trait need satisfaction was a positive predictor of well-being and trait need frustration was a negative predictor of well-being, both as expected. Each

one-*SD* increase in trait need satisfaction was associated with a 0.29-*SD* increase in average daily well-being. In contrast, each one-*SD* increase in trait need frustration was associated with a 0.39-*SD* decrease in average daily well-being. Of the four cross-level interactions, only the one between trait need satisfaction and real-world need satisfaction was significant. The link between daily real-world need satisfaction and daily well-being increased as trait need satisfaction increased, suggesting that people with high levels of need satisfaction in general may be sensitized to daily experiences of need satisfaction, granting them a bigger boost to well-being (a "rich get richer" effect). The non-significance of the other cross-level interactions, however, means that the daily effect of video game need satisfaction on well-being did not depend on trait need satisfaction and the daily effects of real-world need frustration and video game need frustration on well-being did not depend on trait need frustration.

Finally, the random effects were generally similar to those found in Models 3a and 3b with a few key differences. The slopes for real-world need satisfaction, $\chi^2(4) = 11.01$, $p = .026$, and video game need frustration, $\chi^2(4) = 15.20$, $p = .004$, varied significantly across persons but the slope for real-world need frustration did not, $\chi^2(4) = 8.95$, $p = .062$. In this model, the intercept was negatively related to the slopes for real-world need satisfaction ($r = -.12$; a reversal of prior directions) and video game need frustration ($r = -.49$; an increased magnitude relative to Models 3a & 3b) but positively related to the slope for real-world need frustration ($r = .29$; more than double the magnitude found in Model 3b). Thus, those with high levels of well-being were less affected by video game need frustration and real-world need satisfaction but more affected by real-world need frustration. Compared to Model 3b, the magnitude of two additional relations also approximately doubled. The slope for real-world need frustration was positively related to the slopes for real-world need satisfaction ($r = .19$) and video game need frustration ($r = .13$).

This means that those who were strongly affected by real-world need frustration also tended to be more affected by real-world need satisfaction and video game need frustration. The link between the slope for real-world need satisfaction and video game need frustration was nearly identical to Models 3a and 3b (*r* = .49).

Summary

In short, these models indicate that people had better well-being on days with below-average levels of real-world need frustration and above-average levels of real-world need satisfaction and video game need satisfaction (with the latter effect being much weaker than the former). These relations did not vary as a function of harmonious or obsessive passion for gaming, IGD symptoms, or trait need frustration. Trait need satisfaction did moderate the daily relation between real-world need satisfaction and well-being, however. Higher levels were associated with a stronger link. The "main effects" of person-level variables on average daily well-being were the same as in Models 2a, 2b, and 2c.

Secondary Hypothesis Testing

Next, secondary hypotheses were tested using bivariate correlations among baseline measures (see Tables 13 and 14) followed by exploratory polynomial regression analyses.

Harmonious Passion

Based on the DMP, I predicted that harmonious passion for gaming would be positively related to autonomous forms of motivation and regulation (i.e., intrinsic, integrated, and identified) and less positively (perhaps negatively) related to controlled forms of motivation and regulation (i.e., introjected, external, and amotivated). These predictions were supported, with strong and significant positive correlations between harmonious passion and autonomous motivations (*r*s = .52-.74), weaker but significant positive correlations between harmonious

passion and introjected (*r* = .27) and external (*r* = .30) regulations, and a significant negative correlation between harmonious passion and amotivation (*r* = -.21).

I also expected harmonious passion to be positively related to well-being (i.e., positive affect, subjective vitality, and life satisfaction) and negatively related to ill-being (i.e., negative affect, physical symptoms, and perceived stress). However, this was not the case—none of the correlations were significant.

Finally, I expected harmonious passion to be positively related to trait need satisfaction and negatively related to trait need frustration. This expectation was largely unsupported, however, as the only significant correlation was with autonomy satisfaction (*r* = .21).

Overall, these findings suggest that those with harmonious passion for gaming are likely to have autonomous (vs. controlled) motivations for gaming and to have higher autonomy satisfaction. Harmoniously passionate gamers did not differ in other forms of need satisfaction or frustration, however, and did not have different levels of well-being.

Obsessive Passion

Based on the DMP, I predicted that obsessive passion for gaming would be positively related to controlled forms of motivation and regulation and less positively (perhaps negatively) related to autonomous forms of motivation and regulation. Obsessive passion was, in fact, significantly positively related to controlled forms of motivation (*r*s = .21-.46), but it was also significantly positively related to autonomous forms of motivation with connections of a similar magnitude (*r*s = .24-.43). Thus, there was mixed support for these predictions.

I also predicted that obsessive passion would be negatively related to well-being (i.e., positive affect, subjective vitality, and life satisfaction) and positively related to ill-being (i.e., negative affect, physical symptoms, and perceived stress). These predictions were supported for well-being (*r*s = -.19 to -.30) and supported for two of the three ill-being variables—negative

affect and perceived stress (*r*s = .25 and .22, respectively). Obsessive passion for gaming was not significantly related to physical symptoms.

Finally, I predicted that obsessive passion would be positively related to trait need frustration but negatively related to trait need satisfaction. This was supported at the composite level for need frustration (*r* = .39) and need satisfaction (*r* = -.19). At a more specific level, obsessive passion was significantly positively related to the frustration of all three needs (*r*s = .31-.34) and significantly negatively related to relatedness satisfaction (*r* = -.21), but not competence or autonomy satisfaction.

Overall, these findings suggest that obsessively passionate gamers have elevated levels of both autonomous and controlled motivations and regulations. They also have poorer well-being as indicated by lower levels of positive affect, vitality, and life satisfaction as well as higher levels of negative affect and perceived stress. Obsessively passionate gamers are also more likely to have frustrated needs for competence, autonomy, and relatedness as well as lower levels of relatedness satisfaction.

Internet Gaming Disorder Symptoms

The simple bivariate predictions for IGD symptoms were the same as those for obsessive passion. As with obsessive passion, IGD was significantly positively related to both controlled (*r*s = .26-.46) and autonomous (*r*s = .30-.35) forms of motivation and regulation, with controlled and autonomous relations being of similar magnitudes. Thus, predictions were partially supported.

The pattern of findings for well-being was also highly similar to the pattern found for obsessive passion. IGD symptoms were significantly negatively related to all three indicators of well-being (*r*s = -.22 to -.36) and significantly positively related to two indicators of ill-being

(negative affect and perceived stress; *r*s = .38 and .43, respectively). IGD symptoms were not significantly related to physical symptoms.

Finally, at the composite level, IGD symptoms were significantly positively related to trait need frustration (r = .49), as expected, but not trait need satisfaction. At the more specific level, IGD symptoms were significantly positively related to the frustration of all three needs (*r*s = .36-.42) and significantly negatively related to relatedness satisfaction (r = -.23) but not competence or autonomy satisfaction.

An additional prediction was made regarding relations between passion and IGD symptoms. Specifically, at the bivariate level I expected IGD to be strongly positively related to obsessive passion but unrelated to harmonious passion. However, at the multivariate level, I expected IGD to increase as obsessive passion surpassed (or dominated) harmonious passion.

The predictions at the bivariate level were partially supported. As expected, IGD was strongly positively related to obsessive passion, $r(131) = .62$, 95% CI = [.51, .72], $p < .001$. However, IGD was also moderately positively related to harmonious passion, $r(131) = .32$, 95% CI = [.16, .47], $p < .001$.

The multivariate predictions were tested using exploratory polynomial regression which provides a sensitive test of hypotheses concerning differences between two predictor variables (Edwards, 2002; Phillips, 2013; Shanock et al., 2010). This approach involves testing specific models of increasing order (i.e., linear, quadratic, cubic) until adding higher-order terms no longer significantly increases the explained variance. The simplest model explaining the most variance is then treated as final. First, harmonious passion and obsessive passion were centered at the midpoint. Next, a linear model was specified in which harmonious and obsessive passion were entered as predictors of IGD symptoms. This model was significant, $F(2, 130) = 42.48$, $p <$

.001, and explained 39.5% of the variance in IGD symptoms. Obsessive passion was a significant, positive predictor (b = 0.45, 95% CI = [0.34, 0.56], SE = 0.06, t = 7.91, p <.001, β = 0.59), but harmonious passion was not a significant predictor (b = 0.03, 95% CI = [-0.02, 0.09], SE = 0.03, t = 1.20, p = .233, β = 0.09). Next, a quadratic model was tested, which added an interaction between harmonious and obsessive passion as well as squared terms for harmonious and obsessive passion. This model did not significantly increase the amount of variance explained, however, $F(3, 127) = 0.38$, p = .805, so the linear model was treated as final. This means that IGD increased as obsessive passion increased regardless of the level of harmonious passion. Thus, the multivariate hypothesis was not supported.

Overall, these findings suggest that people suffering from IGD have elevated levels of both autonomous and controlled motivations for gaming as well as poorer well-being as indicated by lower levels of positive affect, vitality, and life satisfaction, as well as higher levels of negative affect and perceived stress. IGD symptoms are also associated with higher levels of competence, autonomy, and relatedness frustration as well as lower levels of relatedness satisfaction. Finally, although IGD is positively related to both harmonious and obsessive passion at the bivariate level, the relation with harmonious passion disappears after controlling for obsessive passion which remains a strong predictor. The connection between IGD and obsessive passion is further supported by the fact that the two variables related similarly to measures of motivation, well-being, and trait need satisfaction and frustration.

CHAPTER 9. DISCUSSION

This study examined the daily fluctuations of need satisfaction and frustration in the real world, need satisfaction and frustration in video games, video game playtime, and well-being to determine whether gaming is psychologically nutritious like need-satisfying real-world experiences are. Analyses addressed three primary questions. First, do daily real-world need satisfaction and frustration predict daily video game playtime? Second, does daily video game playtime predict well-being (without consideration of daily need satisfaction and frustration)? And third, do daily video game need satisfaction and frustration predict daily well-being above and beyond daily real-world need satisfaction and frustration? Analyses also examined whether the answers to these questions depended on the person's level of (a) harmonious and obsessive passion for gaming, (b) IGD symptoms, or (c) trait need satisfaction and frustration. The main effects of these person-level variables on the average levels of daily video game playtime and daily well-being were also assessed.

