The Relation Between Gaming and the Development of Emotion Regulation Skills

Adam Lobel
GAME ON 8

The relation between gaming & emotion regulation development

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For my Mishpacha
&
For my Savta Rita,
who would have been so proud
to read the books of her offspring
Game on:

De relatie tussen gamen

en de ontwikkeling van emotieregulatie waardigheden

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Now a cultural mainstay, video games offer highly engaging and emotion-eliciting experiences. This dissertation promotes an emotion regulation-focused approach for investigating the effects of video game playing. Calling on research and classical theories in the fields of play and psychosocial development, this dissertation argues that video games can provide a valuable domain for the development of healthy emotion regulation skills, particularly among children. Three streams of research are presented to support this argument. First, the known benefits of play in general, and of gaming more specifically are synthesized in a comprehensive review. Second, three studies embedded in a longitudinal research project investigated the relationship between gaming and (changes in) children’s psychosocial development. Third, two observational studies explored the psychophysiological processes that underlie emotion regulation processes during gaming in adults; these studies focused in particular on interoceptive awareness as a skill that video games can train to benefit real world emotion regulation skills. Taken together, these streams of research indicate that (a) among children, the risks of gaming are likely low, whereas there may be psychosocial benefits, particularly when gaming is performed with peers; and (b) interoceptive awareness is a worthwhile skill to consider for game developers who strive to build games that train emotion regulation skills. Important considerations for future emotion regulation-focused gaming research and the future development of games for psychosocial health are discussed.
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TUTORIAL

The importance of researching the emotion regulation benefits of gaming
Chapter I

General introduction
We have witnessed a cultural genesis in the rise of video games. In this dissertation, I argue that video games provide a valuable context for the development of healthy emotion regulation skills. To do so, I call on classic psychological theories that describe the emotion regulation benefits of play in child development. These theories highlight play as an important context for children to not only develop cognitive skills and to experience positive emotions (Nicolopoulou, 1993), but perhaps more importantly, to also work through negative emotions within a safe context. Because video games have emerged as a modern domain for play, it seems imperative to similarly investigate video games as a domain for the development of emotion regulation skills. For the purpose of this dissertation, emotion regulation refers to both the deliberate and the automatic means by which individuals monitor and alter their affective states (Webb, Miles, & Sheeran, 2012). Emotion regulation skills are crucial for psychosocial health as they help individuals resolve their negative emotions (Gross, 1998) and amicably resolve conflicts with others (Jordan & Troth, 2004). This dissertation describes how playing video games may test and train these skills in a number of ways.

To do so, this dissertation presents three arms of research. These arms of research become progressively narrower in scope, beginning with a literature review, continuing with developmental research that focuses broadly on gaming and the development of children's psychosocial health, and concluding with correlational research into psychophysiological processes that underlie emotion regulation skills. The first arm of research, Chapter II, is a review of past work that demonstrates the cognitive, motivational, emotional, and social benefits of playing video games. This review also highlights the need for more developmental research into the benefits of video game play in children, and an analysis of how emotion regulation strategies enacted during video game play may generalize to
real world behavior. The other arms of research in this dissertation follow the suggestions put forward in the review. **Chapters III, IV, and V** present developmental research derived from a longitudinal study among Dutch pre-adolescent children. This study examined the co-development of children’s psychosocial health and gaming behavior by looking at the co-development of gaming and children’s conduct problems, internalizing problems, attention problems, peer relationships, and prosocial behavior. **Chapters VI and VII** present research performed among adult gamers who played highly stress-inducing video games in a lab setting. These studies examined the link between being able to recognize and manage physiological stress during video game play and the ability to adaptively regulate emotions during real world stressful situations. In all, these arms of research shed light on gaming as a potential context for emotion regulation training for both children and adults.

In this Introduction chapter, I begin by illustrating gaming’s widespread use and the characteristics of modern video games that are most responsible for this popularity. I then illustrate how popular forms of video game playing mirror traditional forms of play that are known to have emotion regulation benefits. Finally, I summarize the extant psychological research on gaming and emotion regulation skills and highlight the gaps in this literature which the studies in this dissertation aim to address. In this dissertation, video games refer to any game that is played on the computer, on televisions via gaming consoles (e.g. a Playstation or Xbox), and on handheld devices such as cell phones, tablets, or handheld consoles (e.g. a Nintendo 3DS). A Glossary is provided for readers wanting more detailed information about the video game genres mentioned in this dissertation.
Over the last twenty to thirty years, gaming has gone from fringe to mainstream entertainment. Today, the gaming industry is a $65+ billion international industry, annually amassing over $800 million dollars in revenue in the Netherlands alone (Pricewaterhouse Coopers, 2012). The gaming industry rivals Hollywood in budgets and revenue, and like Hollywood, it commands a large, diverse audience (Bloomberg, 2015). In its evolution, gaming has created a modern playground characterized by (1) a mélange of emotionally engaging games (El-Nasr, Morie, & Drachen, 2011; Isbister, 2016), (2) a large body of child, adolescent, and young adult players (Entertainment Software Association (ESA), 2016), and (3) a strong prevalence of social play. By describing gaming in these three aspects, this section is meant to provide the backdrop for the research reviewed and presented in the rest of the dissertation.

Video games provide challenging interactive experiences that are unlike those in any other entertainment medium. As a result, today’s most successful titles attract large, highly devoted audiences. For example, the Multiplayer Online Battle Arena (MOBA) game League of Legends regularly hosts up to 7.5 million concurrent players (Riot Games, 2016) who compete in complex battles of wits, reflexes, and teamwork. In Massively Multiplayer Online Role Playing Games (MMORPG’s), millions of players painstakingly customize their own unique characters and social networks by exploring and taking on challenges in vast virtual worlds. In similar fashion, players in sandbox games imaginatively test the limits of a game’s world. For instance, Grand Theft Auto V (GTA V) provides a free-for-all virtual world for players or groups to simulate acts of childlike fantasy;
armed crime sprees, drag races, motorcycle stunts, and jet piloting are just limited examples of the game's possibilities. With over 60 million copies sold (IGN, 2016), GTA V's popularity as a sandbox game is second only to the more child-friendly Minecraft (Mojang, 2016). Minecraft grants players the nearly boundless freedom to construct their own unique structures and mechanisms, and even to invent their own games.

The gaming industry has also made it seemingly easy for everyone to be regular gamers. For example, more than 90% of children and adolescents in the United States (U.S.) play video games (Lenhart et al., 2008) and constitute over 25% of the gaming population (ESA, 2016). A further nearly 30% of U.S. gamers are adults aged 18 to 35. According to a recent report in the Netherlands, 87% of Dutch primary school children play video games, with 33% of children playing on a daily or nearly daily basis (Dorsselaer et al., 2016). To attract players of all ages, the gaming market offers titles for potential players at every level of experience. The distinction between “casual” and “hardcore” games helps illustrate this: Casual video games seem particularly aimed at young children and older adults. These games have a low barrier for entry because they utilize simple inputs and user interfaces, and they quickly reward player input with points or colorful sounds and animations (Casual Games Association, 2007). These are games such as Angry Birds and Candy Crush which tend to be available on mobile devices and/or embedded in social media services. In contrast, more hardcore video games seem to target adolescents and young adults as well as older children as they enter adolescence; they are generally more challenging as they feature more complex input schemes, more dynamic in-game systems, and they generally afford more gradations of skillful play. Through this diversity of available games, children are enticed to begin playing video games at an increasingly younger age (Lenhart et
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al., 2008); further, as these children grow older, the availability of progressively more complex and challenging games encourage their continued play.

Finally, today’s most popular titles tend to be those designed for social interaction. Of the top ten video games sold in 2015, nine featured multiplayer capabilities, with eight of these nine games being designed with multiplayer as a main mode of play (NPD Group, as cited by Venture Beat, 2016). Further, the entire MMORPG genre is founded on players’ desire to play with others, and MMORPG’s such as World of Warcraft and Guild Wars 2 attract millions of users to their virtual worlds every month (MMO Champion, 2015). Multiplayer functionality is also ubiquitous among games that are free to play: MOBA’s are the most popular of this kind with League of Legends being the most played video game for the computer, and among mobile games, those which involve social interaction such as Candy Crush Saga, Clash of Clans, and Words With Friends were the most popular of 2014 (Mobidia, as cited by Geek Wire, 2014).

The gaming industry has therefore established a diverse marketplace for fun, distraction, challenge, and social connection. Its success as an industry speaks to both the ingenuity of game designers and to the public’s enthusiasm for play. The following section describes how game designers draw on classic forms of play to construct their games. This description lends itself to a perspective where video games – like traditional forms of play – merit research for their potential to benefit social and emotional development.
A link to the past: 
Play, yesterday and today 
(Chapter II)

Play is integral to human development. Play helps fulfill basic needs, providing a sense of accomplishment with success and mastery, a sense of autonomy with its lack of constraints, and a sense of relatedness with its ability to bring people together in pursuit of a common goal (Ryan, Rigby, & Przybylski, 2006). More than a mere respite from burdensome responsibilities, play can also be a rehearsal space for dealing with real life challenges (Saracho & Spodek, 1998). While typical for people of all ages, play has predominantly been the focus of research and discussion in child development. For instance, in pretend play, children use their imagination to transform the meaning of the world around them. In one form of pretend play, socio-dramatic play, children assume adult, heroic, or imaginary roles and work through hypothetical conflicts (Lillard et al., 2013). For Piaget (1962) and Erikson (1977) this form of play has been argued to create a space for children to resolve negative emotions that arise from real-life conflicts. From this perspective, socio-dramatic play allows children to play out adversarial impasses in ways that allow them to explore fulfilling resolutions. This aligns with Huizinga's magic circle concept (Huizinga, 1949) in which the act of play creates a context that is psychologically removed from the real world. Under the pretense of play, therefore, players create an implicit distance between real and imagined conflicts. For children in particular, this distance allows them to safely re-enact or re-imagine real world conflicts, and to experiment with ways of achieving emotional closure (Gottman, 1986).
These affordances are also seen in another popular form of play, competitive play. Unlike socio-dramatic play however, competitive play *by definition* pits its participants in adversarial relationships. Also unlike socio-dramatic play, competitive play generally involves pre-defined states for victory and defeat. As a result, competitive play involves themes of power and dominance on the one hand (victory), and anxiety and loss on the other (defeat) (Gottman, 1986). Here again, the magic circle of play affords children the opportunity to experience emotional duress in a seemingly safe context. Moreover, children are challenged to regulate the aggressive impulses which often arise through competition (Ensor, Hart, Jacobs, & Hughes, 2011). Children must find a delicate balance: while aggressive behaviors may be promoted through competitive play – success often hinges on hindering the opposition – spiteful behaviors and being ungracious in victory or defeat is considered transgressive (Adachi, 2015). Finally, because competitive play is social in nature, sharing these experiences with peers may facilitate stronger bonds between players. Competitive play may therefore bring peers closer together while forcing them to effectively manage negative affective states.

Socio-dramatic play and competitive play are staples of today’s most popular video games. For example, in sandbox games like those in *The Sims* series, players can explore adult life by influencing the daily lives of virtual characters that possess different personalities, life goals, and occupations. Through role-playing, players explore the constraints of daily adult life, balancing work, basic needs, hobbies, and friendships in order to maximize their characters’ life satisfaction. Other sandbox games like *Minecraft* allow for pretend and socio-dramatic play by providing a blank canvas for imaginative building, cooperation, and for players to construct their own narratives and conflicts. Moreover, game designers often
adopt design choices that encourage players to interject themselves into a game's world and dramas (Schrier, 2010). For instance, many games that tell a narrative put players in control of a protagonist that is silent throughout the game's story (Wolpaw, Laidlwa, & Kosmatka, 2011). It is also commonplace for (MMO)RPG's and sports games to allow players to create their own character. Through these design choices, players are subtly encouraged to feel like they are themselves experiencing the conflicts, relationships, and emotional resolutions in these games.

Similarly, with many video games being designed for social interaction, video games often follow a tradition of competitive games. Thus sports games like those in the FIFA series, party games like those in the Mario Party series, and first-person shooters like those in the Halo series provide modern arenas for competitive play. Like more traditional competitive games, these games are designed to situate players in stressful interactions by putting players' reputations and level of skill on the line. As a result of this pressure, players commonly taunt each other in order to provoke frustration and carelessness in their opponents (Linderoth, Bjork, & Olsson, 2012). Still, opponents are ultimately expected to show camaraderie and respect. For example, in competitive online games, game designers often implement ways for transgressive behaviors to be reported and for transgressive players to be penalized (Maher, 2016; PC Gamer, 2015). Thus, like in traditional competitive play, competitive video games seem to pit players in a stressful environment while challenging them to regulate themselves against behaving antisocially.

To conclude, play is an important domain for the development of emotion regulation skills. In childhood, pretend play and competitive play allow children to
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deal with conflict and emotional distress (Lillard et al., 2013) and may teach
children to navigate healthy peer relationships (Hartup, Laursen, Stewart, &
Eastenson, 1988). These forms of play seem common in video games, with some
of the most popular games among children being designed to allow imaginative
play and playful competition. Video games may therefore provide a modern
playground for children to play and develop their emotion regulation skills much in
the same way that more traditional forms of play do. In so doing, video games may
positively contribute to children's psychosocial health.

Growing up gaming:
Gaming and emotion regulation
in child development
(Chapters III, IV, & V)

Despite the similarities between traditional play and gaming, limited research has
investigated how video game playing can benefit children's emotion regulation
skills (Hromek & Roffey, 2009). Instead, the preponderance of research on
gaming's influence on emotion regulation skills has focused on whether playing
violent video games promotes aggressive thinking and behavior. Based on
Bandura's Social Learning Theory (1973), The General Learning Model (GLM) is the
forerunning theoretical model that describes the processes by which violent video
gaming is argued to have these effects (Buckley & Anderson, 2006; originally
formulated as the General Aggression Model in Anderson & Bushman, 2001) .
According to the GLM, playing violent video games has short- and long-term
consequences for aggression. During play, violent video games present threats to
the player in the form of enemies; these threats are argued to heighten the player's
arousal and instill negative affect. When these threats are eliminated, violent video
games reward players with points and in-game progress. According to the GLM’s proponents, because these rewards instill positive affect, players adopt cognitive-behavioral scripts where performing aggressive behaviors is an appropriate means for resolving negative affective states. This theoretical perspective has underscored hypotheses for short- and long-term consequences of playing violent video games. In the short-term, players are expected to interpret ambiguous social cues as being more aggressive (Kirsh, 1998) and to behave more aggressively in the face of threats (Anderson & Dill, 2000). In the long-term, this pattern is argued to influence personality traits, with habitual violent video game players becoming more aggressive and less prosocial (Anderson et al., 2010).

The veracity of these hypotheses is an ongoing topic of debate among researchers. For example, a recent special section in *Perspectives on Psychological Science* hosted contrasting viewpoints into whether violent video gaming influences childhood aggression and mental health (see: Boxer, Groves, & Docherty, 2015; Ferguson, 2015a, 2015b; Gentile, 2015; Markey, 2015; Rothstein & Bushman, 2015; Valkenburg, 2015). For the most part, this debate seems polarized between those in support of the General Learning Model’s predictions – namely, Anderson, Bushman, and others – and those not – namely, Ferguson and others (see Ferguson & Konijn, 2015). Both sides have produced meta-analyses to support their claims: For the influence of violent gaming on aggressive behavior, meta-analyses conducted by Anderson and colleagues have produced effect sizes of approximately $r = .2$ (a small to medium effect according to Cohen, 1992) (see Anderson & Bushman, 2001; Anderson, 2004; Anderson et al., 2010), where violent video gaming was associated with heightened levels of aggression across both short-term experimental studies, and in longitudinal studies. However, Ferguson’s (2007) meta-analysis showed no effects and argued that publication bias had
contributed to false conclusions by those on the other side. In a meta-analysis specifically into the effects of gaming in children, Ferguson argued that the influence of violent video gaming on aggression was “minimal” given an observed effect size of just $r = .06$ (2015a, p. 646).

This ongoing debate has shaped the landscape of gaming research in several important ways. First, it has drawn a large body of media and psychology researchers to investigate the potential influence of violent video games. Yet, gaming is not an inherently violent activity. Moreover, with the dominant focus being on violent gaming there is a relative lack of research that investigates gaming as a normative form of play with potential psychosocial benefits (see Adachi & Willoughby, 2013; Ferguson & Garza, 2011). This lack of research is especially seen in the scarcity of studies conducted among pre-adolescent children. Second, this debate has challenged researchers on both sides to be critical about the research methods used in this field. Such critical discussion has yielded important considerations for the field and was an important springboard for the research presented in this dissertation (Gunter & Daly, 2012; Sherry, 2007). Third, the violent gaming debate has led to research into the effects of social forms of gaming, namely cooperative and competitive gaming (Anderson & Carnagey, 2009; Ewoldsen, Eno, & Okdie, 2012). The remainder of this section elaborates on these three aspects of the current state of the literature.

Ferguson’s (2015a) meta-analysis identified 101 studies that investigated the effects of playing (violent) video games on children’s and adolescents’ psychosocial health. Of these studies, nearly 70 of them assessed whether (violent) video games were related to aggression. In contrast, prosocial behavior (e.g. Gentile et al., 2009) and depressive symptoms (e.g. Parkes, Sweeting, Wight,
& Henderson, 2013) were each assessed in about 20 studies. Just 9 studies assessed the relation between gaming and attention problems (e.g. Bioulac, Arfi, & Bouvard, 2008) and even fewer investigated the relation between gaming and children's peer relationships (e.g. Przybylski, 2014). Furthermore, despite researchers arguing that children may be more prone to the long-term effects of gaming than adults (Bushman & Huesmann, 2006), and despite the trend of children picking up video games at an increasingly younger age (Lenhart et al., 2008), these studies have tended to recruit predominantly adolescent samples. While approximately 60 studies included children 12 years or younger, the mean age in nearly 40 of these samples was 13 or older. As a result, pre-adolescent children are underrepresented in gaming research. In sum, given researchers' predominant focus on violent gaming and a lack of studies on pre-adolescent children, there is an overall lack of insight into the role played by video games in the development of pre-adolescent children's psychosocial health.

Several methodological shortcomings are also important to highlight. First, gaming research among children has predominantly been cross-sectional in nature – 64 of the 101 studies identified in Ferguson (2015a) were correlational. The major limitation of these studies is that they do not allow inferences about order. Moreover, many of these studies have not controlled for relevant background variables such as socio-economic status (SES) and gender. Also, in many studies, the data for both correlates were provided by a single reporter (e.g. only parents or only children provided data), potentially giving rise to a single source bias where the participants' belief in the relationship between two variables may influence their reporting (also called a single responder bias Ferguson, Garza, Jerabeck, & Ramos, 2013, and shared method variance Baumrind, Larzelere, & Cowan, 2002).
Regarding the experimental studies in the field, while such studies allow researchers to draw causal inferences, their real-world generalizability remain debated. For example, researchers have questioned the ecological validity of the outcome measures used in these studies (see Anderson & Bushman, 1997; Ritter & Eslea, 2005) and the extent to which these studies used well-matched control conditions (see Przybylski, Deci, Rigby, & Ryan, 2014). Beyond these issues, as most of these experimental studies were run in a single lab session, these experiments do not give enough insight into the long-term consequences of playing video games. Moreover, while gaming has become increasingly social in nature, experimental studies have – likely out of practical considerations – neglected this social element by testing participants in controlled lab environments where gaming is done in isolation.

The shortcomings of past cross-sectional and experimental studies point to the necessity for longitudinal studies. Because variables in these studies are collected at multiple time points, causal inferences can be posited. However, only 12 longitudinal studies have been conducted with samples consisting of children 12 years or younger (Ferguson, 2015a); again, with half of these studies focusing on aggressive outcomes, the influence of video games on children’s psychosocial health remains understudied (Parkes et al., 2013). Further, these studies feature several methodological shortcomings. First, like in correlational studies, the data from many of these studies was derived from a single source. Second, in many of these studies the baseline measure of the dependent variables was not statistically controlled for. In such studies the analyses do not assess changes in the dependent variable as a function of gaming, meaning that causality cannot be inferred. Third, almost without exception, these studies fail to explore potential selection effects. The extent to which gaming behaviors (e.g. gaming frequency
and genre preferences) are influenced by psychological factors therefore remains overlooked (see Gentile, Swing, & Lim, 2012; von Salisch, Vogelgesang, Kristen, & Oppl, 2011).