Predicting Daily Video Game Playtime

Research has shown that playing video games can satisfy basic psychological needs, yielding high levels of enjoyment, motivation to play, and short-term improvements in well-being (Oliver et al., 2016; Reinecke et al., 2012; Rieger et al., 2014; Ryan et al., 2006; Tamborini et al., 2010, 2011). Other work has shown that excessive and problematic patterns of video game play are more common when basic psychological needs are frustrated or unsatisfied in the real world (Mihara & Higuchi, 2017; Rigby & Ryan, 2011; Wan & Chiou, 2006b; N. Weinstein et al., 2017; Wu et al., 2013; Yu et al., 2015) and especially likely when need satisfaction from video games is high and need satisfaction from the real world is low (Allen & Anderson, 2018; Mills, Milyavskaya, Mettler, & Heath, 2018). Taken together, this work supports the need

density hypothesis, derived from SDT, which proposes that excessive gaming emerges as a way to compensate for deficits in real-world need satisfaction (Rigby & Ryan, 2011, 2016).

Based on this work, I expected people to spend more time playing video games on days with above-average levels of need frustration and below-average levels of need satisfaction in the real world. Surprisingly, the opposite pattern emerged—although the relation was not significant for real-world need satisfaction. Specifically, people spent *less* time playing video games when their needs were more frustrated than usual in the real world. This relation was not affected by a person's passion for gaming (harmonious or obsessive), severity of IGD symptoms, or trait levels of need satisfaction and frustration. It was affected, however, by a person's average daily video game playtime. People with high levels of video game playtime across the two weeks were less affected by real-world need frustration whereas those with low levels of video game playtime were more affected by real-world need frustration. This suggests that casual gamers are likely to pull away from gaming when feeling incompetent, controlled, and socially disconnected, whereas this is less true for more dedicated gamers. In short, it may be that people generally are not "in the mood" to play video games when their needs are highly frustrated although those with strong gaming habits may continue playing regardless. This finding is similar to that observed by Mills, Milyavskaya, Mettler, Heath, et al. (2018), where gamers with low obsessive passion played less when their needs were frustrated but gamers with high obsessive passion played the same amount when their needs were frustrated. Of course, the lack of moderation by obsessive passion in the present study means this parallel is not exact.

The discrepancy between the present findings and those described previously may be due to differences in the constructs assessed. Specifically, many of the past studies focused on *problematic* video game play (essentially variants of IGD) rather than actual video game

playtime. Although video game playtime is positively related to problematic patterns of play, the correlation is far from perfect. For example, correlations among baseline variables showed that average weekly playtime was only moderately related to obsessive passion for gaming (r = .36) and IGD symptoms (r = .25). Thus, although gamers may be especially motivated to play when they find games more satisfying than the real world, this motivation may not translate into actual playtime. This is likely because even gamers who struggle to control their gaming can exert some self-control and refrain from playing when necessary.

As mentioned above, past work has shown that harmonious and obsessive passion for gaming (Lafrenière et al., 2009; Mills, Milyavskaya, Mettler, Heath, et al., 2018; Przybylski et al., 2009; C.-C. Wang & Chu, 2007) and IGD symptoms (Allen & Anderson, 2018; Gentile et al., 2011; Mihara & Higuchi, 2017; Mills & Allen, 2020) are all positively related to video game playtime, however, obsessive passion is generally a stronger predictor than harmonious passion. Thus, I predicted positive relations between average daily video game playtime and these three variables and expected the link the be stronger for obsessive passion than for harmonious passion. These predictions were partially supported. In line with prior research, people with more severe IGD symptoms did spend more time playing video games across the two weeks. However, when harmonious and obsessive passion were considered simultaneously (in a separate model), only harmonious passion predicted higher video game playtime. This finding contrasts with prior work focused on video games, but because both forms of passion involve high levels of engagement the pattern is still consistent with the DMP. In fact, although meta-analytic findings for passion activities generally (i.e., not specific to video games) suggest that obsessive passion is a more reliable predictor of weekly engagement than harmonious passion (Curran et al., 2015), other work has found that obsessive passion predicts more frequent engagement while

harmonious passion predicts engagement for longer periods of time (again, for non-gaming activities; Mageau & Vallerand, 2007). Thus, the relation between passion and weekly engagement appears to be complicated and one passion may dominate the other based on the number of opportunities for activity engagement.

Predicting Daily Well-Being

Because gamers typically find video game play to be enjoyable and satisfying (Oliver et al., 2016; Reinecke et al., 2012; Rieger et al., 2014; Rigby & Ryan, 2011; Ryan et al., 2006; Tamborini et al., 2010, 2011; Uysal & Yildirim, 2016), I predicted that daily video game playtime would be positively related to daily well-being. This hypothesis was supported—people had better well-being on days with above-average levels of video game playtime. This relation was not affected by a person's (a) harmonious or obsessive passion for gaming, (b) IGD symptoms, or (c) trait need satisfaction or frustration. The relation was, however, affected by a person's average daily well-being. Those with high levels of well-being were less affected by daily video game playtime and those with low levels of well-being were more affected by daily video game playtime. Thus, it seems that gamers with poor well-being get a bigger boost from gaming than those who already have good well-being. This aligns well with coping models of problematic gaming (Kardefelt-Winther, 2017; Kardefelt-Winther, 2014b, 2014b; Rigby & Ryan, 2011, 2016) and may explain why gamers with poor well-being (including those with unsatisfied needs) seem to be especially prone to overuse (Ballabio et al., 2017; Colder Carras et al., 2017; Laconi et al., 2017; Lemmens et al., 2011; Männikkö et al., 2017; C. N. Plante et al., 2018; Schimmenti et al., 2017; Sioni et al., 2017; Wan & Chiou, 2006a, 2006b). If video games reliably boost a person's immediate well-being, then it is easy to see how some gamers could become dependent, especially if they are lacking in other activities that promote well-being.

Based on SDT and prior research, at least part of the effect of video game play on well-being is due to the need satisfaction experienced during play (Rieger et al., 2014; Ryan et al., 2006). Thus, I predicted that daily need satisfaction in video games as well as in the real world would be positively related to daily well-being and that daily experiences of need frustration in video games as well as in the real world would be negatively related to daily well-being. These hypotheses were supported for all variables except video game need frustration, which was unrelated to well-being. In short, people had higher well-being on days with below-average real-world need frustration but above-average real-world need satisfaction and video game need satisfaction. The effect of real-world need satisfaction was much larger than the effect of video game need satisfaction, however—approximately 10 times as large. Thus, it seems that video games are psychologically nutritious, but not as nutritious as need-satisfying real-world experiences. It is worth noting, though, that daily playtime values indicated that participants spent far more time in the real world than in video games (as would be expected). Thus, if a dose-response relation exists between need satisfaction and well-being, people had much stronger doses of real-world experiences than of video game experiences. This leaves comparatively little room for video game experiences to influence well-being. Future work would benefit from a closer consideration of the exact amount of time spent in different activities. Adopting a clearer category than "real world" would be useful in such studies to increase the specificity. For example, need satisfaction and frustration at work could be contrasted with need satisfaction and frustration during video game play and values could be weighted by the number of hours spent in each activity.

The observed daily relations did not vary based on a person's (a) harmonious or obsessive passion for gaming, (b) IGD symptoms, or (c) trait need frustration. However, one

cross-level interaction did emerge—people with high (vs. low) levels of need satisfaction were more strongly affected by daily experiences of real-world need satisfaction. This "rich get richer" pattern provides further support to the sensitization effects found in past research on real-world need satisfaction and well-being (Reis et al., 2000). Thus, it seems that people with generally high levels of need satisfaction are sensitized to daily experiences of need satisfaction, giving them a bigger boost to well-being. This interaction did not occur with video game need satisfaction, however, meaning the sensitivity may not generalize to all domains.

Although daily relations were largely unaffected by person-level predictors, there was a negative relation between the effect of real-world need frustration and average daily well-being. People with high (vs. low) levels of well-being were more strongly affected by real-world need frustration. This finding may be like the phenomenon of regression to the mean. Specifically, if people already have very high levels of well-being, it is easier for well-being to decrease than it is for well-being to increase due to ceiling effects.

The findings regarding daily need satisfaction and frustration replicated patterns observed in previous daily diary studies guided by SDT (Reis et al., 2000; Sheldon et al., 1996; Uysal et al., 2010; van der Kaap-Deeder et al., 2017) and extended those findings by demonstrating that experiences of need satisfaction while gaming contributed to well-being above and beyond real-world experiences. Thus, despite their virtual nature, video games provided very real (albeit comparatively small) benefits. This lends further support to the propositions of SDT and to the usefulness of SDT for understanding video game effects. Although the absence of an effect of daily video game need frustration was unexpected, this is likely attributable to a floor effect. The amount of daily video game need frustration was very low (average M = 1.27/5.00) and did not vary much (average SD = 0.45, compared to an average SD of 1.51 for video game need

satisfaction). Thus, the relative lack of need frustration during video game play means this construct was less able to influence well-being. Given that gaming is usually a voluntary activity (at least outside of research labs), gamers may be relatively unlikely to experience video game need frustration in their everyday lives because they may simply choose to quit if the game is too frustrating. This possibility is anecdotally supported by the existence of "rage quitting" in the gaming community, where players become extremely frustrated (usually after a failure) and stop playing in a fit of anger (sometimes accompanied by the throwing of controllers or other gaming accessories).

Of course, these day-level findings must be interpreted in light of the person-level findings. In line with SDT, the DMP, and prior research, I predicted that harmonious passion and trait need satisfaction would be positively related to average daily well-being and I predicted that obsessive passion, IGD symptoms, and trait need frustration would be negatively related to average daily well-being. Hypotheses were supported for all variables, except for harmonious passion, which was unrelated to well-being after controlling for obsessive passion. This result diverges from meta-analytic evidence showing that harmonious passion is generally a stronger predictor of well-being than obsessive passion when both are considered simultaneously (Curran et al., 2015). The dominance of obsessive passion here may be due to the nature of gaming compared to other passion activities. Specifically, most video games are intentionally designed to maximize player engagement, to the point that calling a game addictive is often considered a compliment to the game's quality. This is usually not the case with other activities that people are passionate about (e.g., playing an instrument, exercising). More work is needed to understand how passion for gaming compares to passion for other activities, especially considering the financial incentives for keeping players addicted within the gaming industry.

The negative effect of baseline IGD symptoms on daily well-being across the subsequent two weeks aligns well with other longitudinal work showing that IGD predicts poorer future well-being (Coyne et al., 2020; Gentile et al., 2011; Lemmens et al., 2011; Mihara & Higuchi, 2017; Scharkow et al., 2014) and lends further credibility to this controversial construct. Finally, the effects of trait need satisfaction and trait need frustration on average daily well-being align well with prior daily diary studies (Reis et al., 2000; Sheldon et al., 1996; Uysal et al., 2010; van der Kaap-Deeder et al., 2017) and provide further support for SDT's proposition that need satisfaction is psychologically nutritious whereas need frustration is psychologically poisonous.

Finally, it is worth noting that although these findings suggest that video game play is beneficial for well-being on a daily basis, these relations may not generalize to long-term contexts. If, for example, a person comes to depend on video games as their only source of well-being, then they may develop IGD or an obsessive passion for gaming that impairs their long-term well-being, even if the person does feel better immediately after playing. Prior cross-sectional research has found that the relation between video game need satisfaction and well-being varies based on the person's real-world need satisfaction (at least for competence and autonomy), with the relation sometimes positive and sometimes negative (Allen & Anderson, 2018).

Similarly, the link between video game play and well-being may vary as a function of the content of the video games that are played. Specifically, repeatedly playing violent video games promotes the gradual development of a more aggressive personality which in turn could impair a person's well-being (e.g., through harming relationships with others; Anderson et al., 2007, 2010; Gentile, 2014; C. Plante et al., 2019). In contrast, repeatedly playing prosocial video games promotes the development of a prosocial orientation which could, in turn, promote a

person's well-being (e.g., through improving relationships with others; Barlett & Anderson, 2013; Buckley & Anderson, 2006; Gentile et al., 2009; Greitemeyer & Mügge, 2014). Future work assessing the effects of gameplay on well-being would benefit from considering video game content in addition to the extent to which gameplay satisfies basic psychological needs.

Cross-Sectional Relations at Baseline

A secondary goal of this research was to replicate and extend previous cross-sectional findings in gaming studies guided by SDT, the DMP, and theories of IGD. According to the DMP and prior research, harmonious passion involves an autonomous internalization of the activity within the self and is generally positively related to well-being, due in part to the fact that harmoniously-passionate people are able to exert self-control to ensure that their passion does not interfere with other life activities (Curran et al., 2015; Vallerand, 2010). In contrast, obsessive passion involves a controlled internalization of the activity within the self and is generally negatively related to well-being, due in part to the fact that obsessively-passionate people struggle to control their behavior and experience conflict between their passion and other life activities. Relations with gaming motivations generally supported these propositions. Harmoniously (vs. obsessively) passionate gamers had more autonomous (vs. controlled) forms of motivation for gaming, suggesting an autonomous internalization in identity. Although I expected obsessive passion to be more strongly related to controlled motivations than autonomous motivations, the relations were of a similar magnitude. Thus, the key distinctions between the two passions were that intrinsic motivation, integrated regulation, and identified regulation were higher with harmonious passion whereas amotivation was lower. This suggests that obsessively-passionate gamers are driven by intrinsic as well as extrinsic rewards associated with gameplay whereas harmoniously-passionate gamers are mostly driven by intrinsic rewards. Additionally, the elevation of amotivation among obsessively-passionate gamers suggest that

they sometimes play without a sense of purpose and volitional engagement. These findings are similar to those observed with IGD (King & Delfabbro, 2009; Mills & Allen, 2020).

Hypotheses regarding well-being were supported for obsessive passion (except for with physical symptoms) but not for harmonious passion. Thus, obsessive passion was associated with poorer well-being, but harmonious passion was not associated with better well-being. As previously mentioned, the dominance of obsessive passion here may be due to differences between gaming and other passion activities. Specifically, the fact that games are often designed to be "addictive" may foster obsessive passions in players and increase the potential negative effects. Comparisons with different passion activities would be useful for testing this possibility.

The development of obsessive passions appear to be fueled by deficits in real-world need satisfaction (Lalande et al., 2017). The fact that obsessive passion for gaming was associated with greater frustration of all three basic psychological needs and lesser satisfaction of the need for relatedness lends further support to this proposition. Although the opposite pattern was expected for harmonious passion, these hypotheses were largely unsupported. Harmonious passion for gaming was, however, positively related to satisfaction of the need for autonomy. This lends further support to the DMP's proposition that harmoniously passionate people live more autonomously and avoid conflicts between their passion and other life activities.

Several studies have found that obsessive passion for gaming is strongly positively related to IGD (or similar variants), suggesting that the two constructs are very similar (Kneer & Rieger, 2015; Lafrenière et al., 2009; C.-C. Wang & Chu, 2007). Given this, hypotheses concerning IGD were the same as those for obsessive passion. The pattern of findings for IGD was identical to the pattern observed for obsessive passion, providing further support for the strong similarity of these constructs. Additionally, as expected, IGD was strongly positively

related to obsessive passion, however, contrary to predictions, it was also positively related to harmonious passion. When the two passions were considered simultaneously, though, obsessive passion was the only unique predictor. Finally, contrary to expectations, polynomial regressions revealed that IGD did not increase as obsessive passion surpassed harmonious passion—it simply increased as obsessive passion increased (without any effect of harmonious passion). This suggests that it is not necessary for obsessive passion to be higher than harmonious passion for issues to arise. Thus, high levels of harmonious passion may not be sufficient to prevent harmful gaming habits.

Given the strong similarity between IGD and obsessive passion for gaming, it appears that future work on either construct would benefit from the consideration of research on both constructs. Additionally, given concerns about measures of IGD over-pathologizing gamers by including symptoms that may reflect engagement that is high but harmless (e.g., Bean et al., 2017), considering harmonious and obsessive passion in addition to IGD symptoms may provide a fruitful avenue for identifying which symptoms (if any) reflect healthy versus unhealthy engagement. At the very least, considering both harmonious and obsessive passion for gaming allows for the exploration of potential positive effects of gaming as well as potential negative effects, a broadened focus that several scholars have called for (e.g., Gentile, 2011; Granic et al., 2014; Halbrook et al., 2019; Prot et al., 2014).

Limitations

The results of this study should be interpreted with a few limitations in mind. First, the present study used a sample of undergraduate students who regularly played video games, with most self-identifying as White (85.0%) and male (77.4%). Thus, findings may not generalize to all gamers and future research would benefit from diversified sampling. For example, the scheduling of undergraduate education may provide more flexibility than the scheduling for

working professionals who may be bound to specific work hours (e.g., 9 am to 5 pm). This additional flexibility may make it more difficult for students to regulate gameplay. Alternatively, it may give students more opportunities to strike a balance between work and play that works well for them (e.g., taking breaks in the middle of a workday instead of at the end).

Second, although the sample size and number of completed daily surveys was sufficient to yield high statistical power for daily diary analyses, the statistical power was lower for tests of correlations among baseline variables. Thus, some of the relations that were not significant here may be small but statistically reliable.

Third, although this study adopted an intensive longitudinal design, the multilevel models focus on cross-sectional relations at the daily level. Thus, the present results do not provide strong evidence for causal relations among daily variables. However, other work (e.g., Przybylski et al., 2014; Ryan et al., 2006; Sheldon & Filak, 2008) has shown that need satisfaction and frustration do causally influence well-being so there is good reason to expect this direction of causal influence for the final set of models. More work is needed to determine whether the observed relations are causal, especially for those involving real-world need frustration as a predictor of video game playtime and video game playtime as a predictor of well-being.

Fourth, a substantial proportion of participants reported daily video game playtime in hours instead of minutes (as requested). Although these cases were identified and corrected based on participant's responses to other questions (i.e., average weekly playtime and typical length of gaming sessions), the accuracy of this measure could be improved in future studies. Specifically, instead of allowing participants to type in their own playtimes (in an open response format), presenting them with a slider ranging from zero to the maximum amount of playtime

could have prevented this problem. Alternatively, participants could choose from a list of possible playtimes in 15-minute increments. Of course, self-reported playtimes are likely to remain somewhat inaccurate due to difficulties in estimating how much time has passed and in keeping track of starting and stopping times. Thus, obtaining objective measures of playtime would be ideal. This is possible with many gaming platforms (e.g., PC games played through Steam), but not all.

Fifth, at the aggregate level, there were very strong correlations between average daily well-being and average daily need satisfaction and frustration. Despite these strong relations, the amount of variance explained in the final multilevel models predicting well-being suggests that these variables were not simply redundant (otherwise they would have explained most of the variance in well-being). The correlations in this study may be especially high because composite measures were used for need satisfaction, need frustration, and well-being, whereas many previous studies examined the three needs or indicators of well-being separately (Reis et al., 2000; Sheldon et al., 1996; Uysal et al., 2010; van der Kaap-Deeder et al., 2017). The fact that composite measures represent a high level of abstraction likely inflates these relations. Nonetheless, future work would benefit from using different measures of need satisfaction, need frustration, and well-being to ensure that findings conceptually replicate.

Finally, the present study focused specifically on video game use, meaning that findings may not generalize to other activities. Future research could test whether other forms of media use (e.g., social media use) or other leisure activities can also be considered psychologically nutritious based on the satisfaction of basic psychological needs.

Strengths

Despite these limitations, the present study has several strengths worth highlighting. First, the hypotheses, methods, and analyses for this study were pre-registered, allowing the findings to be interpreted more confidently.

Second, the study utilized a daily diary design, which is rare in gaming research and provides excellent ecological validity—especially compared to lab studies where participants are frequently assigned to play specific games instead of choosing their own games to play (as in their everyday lives). Additionally, this design allows for the examination of effects at the within-person (i.e., daily) and between-person levels, yielding a more precise understanding of relations among variables.

Third, the measures used provided a thorough assessment of day-level and person-level variables. At the day level, the frustration of needs was considered in addition to the frustration of needs in both video games and the real world, whereas many past studies focus on only a few of these areas. Additionally, well-being was assessed with three positive indicators and three negative indicators, providing broad coverage of this construct. At the person level, the inclusion of (a) harmonious and obsessive passion, (b) IGD symptoms, and (c) trait need satisfaction and frustration provided broad coverage of relevant motivational constructs. Furthermore, these variables allowed for the examination of both positive and negative effects of gaming to provide a more comprehensive understanding of how regular gameplay influences players.

Finally, this study is the first (to my knowledge) to demonstrate several important findings, including the following: (a) daily video game need satisfaction predicts better daily well-being above and beyond daily real-world need satisfaction and frustration; (b) baseline IGD symptoms and obsessive passion for gaming predict daily well-being in subsequent weeks; and

(c) baseline IGD symptoms and harmonious passion for gaming predict daily video game playtime in subsequent weeks.