Finally, the influence of cooperative and competitive gaming has recently emerged as an important moderator of game effects. This field of research stems from studies into the potential prosocial benefits of gaming. Researchers such as Greitemeyer and Ewoldsen noted that just as some games predicate in-game progress on violence, other games predicate progress on prosocial behaviors (Ewoldsen et al., 2012; Greitemeyer & Osswald, 2011). For instance, many games designed for multiple players feature cooperative game modes where players are encouraged to work together with others. A number of studies support the hypothesis that cooperative gaming may promote prosocial behavior (Dolgov, Graves, Nearents, Schwark, & Brooks Volkman, 2014; Ewoldsen et al., 2012) and may curb aggressive behaviors (Jerabeck & Ferguson, 2013; Velez, Greitemeyer, Whitaker, Ewoldsen, & Bushman, 2014) (although many of these studies feature the sorts of methodological shortcomings mentioned above). In contrast to cooperative gaming, researchers have also investigated whether competitive gaming promotes aggression and discourages prosocial behavior (Eastin, 2007). For instance, Adachi and colleagues performed a series of studies to test the relative extent to which violent content and competitive play each promote aggression (Adachi, 2015). Using experimental and longitudinal designs, these studies indicated that in both the short- and long-term, competitive gaming may be a greater predictor of aggressive outcomes than violence alone. However, cooperative and competitive gaming have yet to be researched in the way these forms of play most commonly occur in the real world – in tandem. Thus, while researchers have tried to individually assess the effects of these forms of play, they
often co-occur in the real-world of gaming most children participate. This is because many competitive video games not only allow cooperative modes, but the competition in these games is often team-based.

Given this landscape, the studies in Chapters III, IV, and V were designed to address the lack of research where (a) gaming’s role in normative development (b) among pre-adolescent children is studied (c) longitudinally and (d) using multiple reporters. These studies also (e) explored the potential bidirectionality between gaming behaviors and psychosocial health and (f) simultaneously investigated the influences of cooperative and competitive gaming. These studies come from the perspective that is outlined in the previous section and is further elaborated on in the Review presented in Chapter II. In this perspective, video games present themselves as a safe place for children to experience and work through conflicts and negative emotions. Given their increasingly social nature, video games also present themselves as a safe space to work through these conflicts together with peers; in so doing, gaming may help strengthen peer relationships. Broadly, these studies therefore evaluated the hypothesis that gaming would predict improvements in children’s psychosocial health. This hypothesis was assessed using parent reports on children’s conduct problems, internalizing problems, attention problems, peer relations, and prosocial behavior.
Playing on hard mode: Stressful gaming and emotion regulation in adults (Chapters VI & VII)

The final two studies presented in this dissertation operate under the same fundamental reasoning – overcoming stress during video game play may train real world emotion regulation skills. These studies however zoomed in on psychophysiological processes that may be valuable to emotion regulation during both stressful video game play and stressful real world experiences. These studies therefore investigated the processes by which stressful gaming may benefit the development of emotion regulation skills. Due to this focus on gaming as a potentially stress-inducing activity, this research also offers a counterpoint to research in adults showing that video games can have a cathartic, anxiety-relieving effect.

Throughout this chapter, I have focused on play as a domain to experience and overcome negative emotional arousal. But play is sometimes simply a way to cool off. In this vein, research has investigated whether playing video games – and casual video games in particular – can be cathartic. According to this research, individuals may turn to video games in the face of real world stress and anxiety. For instance, a study conducted by Ferguson and Olson (2013) demonstrated that part of why children feel motivated to play video games is because gaming was seen as an activity that “helps me relax” and “helps me forget my problems” (p. 158). A recent analysis of gaming discussion boards also supported the notion that gamers are drawn to video games for their perceived cathartic effects (Hilgard, Engelhardt, & Bartholow, 2013).
More convincingly, participants in a recent experiment played a video game after half had randomly been subjected to a frustrating task (Bonus, Peebles, & Riddle, 2015). Frustrated players were seemingly more motivated to perform well, which the researchers inferred based on these players progressing further in their game. Moreover, the more progress these players made in the game, the greater their sense of competency and their perceived enjoyment of the game. Thus, frustration prior to play was seen to increase player motivation during play, which in turn increased enjoyment.

Finally, several studies have studied the causal link between playing casual video games and reducing negative mood. Noting that these games provide a quick and easy distraction from stress and anxious thinking, Russoniello, O’Brien, and Parks (2009) compared mood changes in individuals randomly assigned to either play a casual video game or to surf the internet. Across a variety of self-report and physiological measures, playing a casual video game had mood benefits. Following these findings, participants in a randomized control trial either committed to playing a casual video game for at least 30 minutes, three times a week, and for one month (experimental condition) or to refrain from playing casual video games over the same time period (control condition) (Fish, 2011). Compared to those in the control condition, participants in the experimental condition showed improvements in state and trait anxiety.

On the other hand, there is another line of research that suggests games are stress inducing and that this is perhaps part of their appeal. For instance, Juul’s The Art of Failure (2013) characterizes video games as being designed to make players experience failure and its resulting negative emotions. Studies employing a variety of methods have shown that video games evoke frustration and negative
affective arousal. Players randomly assigned to play a fast-paced first-person shooting game reported higher levels of anxiety after play and showed an increase in blood pressure during play (Baldaro et al., 2004). Similarly, Ravaja and colleagues used electromyography to demonstrate increases in anxiety during video game play (Ravaja, Turpeinen, Saari,uttonen, & Keltikangas-Järvinen, 2008). Finally, competitive games which rank players based on performance are known to induce anxiety due to the added social pressure to perform well; this so-called “ladder anxiety” is a major topic of discussion among gamers, particularly in the competitive communities surrounding titles such as League of Legends, and Starcraft II (Team Liquid, 2010).

By inducing and not relieving stress, these games may engage players’ emotion regulation skills. In other words, stressful gameplay may challenge players to better manage negative affective arousal. This is because these games are often designed to reward players whose decision-making is optimal in the face of stress. However, little is known about the emotion regulation processes that occur during video game play (Imre, 2016; Nacke, 2009). Moreover, it remains unclear whether the emotion regulation processes that are relevant while gaming generalize to how individuals regulate their emotions outside of video games.

Chapters VI and VII present interoceptive awareness as a skill to consider in addressing these open questions. Interoceptive awareness is the ability to accurately recognize internal physiological states (Mehling & Price, 2012). Based on the inherent link between emotional and physiological states (Damasio, 1994; James, 1884; Niedenthal, 2007) a growing number of studies have demonstrated the emotion regulation benefits of interoceptive awareness (Kanbara & Fukunaga, 2016; Wiens, 2005). On a fundamental level, interoceptive awareness is therefore
associated with individuals being better able to recognize their emotional states (Pistoia et al., 2015). More practically, it has also been associated with the tendency of individuals to regulate their emotions (Kever, Pollatos, Vermeulen, & Grynberg, 2015), to facilitate the down-regulation of negative affect (Füstös, Gramann, Herbert, & Pollatos, 2013), and to buffer the negative affect that results from social exclusion (Pollatos, Matthias, & Keller, 2015).

Focusing on interoceptive awareness and the regulation of one's physiological states, the studies in Chapters VI and VII therefore aimed to establish a link between in-game and real world emotion regulation processes. Specifically, interoceptive awareness during stressful video game play was expected to correlate positively with the enactment of adaptive emotion regulation strategies, and to correlate negatively with maladaptive emotion regulation strategies. These studies were conducted with adult samples for multiple reasons. First, albeit while gaming, these studies aimed to test participants' psychophysiological changes and interoceptive awareness under stressful circumstances. Ethical concerns about subjecting children to stressful situations therefore motivated study designs using adult participants. Second, children may lack the introspective and metacognitive ability to accurately report on how they manage stressful situations in their everyday lives (Cole, Marin, & Dennis, 2004). Third, these studies were conceptualized as a starting point for learning about how psychophysiological processes could be embedded as a form of play in psychoeducational games for children. At the time these studies were conceived, there were no games designed for children that seemed suitable for this purpose.
The papers in this dissertation build on the past research in several ways. The following chapter, Chapter II, elaborates on the core themes presented here. The goal of this chapter was to review the existing literature about the benefits of video game playing, and to recommend important future research directions based on the existing literature. This review gives additional nuance to the importance of play in children's socio-emotional development, and elaborates on how video games seem to represent a modern extension of more traditional forms of play. Reviewing developmental, neuroscientific, and motivational theories and research, this review represents one of the first comprehensive, empirically and theory driven arguments for investigating the emotion regulation benefits of gaming (see also: Adachi & Willoughby, 2013; Birk & Mandryk, 2016).

Chapters III, IV, and V build on each other, each drawing from the same three-year longitudinal study at consecutive time points. Collectively, they represent one of the few longitudinal studies conducted among pre-adolescent children to research the role of gaming in normative development. More specifically, Chapter III presents a cross-sectional study that broadly investigates the relationship between gaming frequency and children's psychosocial health. This study further investigated the potential influence of single source bias in similarly designed gaming studies. Recent research has indicated that individuals with less gaming experience may hold more negative attitudes towards video games (Przybylski & Weinstein, 2016; Przybylski, 2013); this may contribute to a single source bias. We therefore also investigated whether parents may, compared to their children, negatively skew the relationship between their children's gaming
frequency and their well-being. Chapter IV takes a more in-depth look at children’s gaming habits. First, it builds on Chapter III by investigating the longitudinal associations between gaming frequency and changes in children’s psychosocial health. Second, it investigates the link between violent gaming and the development of both anti- and pro-social behavior. Finally, it simultaneously investigates the link between cooperative and competitive gaming on prosocial behavior. Chapter V focuses specifically on competitive video game play and also takes a longitudinal approach. This chapter investigates whether competitive gaming can facilitate improvements in emotion regulation skills as marked by changes in anti-social behavior, prosocial behavior, and peer relationships.

Chapters VI and VII provide an early step at investigating emotion regulation processes that are at work during stressful gameplay. These cross-sectional, observation studies examine the association between real world and in-game emotion regulation. In each study, experienced gamers played a stressful video game while their heart rate was recorded. The study in Chapter VI measured interoceptive awareness during a session of stressful video game playing; the study aimed to determine whether players who could more accurately assess their physiological arousal during stressful gameplay would also exhibit healthier real world emotion regulation tendencies. Building on this, Chapter VII describes a horror-themed video game that was designed to engage players’ interoceptive awareness and their ability to regulate their physiology. The game uses biofeedback technology whereby the player’s heart rate (variability) continuously influences the game world. Using this technology, the game both instigates and adapts to negative affective arousal by making it more difficult for players to progress when exhibiting stress. As a result, stress triggers visual and contextual cues meant to encourage players to manage their stress by regulating their
physiology. Based on the physiological and in-game data retrieved from participants, Chapter VII discusses how investigating players’ physiological regulation during play may be informative of their real world emotion regulation tendencies.

Finally, **Chapter VIII** provides a discussion of the findings from these studies. It gives an overview of each study’s outcomes and describes how these outcomes relate to the current literature in the field. Following these discussions, a number of limitations are raised, providing further suggestions for future research. Finally, a Conclusion is given with the take-home messages of this dissertation.
Chapter II
The benefits of playing video games

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ABSTRACT

Video games are a ubiquitous part of almost all children's and adolescents' lives with 97% playing at least one hour per day in the U.S. The vast majority of research by psychologists on the effects of "gaming" has been on its negative impact: the potential harm related to violence, addiction, and depression. We recognize the value of that research, however, we argue that a more balanced perspective is needed, one that considers not only the possible negative effects, but also the benefits of playing these games. Considering these potential benefits is important, in part, because the nature of these games has changed dramatically in the last decade, becoming increasingly complex, diverse, realistic and social in nature. A small but significant body of research has begun to emerge, mostly in the last five years, documenting these benefits. In this article, we summarize the research on the positive effects of playing video games, focusing on four main domains: cognitive, motivational, emotional, and social. By integrating insights from developmental, positive, and social psychology, as well as media psychology, we propose some candidate mechanisms by which playing video games may foster real-world psycho-social benefits. Our aim is to provide strong enough evidence and a theoretical rationale to inspire new programs of research on the largely unexplored mental health benefits of gaming. Finally, we end with a call to intervention researchers and practitioners to test the positive uses of video games and we suggest several promising directions for doing so.
The game of Chess is not merely an idle amusement. Several very valuable qualities of the mind, useful in the course of human life, are to be acquired or strengthened by it, so as to become habits, ready on all occasions... we learn by Chess the habit of not being discouraged by present appearances in the state of our affairs, the habit of hoping for a favourable change, and that of persevering in the search of resources.

–Benjamin Franklin, The Morals of Chess

Today, in the United States (U.S.), 91% of children between the age of two and seventeen play video games (NPD Group, 2011) and a nationally representative study of U.S. teenagers found that up to 99% of boys and 94% of girls play these games (Lenhart, Kahne, Middaugh, Macgill, Evans, & Vitak, 2008). In the U.S. alone, video games brought in over $25 billion in 2010, more than doubling Hollywood’s 2010 box office sales of $10.8 billion in the U.S. and Canada (Motion Picture Association of America, 2011). Against this backdrop of nearly ubiquitous play, the popular press regularly pulses out urgent warnings against the perils of addiction to these games and their inevitable link to violence and aggression, especially in children and adolescents. Indeed, the vast majority of psychological research on the effects of “gaming” has been focused on its negative impact: the potential harm related to aggression, addiction, and depression (e.g., Anderson et al., 2010; Ferguson, 2013; Lemola, Brand, Vogler, Perkinson-Gloor, Allemand, & Grob, 2011). It is likely that this focus will not diminish in the near future, in part because of the enormous media attention garnered when mass killings (e.g. the Columbine High School slayings in 1999) are associated with youth who play violent video games (Ferguson, 2007). Most recently (December 2012), the revelation that the Sandy Hook elementary school gunman played shooter games directly resulted in President Obama requesting Congress to allocate $10 million for research on the effects of violent media, especially video games (Obama, 2013).
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Decades of valuable research on the effects of violent video games on children's and adolescents' aggressive behavior already exists, and this is indeed an important body of work to consider. However, we argue that, in order to understand the impact of video games on children's and adolescents' development, a more balanced perspective is needed, one that considers not only the possible negative effects, but also the benefits of playing these games. Considering these potential benefits is important, in part, because the nature of these games has changed dramatically in the last decade, becoming increasingly complex, diverse, realistic and social in nature (Ferguson & Olson, 2013). A small but significant body of research has begun to emerge, mostly in the last five years, documenting these benefits. We propose that, taken together, these findings suggest that video games provide youth with immersive and compelling social, cognitive, and emotional experiences. Further, these experiences may have the potential to enhance mental health and well-being in children and adolescents.

In this article, we summarize the research on the benefits of playing video games, focusing on four main domains: cognitive (e.g., attention), motivational (e.g., resilience in the face of failure), emotional (e.g., mood management), and social benefits (e.g., prosocial behavior). By integrating insights from developmental, positive, and social psychology, as well as media psychology, we propose some candidate mechanisms by which playing video games foster real-world benefits. Our hope is to provide strong enough evidence and a theoretical rationale to inspire new programs of research on the largely unexplored mental health benefits of gaming. Finally, we end with a call to intervention and prevention researchers to test the potential positive uses of video games and we suggest several promising directions for doing so.
**The function of play**

Although relatively little research has focused on the benefits of playing video games specifically, the functions and benefits of play more generally have been studied for decades. Evolutionary psychology has long emphasized the adaptive functions of play (for review, see Bjorklund & Pellegrini, 2011) and in developmental psychology, the positive function of play has been a running theme for some of the most respected scholars in the field (e.g., Erikson, 1977; Piaget, 1962; Vygotsky, 1978). Erikson (1977) proposed that play contexts allow children to experiment with social experiences and simulate alternative emotional consequences, which can then bring about feelings of resolution outside the play context. Similarly, Piaget (1962) theorized that make-believe play provides children opportunities to reproduce real-life conflicts, to work out ideal resolutions for their own pleasure, and to ameliorate negative feelings. Both Piaget (1962) and Vygotsky (1978) espoused strong theoretical links between play and a variety of elements that foster the development of social cognition.

Beyond social cognition, developmentalists have emphasized that play constitutes an emotionally significant context through which themes of power and dominance, aggression, nurturance, anxiety, pain, loss, growth, and joy can be enacted productively (e.g., Gottman, 1986). For example, in his qualitative research of children's play conversations, Gottman (1986) showed how children use play for emotional mastery in their real lives. Whereas adolescents and adults often use self-disclosure and direct discussion with close friends to resolve emotional issues, children use play to work them out through pretend-based narratives enacted either alone or with others. Links between children's propensity to play
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and their development of cooperative skills, social competence, and peer acceptance have also been empirically established (e.g., Connolly & Doyle, 1984).

More recently, neuroscientific research with rats suggests specific brain mechanisms that help explain how play fighting in particular leads to the development of social competence (for a review, see Pellis & Pellis, 2007). Experimental laboratory studies indicate that play fighting results in the release of chemical growth factors in the parts of the brain that are coordinated for highly social activities (e.g., the orbital frontal cortex; OFC), thus promoting the growth and development of these areas. Given how similar human and nonhuman animals are in terms of several forms of play, there may be a similar mechanism by which play experiences improve social competence in children (Pellis & Pellis, 2007). We propose that, in addition to several unique factors, the same emotional themes identified in children's play experiences in general (e.g., dominance, nurturance, anxiety, and growth) are also explored in video games, allowing for important cognitive, emotional and social competencies to be acquired.

Defining our terms

Before we go further, it is essential to specify what we mean by the term "video games" and how they differ from other media (e.g., books, television, movies). The most essential distinguishing feature of video games is that they are interactive; players cannot passively surrender to a game's storyline. Instead, video games are designed for players to actively engage with their systems and for these systems to, in turn, react to players' agentive behaviours. There are millions of video games, with vastly different themes and goals. These games can be played cooperatively or competitively, alone, with other physically-present players, or with thousands of
other online players, and they are played on various devices from consoles (e.g., Nintendo Wii, Playstation) to computers to cell phones. Because of their diversity in terms of genres and the vast array of dimensions on which video games can vary, a comprehensive taxonomy of contemporary games is exceedingly difficult to develop (many have tried). However, to provide a glimpse into this diversity, Figure 1 depicts most of the genres (with examples) along two dimensions: the level of complexity and the extent of social interaction. This taxonomy is a necessary simplification; many games also differ on other important dimensions and, increasingly, commercial games can be played both socially and non-socially, cooperatively and competitively, and the complexity of games often depends on the manner in which the player engages in these various gaming contexts.

To provide only a small cross-section of 2011’s most popular games (Entertainment Software Association, 2012): In *World of Warcraft*, 12 million players regularly log on to customize their fantasy personae, explore complex and ever-changing vistas, and collaboratively battle human and computer opponents. In *Starcraft 2*, millions worldwide play a complex chess-like strategy game that demands perpetual multi-tasking between procuring resources, amassing an army, and penetrating opponents’ defenses. In *The Sims 3*, players cultivate a virtual existence where their character(s) socialize, learn new skills, work steady jobs, and develop complex relationships. In *Halo 4*, players take on the first-person perspective of a highly equipped supersoldier, violently killing alien races over the course of a narrative, and when online, competing and cooperating with peers. In *FIFA 13*, players take control of their favorite soccer teams, competing in realistic simulations against computer- or human-controlled teams. Finally, in *Minecraft*, millions of players use Lego-like elements to construct their own unique structures and mechanisms, sharing their creations with others in immense virtual worlds.
Figure 1. Conceptual map of the main genres of video games, with examples, organized according to two important dimensions: level of complexity and the extent of social interaction required.

Note. The figure is not empirical but conceptual and is intended to demonstrate the variety of ways video games engage their users. Some genres have been necessarily excluded. The same game (Halo 4) was intentionally repeated to illustrate that many games have the option of being played in either a single- or multi-player mode.

*Massive Multiplayer Online Role-playing Game
Given this vast diversity in video games, a single definition may not be useful. In fact, top scholars in the field have declared: "One can no more say what the effects of video games are, than one can say what the effects of food are." (Bavelier, Green, Han, Renshaw, Merzenich & Gentile, 2011, p. 763). Thus, rather than define video games according to a convenient generality, we will be specific in defining the genre of games to which we are referring when we can and whether they are single- or multi-player games, played cooperatively or competitively, and so on. When we refer to "gamers," we mean individuals who play video games regularly, more than one hour every day. We now turn to the literature on the benefits of gaming.