CHAPTER 10. CONCLUSION

According to SDT, need satisfaction is psychologically nutritious because it boosts well-being. It is not clear based on past research, however, whether need satisfaction experienced during video game play is just as nutritious as need satisfaction experienced in the real world. The results of the present study suggest that gaming is psychologically nutritious, but less nutritious than need-satisfying real-world experiences (based on a smaller effect size). Separate models showed that gamers had superior well-being on days with (a) above-average levels of gaming time (without considering need satisfaction or frustration), and (b) above-average levels of need satisfaction from video games (after controlling for real-world need satisfaction and frustration). These effects did not depend on (a) harmonious or obsessive passion for gaming, (b) IGD symptoms, or (c) trait need satisfaction or frustration. However, people with high levels of obsessive passion, severe IGD symptoms, and unsatisfied or frustrated needs at the trait level had poorer well-being over the two weeks observed.

Additional analyses showed that gamers spent less time gaming on days with above-average levels of real-world need frustration, suggesting that people tend to pull away from gaming when they feel incompetent, controlled, and socially disconnected. This effect did not vary based on (a) harmonious or obsessive passion for gaming, (b) IGD symptoms, or (c) trait need satisfaction or frustration, but people with high levels of harmonious passion or severe IGD symptoms spent more time playing over the course of two weeks.

Overall, findings suggest that despite their virtual nature, video games provide very real benefits to well-being for gamers, so long as they can control their gaming to avoid interference with other life activities. In contrast, these findings also make it clear that addictive patterns of

play (as indicated by obsessive passion or IGD symptoms) are harmful to well-being. Thus, gaming is beneficial but must be balanced with the rest of one's life.

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FIGURES AND TABLES

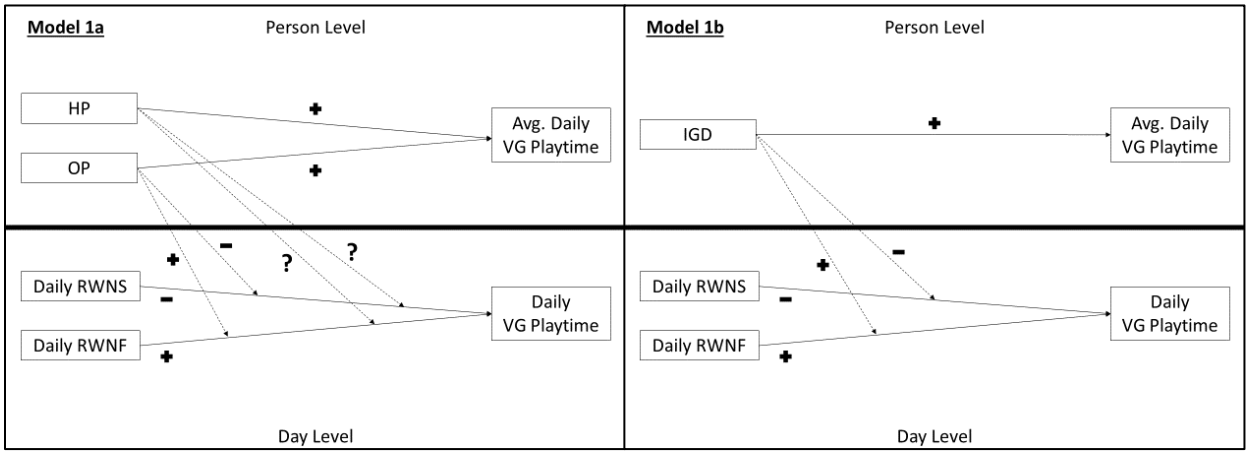

Figure 1. Models 1a and 1b: predicted relations among daily measures of real-world need satisfaction (RWNS), real-world need frustration (RWNF) and video game (VG) playtime, and person-level measures of harmonious passion (HP), obsessive passion (OP), and Internet Gaming Disorder symptoms (IGD).

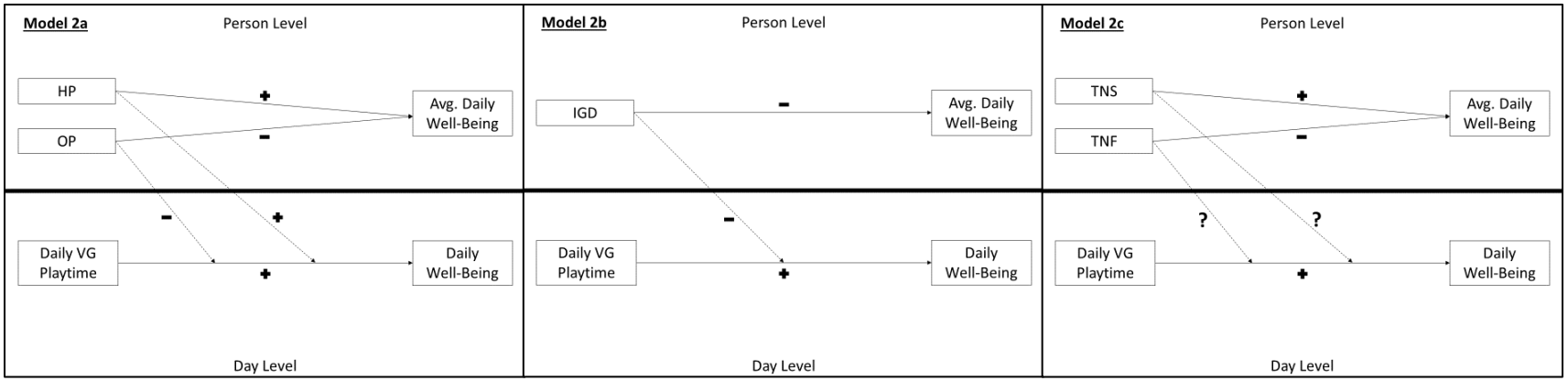

Figure 2. Models 2a, 2b, and 2c: predicted relations among daily measures of video game (VG) playtime and well-being, and person-level measures of harmonious passion (HP), obsessive passion (OP), Internet Gaming Disorder symptoms (IGD), trait need satisfaction (TNS), and trait need frustration (TNF).

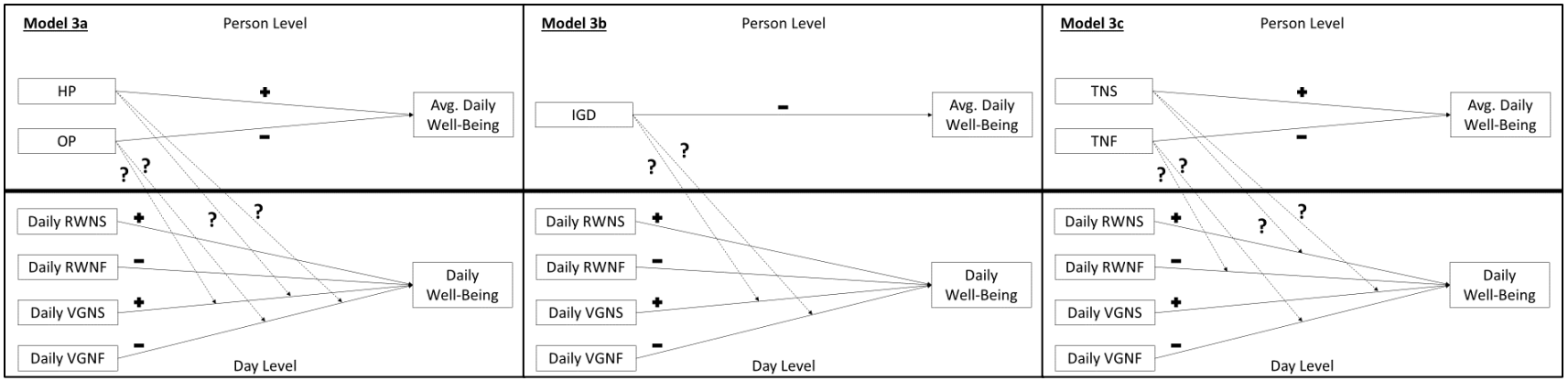

Figure 3. Models 3a, 3b, and 3c: predicted relations among daily measures of real-world need satisfaction (RWNS), real-world need frustration (RWNF), video game need satisfaction (VGNS), video game need frustration (VGNF) and well-being, and person-level measures of harmonious passion (HP), obsessive passion (OP), Internet Gaming Disorder symptoms (IGD), trait need satisfaction (TNS), and trait need frustration (TNF).

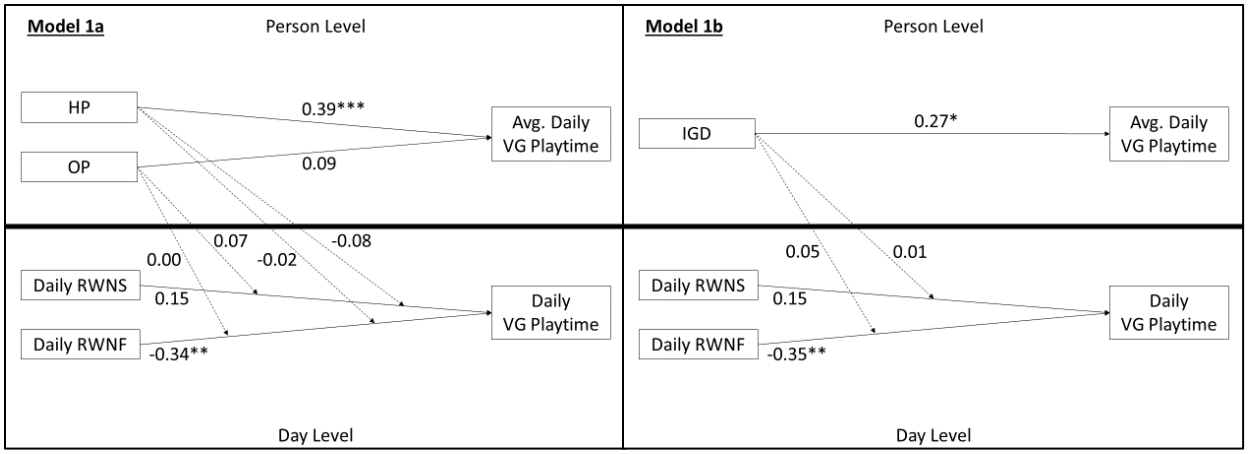

Figure 4. Models 1a and 1b: observed relations among daily measures of real-world need satisfaction (RWNS), real-world need frustration (RWNF) and video game (VG) playtime, and person-level measures of harmonious passion (HP), obsessive passion (OP), and Internet Gaming Disorder symptoms (IGD). Estimates are unstandardized. * $p < .05$. ** $p < .01$. *** $p < .001$.

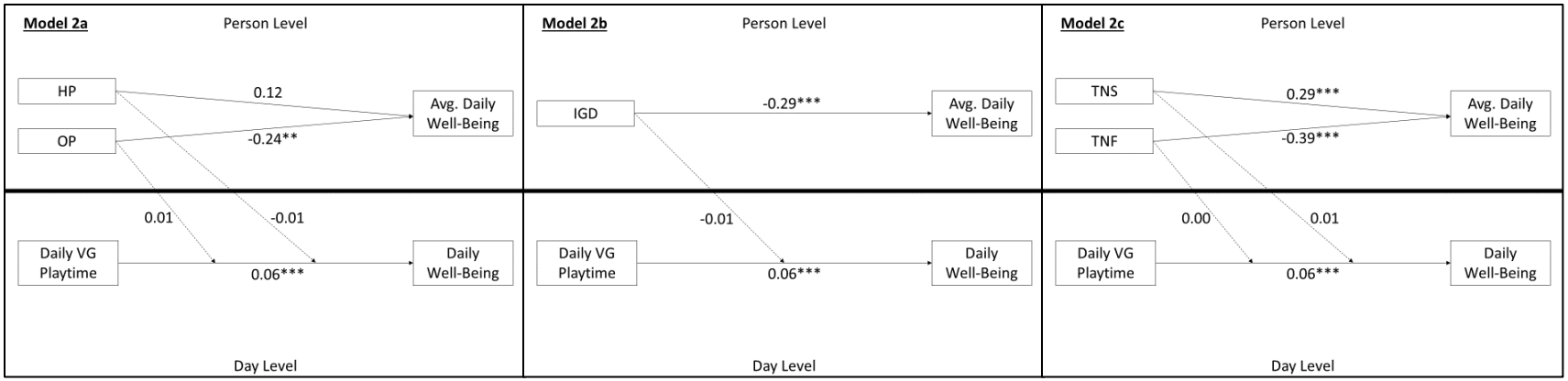

Figure 5. Models 2a, 2b, and 2c: observed relations among daily measures of video game (VG) playtime and well-being, and person-level measures of harmonious passion (HP), obsessive passion (OP), Internet Gaming Disorder symptoms (IGD), trait need satisfaction (TNS), and trait need frustration (TNF). Estimates are unstandardized. * $p < .05$. ** $p < .01$. *** $p < .001$.

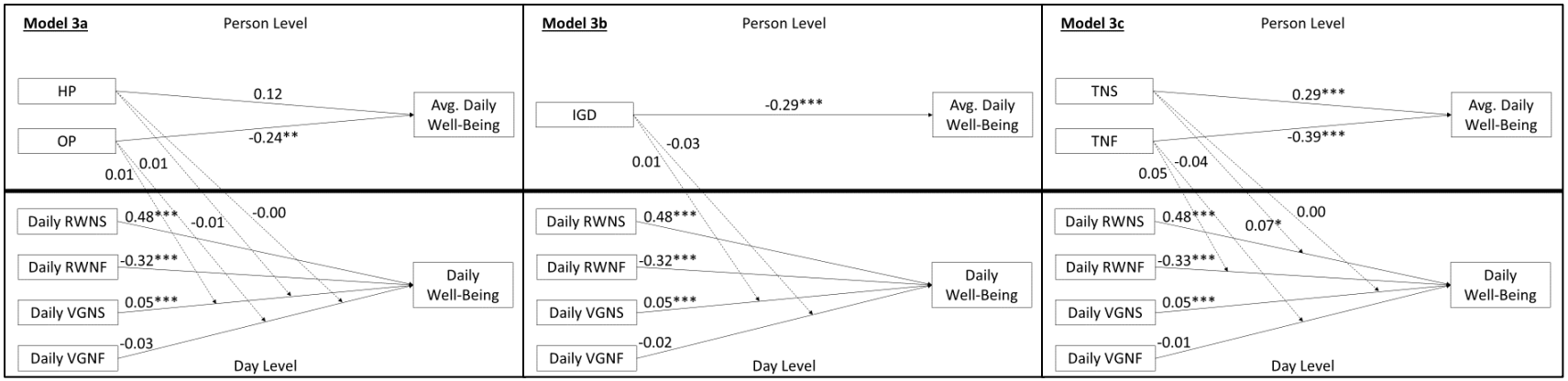

Figure 6. Models 3a, 3b, and 3c: observed relations among daily measures of real-world need satisfaction (RWNS), real-world need frustration (RWNF), video game need satisfaction (VGNS), video game need frustration (VGNF) and well-being, and person-level measures of harmonious passion (HP), obsessive passion (OP), Internet Gaming Disorder symptoms (IGD), trait need satisfaction (TNS), and trait need frustration (TNF). Estimates are unstandardized. * $p < .05$. ** $p < .01$. *** $p < .0$

Table 1. Weighted Partial Correlations (Controlling for the Other Passion) between Intrapersonal Outcomes and the Two Types of Passion

	Harmonious Passion	Obsessive Passion
Well/Ill-Being		
Positive affect	.35	.03
Negative affect	-.12	.25
Life satisfaction	.39	-.05
Vitality	.23	-.03
Burnout	-.44	.15
Cognitive-emotional engagement	.50	.07
Motivation Factors		
Intrinsic motivation	.41	-.00
Identified regulation	.34	.08
Introjected regulation	.06	.30
External regulation	-.03	.23
Amotivation	-.19	.16
Mastery approach goal	.31	.10
Performance approach goal	.08	.16
Performance avoidance goal	-.03	.21
Psychological need satisfaction	.35	-.02
Cognitive Outcomes		
Concentration	.26	.03
Flow	.43	-.02
Self-esteem	.33	-.18
Anxiety	-.26	.27
Rumination	-.02	.47
Activity/life conflict	-.24	.37
Behavior and Performance		
Deliberate practice	.25	.18
Hours/week	.02	.19
Activity dependence	.05	.56
Objective performance	.06	.07
Subjective performance	.18	.06

Note. Values are weighted partial correlations (controlling for the other passion type) corrected for sampling error. The number of independent studies ranged from 4-28. Table adapted and simplified from Curran et al. (2015).

Table 2. Descriptive Statistics and Internal Consistencies for Baseline Variables

Variable	# of Items	Mean	*SD*	Min.	Max.	α
Intrinsic Motivation	3	4.68	1.20	1.33	7.00	0.62
Integrated Regulation	3	2.83	1.45	1.00	6.67	0.86
Identified Regulation	3	3.33	1.40	1.00	6.67	0.75
Introjected Regulation (W)	3	1.66	0.75	1.00	3.33	0.54
External Regulation	3	4.04	1.55	1.00	7.00	0.71
Amotivation	3	2.17	1.38	1.00	7.00	0.82
Amotivation (SQRT)	3	1.41	1.38	1.00	2.65	0.82
Harmonious Passion	6	3.86	1.33	1.00	7.00	0.85
Obsessive Passion (W)	6	1.69	0.69	1.00	3.17	0.71
Passion Criteria	4	4.20	1.51	1.25	7.00	0.88
Passion Criteria (SQRT)	4	2.01	0.38	1.12	2.65	0.88
Internet Gaming Disorder (W)	9	0.70	0.52	0.00	1.93	0.78
Positive Gaming Engagement	4	4.70	1.00	1.00	7.00	0.72
Negative Gaming Engagement	4	2.07	1.07	1.00	4.50	0.80
Competence Satisfaction	4	3.99	0.70	2.25	5.00	0.86
Autonomy Satisfaction	4	3.78	0.69	1.75	5.00	0.72
Relatedness Satisfaction	4	4.20	0.72	2.00	5.00	0.81
Competence Frustration	4	2.35	0.99	1.00	5.00	0.86
Autonomy Frustration	4	2.47	0.91	1.00	4.75	0.77
Relatedness Frustration	4	1.71	0.65	1.00	3.25	0.73
Trait Need Satisfaction (Composite)	12	3.99	0.56	2.08	5.00	0.86
Trait Need Frustration (Composite)	12	2.18	0.71	1.08	4.00	0.87
Openness	2	5.47	1.05	2.50	7.00	0.21
Conscientiousness (W)	2	5.49	1.25	2.50	7.00	0.64
Extraversion	2	4.00	1.64	1.00	7.00	0.76
Agreeableness	2	4.88	1.21	1.00	7.00	0.45
Neuroticism	2	3.31	1.40	1.00	6.50	0.56
Past-Month Positive Affect	4	5.24	1.18	1.75	7.00	0.91
Past-Month Negative Affect	5	3.37	1.26	1.00	7.00	0.81
Trait Vitality	7	4.45	1.11	1.57	6.86	0.88
Past-Month Physical Symptoms (W)	9	2.52	0.65	1.44	3.82	0.72
General Life Satisfaction	5	4.88	1.30	1.00	7.00	0.88
Past-Month Perceived Stress	14	2.63	0.54	1.36	3.86	0.84
Well-Being (Composite)*	6	0.00	1.00	-3.00	2.18	0.82
Active Coping	13	2.94	0.46	1.92	4.00	0.84
Avoidance Coping	15	2.24	0.42	1.40	3.93	0.77
Avoidance Coping (SQRT)	15	1.49	0.14	1.18	1.98	0.77
Support Seeking	6	2.36	0.87	1.00	4.00	0.90
Distraction Coping	6	1.90	0.49	1.00	3.17	0.86
Video Game Coping	4	2.09	0.54	1.00	3.25	0.55

Note. *The number of items and the α for the composite well-being variable was based on treating the six preceding indicators as items. W = a 90% Winsorization was applied; SQRT = a square root transformation was applied. The sample size was 133 for all variables.

Table 3. Intraclass Correlations and the Averages (and Standard Deviations) of the Descriptive Statistics and Internal Consistencies for Primary Daily Variables Across Two Weeks

Variable	# of Items	Mean	*SD*	Min.	Max.	α	ICC
Video Game Playtime	4	1.69	1.94	0.00	6.52	N/A	0.36
(in Hours)		(0.30)	(0.40)	(0.00)	(1.33)	(N/A)	
Real-World Need	6	3.80	0.82	1.57	5.00	0.89	0.64
Satisfaction		(0.09)	(0.05)	(0.52)	(0.00)	(0.03)	
Real-World Need	6	1.80	0.73	1.00	3.58	0.83	0.60
Frustration		(0.09)	(0.05)	(0.00)	(0.43)	(0.05)	
Video Game Need	6	2.75	1.51	1.00	5.00	0.97	0.30
Satisfaction		(0.16)	(0.09)	(0.00)	(0.00)	(0.01)	
Video Game Need	6	1.27	0.45	1.00	2.48	0.85	0.40
Frustration		(0.07)	(0.08)	(0.00)	(0.26)	(0.03)	
Well-Being	6	0.00	1.00	-2.54	1.67	0.86	0.67
(Composite)*		(0.00)	(0.00)	(0.47)	(0.17)	(0.01)	

Note. *The number of items and the α for the composite well-being variable was based on treating the six indicators (positive affect, negative affect, vitality, physical symptoms, life satisfaction, and stress) as items. N/A = Not Applicable. The sample size ranged from 99-129.