Cognitive benefits of gaming

Contrary to conventional beliefs that playing video games is intellectually lazy and sedating, it turns out that playing these games promotes a wide range of cognitive skills. This is particularly true for shooter video games (often called "action" games by researchers), many of which are violent in nature (e.g., Halo 4, Grand Theft Auto IV). The most convincing evidence comes from the numerous training studies which recruit naive gamers (those who have hardly or never played shooter video games) and randomly assigns them to play a shooter or another type of video game for the same period of time. Compared to control participants, those in the shooter video game condition show faster and more accurate attention allocation, higher spatial resolution in visual processing, and enhanced mental rotation abilities (for review, see Green & Bavelier, 2012). A recently published meta-analysis (Uttal et al., 2012) concluded that the spatial skills improvements derived from playing commercially-available shooter video games are comparable to the effects of formal (high school and university-level) courses aimed at enhancing these same skills.
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skills. Further, this recent meta-analysis showed that spatial skills can be trained with video games in a relatively brief period, that these training benefits last over an extended period of time and, crucially, that these skills transfer to other spatial tasks outside the video game context.

These training studies have critical implications for education and career development. A 25-year longitudinal study with a U.S. representative sample (for review, see Wai, Lubinski, & Benbow, 2010) established the power of spatial skills in predicting achievement in science, technology, engineering and mathematics (STEM). STEM areas of expertise have been repeatedly linked to long-term career success and are predicted to be especially critical in the next century (Wai et al., 2010).

Preliminary research has also demonstrated that these cognitive advantages manifest in measurable changes in neural processing and efficiency. For example, a recent fMRI study found that the mechanisms that control attention allocation (e.g., the fronto-parietal network) were less active during a challenging pattern-detection task in regular gamers than non-gamers, leading the researchers to suggest that shooter game players allocate their attentional resources more efficiently and filter out irrelevant information more effectively (Bavelier, Achtman, Mani, & Föcker, 2012). As summarized recently in Nature Reviews Neuroscience: "Video games are controlled training regimens delivered in highly motivating behavioral contexts... because behavioral changes arise from brain changes, it is also no surprise that performance improvements are paralleled by enduring physical and functional neurological remodeling" (Bavelier et al., 2011, p. 763). These changes in neural functioning may be one means by which the cognitive skills gained through video games generalize to contexts outside games.
It is important to stress that enhanced cognitive performance is not documented for all video game genres. The most robust effects on cognitive performance come from playing shooter video games and not from, for example, puzzle or role-playing games (Green & Bavelier 2012). These cognitive enhancements are likely a product of the visually rich 3-dimensional navigational spaces and the fast-paced demands that require split-second decision-making and acute attention to unpredictable changes in context. These assumptions, however, remain somewhat speculative because the vast majority of video games include an enormous number of game mechanics intertwined, rendering specific hypothesis-testing about these mechanisms extremely difficult. Moreover, it is virtually impossible to choose an appropriate control condition wherein all aspects of a game (e.g., visual stimulation, arousal induction, gameplay) are kept constant across conditions and only one cognitive challenge is manipulated (e.g., navigating 3D space efficiently versus inhibiting pre-potent responses). Cognitive neuroscientists have just recently put out a call to game developers to design new games for testing hypotheses about the specificity of cognitive advances and the particular mechanisms on which they are based (Bavelier & Davidson, 2013).

In addition to spatial skills, scholars have also speculated that video games are an excellent means for developing problem-solving skills (Prensky, 2012). Indeed, problem solving seems central to all genres of video games (including those with violent content). In-game puzzles range in complexity from finding the quickest route from A to B, to discovering complex action sequences based on memorization and analytical skills. Further, game designers often provide very little instruction about how to solve in-game problems, providing players with a nearly blank palette from which to explore a huge range of possible solutions based on past experience and intuitions. Prensky (2012) has argued that exposure to
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despite these sorts of games with open-ended problems (and other learning experiences on the internet) has influenced a generation of children and adolescents growing up as "digital natives." Instead of learning through explicit linear instruction (e.g., by reading a manual first), many children and youth problem-solve through trial and error, recursively collecting evidence which they test through experimentation. Only two studies have explicitly tested the relation between playing video games and problem-solving abilities; in both, problem-solving was defined in the reflective sense (e.g., taking time to gather information, evaluate various options, formulate a plan, and consider changing strategies and/or goals before proceeding further). One study, with *World of Warcraft* players, was correlational (Steinkuehler & Duncan, 2008), making it impossible to discern whether playing the game improved problem-solving or if people with better skills in the first place were drawn towards this type of open-ended role-playing game. The other study (Adachi & Willoughby, 2013) was longitudinal and showed that the more adolescents reported playing strategic games (e.g., role-playing games) the more improvements were evident in self-reported problem-solving skills the next year. The same positive predictive association was not found for fast-paced games such as racing and fighting games. Moreover, this latter study showed an indirect mediation effect such that playing strategic games predicted higher self-reported problem-solving skills which, in turn, predicted better academic grades. More research needs to tackle the causal question of whether and to what extent video games teach problem-solving skills and whether these skills generalize to real world contexts.

Finally, video games seem to be associated with an additional cognitive benefit: enhanced creativity. New evidence is emerging that playing any kind of video game, regardless of whether it is violent or not, enhances children's creative
capacities. For example, among a sample of almost 500 12-year old students, video game playing was positively associated with creativity (Jackson, et al., 2012). Critically, children's use of other forms of technology (e.g. computer, internet, cell-phone) did not relate to enhanced creativity. However, this study's cross-sectional design makes it unclear as to whether playing video games develops creative skills or if creative people prefer video games (or both).

The story behind a recent breakthrough in biology research provides a nice illustration of how gamers’ superior spatial and problem-solving skills, as well as their creativity, all came together to solve a real-world, previously insoluble problem. In 2008, researchers at the University of Washington created an online game called *Foldit* (Cooper et al., 2010), allowing the public to play games where they model the genetic makeup of proteins. At the end of a three-week competition in 2010, top scoring players had generated phase estimates that allowed researchers to identify a rapid solution of the crystal structure for a monkey virus related to AIDS. The structure had eluded researchers for over 10 years; however, the nonlinear, cooperative, and creative problem-solving techniques used by these gamers seemed to be precisely the skills needed to finally solve this elusive problem.

In summary, specific types of video games seem to enhance a suite of cognitive functions, some of which appear to generalize to real-world contexts. These data suggest that agendas to ban *shooter* games may be too simplistic. At the very least, the research on the negative impact of these games needs to be balanced with evidence for the cognitive benefits of these same games.

We now turn to the motivational, emotional, and social benefits of playing video games. It is important to highlight an across-the-board difference in the
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amount, breadth, and quality of research that can be found on these topics. Whereas cognitive mechanisms may be more easily isolated and tested, the motivational, emotional, and social effects of gaming are more complex and harder to disentangle. Thus, research programs in these latter areas are only now beginning to gather steam. As a result, our claims about these latter benefits are more speculative but the nascent research suggests immense promise for both theory-development and practice.

Motivational benefits of gaming

Game designers are wizards of engagement. They have mastered the art of pulling people of all ages into virtual environments, having them work towards meaningful goals, persevere in the face of multiple failures, and celebrate the rare moments of triumph after successfully completing challenging tasks. In this section, we do not focus on the motivations children and youth have for playing video games (see Ferguson & Olson, 2013). Instead, we aim to identify several characteristics of video games that seem to promote an effective motivational style both in and outside gaming contexts. Specifically, decades of research in developmental and educational psychology suggest that motivational styles characterized by persistence and continuous effortful engagement are key contributors to success and achievement (for a review, see Dweck & Molden, 2005).

According to Dweck and her colleagues, children develop beliefs about their intelligence and abilities which underlie specific motivational styles and directly affect achievement. Children who are praised for their traits rather than their efforts (e.g., “Wow, you’re such a smart boy”) develop an entity theory of intelligence which maintains that intelligence is an innate trait, something which is
fixed and cannot be improved. In contrast, children who are praised for their effort (e.g., "You worked so hard on that puzzle!") develop an incremental theory of intelligence; they believe intelligence is malleable, something which can be cultivated through effort and time. We propose that video games are an ideal training ground for acquiring an incremental theory of intelligence because they provide players concrete, immediate feedback regarding specific efforts players have made.

Immediate and concrete feedback in video games (e.g., through points, coins, dead ends in puzzles) serves to reward continual effort and keep players within what Vygotsky (1978) coined the "zone of proximal development." This motivational "sweet spot" balances optimal levels of challenge and frustration with sufficient experiences of success and accomplishment (Sweetser & Wyeth, 2005). Importantly, in the best games available on the market, this "sweet spot" is so effective because it adjusts itself dynamically; the difficulty level is continuously being calibrated to players' abilities through increasingly more difficult puzzles demanding more dexterity, quicker reaction times and more clever and complex solutions.

Further, research has shown that the extent to which individuals endorse an incremental versus entity theory of intelligence reliably predicts whether individuals in challenging circumstances will persist or give up, respectively (Dweck & Molden, 2005). Thus, these implicit theories of intelligence have implications for how failure is processed and dealt with. If one believes that intelligence or ability is fixed, failure induces feelings of worthlessness. But if intelligence or ability is presumed to be a mark of effortful engagement, failure signals the need to remain engaged and bolster efforts. In turn, this positive
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attitude towards failure predicts better academic performance (e.g. Blackwell, Trzesniewski, & Dweck, 2007).

Importantly, video games use failure as motivational tools and provide only intermittent chances for large-scale success. As behaviorists have documented for decades (e.g., Kendall, 1974), the kinds of intermittent reinforcement schedules that are doled out to video game players are the most effective for "training" new behaviors. We propose that being immersed in these gaming environments teaches players an essential basic lesson: persistence in the face of failure reaps valued rewards (Ventura et al., 2012). Moreover, contrary to what we might expect, these experiences of failure do not lead to anger, frustration or sadness, although players often do feel these negative emotions intermittently. Instead, or as well, players respond to failures with excitement, interest and joy (Salminen & Ravaja, 2007). When faced with failure, players are highly motivated to return to the task of "winning" and they are "relentlessly optimistic" about reaching their goals (McGonigal, 2011). The development of a persistent motivational style, charged with positive affect may, in turn, lead to lasting educational success (Ventura, Shute, & Zhao, 2012).

Almost no empirical studies have directly tested the relation between playing video games, persistence in the face of failure, and subsequent "real world" success. However, one recent study indicates that these relations may indeed exist. Ventura and colleagues (2012) used an Anagram-Riddle Task (ART) and demonstrated that the extent of video game use predicted how long participants would (outside of a gaming context) persistently attempt to solve difficult anagrams. Of course, a great deal more research is required to establish causal relations between regular gaming and persistence in the face of failure. It may be
particularly fruitful to examine, longitudinally, whether gaming predicts school achievement and whether this effect is mediated by increases in persistence.

In summary, although playing games is often considered a frivolous pastime, gaming environments may actually cultivate a persistent, optimistic motivational style. This motivational style, in turn, may generalize to school and work contexts. It is also probably the case that certain types of games will more likely foster these healthy motivational styles while others may not. Moreover, individual differences in players' personalities and preferences for game genres may also have a differential impact on motivational outcomes. New studies that are designed to take these complexities into consideration are necessary to move the field forward significantly.

**Emotional benefits of gaming**

Based on the *uses and gratifications theory*, one of the oldest and most well-validated theories in communications research (Ruggiero, 2000), among the top reasons individuals cite for using diverse forms of media are to manage their moods and to enhance their emotional states. Gaming may be among the most efficient and effective means by which children and youth generate positive feelings. Several studies have shown a causal relation between playing preferred video games and improved mood or increases in positive emotion (e.g., Russoniello, O'Brien, & Parks, 2009; Ryan, Rigby, & Przybylski, 2006). For example, studies suggest that playing puzzle video games – games with minimal interfaces, short-term commitments, and a high degree of accessibility (e.g. Angry Birds, Bejeweled II) – can improve players' moods, promote relaxation, and ward off anxiety (Russoniello, et al., 2009).
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It has been further suggested that some of the most intense positive emotional experiences are triggered in the context of playing video games (McGonigal, 2011). For instance, *fiero*, the Italian word for intense pride after succeeding against great adversity, is a feeling that gamers often report seeking and experiencing. *Flow* or *transportation* is another positive emotional experience described by gamers during which they are immersed in an intrinsically rewarding activity that elicits a high sense of control while simultaneously evoking a loss of self-consciousness (Sherry, 2004). In psychology, flow experiences have been repeatedly linked to a host of positive outcomes for adolescents, including commitment and achievement in high school (e.g., Nakamura & Csikszentmihalyi, 2002), higher self-esteem, and less anxiety (Csikszentmihalyi, Rathunde, & Whalen, 1993). Experiencing flow or transportation in games may lead to similar positive real-world outcomes; however, this hypothesis remains untested.

Although not specific to game-playing, the importance of experiencing positive emotions on a daily basis has been elaborated in Fredrickson's (2001) broaden-and-build theory of positive emotions. She demonstrates that experiencing positive emotions may help *broaden* the number of behaviors one perceives as both possible and motivating, and may *build* social relationships that provide support for goal pursuit and coping with failure. Further, Fredrickson and colleagues propose that positive emotions help undo the detrimental and demotivating results of negative emotions. Positive emotions are thus the bedrock for well-being, crucial not only as end-states but as sources of inspiration and connectivity. If playing games simply makes people happier, this seems to be a fundamental emotional benefit to consider.
Although it is clear that games are fun and that they elicit positive emotions, there remain unanswered questions regarding the consequences of positive emotional experiences during video game play. For instance, puzzle games have been empirically shown to trigger positive emotions, but these games are designed for brief, intermittent play. The extent to which games designed for long-term engagement also foster positive changes in mood is unclear. Further, although correlational studies suggest that individuals consciously turn to these games to regulate their emotions (Olson, 2010), it may simply be that positive moods and game-playing co-occur and players report retrospectively that experiencing positive emotions was a conscious motivation that preceded play. We therefore need temporally-sensitive designs (e.g., diary studies) to more rigorously assess whether youth in negative moods play games because they want to stop feeling badly and, crucially, the extent to which playing these games predicts their mood improvements at subsequent time points. Finally, it is important to study the extent to which turning to video games to feel better is adaptive, and at what point using games becomes an avoidant strategy that leads to more negative outcomes.

Evaluating the emotional benefits of video games leads to the study of emotion regulation in these contexts. Simple up-regulation of positive emotions is one emotion-regulation strategy that has been linked to beneficial outcomes (e.g., Fredrickson, 2001) but there may be additional emotion-regulation benefits of playing video games. Games do not only elicit positive emotions; video games also trigger a range of negative ones including frustration, anger, anxiety and sadness. But similar to Gottman's research (1986) on the function of traditional play, the pretend context of video games may be real enough to make the accomplishment of goals matter, but also safe enough to practice controlling, or modulating, negative emotions in the service of those goals. Adaptive regulation strategies
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such as acceptance, problem-solving and reappraisal have been repeatedly linked to less negative affect, more social support, and lower levels of depressive symptoms (Aldao, Nolen-Hoeksema & Schweizer, 2010). These same adaptive regulation strategies seem to be rewarded in gaming contexts because their use is concretely and clearly linked to goal achievement. For example, reappraisal (a cognitive "habit" involving reevaluations of a situation or one's ability to cope with that situation) is a well-established emotion-regulation strategy (Gross & John, 2003) that appears to be fundamental for many video games. Games continuously provide novel challenges, demanding players to shift already-established appraisals to new ones in order to most efficiently reach goals. For example, Portal 2, an immensely popular first-person puzzle game, challenges the player to solve intricate maze-like problems by exploiting physics-based rule structures. As soon as a player masters one type of puzzle, however, the rules change drastically, frustrating players, and often triggering anxiety while also forcing the player to "un-learn" their previous strategies and flexibly switch their appraisal system to uncover the new rule structure. Without applying reappraisal strategies, anxiety and frustration would likely be amplified. This continual switching of whole systems of rules is also evident in certain role-playing games (e.g., World of Warcraft, Pokémon, Final Fantasy) wherein players cultivate an array of avatars, each with its own unique skillset (e.g., healers, warriors, sorcerers), allegiances, associated social behaviors, advantages and vulnerabilities. Many players switch among these avatars, forcing themselves to fluidly adjust to unique social and emotional goals. Thus, game playing may promote the ability to flexibly and efficiently reappraise emotional experiences, teaching players the benefits of dealing with frustration and anxiety in adaptive ways. In contrast, less adaptive strategies, like rumination (Aldao et al., 2010) are less likely to be rewarded by
video games, because they impede players from reacting quickly and flexibly to constantly changing, often frustrating, challenges.

The extent to which adaptive emotion regulation skills are learned through gaming remains speculative at this point but testing these ideas seems like an exciting new area for future programs of research. Importantly, the type of contexts that most often pull for effective emotion regulation strategies – such as reappraisal – are social in nature.

**Social benefits of gaming**

Perhaps the biggest difference in the characteristics of video games today, compared to their predecessors of 10 to 20 years ago, is their pervasive social nature. Contrary to stereotypes, the average gamer is not a socially isolated, inept nerd who spends most of his time alone loafing on the couch (Lenhart et al., 2008). Over 70% of gamers play their games with a friend, either cooperatively or competitively (ESA, 2012). For example, *World of Warcraft* – a multiplayer fantasy game set in a massive virtual world – boasts 12 million regular players and *Farmville* – one of the most popular social networking games on Facebook – hosted over 5 million daily users in 2012 (Socialdon, 2012). In these virtual social communities, decisions need to be made on the fly about whom to trust, whom to reject, and how to most effectively lead a group. Given these immersive social contexts, we propose that gamers are rapidly learning social skills and prosocial behavior that might generalize to their peer and family relations outside the gaming environment (Gentile & Gentile, 2008; Gentile et al., 2009).

Players seem to acquire important prosocial skills when they play games that are specifically designed to reward effective cooperation, support, and helping
behaviors (Ewoldsen, Eno, Okdie, Guadango, & DeCoster, 2012). One study that summarized international evidence from correlational, longitudinal, and experimental studies found that playing prosocial video games consistently related to, or predicted, prosocial behaviors (Gentile et al., 2009). More specifically, playing prosocial games led to causal, short-term effects on "helping" behaviors and, longitudinally, children who played more prosocial games at the beginning of the school year were more likely to exhibit helpful behaviors later that year. It may be tempting to conclude from this work that games with exclusively non-violent, prosocial content lead to prosocial behavior. But compelling work is just emerging that seems to refute this simple interpretation, suggesting that violent games are just as likely to promote prosocial behavior. The critical dimension that seems to determine whether violent games are associated with helping, prosocial behavior versus malevolent, antisocial behavior is the extent to which they are played cooperatively versus competitively. For example, players who play violent games that encourage cooperative play are more likely to exhibit helpful gaming behaviors online and offline than those who play nonviolent games (Ferguson & Gaza, 2011) and playing violent video games socially (in groups) reduces feelings of hostility compared to playing alone (Eastin, 2007). Likewise, violent video games played cooperatively seem to decrease players' access to aggressive cognitions (Schmierbach, 2010; Valez, Mahood, Ewoldsen, & Moyer-Guse, 2013). Two recent studies have also shown that playing a violent video game cooperatively, compared to competitively, increases subsequent prosocial, cooperative behavior outside of the game context (Ewoldsen et al., 2013) and can even overcome the effects of outgroup membership status (making players more cooperative with outgroup members than if they had played competitively; Velez et al., 2013). Conversely, recently published experimental studies (Tear & Nielsen, 2013)
suggest that even the most violent video games on the market (Grand Theft Auto IV, Call of Duty) fail to diminish subsequent prosocial behavior. All of these studies examined immediate, short term effects of cooperative play but they point to potential long-term benefits as well. The social benefits of cooperative versus competitive game play needs to be studied longitudinally, with repeated assessments, to have clearer implications for policy and practice.

Social skills are also manifested in forms of civic engagement: the ability to organize groups and lead like-minded people in social causes. A number of studies have focused on the link between civic engagement and gaming. For example, one large-scale U.S. representative study (Lenhart et al., 2008) showed that adolescents who played games with civic experiences (e.g., Guild Wars 2, an MMORPG) were more likely to be engaged in social and civic movements in their everyday lives (e.g., raising money for charity, volunteering, and persuading others to vote). Unfortunately, as is the case with most survey studies in the field, this study did not differentiate the causal direction of effects.