Table 4. Summary of Which Daily Variables Were Winsorized and Which Distributional Issues Remained

Day	VGP	RWNS	RWNF	VGNS	VGNF	WB
1	.	.	-K	-K	W, +S	.
2	W	.	.	-K	W, +S	.
3	W, +S	.	.	-K	W, +O, +S	.
4	W, +O, +S	W, -K	.	-K	W, +S	.
5	W, +O, +S, +K	.	.	-K	W, +S, +K	W
6	W, +S	.	W, +S	-K	W, +S, +K	.
7	W, +S	.	.	-K	W, +S	.
8	W, +S	.	W	-K	W, +O, +S, +K	W, -K
9	W, +S	.	W	-K	W, +O, +S, +K	W
10	W	.	.	-K	W, +S, +K	.
11	W	.	W	-K	W, +O, +S, +K	.
12	W, +S	W, -K	.	-K	W, +S, +K	W
13	W, +S	.	W	-K	W, +S, +K	.
14	W, +S	.	W	-K	W, +O, +S, +K	.

Note. VGP = video game playtime; RWNS = real-world need satisfaction; RWNF = real-world need frustration; VGNS = video game need satisfaction; VGNF = video game need frustration; WB = well-being (composite). W indicates that a 90% Winsorization was applied to the variable. O indicates the presence of outliers, either high (+) or low (-). S indicates skewness greater than one (+) or less than one (-). K indicates kurtosis greater than one (+) or less than one (-). A period indicates normality and the absence of outliers.

Table 5. Bivariate Correlations Among Primary Person-Level Variables and Select Baseline Variables

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.
1. Harmonious Passion	--	.000	.000	.213	.284	.000	.792	.384	.398	.197	.033	.959	.011	.399	.075	.985	.000	.000	.164	.926	.091	.396
2. Obsessive Passion (W)	**.40**	--	.000	.032	.000	.000	.000	.106	.047	.687	.004	.169	.230	.857	.013	.499	.000	.000	.000	.159	.019	.765
3. IGD (W)	**.32**	**.62**	--	.064	.000	.003	.000	.766	.158	.663	.006	.016	.942	.012	.053	.814	.014	.001	.000	.224	.031	.688
4. Trait Need Sat. (Composite)	.11	**-.19**	-.16	--	.000	.821	.000	.000	.000	.414	.139	.000	.000	.417	.002	.001	.507	.181	.070	.897	.428	.001
5. Trait Need Frust. (Composite)	.09	**.39**	**.49**	**-.59**	--	.943	.000	.076	.000	.301	.111	.000	.004	.000	.032	.078	.732	.340	.001	.647	.212	.020
6. Avg. Weekly Playtime (W)	**.38**	**.36**	**.25**	-.02	-.01	--	.431	.277	.771	.606	.224	.229	.820	.987	.866	.555	.000	.000	.144	.651	.939	.232
7. Well-Being (Composite)	.02	**-.30**	**-.41**	**.66**	**-.78**	.07	--	.016	.000	.410	.219	.000	.000	.000	.133	.001	.837	.506	.054	.605	.224	.001
8. Openness	.08	-.14	.03	**.32**	-.15	-.09	**.21**	--	.346	.000	.554	.007	.002	.731	.627	.058	.739	.118	.654	.684	.696	.382
9. Conscientious-ness	-.07	**-.17**	-.12	**.36**	**-.34**	-.03	**.30**	.08	--	.799	.281	.351	.005	.326	.000	.001	.874	.035	.040	.599	.223	.000
10. Extraversion	-.11	-.04	.04	.07	-.09	.05	.07	**.31**	-.02	--	.096	.038	.577	.869	.750	.663	.624	.921	.586	.701	.449	.594
11. Agreeableness	**-.18**	**-.25**	**-.24**	.13	-.14	-.11	.11	.05	.09	.14	--	.004	.014	.011	.002	.370	.332	.331	.000	.800	.023	.830
12. Neuroticism	.00	.12	**.21**	**-.37**	**.45**	.10	**-.56**	**-.23**	-.08	**-.18**	**-.25**	--	.011	.000	.025	.688	.697	.384	.607	.511	.025	.033
13. Active Coping	**.22**	-.10	.01	**.52**	**-.25**	.02	**.37**	**.27**	**.24**	-.05	**.21**	**-.22**	--	.379	.018	.002	.701	.096	.391	.136	.615	.018
14. Avoidance Coping (SQRT)	-.07	-.02	**.22**	-.07	**.31**	.00	**-.32**	-.03	.09	.01	**.22**	**.30**	.08	--	.000	.400	.337	.855	.530	.028	.002	.793
15. Support Seeking	-.15	**-.21**	-.17	**.27**	**-.19**	-.01	.13	-.04	**.31**	-.03	**.27**	**.19**	**.20**	**.33**	--	.006	.559	.129	.002	.445	.000	.093
16. Distraction Coping	.00	-.06	.02	**.28**	-.15	-.05	**.29**	.16	**.29**	.04	-.08	-.04	**.27**	.07	**.24**	--	.045	.526	.170	.388	.110	.001
17. Video Game Coping	**.40**	**.30**	**.21**	.06	.03	**.38**	.02	.03	-.01	-.04	-.08	-.03	.03	.08	.05	**.17**	--	.000	.882	.178	.014	.751
18. Pos. Gaming Experiences	**.66**	**.40**	**.29**	.12	.08	**.37**	.06	.14	**-.18**	-.01	-.08	-.08	.15	.02	-.13	-.06	**.41**	--	.239	.914	.368	.606
19. Neg. Gaming Experiences (W)	.12	**.50**	**.54**	-.16	**.29**	.13	-.17	.04	**-.18**	.05	**-.31**	.04	-.08	-.05	**-.27**	.12	.01	.10	--	.773	.047	.710
20. Age (W)	-.01	.12	.11	-.01	.04	-.04	-.05	.04	.05	-.03	-.02	.06	.13	**-.19**	-.07	-.08	-.12	.01	-.03	--	.214	.001
21. Male Gender	.15	**.20**	**.19**	.07	-.11	-.01	.11	.03	-.11	.07	**-.20**	**-.19**	.04	**-.27**	**-.37**	.14	**.21**	.08	**.17**	.11	--	.407
22. GPA	.07	-.03	-.04	**.28**	**-.20**	-.10	**.29**	.08	**.32**	.05	.02	**-.19**	**.21**	-.02	.15	**.29**	-.03	.05	-.03	**-.28**	.07	--

Note. Correlation coefficients (*r*) are shown below the diagonal and *p*-values are shown above the diagonal. Confidence intervals have been omitted due to space limitations. IGD = Internet Gaming Disorder; Sat. = Satisfaction; Frust. = Frustration; Avg. = average; Pos.

Table 6. Bivariate Correlations Among Averaged Daily Variables (Aggregated Data)

Variable	Avg. Daily RWNS	Avg. Daily RWNF	Avg. Daily VGNS	Avg. Daily VGNF	Avg. Daily VGP	Avg. Daily WB
Avg. Daily RWNS	--	< .001	< .001	< .001	.926	< .001
Avg. Daily RWNF	**-.71** **[-.79, -.61]**	--	< .001	< .001	.058	< .001
Avg. Daily VGNS	**.43** **[.28, .56]**	**-.40** **[-.54, -.25]**	--	.944	< .001	< .001
Avg. Daily VGNF	**-.51** **[-.62, -.37]**	**.63** **[.52, .72]**	.01 [-.16, .18]	--	.121	< .001
Avg. Daily VGP	.01 [-.16, .18]	-.17 [-.33, .01]	**.66** **[.55, .75]**	.14 [-.04, .30]	--	.525
Avg. Daily WB	**.85** **[.79, .89]**	**-.80** **[-.85, -.72]**	**.38** **[.22, .52]**	**-.52** **[-.63, -.38]**	.06 [-.12, .22]	--

Note. Correlation coefficients (*r*) are shown below the diagonal with 95% confidence intervals in brackets and *p*-values are shown above the diagonal. Avg. = average; RWNS = real-world need satisfaction; RWNF = real-world need frustration; VGNS = video game need satisfaction; VGNF = video game need frustration; VGP = video game playtime; WB = well-being (composite). Correlations significant at $p < .05$ are bolded.

Table 7. Fixed Effects in the Multilevel Models Predicting Daily Video Game Playtime from Daily Real-World Need Satisfaction, Daily Real-World Need Frustration, and Person-Level Variables

Parameter	*b*	*SE*	95% CI	df	*t*	*p*
Model 1a						
Intercept	**1.66**	**0.10**	**[1.46, 1.86]**	**131.47**	**16.10**	**< .001**
RWNS	0.15	0.11	[-0.06, 0.36]	108.31	1.41	.160
RWNF	**-0.34**	**0.11**	**[-0.55, -0.14]**	**83.66**	**-3.25**	**.002**
HP	**0.39**	**0.11**	**[0.17, 0.61]**	**131.97**	**3.43**	**< .001**
OP	0.09	0.11	[-0.13, 0.31]	132.98	0.80	.425
RWNS x HP	-0.08	0.12	[-0.31, 0.16]	127.90	-0.63	.531
RWNF x HP	-0.02	0.12	[-0.25, 0.20]	75.08	-0.20	.845
RWNS x OP	0.07	0.12	[-0.15, 0.30]	106.50	0.61	.543
RWNF x OP	0.00	0.11	[-0.21, 0.22]	84.99	0.04	.970
Model 1b						
Intercept	**1.66**	**0.11**	**[1.45, 1.87]**	**132.46**	**15.65**	**< .001**
RWNS	0.15	0.11	[-0.06, 0.36]	104.60	1.43	.156
RWNF	**-0.35**	**0.10**	**[-0.55, -0.15]**	**71.13**	**-3.39**	**.001**
IGD	**0.27**	**0.11**	**[0.06, 0.48]**	**132.73**	**2.56**	**.012**
RWNS x IGD	0.01	0.10	[-0.18, 0.20]	81.86	0.12	.907
RWNF x IGD	0.05	0.09	[-0.13, 0.22]	50.02	0.53	.600

Note. Day-level variables: RWNS = real-world need satisfaction; RWNF = real-world need frustration. Person-level variables: HP = harmonious passion for gaming; OP = obsessive passion for gaming; IGD = Internet Gaming Disorder symptoms. Effects significant at $p < .05$ are bolded.