“Serious” games in health and education

Up to this point, we have reviewed a diverse set of potential benefits of gaming relevant to children’s cognitive, motivational, social, and emotional development. The medical field has picked up on these positive effects and become increasingly interested in "gamifying" medical interventions (Ritterfeld, Cody, & Vorderer, 2009), as evidenced by the emergence of a new journal (Games for Health Journal), calls for proposals from major granting agencies (e.g., National Science Foundation; European Research Council), and some highly successful “serious
The benefits of playing video games

games" that have made international headlines for their promising outcomes. Researchers and practitioners alike in the medical field have begun to harness the power of video games to motivate and, ultimately, to improve their health outcomes (for a review, see Kato, 2010).

Perhaps the most celebrated success story of a game that had a significant impact on health-related behaviors is the case of *Re-Mission* (Kato, Cole, Bradlyn, & Pollock, 2008), a video game designed for child cancer patients. By shooting cancer cells, overcoming bacterial infections, and managing signs of nausea and constipation (common barriers to cancer patients' treatment adherence), the game aimed to teach children how best to adhere to their cancer treatments. A randomized controlled study conducted internationally in thirty-four medical centers compared children assigned to play *Re-Mission* to a control group of children playing another computer game (Kato et al., 2010). Adherence to treatment protocol, self-efficacy, and cancer-related knowledge were all significantly greater in the intervention group. The game has now been distributed to over 200,000 patients and continues to be viewed as a successful treatment approach.

The promise of video games has also made a great stir in the field of education. Space limitations preclude a review of the myriad of games developed to improve educational outcomes in almost every subject taught in schools. Several reviews already exist on the learning outcomes associated with educational games (e.g., O'Neil, Wainess, & Baker, 2005) and a meta-analysis concluded that games can make important advances in the educational reform necessary to deal with the learning challenges of the next century (Vogel et al., 2006).
Despite the emerging hype regarding the "gamification" of interventions in the health and educational sciences, caution is also warranted. The most important reason is that very few of the games developed to improve health and learning outcomes are ever scientifically evaluated. As a result, it is still unknown how much more effective these games are in changing behavioral and health outcomes compared to conventional approaches. The second shortcoming is that medical practitioners, teachers, and researchers, are not game designers and, as a result, they often develop products that miss the most essential mechanism of engagement in games – the fun. In an effort to pull together a set of valid principles or lessons, games for health and education often end up with the "chocolate-covered broccoli" problem – the games look great, they are good for you, but they ultimately fail to work because the creative game dynamics that induce transportation and immersion are missing, making them simply not fun. We highlight these shortcomings in the domain of games for health in particular because the same cautionary notes should be taken seriously if (and when) psychologists consider developing games for mental health. We now turn to a discussion of more general limitations of the gaming literature and attempt to address these limitations with suggestions for novel research directions.

Challenges and future research directions

By highlighting the positive effects of playing a wide range of video games, it is not our intention to gloss over their very real potential for harm. Indeed, important research has already been conducted for decades on the negative effects of gaming, including addiction, depression, and aggression (Anderson et al., 2010; Ferguson, 2007) and we are certainly not suggesting that this body of research
The benefits of playing video games

should be ignored. For example, two large-scale survey studies have found that 3% of Dutch (Rooij, Schoenmakers, Vermulst, van den Eijnden & van de Mheen, 2010) and about 8% of U.S. youth (Gentile, 2009) who play video games exhibit pathological symptoms of addiction (i.e., damage to family, school, or psychological functioning). Also, two major meta-analyses have been published on the series of studies on aggressive behavior and violent video games (Anderson et al., 2010; Ferguson, 2007). Unfortunately, these meta-analyses, which dealt with almost the same data pool, reached very different conclusions. Ferguson and his group (see Ferguson, 2013) have argued that the effect sizes are so small, they provide little meaningful predictive power, and the methodological weaknesses in the field make it almost impossible to come to any conclusion. In stark contrast, Anderson, Bushman and their colleagues (Anderson, et al., 2010; Anderson & Bushman, 2002) counter that, although the effect sizes may be small, they are reliable even after controlling for a variety of potential confounding factors, such as socioeconomic status, IQ, and previous aggressive behavior problems. Ultimately, both camps have valid points and perhaps the most important lesson from these conflicting meta-analyses is that the picture is much more complex than popular press headlines suggest (Ferguson, 2013).

If the popular press simplifies the effects of video games, it is no less true for most psychological research. By dichotomizing video games into either "good" or "bad;" "violent" or "prosocial," the complex new playground of contemporary video games and the varied landscape of virtual interactions taking place in those games are largely being overlooked by psychologists (with the exception of media psychologists). Players are drawn towards different types of games based on individual differences on a variety of factors including personality differences, their own needs assessments, their mood, and so on (e.g., Tamborini, Bowman, Eden,
Grizzard, & Organ, 2010). The games people choose to play, in turn, exert diverse influences on players' motivations, emotional states and social interactions. Moreover, most popularly played games today are complex and change dynamically (see top half of Figure 1) which means that players' in-game behaviors change how the game itself progresses, feeding back to, and constraining, how the player continues to adapt to these changes in subsequently updated game contexts (Klimmt, Vorderer, & Ritterfield, 2007). Games that are fundamentally social and rely on varied social partners also provide a large amount of variability in game experiences, depending on who the player encounters each time she enters the gaming world. Ultimately, these dynamic features mean that there is a certain element of uniqueness to each player's experience, each time she plays even the very same game. Thus, the question for psychological research on gaming is not what games are "good" or "bad" for us; rather, it seems important to start by acknowledging the growing complexity and interactivity and, from there, develop equally complex models to explain how gaming influences players in relevant cognitive, social and emotional domains.

Towards that aim, there are several methodological drawbacks to gaming research that, if addressed, provide novel concrete directions for future research. First, there are very few, if any, well-designed published studies that examine *both* the positive and negative effects of the same games and the conditions under which these effects are most likely manifested, whether they are violent in nature or otherwise. Second, the majority of studies on video games (both on the negative and positive effects) continue to depend on survey assessments. Although self-report and retrospective assessments are useful, relying exclusively on these data limits our understanding. Instead, a more multi-method approach seems to be warranted, in which objective observations of in-game behaviors are associated
The benefits of playing video games with immediate and long-term "real-world" effects. These methods can also fruitfully incorporate psychophysiological and neural assessments that may be better able to identify the emotional, cognitive, and neural changes associated with playing video games (Bavelier et al., 2011).

Another limitation of past approaches is the almost exclusive focus on the short-term impact of games; very few longitudinal studies have been conducted in this area. Moreover, no studies have assessed the daily patterns of gaming and the function that these patterns of use may serve. Diary studies, combined with observational and survey methods that are repeated over months and years, would be immensely useful to clarify the details of daily playing and its long-term impact. These studies would be especially helpful if they began their baseline assessments in childhood, prior to children's exposure to games. These types of developmental designs can yield some substantive data about how much game-playing is too much, information urgently sought after by parents, teachers, and clinicians alike. We also need information on whether different types of games are not only beneficial but also appropriate to play at specific developmental stages and whether there are specific benefits that are procured during specific developmental windows and not others. As it stands, the suitability ratings ascribed to games by the entertainment industry (e.g. E for Everyone, M for not appropriate for children under the age of 18) are based on little to no scientific evidence regarding potential harms or benefits. Finally, without longitudinal designs that are explicitly designed to disentangle selection from influence effects as much as possible, it is impossible to know whether games directly cause changes in emotions, cognitions, and social functioning or whether children with certain characteristics select particular games that match these characteristics.
Finally, the vast majority of previous work has examined children's and adolescents' experiences with single-player games, ignoring the fact that more than 70% of individuals play games socially, online or in person, with friends and acquaintances (ESA, 2012). Although studies that track multiplayer, social interactions on- and offline are vastly more complex than focusing on single-player experiences, they are also far more ecologically valid given that these are the games in which youth are increasingly immersed.

**Implications for mental health interventions**

Given that video games have permeated almost all households, across almost all countries, it is striking how little attention has been paid to using this medium for purposes that go beyond entertainment and beyond demonstrated benefits for education and health care. Although we have chosen to avoid taking part in the debate regarding the harms versus benefits of gaming, there is one point that both sides are advocating with which we fervently agree: video games hold immense potential to teach new forms of thought and behavior. We argue that this learning potential has been left largely untapped in the mental health arena, and addressing this gap holds a great deal of promise for a radical new approach to intervention.

Our expertise is in the area of developmental psychopathology, where we contend video games can have a particularly large impact. The vast majority of evidence-based interventions in this field are based on cognitive-behavioral principles (see Kendall, 2011). Despite optimistic conclusions about the effectiveness of cognitive-behavioral therapy (CBT), overarching limitations have also been pointed out (see Kazdin, 2011 for review). We propose that video games
The benefits of playing video games can uniquely and significantly address these limitations and, in turn, improve intervention effects across a broad spectrum of disorders.

The first limitation of a number of evidence-based approaches, particularly those oriented around CBT principles, is that they largely rely on imparting psychoeducational information, usually in some didactic style (albeit with efforts to make these lessons interactive). Learning about cognitive biases, the extent to which our feelings are intricately linked to our thoughts and how this interaction underpins behavior and effective problem-solving strategies is, indeed, critical. However, children and adolescents, especially those who do not recognize that they have a mental health problem or are not motivated to change, often find these lessons boring. Engaging children and youth is one of the most challenging tasks faced by clinicians (Crenshaw, 2008). A video game that can impart this same knowledge, but use elements of play and game mechanics that have proven immensely engaging, may help to address this barrier. Indeed, a fantasy role-playing game based on CBT for depression was recently developed (*SPARX*) to explicitly increase engagement and a randomized controlled trial showed it to be as effective in treating depression as a therapist-administered CBT program (Merry et al., 2012).

A second, related barrier to the majority of CBT approaches is that these programs do an adequate job of imparting new knowledge, but they leave a large gap between what youth actually *know* and what they *do* in their everyday lives. This gap between knowledge and behavior has long been recognized as a problem in the field and, thus, many interventions incorporate role-playing, problem-solving exercises, and homework assignments (e.g., Kendall, 2011). But these are mostly de-contextualized exercises that rarely involve the authentic emotional
experiences during which most conflicts arise. Developing therapeutic video games can address this gap because they engage players in immersive emotional experiences (eliciting a range of emotions) and provide opportunities to practice new regulatory skills until they are automatized, canalizing new neural patterns which can lead to generalization outside the game.

A third challenge faced by many intervention programs is access to care. Many people, often those most in need of care, have a difficult time accessing treatment programs because they either live in hard-to-reach rural locations, they work or go to school during treatment hours, or they are physically or psychologically unable to commute. Adolescents, minority youth, and the elderly are particularly likely to face these challenges. Games designed for mental health interventions can reach these populations because they can be delivered to wherever clients reside, with little cost and effort. Moreover, it is likely that games are associated with less stigma than conventional therapy, addressing another barrier. Finally, the cost effectiveness of delivering mental health interventions is often a barrier to treatment delivery. Many children and families cannot afford individual or group therapy, and schools worldwide are facing cuts in funding that have significantly decreased the number of programs that can be offered as part of the curriculum. Games are simply cheaper, given that there are no costs associated with therapists’ time and training, renting facilities, and so on.

It bears emphasizing that we are by no means advocating the elimination or replacement of the many intervention practices already used. In fact, there is strong evidence for the effectiveness of particular qualities of conventional intervention approaches that are difficult to incorporate in a game, including the healing effects of a strong therapeutic alliance (e.g., Green, 2005) and the benefits
of experiencing emotional and social support in group-based interventions (e.g., Fine, Forth, Gilbert, & Haley, 1991). It may be ideal to combine established intervention approaches with the use of video games to enhance motivation, increase engagement, and provide varied opportunities for practicing new skills in flexibly designed contexts.

Conclusions

We began this paper by summarizing the rich and long history of the study of play. Video games share many similarities to traditional games and likely procure similar benefits as play more generally. Both traditional and video games are fundamentally voluntary in nature, they can include competitive and cooperative objectives, players immerse themselves in pretend worlds which are safe contexts through which negative emotions can be worked out and games allow a sense of control with just enough unpredictability to feel deep satisfaction and intense pride when formidable goals are finally reached. Yet video games today and those on the radar for development in the near future are also unique. Video games are socially interactive in a way never before afforded. Increasingly, players are gaming online, with friends, family, and complete strangers, crossing vast geographical distances and blurring not only cultural boundaries, but also age and generation gaps, socioeconomic differences, and language barriers. The large amount of time invested in playing video games may also provide qualitatively different experiences than conventional games. Although we may remember spending whole weekends playing Monopoly with siblings and neighbors, few traditional games can boast the weeks and months of gameplay that many video games provide. These differences in space and time likely hold wholly new benefits and risks that have yet to be conceptualized.
After pulling together the research findings on the benefits of video games, we have become particularly inspired by the potential that these games hold for interventions that promote well-being, including the prevention and treatment of mental health problems in youth. Remarkably, there are very few video games that have been developed with these aims in mind. Given how enthralled most children and adolescents are with video games, we believe that a multidisciplinary team of psychologists, clinicians and game designers can work together to develop genuinely innovative approaches to mental health intervention.
WORLD I

A longitudinal project into the long-term relationships between gaming & psychosocial development in children
Chapter III

Correlations between gaming and psychosocial health, and the importance of using multiple reporters in gaming research

Published as:
Abstract

Video games are a highly heterogeneous form of entertainment. As recent reviews highlight, this heterogeneity makes likely that video games have both positive and negative consequences for child development. This study investigated the associations between gaming frequency and psycho-social health among children below the age of twelve, an understudied cohort in this field. Both parents and children reported children's gaming frequency, with parents also reporting on children's psycho-social health. Given that children may be too young to accurately report the time they spend playing video games, children's reports were scaffolded by a developmentally appropriate measure. We further investigated the potential bias of having parents report both their children's gaming frequency and their children's psycho-social health (i.e. a single source bias). Parental reports of children's gaming frequency was higher than their children's; however a direct test of the potential single source bias rendered null results. Notably however, while parental reports showed negative associations between gaming and psycho-social health, children's reports showed no associations. Specifically, based on parent reports, children's gaming was associated with more conduct and peer problems, and less pro-social behavior. As children's reports produced no associations between gaming and psycho-social health, parental reports in this study may belie an erroneous set of conclusions. We therefore caution against relying on just one reporter when assessing children's gaming frequency.
Introduction

Video games have become an inevitable facet of children’s lives. This may have numerous consequences; video games have been identified as a potentially deleterious influence on children’s aggressive tendencies (Anderson et al., 2010), emotional health (Gentile, 2009), and attention retention skills (Chan & Rabinowitz, 2006; Swing, Gentile, Anderson, & Walsh, 2010). Yet, despite claims of children’s susceptibility to negative gaming effects (Gentile & Gentile, 2008), most research has been limited to adolescent and young adult samples. Further, the limited studies with child samples are inconsistent in how they assess the frequency with which children play video games, relying on either parental or child reports but never including both to investigate potential differences in reporter effects. The current study addresses these gaps by assessing psycho-social health in children and by acquiring both parent and child reports of gaming frequency.

Video games are a quickly evolving medium. With the availability of video games on mobile and non-mobile devices, and mainstream game-makers striving for more complex visuals and play mechanics, today’s video games offer a highly diverse array of possible interactions (Granic, Lobel, & Engels, 2014). Video games today are popular among adults as well as children (Entertainment Software Association, 2013), more social in nature, and they show a younger age of onset than in the past (Gentile & Sesma, 2003; NPD Group, 2011). These changes raise several issues for video game research. First, they indicate that study outcomes may quickly become outdated (Hastings et al., 2009), necessitating ongoing research to understand the effects of the most modern games. Second, research which treats video games as a homogenous entity may be less likely to unveil valid and reliable effects of game playing (Bavelier et al., 2011). While research has
predominantly taken the position that video games have negative developmental consequences (Anderson et al., 2010; Gentile, Lynch, Linder, & Walsh, 2004), recent reviews (Adachi & Willoughby, 2013; Granic et al., 2014) suggest that these same games may confer psycho-social benefits. In particular, video games may facilitate social bonding through cooperation (Coyne, Padilla-Walker, & Stockdale, 2011), provide a training ground for emotion regulation skills (Johnson, Wyeth, & Sweetser, 2013; Lobel, Granic, Stone, & Engels, 2014), and promote healthy motivational styles for dealing with real world failure (Granic et al., 2014; Ventura, Shute, & Zhao, 2013). However, these hypotheses are rarely researched. Finally, given gaming’s increased prevalence among young children, this population seems particularly relevant for research. However, few studies have investigated the associations between video game playing and psycho-social health in children.

For instance, only ten studies have examined the potential effects of violent video game play on aggression (Bensley & Van Eenwyk, 2001; Hastings et al., 2009) in children under the age of twelve. Of these studies, nine and seven of them were conducted before the years 2000 and 1990 respectively. These studies therefore investigated violent video gaming in periods when video games were far less dynamic and social than today’s games. Still, in a recent correlational study, parent reports on their children’s gaming habits and psycho-social health revealed a positive association between game playing and aggression and attentional difficulties (Hastings et al., 2009).

The present study had two goals. First, it aimed to add to the limited amount of gaming literature on children below the age of twelve. This is an important group for study as several developmental differences between children and adolescents and adults make them potentially more susceptible to gaming
effects (Anderson et al., 2010). Namely, children have poorer working memory (Gathercole, Pickering, Ambridge, & Wearing, 2004) and executive functioning (Zelazo, Craik, & Booth, 2004), and seem to have a poorer ability to differentiate between emotional states (Lindquist & Barrett, 2014). Second, it aimed to investigate the potential single source bias that could account for past findings relating children’s gaming frequency to negative psycho-social development. The single source bias is a form of shared-method variance where the same reporter is used to measure both the study’s predictor and predicted variables (Orth, 2013).

It is worth distinguishing between parent and child reports of children’s gaming for at least two reasons. First, compared to their children, parents likely provide higher estimates of their children’s game playing (Funk, Hagan, & Schimming, 1999); this could be because parents perceive video games as a dominant aspect of children’s lives. Second, parents and children are susceptible to different reporting biases (Swing et al., 2010); parent’s estimates may hinge on their opinions of video games being better or worse for their children. These issues seem more problematic in studies where parents report on both their children’s gaming habits and their psycho-social health (Hastings et al., 2009), increasing the likelihood of single source bias (Burk & Laursen, 2010). In such cases, parents may have preconceived notions about gaming’s influence on their children’s lives, potentially manipulating their responses. These potential biases have strong implications; particularly, relying solely on parental reports may exaggerate the evidence for gaming’s detrimental effects.

In studies of young children, the choice to use parent reports for both time spent gaming and children’s development has been defended based on how difficult it is to get young children to accurately report time-sensitive questions
(Welk, Corbin, & Dale, 2000). To resolve this, we implemented a developmentally appropriate method for attaining accurate reports of gaming frequency from children – a gaming calendar. Derived from similarly used methods (Gentile et al., 2004; Swing et al., 2010), children filled in a calendar with the help of an interviewer, responding yes-or-no to whether they had played video games during 21 discrete periods of the past week. This method likely aids recall by giving children a concrete schema, and allows children to talk through their usage with an interviewer.

**Design and hypotheses**

In the present study, both parents and children estimated children’s gaming frequency. Parents reported their children’s number of hours spent gaming, with children also providing estimates of hours gaming, scaffolded by them completing a gaming calendar. These measures were correlated with children’s psycho-social health, namely aggressive tendencies, emotional health, hyperactivity, peer relations, and prosocial behavior. Based on recent literature highlighting the potential benefits of gaming, we expected video game playing to be positively associated with psycho-social health. In line with past research (Funk et al., 1999), we also expected parents to report a greater amount of gaming frequency than their children. Lastly, we tested whether this expected difference reflects the influence of a single source bias, something not previously examined in this field. We therefore expected the correlations between parental reports of gaming and psycho-social health to be less positive than the correlations between children's reports of gaming and psycho-social health.
Method

Participants

Dutch children aged 7 to 12 years old (n = 194, age range 7.27–11.43, M = 9.22, SD = 1.14 years old) along with their primary caregiver (age range 29.95–51.47, M = 41.88, SD = 3.66 years old; n = 174) participated in this study. Twenty children also had a sibling participate. Participants were recruited from a pool of 298 participants already participating in research which tracked children’s psycho-social health (Stone, Otten, & Engels, 2010). Participants were contacted via letters sent to their homes and follow-up phone invitations. The children’s gender was evenly split (boys n = 98), and 86.6% of parent reporters were female (n = 168); with the exception of three adopted mothers and one adopted father, all parents were the child’s biological parent. 96.9% of parents were Dutch (n = 188), with the others coming from Suriname (n = 1) or nearby European countries (n = 5).