Table 8. Random Effects in the Multilevel Models Predicting Daily Video Game Playtime from Daily Real-World Need Satisfaction, Daily Real-World Need Frustration, and Person-Level Variables: Correlations, Variances, and Standard Deviations

Parameter	Intercept	RWNS	RWNF	Variance	*SD*
Model 1a					
Intercept	--			1.22	1.11
RWNS	-.15	--		0.31	0.56
RWNF	-.54	-.37	--	0.10	0.31
Residual				2.34	1.53
Model 1b					
Intercept	--			1.33	1.15
RWNS	-.17	--		0.31	0.55
RWNF	-.68	-.51	--	0.08	0.28
Residual				2.34	1.53

Note. RWNS = real-world need satisfaction; RWNF = real-world need frustration. The residual was not correlated with the random intercept or random slopes.

Table 9. Fixed Effects in the Multilevel Models Predicting Daily Well-Being from Daily Video Game Playtime and Person-Level Variables

Parameter	*b*	*SE*	95% CI	df	*t*	*p*
Model 2a						
Intercept	-0.04	0.07	[-0.17, 0.10]	129.83	-0.50	.617
VGP	**0.06**	**0.01**	**[0.04, 0.08]**	**90.00**	**5.03**	**< .001**
HP	0.12	0.08	[-0.03, 0.27]	129.99	1.53	.128
OP	**-0.24**	**0.08**	**[-0.39, -0.09]**	**130.30**	**-3.08**	**.003**
VGP x HP	-0.01	0.01	[-0.04, 0.01]	80.54	-1.19	.239
VGP x OP	0.01	0.01	[-0.02, 0.03]	76.65	0.43	.668
Model 2b						
Intercept	-0.03	0.07	[-0.17, 0.10]	130.57	-0.51	.610
VGP	**0.06**	**0.01**	**[0.04, 0.08]**	**84.88**	**5.13**	**< .001**
IGD	**-0.29**	**0.07**	**[-0.42, -0.15]**	**130.65**	**-4.19**	**< .001**
VGP x IGD	-0.01	0.01	[-0.03, 0.01]	67.86	-0.88	.383
Model 2c						
Intercept	-0.04	0.05	[-0.13, 0.06]	130.34	-0.71	.478
VGP	**0.06**	**0.01**	**[0.03, 0.08]**	**82.90**	**4.86**	**< .001**
TNS	**0.29**	**0.06**	**[0.17, 0.41]**	**131.78**	**4.64**	**< .001**
TNF	**-0.39**	**0.06**	**[-0.51, -0.27]**	**130.85**	**-6.24**	**< .001**
VGP x TNS	0.01	0.02	[-0.02, 0.04]	105.44	0.66	.513
VGP x TNF	0.00	0.02	[-0.03, 0.03]	99.61	0.12	.907

Note. Day-level variables: VGP = video game playtime (in hours). Person-level variables: HP = harmonious passion for gaming; OP = obsessive passion for gaming; IGD = Internet Gaming Disorder symptoms; TNS = trait need satisfaction; TNF = trait need frustration. Effects significant at $p < .05$ are bolded.

Table 10. Random Effects in the Multilevel Models Predicting Daily Well-Being from Daily Video Game Playtime and Person-Level Variables: Correlations, Variances, and Standard Deviations

Parameter	Intercept	VGP	Variance	*SD*
Model 2a				
Intercept	--		0.64	0.80
VGP	-.17	--	0.00	0.05
Residual			0.32	0.57
Model 2b				
Intercept	--		0.59	0.77
VGP	-.31	--	0.00	0.06
Residual			0.32	0.57
Model 2c				
Intercept	--		0.31	0.55
VGP	-.40	--	0.00	0.06
Residual			0.32	0.57

Note. VGP = video game playtime (in hours). The residual was not correlated with the random intercept or the random slope.

Table 11. Fixed Effects in the Multilevel Models Predicting Daily Well-Being from Daily Need Satisfaction and Frustration from the Real World and Video Games as Well as Person-Level Variables

Parameter	*b*	*SE*	95% CI	df	*t*	*p*
Model 3a						
Intercept	-0.04	0.07	[-0.17, 0.10]	129.91	-0.51	.611
RWNS	**0.48**	**0.03**	**[0.41, 0.54]**	**96.63**	**14.63**	**< .001**
RWNF	**-0.32**	**0.04**	**[-0.39, -0.25]**	**78.74**	**-9.03**	**< .001**
VGNS	**0.05**	**0.01**	**[0.03, 0.07]**	**1,447.62**	**5.10**	**< .001**
VGNF	-0.03	0.05	[-0.12, 0.05]	95.29	-0.75	.457
HP	0.12	0.08	[-0.03, 0.27]	130.04	1.56	.121
OP	**-0.24**	**0.08**	**[-0.39, -0.08]**	**130.12**	**-3.07**	**.003**
VGNS x HP	-0.01	0.01	[-0.03, 0.01]	1,462.60	-0.84	.404
VGNF x HP	-0.00	0.05	[-0.10, 0.10]	76.51	-0.04	.968
VGNS x OP	0.01	0.01	[-0.01, 0.03]	1,426.94	0.92	.355
VGNF x OP	0.01	0.04	[-0.08, 0.10]	63.42	0.23	.819
Model 3b						
Intercept	-0.03	0.07	[-0.17, 0.10]	130.77	-0.52	.602
RWNS	**0.48**	**0.03**	**[0.42, 0.54]**	**96.43**	**14.68**	**< .001**
RWNF	**-0.32**	**0.04**	**[-0.39, -0.25]**	**79.98**	**-9.05**	**< .001**
VGNS	**0.05**	**0.01**	**[0.03, 0.07]**	**1,417.93**	**4.93**	**< .001**
VGNF	-0.02	0.04	[-0.10, 0.07]	92.66	-0.34	.733
IGD	**-0.29**	**0.07**	**[-0.42, -0.16]**	**130.05**	**-4.25**	**< .001**
VGNS x IGD	0.01	0.01	[-0.01, 0.03]	1,198.63	0.64	.526
VGNF x IGD	-0.03	0.04	[-0.10, 0.04]	53.51	-0.80	.429
Model 3c						
Intercept	-0.04	0.05	[-0.13, 0.06]	130.32	-0.72	.474
RWNS	**0.48**	**0.03**	**[0.42, 0.54]**	**92.51**	**15.10**	**< .001**
RWNF	**-0.33**	**0.04**	**[-0.40, -0.26]**	**76.37**	**-9.41**	**< .001**
VGNS	**0.05**	**0.01**	**[0.03, 0.07]**	**1,385.11**	**4.44**	**< .001**
VGNF	-0.01	0.04	[-0.10, 0.08]	109.93	-0.23	.816
TNS	**0.29**	**0.06**	**[0.17, 0.41]**	**133.10**	**4.76**	**< .001**
TNF	**-0.39**	**0.06**	**[-0.51, -0.27]**	**134.34**	**-6.35**	**< .001**
RWNS x TNS	**0.07**	**0.03**	**[0.00, 0.13]**	**106.83**	**2.07**	**.041**
VGNS x TNS	0.00	0.01	[-0.02, 0.02]	1,055.57	0.07	.949
RWNF x TNF	0.05	0.03	[-0.02, 0.11]	73.48	1.39	.168
VGNF x TNF	-0.04	0.04	[-0.11, 0.04]	74.65	-0.90	.374

Note. Day-level variables: RWNS = real-world need satisfaction; RWNF = real-world need frustration; VGNS = video game need satisfaction, VGNF = video game need frustration. Person-level variables: HP = harmonious passion for gaming; OP = obsessive passion for gaming; IGD = Internet Gaming Disorder symptoms; TNS = trait need satisfaction; TNF = trait need frustration. Effects significant at $p < .05$ are bolded.

Table 12. Random Effects in the Multilevel Models Predicting Daily Well-Being from Daily Need Satisfaction and Frustration from the Real World and Video Games as Well as Person-Level Variables: Correlations, Variances, and Standard Deviations

Parameter	Intercept	RWNS	RWNF	VGNF	Variance	*SD*
Model 3a						
Intercept	--				0.65	0.80
RWNS	.06	--			0.04	0.19
RWNF	.05	.10	--		0.04	0.20
VGNF	-.28	.48	-.03	--	0.04	0.21
Residual					0.18	0.42
Model 3b						
Intercept	--				0.61	0.78
RWNS	.12	--			0.04	0.19
RWNF	.13	.11	--		0.04	0.20
VGNF	-.37	.53	.06	--	0.04	0.20
Residual					0.18	0.42
Model 3c						
Intercept	--				0.32	0.56
RWNS	-.12	--			0.03	0.18
RWNF	.29	.19	--		0.04	0.19
VGNF	-.49	.49	.13	--	0.04	0.19
Residual					0.18	0.43

Note. RWNS = real-world need satisfaction; RWNF = real-world need frustration; VGNF = video game need frustration. The residual was not correlated with the random intercept or random slopes.