Procedure

Data were collected during home visits. Children provided self-reports during a face-to-face interview with an experimenter. Parents provided their survey responses via an online questionnaire. Parents were rewarded a 20 Euro voucher check (per child) for their participation.

Measures

Psycho-social health. Psycho-social health was measured along five dimensions by parent’s reports on the reliable and widely-used Strengths and Difficulties Questionnaire (SDQ (Goodman, 1997); Dutch version (van Widenfelt, Goedhart, Treffers, & Goodman, 2003)). The SDQ is comprised of five sub-scales: (a) emotional symptoms, (b) conduct problems, (c) hyperactivity/inattention, (d) peer
relationship problems, and (e) prosocial behavior. All sub-scales consist of five items using a 3-point Likert scale (0–2 Not true to Very true), and, except for the “conduct problems” sub-scale, all sub-scales showed acceptable to good reliability – (a) emotional symptoms (sample: Many worries, often seems worried, $a = .72$); (b) conduct problems (sample: Often fights with other children or bullies them, $a = .54$); (c) hyperactivity (sample: Restless, overactive, cannot stay still for long, $a = .80$); (d) peer problems (sample: Rather solitary, tends to play alone, $a = .68$); and (e) prosocial behavior (sample: Shares readily with other children, $a = .69$). Sum scores were calculated for each sub-scale, and the sum scores of all scales except for prosocial behavior were summed to create a total difficulties score ($a = .81$).

**Gaming frequency.** Children's frequency of video game playing was assessed by: (1) Parental reports for the number of hours their child plays on average per week; (2) Child reports for the number of hours they had played video games during the past week; (3) Children’s ability to recall their gaming hours across a whole week was scaffolded by an additional measure of gaming frequency: In interviews, children looked over a calendar with the experimenter and indicated for each day over the past full week whether or not they had played a video game in the morning, afternoon, and evening. Moderate correlations were observed across all frequency measures ($r \geq .47, p < .001$), supporting the validity of the calendar measure. No interviewer bias was observed; across the study’s five interviewers, child reports for hours gaming ($F(4, 188) = 1.111, p = .353$) and the calendar ($F(4, 188) < 1$) showed no differences.
Planned analyses

To investigate the relationship between video game play and psycho-social health, each outcome measure was correlated with the three measures of children's gaming frequency. As a preliminary step before performing these correlations, we tested for gender differences on all variables to determine whether gender should be controlled for. To explore a potential single reporter bias, we first compared parent and child reports of children's gaming frequency. Parent reports were separately compared to each child measure. We then performed a Fischer's $r$-to-$z$ transformation (Fisher, 1915) to test whether the associations between parental reports of both children's gaming frequency and their psycho-social health would differ from associations between child reports of their gaming frequency and parental reports of children's psycho-social health.

Results

Descriptives

Data from one child (and his parent) was excluded because the child did not complete the gaming calendar. Both parent's and children's reported hours of gaming were corrected for outliers, with the maximum number of reported hours being cut-off at three standard deviations above the mean (parent reports: $M = 5.76, SD = 3.87$, outliers $n = 4$; child reports: $M = 4.86, SD = 4.25$, outliers $n = 6$). Children reported an average of 7.88 discrete play sessions per week ($SD = 4.15$).

Gender differences

We observed several gender differences (Table 1): regarding the SDQ, parents reported boys to be more hyperactive, less prosocial, and to have more total difficulties. Regarding gaming frequency, consistent with past studies, both
parents and children indicated that boys play video games more. These gender differences led us to control for gender by running partial correlations.

**Gaming and psycho-social health**

For the relationship between gaming and psycho-social health, we observed a number of differences between parent and child reports (Table 2). Against our predictions, for parental reports, hours gaming was associated with more conduct and peer problems and with less prosocial behavior. Against our predictions, for child reports, no associations were observed between hours gaming and psycho-social health. Further, no associations were observed between child’s calendar reports and psycho-social health.

### Table 1. Gender differences

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<td><strong>SDQ</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotion</td>
<td>2.07</td>
<td>2.17</td>
<td>1.83</td>
<td>1.94</td>
<td>0.81</td>
<td>0.422</td>
</tr>
<tr>
<td>Conduct</td>
<td>1.19</td>
<td>1.48</td>
<td>0.82</td>
<td>1.28</td>
<td>1.82</td>
<td>0.071</td>
</tr>
<tr>
<td>Hyper</td>
<td>3.52</td>
<td>2.63</td>
<td>2.48</td>
<td>2.38</td>
<td>2.87</td>
<td>0.005*</td>
</tr>
<tr>
<td>Peer</td>
<td>1.36</td>
<td>1.65</td>
<td>0.93</td>
<td>1.58</td>
<td>1.86</td>
<td>0.064</td>
</tr>
<tr>
<td>Prosocial</td>
<td>6.53</td>
<td>1.65</td>
<td>7.01</td>
<td>1.28</td>
<td>-2.28</td>
<td>0.024*</td>
</tr>
<tr>
<td>Total</td>
<td>8.13</td>
<td>5.23</td>
<td>6.06</td>
<td>5.25</td>
<td>2.75</td>
<td>0.007**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>t</td>
<td>p</td>
</tr>
<tr>
<td><strong>Gaming frequency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent hours</td>
<td>6.74</td>
<td>3.96</td>
<td>4.62</td>
<td>2.95</td>
<td>4.21</td>
<td>&lt;.001**</td>
</tr>
<tr>
<td>Child hours</td>
<td>5.93</td>
<td>4.21</td>
<td>3.85</td>
<td>3.67</td>
<td>3.65</td>
<td>&lt;.001**</td>
</tr>
<tr>
<td>Child calendar</td>
<td>9.28</td>
<td>3.99</td>
<td>6.47</td>
<td>3.83</td>
<td>4.99</td>
<td>&lt;.001**</td>
</tr>
</tbody>
</table>

**Note.** SDQ = Strengths and Difficulties Questionnaire. * = p ≤ .05; ** = p ≤ .01.
Comparisons between parent- and child-reported gaming

When comparing reports of children's gaming frequency across parents and children, we observed that, compared to their children, parents tended to report their children playing more video games per week (parent hours = 5.69, child hours = 4.9; \( t = 3.08, p = .002 \)). This was true for both boys and girls (parent hours = 6.74, boys hours = 5.93, \( t = 2.03, p = .045 \); parent hours = 4.63, girl hours = 3.85, \( t = 2.39, p = .019 \)). To compare parent and child reports for the strength of the associations between hours gaming and psycho-social health, partial correlations were conducted with gender partialled out. Partialled correlations between frequency and each psycho-social health measure were compared across reporters using Fisher's \( r \)-to-\( z \) transformation. No significant differences were observed.

Table 2. Partial correlations controlling for gender

<table>
<thead>
<tr>
<th></th>
<th>Emotion Problems</th>
<th>Conduct Problems</th>
<th>Hyperactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( r )</td>
<td>( p )</td>
<td>( r )</td>
</tr>
<tr>
<td>Parent hours</td>
<td>0.131</td>
<td>0.071</td>
<td>0.15</td>
</tr>
<tr>
<td>Child hours</td>
<td>0.105</td>
<td>0.146</td>
<td>0.122</td>
</tr>
<tr>
<td>Child calendar</td>
<td>-0.08</td>
<td>0.265</td>
<td>0.058</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Peer Problems</th>
<th>Prosocial Behavior</th>
<th>Total Difficulties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( r )</td>
<td>( p )</td>
<td>( r )</td>
</tr>
<tr>
<td>Parent hours</td>
<td>0.166</td>
<td>0.022*</td>
<td>-0.176</td>
</tr>
<tr>
<td>Child hours</td>
<td>0.082</td>
<td>0.256</td>
<td>-0.12</td>
</tr>
<tr>
<td>Child calendar</td>
<td>0.092</td>
<td>0.204</td>
<td>-0.04</td>
</tr>
</tbody>
</table>

*Note.* Total difficulties is the sum score of the emotion problems, conduct problems, hyperactivity, and peer problems sub-scales. * = \( p \leq .05 \);
This study investigated the associations between video game play and psycho-social health in children under the age of twelve. With video games increasingly becoming a context for positive emotions and social interaction, we expected video game play to be positively associated with psycho-social health. Further, we investigated the potential influence of a single source bias, where parental reports of gaming frequency were expected to be, compared to children's reports, less positively associated with psycho-social health.

The main outcome of this study was that parent and child reports provided a different account of the association between video game playing and psycho-social health. Whereas parental reports of children's gaming frequency was associated with more conduct, and peer problems, and less prosocial behavior, child frequency reports revealed no such associations. This discrepancy is especially noteworthy for two reasons. First, cross-reporter outcomes are considered more internally valid than same-reporter outcomes (Burk & Laursen, 2010). This is because cross-reporter outcomes are free from single source bias. Second, null findings were observed for both child reports of their gaming frequency, which were both provided during face-to-face interviews. Thus, had parents been the sole reporters in this study – as in past research (Hastings et al., 2009) – this study would have concluded that gaming is negatively associated with children's psycho-social health. This conclusion seems less valid given its failure to replicate based on child reports.

This discrepancy between parent and child reports indicates a potential single source bias. However, no significant differences were observed in the magnitude of the relationship between gaming frequency and psycho-social health.
across reporters. This could have multiple implications. First, that no reporter bias was present; that is, the difference in findings between parents and children were solely due to chance. We maintain that this is unlikely given that parental reports have also been previously shown to indicate negative associations between children's gaming and their psycho-social health (Hastings et al., 2009). We therefore consider it more likely that the same-reporter bias was too small an effect to be detected in a sample of this size. Furthermore, the observed associations between parental reports of gaming frequency and psycho-social health were all relatively small. These small associations may limit the extent to which the same-reporter bias can be of influence.

**Limitations and future research**

This study has several limitations. First, this study's cross-sectional design limits the conclusions that can be drawn. It is possible that psycho-social benefits or difficulties emerge as gaming frequency increases over time. Second, this study did not measure several potential moderators related to gaming. These variables include the type of video game played (e.g. role-playing, shooting, or sport games, each with drastically different goals, and play systems), violent content, the tendency to play socially, and the tendency to play cooperatively and competitively. We have argued that "video games" is an overly broad construct because of the high variability in these factors across games. There could be a number of complex interactions between these factors, for instance that competitive play of sport games may show different associations with psycho-social health than competitive play of shooting games. To properly explore the range of possible interactions between game type, game content, and play style, would require a sample size much larger than the one acquired for this study. The type of video games played may also be relevant when considering the single
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source bias; if parents observe their children playing more violent or stress-inducing games, this may preclude them to over-estimating the potential negative impact of video games. Finally, the conduct problems subscale of the SDQ showed low reliability; this calls into question the validity of the observed negative association between gaming frequency and conduct problems.

Given these limitations, and the observed null associations between children’s reported gaming frequency and psycho-social health, we encourage future studies to employ more robust methodologies, recruit larger samples, and be more comprehensive about including potential moderator and mediators. Thus, longitudinal studies among children are recommended, with future research likely benefitting from including multiple reporters of children’s gaming frequency. We further recommend future studies consider the nature and content of the games frequently played by children. Particularly, recent studies support a Self Determination Theory (Deci & Ryan, 1985) approach for predicting the effects of video game play (Przybylski, Deci, Rigby, & Ryan, 2014; Przybylski, Ryan, & Rigby, 2009). In this approach, games which promote individual’s needs to feel autonomous, competent, and related to others are developmentally beneficial, whereas games which hinder these needs are not. Classifying games along these dimensions, or controlling for individual differences in the fulfilment of these needs during play may therefore too be worthwhile for future research.
Conclusion

This study tentatively supports the notion that video games may not be as detrimental to children’s psycho-social health as widely believed. On the other hand, no positive associations between gaming and psycho-social health were observed either. This was also the first gaming study to assess the potential influence of a single source bias, present when parents are asked to report on both their children’s gaming frequency and psycho-social health. In this study, while parental reports would lead one to conclude that game playing is negatively associated with psycho-social health, child reports cast doubt on this conclusion.
Chapter IV
Longitudinal associations between children’s psychosocial health &
gaming, violent gaming, and cooperative and competitive gaming

Revision under review at the Journal of Youth and Adolescence as:
Abstract

The effects of video games on children's psychosocial development remain the focus of social and scientific debate. This study presents longitudinal data describing the co-development of gaming and five domains of psychosocial development: conduct problems, emotional problems, hyperactivity, peer problems, and prosocial behavior. This study also investigated two more nuanced forms of gaming: violent gaming, and cooperative and competitive gaming. At two timepoints, one year apart, 194 Dutch children (7.27-11.43 years old) reported their gaming frequency, and their tendencies to play violent video games, and to game cooperatively and competitively; likewise, parents reported their children's psychosocial health. While gaming frequency at time one was associated with an increase in emotion problems, no other associations were observed between gaming and psychosocial health. Violent gaming was not associated with changes in conduct problems or prosocial behavior. Finally, while cooperative gaming was not associated with changes in prosocial behavior, competitive gaming was associated with decreases in prosocial behavior but only among children who played video games more frequently than their peers. We argue that replication is needed – particularly among children in this study's age range – and that future research should better distinguish between different forms of gaming for more nuanced and generalizable insight.
Introduction

Video games have rapidly become a universal aspect of child development (Lenhart et al., 2008), and their quick rise to prominence has stimulated scientific inquiry and public concern (Ferguson, 2013). With researchers stressing that children may be particularly susceptible to the influence of video game playing (Bushman & Huesmann, 2006; Lobel, Granic, & Engels, 2014a), the effects of video games on children's psychosocial development remains highly debated. Video games have thus been widely studied as a potential cause for aggressive cognitions and behavior (Anderson et al., 2010; Carnagey & Anderson, 2004), emotion problems such as depression (Tortolero et al., 2014), and hyperactivity and inattention (Gentile, Swing, Lim, & Khoo, 2012). In these lines of research, video games are seen as a compelling entertainment medium whose clever use of feedback loops and positive reinforcement schedules train unhealthy habits of mind (Gentile & Gentile, 2008).

Conversely, researchers have recently begun to look at video games as a domain for training healthy habits of mind (Adachi & Willoughby, 2012; Granic, Lobel, & Engels, 2014). From this perspective, many video games reward communication and cooperation as well as resolving negative emotions such as frustration. Moreover, video games seem to provide a context for the fulfillment of self deterministic needs, thereby positively contributing to psychological well-being (Ryan, Rigby, & Przybylski, 2006). The current paper adds to the discussion on gaming's positive and negative consequences with data from a longitudinal study that could address the relations between different forms of video game playing and the psychosocial development of children.
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Psychosocial development and gaming

In a recent review we argued for the potential of video gaming to afford psychosocial benefits (Granic et al., 2014). This perspective focuses on gaming as a modern and meaningful form of play, and therefore as a context where children's developmental needs can be met (Fisher, 1992; Verenkina, Harris, & Lysaght, 2003). Just as traditional forms of play provide positive contexts for children's psychosocial development (Erikson, 1977; Piaget, 1962; Vygotsky, 1978), so too video games seem to afford promise (Adachi & Willoughby, 2012; Granic et al., 2014). This promise is in part due to the ubiquity of gaming; with between 90% and 97% of children playing video games (Lenhart et al., 2008), it seems that social development has partly migrated from physical playgrounds to digital ones. Moreover, video games have become – particularly in the past decade – a more social and emotionally rich entertainment medium. Thus, modern video games may provide a context for children to bond with others and learn the benefits of cooperation.

Yet despite the potential benefits of gaming for children's psychosocial development, scant empirical work has explored these options. Three recent studies demonstrate the current state of the literature: Among adults, casual video games – games with rules and controls that are simple and intuitive – have been experimentally shown to decrease anxiety (Fish, 2011). Among adolescents, Durkin and Barber (2012) found that gamers had better mental health and healthier friendship networks than non-gamers. Finally, cross-sectional work by Przybylski (2014) indicated that adolescents who game less than an hour per day show better psychosocial adjustment than their non-gamer peers. However, for developmental purposes, these studies were limited in important ways. First, past studies were
conducted among adults or adolescents, leaving open the generalizability of these findings to children. Second, cross-sectional findings do not establish a causal link between gaming and positive outcomes. Third, in the case of Durkin and Barber, these findings may not be generalizable to the effects of modern video games as the data from this study were collected over two decades ago.

In contrast to the few recent studies into the potential psychosocial benefits of gaming (see also Adachi & Willoughby, 2013a; Adachi, Hodson, Willoughby, & Zanette, 2014; Lenhart et al., 2008; Schute, Ventura, & Ke, 2015; Schuurmans, Nijhof, Vermaes, Engels, & Granic, 2015), a great deal more research has investigated the potential harms of gaming. These include conduct problems (such as aggression), emotion problems (such as depression), and hyperactivity and inattention. Conduct problems have received the most focus given how commonly video games portray and reward violence (Anderson et al., 2010). However, the effects of specifically violent video game play on aggression remain highly contested. While experimental studies seem to indicate that violent video games increase conduct problems among adolescents and adults in the short-term, these studies have been criticized for having poorly matched control conditions (Przybylski, Deci, Rigby, & Ryan, 2014), and for using questionable outcome measures (Ritter & Eslea, 2005; see also Anderson & Bushman, 1997). Findings from longitudinal studies are equally contested, with critics citing low effect sizes and publication bias as cause for doubt (Ferguson, 2007; Ferguson, 2013). Importantly, no more than ten published studies have investigated the influence of gaming on conduct problems among children specifically; of these

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1 For an in-depth discussion of this debate from both sides, see Volume 10 Issue 5 of Perspectives on Psychological Science (2015).
studies, only a small minority have been conducted within the past ten years, and none have been longitudinal (Lobel et al., 2014a).

Regarding emotional problems, studies that examine the link between gaming and emotional problems have predominantly focused on “problematic gamers.” These are individuals who habitually play for very many hours and show other signs of dependency, such as avoiding social interactions or obligations in favor of gaming (van Rooij, Schoenmakers, Vermulst, van den Eijnden, & Mheen, 2011). Among adolescents, such gamers seem to have elevated depression symptoms compared to their peers (Messias, Castro, Saini, Usman, & Peeples, 2011). A recent, large scale, cross-sectional study among Canadian adolescents also indicated that video game play was positively associated with symptoms of depression and anxiety (Maras, Castro, Saini, Usman, & Peeples, 2015). These findings are consistent with the conclusions made in a review by Kuss and Griffiths (2012). These problems seem to emerge as a result of escapism; that is that problematic gamers seem drawn to gaming as an escape from real world problems. As a means of escape, gaming may offer temporary distraction, but without alleviating real world distress, and excessive gaming may only exacerbate said problems. Still, the cross-sectional nature of past studies leave open whether individuals with emotional problems retreat to video games as an escape, or whether gaming acts as a precursor to these issues. Moreover, little remains known about the relationship between gaming and emotional problems in children and in normative samples.

Finally, hyperactivity and inattention has been investigated as a detrimental psychosocial outcome of gaming. This research is premised on the perception that video games are fast-paced and offer frequent rewards, thus
potentially habituating children to a steady stream of novel, pleasurable stimuli. On the one hand, children with Attentional Deficit Hyperactivity Disorder (ADHD) have been shown to play more video games than their peers (Mazurek & Engelhardt, 2013) and Gentile and colleagues (2012) argue that there may be a bidirectional effect between attentional problems and gaming. On the other hand, studies among adults show that action video games may confer cognitive benefits, including improvements in executive functioning (Green & Bavelier, 2012). In this research domain again, the cross-sectional nature of most studies leaves open the question of direction of causation.

Prosocial behavior and cooperative and competitive gaming

The potential influence of video games on social behavior seems particularly relevant. This is because, compared to the video games of just two decades ago, contemporary video games have become increasingly social in nature (Olson, 2010). Prosocial behavior is therefore of particular interest as many video games seem to promote social norms which may encourage or discourage real world prosocial behavior. Thus, while violent video games may teach children that harming others and hostile interactions are normative, games with prosocial goals may alternatively teach children that helping others and friendly interactions are normative. In perhaps the first study of its kind, Greitemeyer and Osswald (2009) found that, among adults, playing a video game with the prosocial goal of saving characters from death, made aggressive cognitions less accessible than playing a video game with a socially neutral goal. Thus, it seems that when a game is designed to reward prosocial behavior, anti-social cognitions are made less salient. A recent meta-analysis extended this initial finding, indicating that playing
games with a prosocial goal increases the accessibility of prosocial thoughts and the performance of prosocial behaviors (Greitemeyer & Mügge, 2014).

There are several reasons to be cautious of these conclusions, however. First, few of these studies recruit child samples. Second, there is a lack of longitudinal studies on this topic; only three longitudinal studies have investigated the effects of prosocial gaming on prosocial behavior (Gentile et al., 2009; Prot et al., 2014). Notably, these studies were performed among children in Asian countries (specifically, Japan and Singapore); besides differences in cultural norms regarding prosocial and anti-social behaviors between Western and Asian cultures, gaming culture in these regions are vastly different (Anderson et al., 2010).

Third, experimental studies in this field have predominantly utilized the same video game title for their experimental conditions, *Lemmings*. Released in 1991, however, *Lemmings* bares little graphical similarity to modern games with prosocial mechanics. More importantly, the game mechanics which promote prosocial behavior in Lemmings are not common to modern video games. Today, games predominantly promote prosocial behavior within the context of multiplayer games. In these games, players are rewarded for cooperating with other “real, live” players to achieve mutual goals. Thus, more recent studies have begun to investigate the effects of cooperative video game playing on anti- and prosocial cognitions and behaviors (Przybylski & Mishkin, 2015). Mirroring this, there is also a recent focus on competitive video game playing on these same outcomes (see: Adachi & Willoughby, 2011; Adachi & Willoughby, 2013b; Schmierbach, 2010). However, no longitudinal studies to date have simultaneously investigated the influence of both cooperative and competitive video game playing; this is
important as many competitive video games are team-based, allowing for cooperative play as well.

Design and hypotheses

The present longitudinal study was designed to address the current gaps in the literature. First, we focused on the potential psychosocial benefits that playing video games may have for children. Thus, in addition to assessing negative outcomes such as conduct problems, emotional problems, and hyperactivity and inattention, we also focused on peer relations, and prosocial behavior. Second, this study targeted an under-studied population, namely children between the ages of seven and eleven. Indeed, despite claims that children are especially vulnerable to the effects of video game playing (Bushman & Huesmann, 2006), scant longitudinal research has targeted children. Finally, our longitudinal design allowed us to simultaneously test for both gaming and selection effects; in the former, video game playing may precipitate psychosocial changes, whereas in the latter, children who already show psychosocial deficits may select video games as an outlet. Thus, our longitudinal design also allowed us to investigate the tandem development of video game playing and psychosocial health.

Five domains of children's psychosocial health were assessed at two timepoints – conduct problems, emotional problems, hyperactivity and inattention, peer problems, and prosocial behavior. Given the developmental benefits of play, we expected video game playing at the first time point to predict healthier outcomes in all five domains at the second time point. We further investigated the potential relationships between violent video game content and both conduct problems and prosocial behavior. Finally, we also hypothesized that cooperative
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gaming at the first time point would be associated with increases in prosocial behavior, whereas competitive gaming at the first time point would be associated with decreases in prosocial behavior.

Method

Participants
Data were collected during home visits one year apart (T1 and T2; days between visits: range 265–510, $M = 388.49$). Recruitment procedures and the sample characteristics at T1 are described in detail in Lobel et al. (2014a); in brief, families who participated in Stone and colleagues (2013) were invited to participate in our study. The study’s procedures were approved by the Behavioural Science Institute’s Ethical Review Board under the Radboud University, and informed consent forms were used at both timepoints. Descriptive statistics for the sample at T1 and T2 are reported in Table 1. Ten participants from T1 declined to participate at T2. Additionally, data from ten parent reports were missing at T2 because their data was not properly saved by the recording software. With the exception of five parents, all parent reports were provided by the same parent at T1 and T2. Among parents, education level was low for 6.7%, medium for 30.4%, and high for 60.3%.

Procedure
Children provided self-reports during a face-to-face interview with an experimenter. Parents provided their survey responses via an online questionnaire. Families were rewarded a 20 and 30 Euro voucher check (per child) for their participation at T1 and T2 respectively.
Table 1. Child and parent demographics at T1 and T2

<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th></th>
<th>Parents</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1 (n = 194)</td>
<td>T2 (n = 184)</td>
<td>T1 (n = 194)</td>
<td>T2 (n = 174)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>M</td>
<td>SD</td>
<td>Range</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>7.27–11.43</td>
<td>9.22</td>
<td>1.1</td>
<td>29.95–51.47</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>Sex</td>
<td>98 (50.5%)</td>
<td>96 (49.5%)</td>
<td></td>
<td>26 (13.4%)</td>
</tr>
<tr>
<td></td>
<td>8.31–12.68</td>
<td>10.24</td>
<td>1.1</td>
<td>30.68–52.42</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>Sex</td>
<td>90 (48.9%)</td>
<td>94 (51.1%)</td>
<td></td>
<td>24 (13.8%)</td>
</tr>
</tbody>
</table>

Measures

Psychosocial health. Psychosocial health was measured by parent’s reports on the Dutch version of the Strengths and Difficulties Questionnaire (SDQ (Goodman, 1997); Dutch version (van Widenfelt, Goedhart, Treffers, & Goodman, 2003)). The SDQ uses a 3-point Likert scale (0–2 Not true to Very true) and is comprised of five sub-scales: (a) emotion symptoms, (b) conduct problems, (c) hyperactivity/inattention, (d) peer relationship problems, and (e) prosocial behavior. Consistent with Stone and colleagues (2013) reliability was calculated using $\omega$, this reliability index has repeatedly been shown to yield more accurate estimates than $\alpha$, particularly so when data are skewed, as is the case with SDQ (Stone et al., 2015; Zinbarg, Revelle, Yovel, & Li, 2005). All sub-scales showed acceptable to good reliability at T1 and T2: (a) emotion problems (sample: Many worries, often seems worried, $\omega_{T1} = .83; \omega_{T2} = .81$); (b) conduct problems (sample: Often fights with other children or bullies them, $\omega_{T1} = .75; \omega_{T2} = .89$); (c) hyperactivity/inattention
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(sample: Restless, overactive, cannot stay still for long, $\omega_{T1} = .88; \omega_{T2} = .89$); (d) peer problems (sample: Rather solitary, tends to play alone, $\omega_{T1} = .83; \omega_{T2} = .68$); and (e) prosocial behavior (sample: Shares readily with other children, $\omega_{T1} = .84; \omega_{T2} = .78$). All sub-scales consist of five items; sum scores were calculated for each sub-scale, and the sum scores of all scales except for prosocial behavior were summed to create a total difficulties score ($\omega_{T1} = .95; \omega_{T2} = .95$). Descriptive statistics for these sub-scales are presented in Table 2.

Gaming frequency. Children’s frequency of video game playing was assessed by: (1) Parental reports for the number of hours their child plays on average per week; (2) Child reports for the number of hours they had played video games during the past week; (3) Children’s ability to recall their gaming hours across a whole week was scaffolded by an additional measure of gaming frequency: In interviews, children looked over a calendar with the experimenter and indicated for each day over the past full week whether or not they had played a video game in the morning, afternoon, and evening. “Video games” were explicitly described to parents and children as any game that can be played on an electronic device, and several example games were listed.

Descriptive statistics for the frequency measures are presented in the Appendix (this chapter). Both parent’s and children’s reported hours of gaming were Windorized with a cut-off at 3 SD above the mean ($T1$: parent reports: $M = 5.76$, $SD = 3.87$, outliers $n = 4$; child reports: $M = 4.86$, $SD = 4.25$, outliers $n = 6$. $T2$: parent reports $M = 21.84$, $SD = 5$, outliers $n = 2$; child reports: $M = 5.92$, $SD = 5.9$, outliers $n = 2$). Children reported an average of 7.88 discrete play sessions per week ($SD = 4.15$) at $T1$ and 8.11 ($SD = 4.78$) at $T2$. 

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Table 2. Change in SDQ from T1 to T2

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Emotion problems</td>
<td>1.99</td>
<td>2.1</td>
</tr>
<tr>
<td>Conduct problems</td>
<td>1.01</td>
<td>1.39</td>
</tr>
<tr>
<td>Hyperactivity</td>
<td>2.99</td>
<td>2.55</td>
</tr>
<tr>
<td>Peer problems(^a)</td>
<td>1.14</td>
<td>1.63</td>
</tr>
<tr>
<td>Prosocial behavior</td>
<td>6.77</td>
<td>1.49</td>
</tr>
<tr>
<td>Total difficulties(^b)</td>
<td>7.15</td>
<td>5.33</td>
</tr>
</tbody>
</table>

**Note.** a. Peer problems decreased from T1 to T2, \( t(173) = 2.09, p = .038 \). b. Total difficulties decreased from T1 to T2, \( t(173) = 2.29, p = .023 \).

Moderate correlations were observed across the three frequency measures at each time point (\( T1: r \geq .47, p < .001 \); \( T2: r \geq .41, p < .001 \)). Moderate correlations were also observed within reporters across \( T1 \) and \( T2 \) (Parental report: \( r = .566, p < .001 \); Child report: Hours \( r = .367, p < .001 \), Calendar \( r = .485, p < .001 \)). Game frequency was operationalized as child reports of hours gaming\(^2\). As psychosocial health was reported by parents, this means that our analyses were performed across reporters. This is preferred to analyses using only a single reporter as such analyses introduce a potential single source bias (Burk & Laursen, 2010; Lobel et al., 2014).

**Violent gaming.** Similar to the methods in Anderson and Dill (2000) and Prot et al. (2014), children were asked to report their favorite video game(s) from the past several weeks. At \( T1 \), *Minecraft*, *Super Mario Bros.*, and *Subway Surfer* were the most popularly listed games/franchises, each being reported by 13 children. At \( T2 \),

\(^2\) Analyses using parent reported hours yielded the same pattern of results.
the most popular titles were more diverse with 46 children listing *Minecraft*, 21 listing a title from the *Fifa* franchise, and 18 listing *Mario Party* and *Hay Day* each. Violent gaming was computed as a dichotomous variable; children who listed a violent video game among their favorite games were assigned a 1, and those who did not were assigned a 0. Video games were classified as being violent when gameplay required players to harm other in-game characters.

**Cooperative and competitive gaming.** Following Przybylski and Mishkin (2015), cooperative and competitive gaming were each assessed with a single item. Children were asked to think about the times that they play video games, and to rate the frequency with which, when playing, they play a game where they have to “work together with others; that the game is cooperative” and “play against others; that the game is competitive”. A 5-point Likert scale was used (*Never* to *Every time or almost every time*).

**Planned analyses**

All analyses were performed in R (R Core Team, 2013). For preliminary analyses, paired-sample *t*-tests were used to determine whether children’s psychosocial health and gaming frequency changed from *T1* to *T2*, independent *t*-tests were used to determine whether there were gender differences on all variables at both timepoints, and correlations were calculated. To investigate our hypotheses, three sets of structural path models were estimated with the lavaan package (Rosseel, 2012). In all models, full information maximum likelihood was used to account for missing values and the Hubert-White covariance adjustment (MLR in lavaan) was applied to standard errors in order to deal with the lack of normally distributed variables.
In the first models, cross-lagged panel models were estimated to examine whether gaming at $T1$ would be associated with changes in psychosocial health from $T1$ to $T2$ (see Figure 1 for a template model). These models allowed us to simultaneously test the effects of gaming on psychosocial health, and for the reverse, a selection effect of psychosocial health at $T1$ influencing gaming frequency. Our second and third models targeted those children who regularly played video games, defined as children who played for more than one hour per week (95.9% of children, $n = 186$). We chose to segment out non-gamer children because our hypotheses specifically concern differences in gaming behavior; that is we intended to determine whether one pattern of gaming behavior could be beneficial or detrimental compared to other patterns of gaming behaviors. Therefore, for these children we examined (1) whether social gaming was associated with changes in peer problems (Figure 2), and (2) whether playing cooperatively and competitively was associated with changes in prosocial behavior (Figure 3). All models were saturated (and therefore had zero degrees of freedom).

**Results**

**Preliminary analyses**

Table 2 reports the means and standard deviations for the SDQ at $T1$ and $T2$. Peer problems and total difficulties decreased from $T1$ to $T2$ (peer: $t(173) = 2.09, p = .038$; total difficulties: $t(173) = 2.29, p = .023$). Regarding gaming frequency, while children did not report an increase in the number of discrete sessions per week that

---

3 The observed pattern of results remained the same when only including children who played for more than two (86.08%, $n = 167$) or more than three hours (75.77%, $n = 147$) per week.
they played video games ($t(182) = -1.18, p = 0.238$), children’s hours gaming per week increased according to both parents ($t(173) = -4.15, p < .001$) and children ($t(182) = -2.61, p = .01$). Table 3 reports the correlations between all predictor and predicted variables used for hypothesis testing, and Table 4 reports the correlations between the control variables used in these models (child’s age, gender (1 = Male, 2 = Female), and parent’s education level (1 = low, 2 = medium, 3 = high).

Gender differences were observed at both time points for both the SDQ and gaming frequency (see Appendix, this chapter). Regarding the SDQ, parents reported boys, compared to girls, at $T1$ and $T2$ as having more hyperactivity problems, less prosocial behavior, and more overall difficulties. Parents also reported boys as having more conduct problems at $T2$ than girls, but this was not observed at $T1$. According to parents and children, boys played video games more frequently than girls at both $T1$ and $T2$. Finally, the popularity of violent video games increased from $T1$ ($n = 47$) to $T2$ ($n = 64$), $t(177) = -2.69, p = .008$.

**Gaming and psychosocial health**

Figure 1 illustrates the cross-lagged panel models used to test whether gaming at $T1$ was associated with changes in psychosocial health. Contrary to our expectations, gaming frequency predicted an increase in emotion problems from $T1$ to $T2$ ($\beta_4 = .137, p = .024$). For the entire sample, gaming was unrelated to any of the psychosocial health measures: conduct problems $- \beta_4 = .092, p = .125$; hyperactivity/inattention $- \beta_4 = -.053, p = .255$; peer problems $- \beta_4 = .040, p = .516$; prosocial behavior $- \beta_4 = -.022, p = .727$; total difficulties $- \beta_4 = .039, p = .413$. None of the psychosocial health measures at $T1$ were associated with changes in gaming from $T1$ to $T2$ ($\beta_3$ range: 0-0.69, $p = .299-.944$) thus no selection
effects were observed. Stability paths for these models ranged from 0.54 to .79 with $p \leq .001$ for $\beta_1$ (SDQ across timepoints), and from 0.3 to .31 with $p \leq .001$ for $\beta_2$ (gaming frequency across timepoints).

**Violent gaming, conduct problems, and prosocial behavior**

We next investigated whether changes in conduct problems and in prosocial behavior would be associated with violent gaming among those children who played games at $T1$ (see Figure 2). Violent gaming was therefore added as a direct effect – $\beta_3$ – as was the interaction between gaming frequency (child report)$^4$ and violent gaming – $\beta_4$. In both the conduct problems and the prosocial behavior models, no associations were observed for either violent gaming (conduct: $\beta_3 = 0.017, p = .788$; prosocial: $\beta_3 = 0.091, p = .176$) or the interaction term (conduct: $\beta_4 = -0.122, p = .098$; prosocial: $\beta_4 = -0.081, p = .301$)$^5$.

---

$^4$ The pattern of results remained the same when the interaction term was determined by parental reports of children’s gaming.

$^5$ In coding games as being violent or not, violent games included titles ranging from mild cartoon violence such as *Super Mario Bros.* – and titles with more graphic violence – such as games from the *Halo, Call of Duty*, and *Grand Theft Auto* franchises. There was some discussion regarding *Minecraft* (frequency: $T1 = 16; T2 = 45$). In the reported analyses, *Minecraft* was not classified as a violent video game (despite the game allowing players to fend off “zombies”). We also re-ran the analyses with *Minecraft* coded as a violent video game: The pattern of results remained the same in the conduct problems model, and in the prosocial behavior model a main effect of violent gaming was observed, such that violent gaming at $T1$ was associated with an increase in prosocial behavior.
**Longitudinal: Waves I & II**

**Figure 1.** Cross-lagged panel model testing the bidirectional associations between gaming frequency and psycho-social health.

\[\begin{array}{c}
SDQ \\
\downarrow \beta_1 \\
\downarrow \beta_3 \\
Gaming \\
\downarrow \beta_2 \\
SDQ
\end{array}\]

SDQ = Strengths and Difficulties Questionnaire. Gaming = Gaming frequency in hours reported by children. Not depicted: Gender, child’s age, and parental level of education were included as control variables; correlations among predictor and among outcomes are included in the model.

**Table 4.** Correlations between control variables (age, sex, and parental education) and predictor and predicted variables.

<table>
<thead>
<tr>
<th></th>
<th>T1 – SDQ</th>
<th>T2 – SDQ</th>
<th>T1 - Gaming</th>
<th>T2 - Gaming</th>
</tr>
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<td></td>
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<td>Hyper</td>
<td>Peer</td>
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<td>-0.13</td>
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*Note.* SDQ = Strengths and Difficulties Questionnaire. Emo = Emotion problems; Cond = Conduct problems; Hyper = Hyperactivity and inattention; Pros = Prosocial behavior. Freq = Frequency; Viol = Violent gaming; Coop = Cooperative gaming; Comp = Competitive gaming. * = \( p \leq .05 \); † = \( p \leq .01 \); ‡ = \( p \leq .001 \)
Table 3. Correlations between Strengths and Difficulties Questionnaire and Gaming Measures at both timepoints

<table>
<thead>
<tr>
<th></th>
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<th>T1 – SDQ</th>
<th></th>
<th>T1 – Gaming</th>
<th></th>
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<th>T2 – Gaming</th>
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<td>(2)</td>
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<tr>
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<td>-</td>
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</tr>
<tr>
<td></td>
<td>Comp</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tbody>
</table>

Note. SDQ = Strengths and Difficulties Questionnaire. Emo = Emotion problems; Cond = Conduct problems; Hyper = Hyperactivity and inattention; Pros = Prosocial behavior. Freq = Frequency; Viol = Violent gaming; Coop = Cooperative gaming; Comp = Competitive gaming. * = p ≤ .05; † = p ≤ .01; ‡ = p ≤ .001.
Cooperative gaming, competitive gaming, and prosocial behavior

Finally, we simultaneously investigated whether changes in prosocial behavior would be positively associated with cooperative gaming and negatively associated with competitive gaming among those children who played games at $T1$ (see Figure 3). Cooperative and competitive gaming were added as direct effects – $\beta_5$ and $\beta_7$ respectively – and two interaction terms were added representing the interaction between gaming frequency (child report) and (1) cooperative gaming and (2) competitive gaming – $\beta_6$ and $\beta_8$ respectively. Neither cooperative nor competitive gaming at $T1$ was associated with changes in prosocial behavior (cooperative: $\beta_3 = .056$, $p = .389$; competitive: $\beta_5 = .010$, $p = .880$); moreover, no significant interaction was observed between cooperative gaming and gaming frequency on prosocial behavior ($\beta_4 = .077$, $p = .296$). Yet, a significant interaction was observed between competitive gaming and hours gaming ($\beta_6 = -.159$, $p = .033$). To interpret this interaction, simple slopes analyses were conducted, and the regions of significance were identified using the Johnson-Neyman Technique (Johnson & Fay, 1950; Bauer & Curran, 2005). Specifically, slopes for three levels of competitive gaming (-1, 0, and +1 $SD$) were plotted – see Figure 4. The slopes for the lines reflecting low and mean levels of competitive gaming were not significant; low $t = 0.93$, $p = .352$, mean $t = -.079$, $p = .433$. The high competitive slope was significant, $t = -2.01$, $p = .047$. As marked by the vertical line in the figure, competitive gaming was therefore seen to negatively predict prosocial behavior at $T2$ only for those who played video games 0.92 standard deviation hours above

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6 The Johnson-Neyman Technique was performed using resources provided by Preacher, Curran, & Bauer (http://quantpsy.org/interact/mlr2.htm).
the mean (8.66 hours per week). Thus, hours gaming at T1 predicted less prosocial behavior at T2 only for those who tended to play video games competitively.