Table 13. Tests of Bivariate Correlational Hypotheses Regarding Passion, Internet Gaming Disorder, Motivation, and Well-Being at Baseline

Variable	HP	OP (W)	IGD (W)
Motivation			
Intrinsic Motivation	**.52 [.38, .63]**	**.24 [.07, .39]**	**.35 [.19, .49]**
	(< .001)	**(.005)**	**(< .001)**
Integrated Regulation	**.62 [.51, .72]**	**.43 [.28, .56]**	**.30 [.14, .45]**
	(< .001)	**(< .001)**	**(< .001)**
Identified Regulation	**.74 [.66, .81]**	**.39 [.23, .52]**	**.36 [.20, .50]**
	(< .001)	**(< .001)**	**(< .001)**
Introjected Regulation (W)	**.27 [.10, .42]**	**.46 [.32, .59]**	**.46 [.32, .59]**
	(.002)	**(< .001)**	**(< .001)**
External Regulation	**.30 [.13, .44]**	**.25 [.08, .40]**	**.26 [.10, .41]**
	(.001)	**(.004)**	**(.002)**
Amotivation (SQRT)	**-.21 [-.37, -.04]**	**.21 [.04, .36]**	**.27 [.11, .43]**
	(.015)	**(.017)**	**(.001)**
Well-Being			
Past-Month Positive Affect	.05 [-.13, .21]	**-.19 [-.35, -.02]**	**-.24 [-.40, -.08]**
	(.597)	**(.029)**	**(.005)**
Trait Vitality	-.05 [-.21, .13]	**-.23 [-.38, -.06]**	**-.22 [-.38, -.05]**
	(.601)	**(.008)**	**(.011)**
General Life Satisfaction	-.13 [-.29, .04]	**-.30 [-.44, -.13]**	**-.36 [-.50, -.20]**
	(.132)	**(.001)**	**(< .001)**
Past-Month Negative Affect	-.01 [-.18, .16]	**.25 [.09, .41]**	**.38 [.22, .52]**
	(.879)	**(.003)**	**(< .001)**
Past-Month Physical Symptoms (W)	-.15 [-.31, .02]	.11 [-.06, .28]	.14 [-.03, .30]
	(.088)	(.192)	(.112)
Past-Month Perceived Stress	-.08 [-.25, .09]	**.22 [.05, .38]**	**.43 [.28, .56]**
	(.369)	**(.011)**	**(< .001)**
Well-Being (Composite)	.02 [-.15, .19]	**-.30 [-.45, -.14]**	**-.41 [-.54, -.26]**
	(.792)	**(< .001)**	**(< .001)**

Note. Correlation coefficients (*r*) are shown in each cell followed by 95% confidence intervals in brackets and *p*-values in parentheses. W indicates that a 90% Winsorization was applied. SQRT indicates that a square root transformation was applied. The degrees of freedom are 131 for all correlations. Correlations significant at $p < .05$ are bolded.

Table 14. Tests of Bivariate Correlational Hypotheses Regarding Passion, Internet Gaming Disorder, Motivation, and Trait Levels of Need Satisfaction and Frustration at Baseline

Variable	HP	OP (W)	IGD (W)
Trait Need Satisfaction and Frustration			
Competence Satisfaction	.06 [-.11, .23]	-.12 [-.29, .05]	-.13 [-.29, .04]
	(.512)	(.152)	(.139)
Autonomy Satisfaction	**.21 [.04, .37]**	-.11 [-.27, .07]	-.02 [-.19, .15]
	(.016)	(.227)	(.817)
Relatedness Satisfaction	.00 [-.17, .17]	**-.21 [-.37, -.04]**	**-.23 [-.39, -.06]**
	(.965)	**(.014)**	**(.007)**
Competence Frustration	.10 [-.07, .26]	**.31 [.15, .46]**	**.42 [.27, .55]**
	(.258)	**(< .001)**	**(< .001)**
Autonomy Frustration	.08 [-.09, .25]	**.32 [.15, .46]**	**.41 [.25, .54]**
	(.331)	**(< .001)**	**(< .001)**
Relatedness Frustration (W)	.05 [-.13, .21]	**.34 [.18, .48]**	**.36 [.21, .50]**
	(.605)	**(< .001)**	**(< .001)**
Trait Need Satisfaction (Composite)	.11 [-.06, .27]	**-.19 [-.35, -.02]**	-.16 [-.32, .01]
	(.213)	**(.032)**	(.064)
Trait Need Frustration (Composite)	.09 [-.08, .26]	**.39 [.24, .53]**	**.49 [.35, .61]**
	(.284)	**(< .001)**	**(< .001)**

Note. Correlation coefficients (*r*) are shown in each cell followed by 95% confidence intervals in brackets and *p*-values in parentheses. HP = harmonious passion; OP = obsessive passion; IGD = Internet Gaming Disorder symptoms. W indicates that a 90% Winsorization was applied. SQRT indicates that a square root transformation was applied. The degrees of freedom are 131 for all correlations. Correlations significant at $p < .05$ are bolded.

APPENDIX A. IRB APPROVAL

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
2420 Lincoln Way, Suite 202
Ames, Iowa 50014
515 294-4566

Date:	10/09/2018		
To:	Johnie Allen	Craig Anderson, PhD	
From:	Office for Responsible Research		
Title:	A Day in the Life of a Gamer		
IRB ID:	18-388		
Submission Type:	Initial Submission	Review Type:	Expedited
Approval Date:	10/09/2018	Date for Continuing Review:	10/08/2020

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- Use only the approved study materials in your research, including the recruitment materials and informed consent documents that have the IRB approval stamp.
- Retain signed informed consent documents for 3 years after the close of the study, when documented consent is required.
- Obtain IRB approval prior to implementing any changes to the study.
- Inform the IRB if the Principal Investigator and/or Supervising Investigator end their role or involvement with the project with sufficient time to allow an alternate PI/Supervising Investigator to assume oversight responsibility. Projects must have an eligible PI to remain open.
- Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences involving risks to subjects or others; and (2) any other unanticipated problems involving risks to subjects or others.
- Stop all human subjects research activity if IRB approval lapses, unless continuation is necessary to prevent harm to research participants. Human subjects research activity can resume once IRB approval is re-established.
- Submit an application for Continuing Review at least three to four weeks prior to the date for continuing review as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

IRB 03/2018

- Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

- Please be advised that your research study may be subject to post-approval monitoring **by Iowa State University's Office for Responsible Research.** In some cases, it may also be subject to formal audit or inspection by federal agencies and study sponsors.

- Upon completion of the project, transfer of IRB oversight to another IRB, or departure of the PI and/or Supervising Investigator, please initiate a Project Closure to officially close the project. For information on instances when a study may be closed, please refer to the IRB Study Closure Policy.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

APPENDIX B. INFORMED CONSENT DOCUMENT

Title of the Study: Daily Activities and Well-Being for People Who Play Video Games

Researchers: Johnie J. Allen, M.S. & Craig A. Anderson, Ph.D.

Eligibility Requirements: You must be at least 18 years of age and play video games at least once a week to participate. When we say video games, we mean any games you play on the computer, on video game consoles (e.g., PlayStation 4, Xbox One, Nintendo Switch), on hand-held devices (e.g., Nintendo 3DS, PlayStation Vita, smartphones), or in video arcades. Additionally, you must have consistent access to the Internet to complete online surveys at the end of each day during Phase Two of this study. You may only complete this study once.

Introduction: This study examines the relations between daily activities and well-being. We are interested in learning more about how these variables relate to one another for young adults who play video games. We are also interested in how video game play might relate to academic performance. We are not concerned with the responses of any one person, but rather with assessing the responses of groups of people. You are being invited to participate in this study because you are a student enrolled in Communication Studies 101, Psychology 101, 230, or 280.

Procedure: Participation in this study is voluntary and involves two phases. In Phase One you will be asked to complete a series of questionnaires about yourself and your experiences with video games. Next, you will verify your understanding of what will happen in Phase Two of this study. You will also be asked to enter your Iowa State University email address so that we can contact you during Phase Two. Phase One should take you 31-60 minutes to complete.

After completing Phase One, you will begin Phase Two of the experiment on the following Monday. During Phase Two, you will receive daily emails with a link to a short survey that you will be asked to complete **at the end of each day, before going to sleep**. This will continue for two weeks. These surveys will ask about your daily experiences and should take no more than 10 minutes to complete each day.

Risks: Throughout the study, you will be asked to complete several questionnaires. Some of the questions may be sensitive in nature. If you feel uncomfortable with the questionnaires or any other tasks, you can stop immediately, and you will still receive credit for the time that you have participated. Additionally, you may skip any questions that you are not comfortable answering.

Benefits: You will receive first-hand knowledge of how psychological research is conducted, which will complement information from your psychology or communications class. It is hoped that the information gained in this study will benefit society by (1) improving our understanding of relations between daily activities and well-being for people who play video games, and (2) improving our understanding of the relation between video game play and academic performance.

Costs and Compensation: There won't be any costs to you for participating in this study, except for your time spent completing surveys. Phase One of the study should take 31-60 minutes of

your time, for which you will receive two SONA credits, even if you choose to discontinue participation in the study. During Phase Two, you will be able to earn up to five additional SONA credits, depending on the number of daily surveys you complete (each of which should take 10 minutes or less). At the end of Phase Two, you will receive 1 credit for completing 1-3 daily surveys, 2 credits for completing 4-6 daily surveys, 3 credits for completing 7-9 daily surveys, 4 credits for completing 10-12 daily surveys, and 5 credits for completing 13-14 daily surveys. Please keep in mind that alternative ways to receive course credit are available within each of these classes (Communication Studies 101, Psychology 101, 230, and 280).

Participant Rights: Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to leave the study early, you will still be granted SONA credits for the parts of the study you have completed. You should feel free to keep a copy of this consent form for your records.

Confidentiality: During each survey, you will be asked to provide your Iowa State University email address. This will be used to send you links to daily surveys during Phase Two and to grant you SONA credit based on your participation at the end of the study. Federal government regulatory agencies and the Institutional Review Board (a committee that reviews and approves research with human subjects) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information. Only the research team will have access to data with identifying information which will be stored in a locked office on a password-protected computer or on a password-protected laptop with whole-disk encryption. Before analysis, emails will be replaced with ID codes and a key will be made to link emails to ID codes. The key linking emails to ID codes will be stored (a) in a locked filing cabinet in a locked lab room, and (b) in a Cybox folder, separate from the data. The key will be destroyed after all analyses have been conducted. If the results are published, your identity will remain confidential. De-identified data may be shared with other researchers in the future for additional research or verification of our findings.

Questions or Problems: For further information about the study contact Johnie J. Allen at jallen@iastate.edu, or Dr. Craig A. Anderson at caa@iastate.edu. If you have any questions about the rights of research participants or research-related injury, please contact the Institutional Review Board (IRB) by email at irb@iastate.edu, by phone at 515-294-4566 or 515-294-4215, or by visiting the office at 2420 Lincoln Way, Suite 202, Ames, IA 50014.

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You may or may not choose to participate in this study. If you choose to participate, please read the following statement and acknowledge your voluntary consent by signing and printing your name.

I hereby consent to my participation in this study. I have been informed and understand the purposes and procedures of this study that can be divulged to me in advance. I understand that my participation is completely voluntary and that I am free to withdraw consent and discontinue participation at any time without losing credit for my time. I agree to participate in this experiment as described above.

_____

Signature of Participant Print Name Date

****

FOR EXPERIMENTER TO COMPLETE:

I certify that the participant has been given adequate time to read and learn about the study and all his or her questions have been answered. It is my opinion that the participant understands the purpose, risks, benefits, and the procedures that will be followed in this study and has voluntarily agreed to participate.

_____

Signature of Investigator or Person Obtaining Consent Date