**Figure 2.** Model testing the associations between gaming frequency, violent gaming, and psychosocial health.

SDQ = Strengths and Difficulties Questionnaire. Gaming = Gaming frequency in hours reported by children. Not depicted: Gender, child’s age, and parental level of education were included as control variables; correlations among predictor and among outcomes are included in the model. This model was run twice, each using a different SDQ subscale, once with the conduct problems subscale and once with the prosocial behavior subscale.

**Figure 3.** Model testing the associations between cooperative and competitive gaming and changes in prosocial behavior.

Gaming = Gaming frequency in hours reported by children; Coop = Cooperative gaming (mean-centered); Comp = Competitive gaming (mean-centered); Freq = Frequency. Not depicted: Gender, child’s age, parental level of education, and violent video gaming were included as control variables.
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**Figure 4.** Interaction between competitive gaming and gaming frequency predicting changes in prosocial behavior.

Values to the right of the vertical line represent cases where prosocial behavior differs across groups, and the vertical line marks children who reported playing 7.87 hours per week. On the x-axis, -0.5 represents children who reported playing 2.87 hours per week, 0 represents children who reported playing the mean number of hours per week (4.9).

**Discussion**

The goal of the present study was to provide insight into the potential influences of playing video games on children’s psychosocial development. In contrast to past work, this study employed a longitudinal design and recruited pre-adolescent children, and simultaneously explored cooperative and competitive gaming. No selection effects were observed; that is, psychosocial health at the study’s first time point was not associated with changes in gaming frequency. Likewise, gaming frequency was not associated with declines in most domains of
psychosocial health; that is, changes in neither conduct problems, hyperactivity and inattention, peer problems, nor prosocial behavior were predicted by gaming frequency. Gaming frequency was however associated with increases in emotion problems. Further, children's preference for violent video games was neither associated with changes in conduct problems nor in prosocial behavior. Finally, while neither cooperative nor competitive gaming were associated with changes in prosocial behavior, frequent competitive gaming among children who played video games for approximately eight and a half hours or more per week was associated with declines in prosocial behavior.

For video games, their potential negative influence on children's conduct is perhaps the chief concern among the public and within the scientific community. Violent video games in particular are widely seen as having a deleterious influence on children's conduct, giving rise to aggressive behavior and discouraging prosocial behavior (Anderson et al., 2010). In this study, however, gaming as a general activity, and violent video gaming more specifically were neither associated with a rise in children's conduct problems nor with a decrease in prosocial behavior. Thus, violent gaming had no influence in this study. This outcome aligns this study with a minority of work showing no effect of violent gaming on anti- or pro-social behavior. One potential reason for this may have to do with the study's sample; scant longitudinal studies have been run testing the influence of violent video games among pre-adolescent children.

Another potential reason for this outcome could have to do with how violent gaming was operationalized. For this study, violent gaming was made into a dichotomous variable, thereby lumping together games that were low and high in violent content. A related issue could be that very few children in this study's sample reported playing highly violent games, that is the types of games featuring
realistic violence and which are therefore deemed unsuitable for minors by independent review boards such as the PEGI in Europe and the ESRB in North America. Therefore, the low frequency of highly violent gaming in our sample may have made it more difficult to observe an association between violent gaming and antisocial outcomes.

Against our expectations, gaming was not associated with decreases in hyperactivity and inattention. To our knowledge, this is just the second study to examine this hypothesis with a longitudinal design (see Gentile et al. 2012). With regards to attentional skills, it is possible that video games as a whole was too broad a predictor. Indeed, video games offer a wide variety of interactions and operate under a variety of reward schedules. Regarding hyperactivity and inattention, it seems relevant to distinguish video games based on the duration of play per session intended by the designer, and perhaps the speed and intensity of visual and auditory stimulation. Indeed, while some games are designed to be played in short bursts, others are designed for extensive sessions; and while some games bombard the player’s senses and require rapid inputs, others take a slower pace and allow players to be idle for long periods (Fullerton, 2008). Reward scheduling also seems particularly relevant, and there are numerous dimensions whereby games can differ on this factor (see Bateman, 2005): Games can provide rewards in rapid and sustained succession versus requiring sustained engagement and success. Moreover, games can also tier rewards, offering proximal and distal rewards under different schedules.

In line with this complexity, cognitive (neuro)psychologists interested in gaming’s influence on attention have limited their research to action video games. These are games where players typically need to simultaneously attend to multiple
stimuli, quickly distinguish threats from rewards, quickly switch between tasks, and maintain an accurate mental representation of three-dimensional maps. These studies indicate a variety of cognitive benefits afforded by *action* video games, however these benefits may be orthogonal to hyperactivity and inattention. Our study did not distinguish between different types of video games, largely because at the young age that we assessed children, there was very little variability in the types of games children played. But it may be that some game types may be detrimental (such as games which constantly offer short-term rewards), whereas others may be beneficial (such as action video games that vary these reward schedules), and that these effects may have cancelled each other out, even in our limited sample. We therefore recommend future research to conceptualize video games based on their attentional demands and their reward schedules and to draw new hypotheses based on these factors.

Gaming frequency was associated with an increase in emotion problems, such as anxiety and depressive symptoms. This finding is consistent with reports that excessive gaming relates to heightened levels of depressive symptoms among adolescents (Maras et al., 2015). Notably, no selection effect was observed in our study, thus it was not the case that children experiencing heightened depressive symptoms were more likely to play video games the following year. This seems like an important domain for future research particularly considering how gaming research has mostly focused on externalizing problems such as aggression. Several processes may be at work here. Video games are known to evoke negative emotions, and frustration in particular (Lobel, Granic, & Engels, 2014b); negative arousal and feelings of incompetence experienced while gaming may transfer to afterwards. Also, playing video games may have been associated with other negative outcomes which themselves led to emotion problems. For instance,
heightened video game play may lead to poor scholastic performance (Hastings et al., 2009) or social isolation (van den Eijnden, Meerkerk, Vermulst, Spijkerman, & Engels, 2008). The observed association between gaming and emotion problems may therefore be an indirect consequence of gaming being associated with other maladaptive behaviors.

Finally, habitually playing competitive video games was only associated with a decline in prosocial behavior among children who played video games competitively for about 8 or more hours per week. This was found when controlling for cooperative gaming, which often co-occurs with competitive gaming, and which has been found to promote prosocial behavior (Gentile et al., 2009). This pattern may be due to the fact that in multiplayer games competitive goals often seem to take precedence over cooperative goals. In these games cooperation is often merely a means to better compete against an opposing team; thus, the overarching goal of play in these games remains competition. Here again we stress the importance of replication and of developing and using measures that are sensitive to the variety of social dynamics across different games. Given that many existing multiplayer games allow players to choose roles with either greater focus on cooperation or competition (e.g. that of a medic or a striker), experimental studies could be of particular benefit.

This study’s limitations are important to consider. First, as already discussed, this study examined the potential influence of video games in a broad sense. Modern video games encompass a highly diverse set of interactions (Granic et al., 2014), and even games within the same genre may engage players in diverse ways. We therefore stress the importance of more granular tests of specific forms of gaming. Second, to partly address this issue, this study also examined gaming
more specifically in terms of social dynamics. To do so, we used unstandardized assessments, given there were no validated options. That is, our cooperative, and competitive gaming measures utilized single-item questions for their evaluation. While this is in line with other recent studies in this field (e.g. Przybylski & Mishkin, 2014), validated measures are preferred. This limitation is noteworthy despite the fact that these questions were answered during an interview session with trained researchers. Third, we collected data just one year apart from each other; this is a relatively short term for child development. Fourth, our sample could be more ideal. Many studies showing the effects of (violent) video game play indicate small to moderately sized effects. While our sample size and analysis strategies made for a sufficiently powered study, it is possible that a larger sample would have revealed overlooked effects. Our sample size therefore leaves open questions about generalizability, as does the fact that we recruited a convenience sample. Finally, a total of six models were run for relating gaming to the SDQ, a further two models were run to examine violent gaming, and another model was run to examine changes in prosocial behavior. Given this multiple testing, and the relatively small size of the beta's that were of significance, the findings in this study should be taken with some caution and should be replicated before strong conclusion can be made.

In sum, video games did not seem to pose harm for most domains of children's psychosocial development. Parents should be particularly attentive to potential increases in children's emotion problems as a result of video game playing. The deleterious effects of violent video game play remains a highly debated topic, with this study not lending support for the influence of violent gaming on conduct problems or on prosocial behavior. While cooperative gaming seems unrelated to prosocial behavior in our sample, frequent gamers who also
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tend to play competitively may be at risk for behaving less prosocially. Finally, this field would benefit greatly from validated measures that quantify or categorize the types of social and emotional processes being activated by different games and game types, and that accurately measure the social environment of video game sessions.
Appendix

Gender differences in gaming frequency at $T_1$ and $T_2$.

<table>
<thead>
<tr>
<th>Parent hours</th>
<th>Child hours</th>
<th>Child calendar</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_1$ $T_2$</td>
<td>$T_1$ $T_2$</td>
<td>$T_1$ $T_2$</td>
</tr>
<tr>
<td>$M$ $SD$ $M$ $SD$</td>
<td>$M$ $SD$ $M$ $SD$</td>
<td>$M$ $SD$ $M$ $SD$</td>
</tr>
<tr>
<td>Total</td>
<td>5.67 3.63</td>
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</tr>
<tr>
<td>Boys</td>
<td>6.75 3.94</td>
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</tr>
<tr>
<td>$t$ $p$ $t$ $p$</td>
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</tr>
<tr>
<td>4.24 &lt;.001</td>
<td>3.87 &lt;.001</td>
<td>3.65 &lt;.001</td>
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</table>

Gender differences in Strenghts and Difficulties Questionnaire at $T_1$ and $T_2$.

<table>
<thead>
<tr>
<th>Emotion</th>
<th>Conduct</th>
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<td>$T_1$ $T_2$</td>
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<td>$M$ $SD$ $M$ $SD$</td>
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<td>$t$ $p$ $t$ $p$</td>
<td>$t$ $p$ $t$ $p$</td>
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<tr>
<td>1.85 0.07</td>
<td>0.9 0.4</td>
<td>-2.2 0.03</td>
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</tbody>
</table>
Chapter V

The benefits of playing competitive video games for children’s social development:
A longitudinal study

Under review at Psychology of Popular Media Culture as:
Lobel, A., Engels, R. C. M. E., Stone, L. L., & Granic, I. Gaining a competitive edge:
Longitudinal associations between children’s competitive video game playing, conduct problems, peer relations, and prosocial behavior.
Abstract

Playful competition is an important hallmark of healthy child development. Playful competition facilitates moral learning, rewards perspective-taking skills, and challenges children to healthily regulate negative emotions such as frustration, anger, and jealousy. Despite this, research on the effects of competitive video gaming has focused on antisocial outcomes, such as declines in prosocial behavior. Moreover, methodological shortcomings such as experimental studies using designs with poor generalizability, and a lack of longitudinal studies, leave open the influence of competitive gaming on the social development among pre-adolescent children. This longitudinal study therefore investigated the relation between competitive gaming and changes in children’s social development across three measures: conduct problems, peer relations, and prosocial behavior. At two timepoints, one year apart, 184 Dutch children (8.31-12.68 years old) reported their gaming frequency and listed their favorite games to play, and their parents reported their children’s psychosocial health. Children’s nominations were coded as including or not including a competitive video game. Children who nominated a competitive game at the first time point were more likely to show a decrease in conduct problems and an improvement in peer relations. No interactions were observed between competitive gaming and gaming frequency. These results encourage future research to investigate the social benefits of playful competitive gaming among peers, and for future studies to take other variables such as violent content, cooperative play, and real world competitive play into account.
Recognized as a child’s right by the United Nations General Assembly (UNGA), play is essential for social development (UNGA, 1959; Frost, Wortham, & Reifel, 2008). Play comes in many forms, each with developmental benefits. As infants, children engage in sensorimotor play, toying with and discovering the capacities of their own bodies and objects in their immediate environment (Piaget 1962). Sensorimotor play remains popular throughout childhood; it is seen in hand-eye coordination games, such as catch, and in forms of pretend play, such as when children play by building. In pretend play, children's imaginations allow them to fantasize about non-existent entities, construct narratives for inanimate objects, and assume the roles of adults and professionals. Because these behaviors may help children develop perspective-taking skills, and learn how to cooperate with others (Fein 1981; Lillard et al., 2012), pretend play is important for children's socialization (Denzin, 1975). At the same time that children enact pretend play with others, they also begin to engage in games with rules. Due to their fixed structure, these rule-based games align with children's interest in better understanding the world (Whitebread, 2012) while also enabling children to playfully compete with peers.

Competitive play is crucial for social development. Playful competition is a hallmark of play in primates and mammals, whose young may invariably engage in rough-and-tumble play (Power, 2000). In humans, rough-and-tumble play emerges early in child development, and often persists through adolescence and into early adulthood. Because of its intimate nature, and the necessity for mutual trust between players, this form of play facilitates emotion recognition and cultivates bonding between children and their peers and family members (Jarvis,
But, as children’s working memory and executive function skills improve, competitive play in games with rules also emerges. Much like rough-and-tumble play, playing competitive games with rules also provides a valuable context for social development. For example, because it encourages players to predict their opponent’s strategies, competitive play may promote perspective-taking and the development of children’s theory of mind. Moreover, competitive play is highly relevant for both children’s moral development and peer relationships. Competitive play forces children to cooperate and take turns, abiding by the game’s rules and finding a common ethical ground. The pressure of competition may also elicit negative emotional experiences, such as frustration, disappointment, and embarrassment. Sharing and working through these experiences with peers may promote bonding, and may also prepare children to regulate these emotions with more facility outside of play contexts.

Modern video gaming and competitive play

Here, we apply this developmental lens to one of the most common “playgrounds” that children today are commonly found, video games. Indeed, video games have become a virtually universal aspect of child development, with over 90% of children and adolescents dedicating at least an hour per week to gaming (Lenhart, Kahne, Middaugh, Macgill, Evans, & Vitak, 2008). The impact of competitive video game play on social development seems particularly relevant. Modern video games have become increasingly social in nature (Olson, 2010). Today's video games can be played alone, in person with small groups, or online with up to hundreds of people simultaneously. Video games therefore seem to represent a modern playground, inviting children to play in a myriad of ways. Reflecting the increased prevalence of gaming as a form of social play, nine of the ten best-selling video games in the
United States in 2015 extensively featured multiplayer functionality (NPD Group, as cited by Grubb in Venture Beat, 2016), with competitive game modes being central to the game’s design in seven of these releases (e.g. *Star Wars: Battlefront*, *Mortal Kombat X*, and *Fifa 16*).

**Competitive gaming and social competencies**

Despite a body of literature supporting the socio-emotional benefits of competitive play, research into the effects of competitive video game play has predominantly focused on the potentially deleterious effects of competition. Under a dichotomy of cooperative-versus-competitive gaming (Schmierbach, 2010; Ewoldsen et al., 2012; Velez, Mahood, Ewoldsen, & Moyer-Gusé, 2014; Greitemeyer, Traut-Mattausch, & Oswald, 2012), competitive gaming has been widely studied as an antecedent to aggression and decreases in prosocial behavior. With the current body of literature indicating that competitive gaming is detrimental in these domains, authors have argued that competitive gaming fosters hostile attitudes and encourages a hostile attribution bias (Anderson & Carnagey, 2009; Anderson & Bushman, 2002). However, these conclusions may not generalize to pre-adolescent child development.

First, scant research has been conducted on the influence of competitive gaming in pre-adolescent children. Moreover, almost without exception, these studies have been conducted in lab settings. This raises a pair of issues. One, the observed effects of competitive gaming in these studies may only operate in the short-term. Longitudinal designs are needed to demonstrate the potential lasting influences of competitive gaming (for a longitudinal study among adolescents, see Adachi & Willoughby, 2013). Second, the assignment procedures in lab-based
studies precluded participants from playing competitively against their known peers. Competitive play against strangers – and against individuals that one may never meet in person – may have different consequences than competitive play against friends. For example, competition among friends seems more prone to instilling a playful spirit, and may also be based on feelings of mutual trust and respect. Competitive play among friends may also lack the sense of finality that play against random strangers might; when playing with friends, losses and victories can be contextualized within a history of competitive play where each player's skills and tactics develop.

There are therefore several gaps in the literature. Given the lack of research conducted on competitive gaming among children, longitudinally, and in naturalized environments, the developmental impact of competitive gaming in children remains largely unclear. Similarly, the relative focus on competitive gaming as an anti-social activity leaves open the question of how competitive gaming among peers may foster healthy relationships. This study therefore employed a longitudinal design to investigate the potential influence of competitive gaming on children's conduct problems, peer relationships, and prosocial behavior.

Competitive gaming may benefit these social competencies for several reasons. Like more traditional games with rules, competitive gaming may be a valuable domain for moral development. Competitive play allows children to grapple with defining “fair” behavior, with children sometimes even negotiating what behaviors are considered cheating. Moreover, competitive play is known to heighten affective arousal, riling up children to become potentially more (physically) aggressive (Ensor, Hart, Jacobs, & Hughes, 2011). Competitive gaming
is similarly known as a potential hotbed for aggressive interactions. Derogatory banter and “rage quitting” (when a player angrily and abruptly quits a game; Linderoth, Björk, & Olsson, 2012) commonly occur in competitive games; but among friends, these behaviors are socially alienating. Children are therefore challenged to work through their aggressive urges, maintain their composure, and restrict themselves to normative, playful responses. Healthy emotion regulation in these heated moments may therefore help equip children for managing their aggressive urges in other contexts, thereby reducing conduct problems.

For similar reasons, competitive gaming also seems valuable for peer relationships and prosocial behavior. Due to the heightened emotional arousal that is experienced during competition, competitive gaming may provide formative shared experiences, promoting bonding (Wagner et al., 2014). This may be especially the case with regards to the emotions experienced when winning or losing. In victory, children must learn how to experience pride without overly bragging, and in defeat, they must learn how to overcome disappointment without unfairly disparaging their play partner. Competitive gaming may therefore lead children to exercise their perspective-taking skills, and learn how to be gracious to their peers even in emotionally charged instances. Moreover, failure to do so successfully may have negative consequences, such as social exclusion. In these instances, children’s conflict resolution skills also become tried. For example, many competitive games that are played online develop self-policing communities which often reject players who are notorious for disparaging others or being a poor sport (Williams, Caplan, & Xiong, 2007). Thus, through competitive gaming, children may be learning to suppress anti-social urges and to resolve conflicts, thereby promoting peer relationships and prosocial behavior.
The present study

This study was designed to address the gaps of past research by (1) using a longitudinal design, to (2) investigate competitive gaming and the development of social competencies among (3) pre-adolescent children. Children between the ages of eight and eleven were interviewed twice, one year apart. Children described their gaming behavior and nominated their favorite video games, and parents were asked to report on children’s social competencies. We hypothesized that children who played competitive video games would show improvements in conduct problems, peer relationships, and prosocial behavior. For exploratory analyses, we investigated a potential dosage effect whereby those children who played competitive video games with greater frequency may show additional benefits.

Method

Participants

Data were collected during home visits one year apart (T1 and T2; days between visits: range 194–462, M = 347.65). For recruitment, we invited participants in Stone and colleagues (2013) to participate in a three wave longitudinal study; the present study used data collected in its second and third waves. We left out the first wave of data from our analyses because there was an insufficient degree of variation in the sample with regards to children playing competitive video games; whereas over 50 children reported preference for a competitive video gaming in the study's second and third waves, only 26 children did so in the study's first wave. This may largely be attributed to the age of study's sample, a quarter of
which was younger than eight years old, and none of which was twelve years or older at the study's first wave.\footnote{The characteristics of the sample at the study’s first wave are described in the previous chapter, Chapter IV (Lobel et al., 2014).}

The study's procedures were approved by the Behavioural Science Institute's Ethical Review Board under the Radboud University, and informed consent forms were collected at both timepoints. Descriptive statistics for the sample at T1 and T2 are reported in Table 1. Ten participants from T1 (n = 184) declined to participate at T2 (n = 174). Data from ten parent reports were missing at T1 because their data was not properly saved by the recording software, and three parents failed to complete their online questionnaires at T2.

**Procedure**

Children provided self-reports during a face-to-face interview with an experimenter. Parents provided their survey responses via an online questionnaire. Families were rewarded a 30 and 50 Euro voucher check (per child) for their participation at T1 and T2 respectively.

**Table 1.** Child and parent demographics at T1 and T2.

<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th></th>
<th>Parents</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>184</td>
<td>90 (48.9%)</td>
<td>94 (51.1%)</td>
</tr>
<tr>
<td>T2</td>
<td>174</td>
<td>83 (47.7%)</td>
<td>91 (52.3%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th></th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>10.23</td>
<td>1.14</td>
<td>8.31 – 12.68</td>
<td>42.83</td>
<td>3.76</td>
<td>30.68 – 52.42</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>11.16</td>
<td>1.14</td>
<td>9.30 – 13.53</td>
<td>43.72</td>
<td>3.68</td>
<td>31.70 – 53.58</td>
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</table>
Measures

Social competency measures. Three social competencies were measured by parent’s reports on subscales of the Dutch version of the Strengths and Difficulties Questionnaire (SDQ (Goodman, 1997); Dutch version (van Widenfelt, Goedhart, Treffers, & Goodman, 2003)). The SDQ uses a 3-point Likert scale (0–2 Not true to Very true). Of the SDQ’s five subscales, the three social competency subscales used were: (a) conduct problems, (b) peer problems, and (c) prosocial behavior. Consistent with Stone and colleagues (2013) reliability was calculated using $\omega$, this reliability index has repeatedly been shown to yield more accurate estimates than $\alpha$, particularly so when data are skewed, as is the case with the SDQ (Stone et al., 2015; Zinbarg, Revelle, Yovel, & Li, 2005). All sub-scales showed acceptable to good reliability at T1 and T2: (a) conduct problems (sample: Often fights with other children or bullies them, $T1: M = 0.84, SD = 1.46, \omega_{T1} = .89; T2: M = 0.78, SD = 1.22, \omega_{T2} = .81$); (b) peer problems (sample: Rather solitary, tends to play alone, $T1: M = 0.97; SD = 1.27, \omega_{T1} = .68; T2: M = 0.92; SD = 1.33, \omega_{T2} = .78$); and (c) prosocial behavior (sample: Shares readily with other children, $T1: M = 6.9; SD = 1.31, \omega_{T1} = .78; T2: M = 6.82; SD = 1.49, \omega_{T2} = .86$).

Gaming frequency. Gaming frequency was measured with child reports for the number of hours they had played video games during the past week. Given the potential difficulty of children recalling their gaming hours across an entire week, this measure was scaffolded by an additional measure of gaming frequency: In interviews, children looked over a calendar with the experimenter and indicated for each day over the past full week whether or not they had played a video game in the morning, afternoon, and evening. Parents also reported on the number of hours
their child played on average per week. Moderate correlations were observed across the three frequency measures at each time point (T1: \( r \approx .44, p < .001; \) T2: \( r \approx .56, p < .001 \)). “Video games” were explicitly described to parents and children as any game that can be played on an electronic device, and several example games were listed.

We specifically used child reports of gaming frequency. This was done so that our analyses would rely on different reporters for the predictor and predicted variables; again, the social competency outcome variables were reported by parents. This cross reporter analysis avoids the potential single source bias that is introduced by relying on a single reporter (Burk & Laursen, 2010; Lobel, Granic, Stone, & Engels, 2014). Children’s reported hours of gaming were Windorized with a cut-off at 3 SD above the mean (T1: \( M = 5.92, SD = 5.9, \) outliers \( n = 2; \) T2: \( M = 5.59, SD = 5.46, \) outliers \( n = 3 \)).

**Competitive gaming.** Similar to previous studies (Anderson & Dill, 2000; Prot et al., 2014), children were asked to report their favorite video game(s) from the past several weeks. Competitive gaming was therefore computed as a dichotomous variable; children who listed a competitive video game among their favorite games were assigned a 1, and those who did not were assigned a 0. Video games were deemed competitive if their design is predominantly built around competition. This included games from a diverse array of genres, such as puzzle games (e.g. Ruzzle, \( n = 1 \)), strategy games (e.g. Clash of Clans, \( n = 12 \)), sports games (e.g. games from the Fifa series, \( n = 21 \)), racing games (e.g. games from the Mario Kart series, \( n = 16 \)), and (violent) first-person shooter games (e.g. games from the Call Of Duty series, \( n = 7 \)). Fifty-seven children identified a competitive game among their favorite games at T1 (30.98%).
**Longitudinal: Waves II & III**

To check the validity of this coding scheme, children were also asked to report how often their gaming sessions involves them "playing against others; that the game is competitive" (5-point Likert scale, *Never* to *Every time or almost every time*). Children who identified a competitive game among their favorite games reported playing competitively more often (competitive $M = 3.05$, non-competitive $M = 2.6$; $t = 2.24$, $p = 0.027$).

**Planned analyses**

All analyses were performed in Statistical Package for the Social Sciences (SPSS; Version 23). Our analyses were performed on children who regularly played video games, defined as children who played for more than one hour per week (98.27% of children at $T1$, $n = 171$). We chose to segment out non-gamer children because our hypotheses specifically concern differences in gaming behavior; that is we intended to determine whether gaming competitively could be beneficial or detrimental compared to gaming in non-competitive ways. For preliminary analyses, independent $t$-tests and a chi-square test were used to determine whether there were gender differences on all variables at both timepoints.

Multiple linear regression analysis was used to investigate our hypotheses. In three separate models, competitive gaming was tested as a main predictor of changes in social competencies. As a follow-up, we next explored whether the amount of competitive gaming may have a dose effect. These models therefore added an interaction term to the each of the previous models. This interaction term was derived from centering children’s gaming frequency and multiplying this value.

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8 The observed pattern of results remained the same when only including children who played for more than two (89.65%, $n = 156$) or more than three hours (77.58%, $n = 135$) per week.
by the competitive gaming variable. As a backup check, these same tests were subsequently run using parental reports of children’s gaming frequency.

**Results**

**Preliminary analyses**

Gender differences were observed at both time points for social competencies, gaming frequency, and for competitive gaming (Table 2). Regarding social competencies, boys showed less prosocial behavior than girls at both timepoints ($t(160) = -2.33, p = 0.02$; $T2: t(151.12) = -2.41, p = 0.017$), and at $T2$, boys showed more conduct (marginally significant: $t(157) = 1.96, p = 0.052$) and peer problems ($t(157) = 1.98, p = 0.050$). Boys also reported gaming more hours per week at both $T1$ ($t(165.13) = 3.64, p < .001$) and $T2$ ($t(138.69) = 4.81, p < .001$). Finally, boys were also more likely to nominate a competitive game, with 51.69% of boys compared to 12.66% of girls listing a competitive game among their favorites ($\chi^2(1) = 26.96, p < .001$). As a result of these gender differences, we controlled for gender in our subsequent analyses.

**Gaming, competitive gaming, and social competencies**

Two regression models were run for each of the three social competencies: one model with competitive gaming as a predictor, and a second which added the interaction between competitive gaming and gaming frequency. Table 3 contains the correlations between the predictor and predicted variables used in the first models.

In line with our predictions, competitive gaming was associated with decreases in conduct ($\beta = -.232, t = -3.23, p = 0.002$) and peer problems ($\beta =
-.198, $t = -2.62, p = 0.010$). Contrary to expectations, competitive gaming was not associated with changes in prosocial behavior ($\beta = -.052, t = -0.77, p = 0.440$). We also observed a positive association between gaming frequency and prosocial behavior ($\beta = .141, t = 2.23, p = 0.028$). Finally, no interaction effects were observed (conduct: $\beta = .045, t = 0.24, p = 0.807$; peer: $\beta = .153, t = 0.77, p = 0.445$; prosocial: $\beta = .035, t = 0.17, p = 0.864$), suggesting no dosage effect of competitive gaming.

With one exception, these patterns of results were identical when using parent reports for children's gaming frequency. The only divergent finding was that parental reports of children's gaming was not associated with changes in children's prosocial behavior ($\beta = -.004, t = -0.208, p = 0.835$).

**Discussion**

This study investigated the relationship between playing competitive video games and changes in children's social competencies. Children who reported playing a competitive video game showed improvements over one year in conduct problems and peer relationships. No associations were observed between competitive gaming and changes in prosocial behavior. Gaming frequency did not moderate any of these findings. The observed main effects of competitive gaming support the notion that, like more traditional forms of competitive play, competitive gaming may provide a context for the healthy development of social competencies. It is further interesting to note that at T1, competitive gaming was negatively associated with conduct problems. This demonstrates that while competitive gaming may be attractive for children looking to express their aggression, it is still a context where they can learn how to better manage their anti-social impulses.
### Table 2. Gender differences in gaming frequency and social competencies at T1 and T2.

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>Conduct problems</td>
<td>1.08</td>
<td>0.68</td>
</tr>
<tr>
<td>Peer problems</td>
<td>1.06</td>
<td>0.91</td>
</tr>
<tr>
<td>Prosocial behavior</td>
<td>6.65</td>
<td>7.13</td>
</tr>
<tr>
<td>Gaming frequency</td>
<td>7.62</td>
<td>5.84</td>
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</table>

### Table 3. Correlations between Social Competency, Gender, and Gaming Measures at T1 and T2.

<table>
<thead>
<tr>
<th></th>
<th>Peer</th>
<th>Prosocial</th>
<th>Gender</th>
<th>Frequency</th>
<th>Competitive</th>
</tr>
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<tbody>
<tr>
<td>T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct</td>
<td>0.31**</td>
<td>-0.13</td>
<td>-0.13</td>
<td>0.21**</td>
<td>0.19*</td>
</tr>
<tr>
<td>Peer</td>
<td></td>
<td>-0.11</td>
<td>-0.06</td>
<td>0.06</td>
<td>-0.07</td>
</tr>
<tr>
<td>Prosocial</td>
<td></td>
<td></td>
<td>0.18*</td>
<td>-0.09</td>
<td>-0.17*</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td>-0.27**</td>
<td>-0.41**</td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>Competitive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gaming (0, 1)</td>
<td>-</td>
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<table>
<thead>
<tr>
<th></th>
<th>Conduct</th>
<th>Peer</th>
<th>Prosocial</th>
<th>Frequency</th>
<th>Competitive</th>
</tr>
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<tbody>
<tr>
<td>T2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct</td>
<td>0.61**</td>
<td>0.30**</td>
<td>-0.05</td>
<td>0.15</td>
<td>0.17**</td>
</tr>
<tr>
<td>Peer</td>
<td>0.36**</td>
<td>0.54**</td>
<td>-0.24**</td>
<td>0.09</td>
<td>-0.13</td>
</tr>
<tr>
<td>Prosocial</td>
<td>-0.12</td>
<td>-0.19*</td>
<td>0.68**</td>
<td>-0.17*</td>
<td>-0.11</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.16</td>
<td>-0.16*</td>
<td>0.19</td>
<td>-0.35**</td>
<td>-0.41**</td>
</tr>
<tr>
<td>Frequency</td>
<td>0.16*</td>
<td>0.15</td>
<td>0.07</td>
<td>0.48**</td>
<td>0.16*</td>
</tr>
<tr>
<td>Competitive</td>
<td>-0.01</td>
<td>-0.13</td>
<td>-0.19*</td>
<td>0.11</td>
<td>0.25**</td>
</tr>
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</table>

*Note.* Gender is coded as 1 = male, 2 = female. * = p ≤ .05; ** = p ≤ .01
Changes in prosocial behavior were not associated with competitive gaming. This is in line with neither past findings that competitive gaming negatively predicts prosocial behavior (Ewoldsen et al., 2012) nor our hypotheses to the contrary. Past research describes competitive gaming as a domain that promotes anti-social cognitions and behaviors (Anderson & Carnaegy, 2009; Schmierbach, 2010). In this light, competitive gaming encourages children to view relationships as being adversarial, and helping behaviors as being costly. However, as our null findings indicate, competitive gaming is likely more complex. For one, competitive gaming requires a certain fundamental level of cooperation; players must collectively abide by the rules of the game. Second, competitive gaming sometimes allows for cooperation and prosocial goals. Team-based competitive play requires cooperation despite players pursuing competitive, arguably anti-social goals. This allows for prosocial behaviors amidst competition, for example, in games that specifically enable players to heal or protect their teammates. Similarly, competitive games may vary greatly in terms of violent content. The competitive games that were popular among children in this study were generally non-violent. This may account for the discrepancy between our findings and past research. Given this discrepancy and our null findings, future studies should investigate the conditions under which competitive games may positively or negatively influence prosocial behavior in the long-term; cooperation and violent content may be relevant mediators.

No dosage effects were observed as the frequency of competitive gaming seemed unrelated to changes in social competencies. This may also speak to the complex nature of competition. For example, the relationship between competitive gaming and social competencies may be non-linear such that competitive play may be beneficial in small doses, while high levels of competitive gaming may be
detrimental. Competitive gaming may therefore be best in moderation; a little amount may provide valuable contexts for moral development and bonding, but excessive competition may foster an unhealthy lens through which children perceive their social environment. Unfortunately, our sample size was not large enough to investigate this nonlinearity hypothesis.

Our sample’s age may also be highly relevant. First, few longitudinal studies have been done on the effects of competitive gaming among children in this study’s age range (pre-adolescent children from eight to twelve years old). Second, given their age, children in this study were likely restricted by their parents in the video games they could play. Pre-adolescent children don’t typically have money to buy their own games, and parents may have the final say in what games their children play. This allows parents to socialize their children, with some perhaps allowing or even preferring that their children game with and against others.

Parental influence is also to consider with regards to gender. Compared to girls, boys generally showed greater deficiencies in their social competencies. Boys also spent more time gaming than girls, and were far more likely to play competitively than girls. These gender differences in social development are commonly observed (Zimmer-Gembeck, Geiger, & Crick, 2005). Moreover, boys seem to generally prefer competitive play more than girls (Lever, 1976; Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010). This could indicate that competitive play is of particular relevance for male social development. For example, boys are more likely to become aggressive during competitive play (Ensor et al., 2011), which may indicate that competitive play is a better testing ground for them to develop their emotion regulation skills. Likewise, parents may be socializing their
children along gender stereotypical lines, giving girls more cooperative games, and boys more competitive ones.

While about half of the boys in this sample played at least one competitive video game, only a small minority of girls did. This prevented us from analyzing the influence of competitive gaming separately among girls (instead, gender was used as a control variable). While, competitive gaming may be uniquely beneficial to boys, it is also possible that competitive video games are disproportionately designed for male audiences. For example, the most popular competitive game in our sample was a soccer video game (*Fifa*); in the Netherlands, soccer is a predominantly male sport. It may therefore be important for studies to identify the competitive games favored by girls and to investigate their potential influence on girls' social competencies. Similarly, it may be worthwhile for game designers to develop competitive games that target female audiences.

**Limitations and future directions**

This study had a number of limitations. First, our competitive gaming variable allowed some ambiguity. We chose to determine competitive gaming based off of children's nominations, a method used similarly in other studies (Adachi & Willoughby, 2013). This is a more naturalistic and likely less subjective method than using a Likert scale. However, children were able to nominate more than one video game among their favorites. Thus, while all children who nominated a competitive video game were considered competitive gamers, some of these children were likely more inclined to play competitively than others. Similarly, for our moderation analyses, the frequency gaming variable was assessed for total gaming in the past week. The interaction term was therefore potentially less valid among participants who played a combination of competitive and non-competitive
games, compared to those who solely or predominantly played competitively. Finally, our competitive gaming variable precluded the possibility that children may have devised ways of creating competition around games that are not competitive by design. For example, children could compete with friends by taking turns to see who could more quickly complete a single-player game’s level.

Second, this study did not directly investigate the potential means by which competitive games may influence social competencies. Future work should consider a more process-oriented approach by looking into relevant mediators. We have already described the potential relevance of cooperative play and violent content. Trait aggression may also influence the extent to which competitive gaming leads to aggressive outcomes, and competitiveness and self-esteem may influence how invested players are when playing competitively. Emotion regulation processes during competitive play would also be worthwhile investigating. We have argued that competitive gaming provides a hotbed for emotionally-charged exchanges between peers, and that these exchanges challenge children to develop healthy emotion regulation strategies. This introduces a variety of variables such as trust between play partners, the subjective experience of self-focused and other-focused frustration, jealousy, schadenfreude, and pride. Investigating the processes at work during competitive play, and focusing on how children resolve negative emotions during play, may lend insight into the conditions under which competitive gaming may be beneficial (or detrimental) for the development of a child’s social competencies.

Third, this study did not investigate the extent to which children may engage in competitive play outside of video game play. We have argued that competitive gaming mirrors more traditional competitive games in that both
stimulate moral thinking and the need to healthily regulate negative expressions such as aggression, bragging, and disparagement. We did not investigate the likely possibility that children who preferred competitive gaming also enjoyed competitive games in other domains (Adachi & Willougby, 2015). On the other hand, it is likely that some children who were not inclined to play competitive video games did experience significant amounts of competitive play either through (organized) sports or other games with rules. Notably, despite this, competitive gaming was related to improvements in conduct problems and peer problems.

Conclusions

Competitive video games seem to be a relevant domain for children's moral development and emotion regulation skills. Children who played a competitive video game also showed improvements in their conduct problems and peer relationships, regardless of gender, and regardless of their gaming frequency. Gaming and competitive gaming have been generally cast as threats to healthy child development; our findings do not corroborate this. It remains difficult to pinpoint the aspects of competitive video games that may be at play here, as even competitive video games allow a diverse range of social interactions, and the rationale for children playing them may be varied. Future studies should therefore investigate the different processes at work during competitive play which are afforded by both the game and the player.
Stressful video games as training for real-world emotion regulation skills
Chapter VI

Associations between in-game and real-world emotion regulation skills among experienced Starcraft players

Published as:
Healthy emotion regulation is crucial for navigating stressful situations. Interoceptive awareness – the awareness of one's internal states – is important for such healthy regulation. Given the propensity for video games to induce stress, the associations between in-game and “real world” emotion-regulation strategies during duress are worth exploring. We therefore present a method for measuring the interoceptive awareness of negative affect during stressful video game play, and investigate whether individual differences in this ability relate to emotion-regulation strategies. Twenty-six proficient video game players were recruited to play a session of the video game Starcraft II in the lab. Players’ physiological and subjective states of in-game negative arousal were measured consecutively. A comparison of these measures was used to calculate players’ interoceptive awareness of real-time, in-game arousal. The relation between interoceptive awareness and a suite of emotion-regulation strategies was then investigated. We observed a positive relation between in-game interoceptive awareness and the self-reported tendency to actively seek a resolution to negative affect; a positive trend was also observed between interoceptive awareness and the self-reported tendency to seek instrumental social support. Findings are discussed in terms of the relative effectiveness of different emotion-regulation strategies for aiding in-game success. We further discuss the benefits and limitations of this pilot testing. In all, we hope to inspire future research into the associations between in-game arousal and emotion-regulation strategies used in everyday life.
Introduction

Video game playing is laden with anxiety, frustration, and anger (Baldaro et al., 2004; Juul, 2013; Ravaja, Turpeinen, Saari, Puttonen, & Keltikangas-Järvinen, 2008; Weber, Behr, Tamborini, Ritterfeld, & Mathiak, 2009). These stressful experiences are often integral in order for a game to feel challenging, indicative that video games may implicitly encourage players to manage and relieve their stress during goal pursuit. Video games may therefore provide a safe context for the development of healthy emotion regulation to the extent that they reward players for successfully down-regulating their negative affective states (Granic, Lobel, & Engels, 2014). Thus, the extensive amount of time spent playing video games, and their potential to promote the down-regulation of negative affect makes it worthwhile to investigate the associations between in-game and real-world responses to negative emotional arousal.

The present study builds upon the emotion regulation benefits of interoceptive awareness. Interoceptive awareness describes how aware one is of his or her internal physiological state (Mehling & Price, 2012). Greater interoceptive awareness provides better awareness of internal emotional states because physiological sensations mark, and perhaps underlie, the experience of emotion (Niedenthal, 2007; Sze, Gyrak, Yuan, & Levenson, 2010). Thus, heightened emotional awareness allows for more effective emotion regulation (Barrett, Gross, Christensen, & Benvenuto, 2001; Hastings et al., 2009). For instance, when asked to observe emotionally evocative stimuli, individuals trained to be more aware of their internal states showed, compared to control subjects, greater consistency between self-reported and physiological indicators of affect (Sze et al., 2010). Interoceptive awareness is also positively related with the ability to down-regulate
negative affect (Füstös, Gramann, Herbert, & Pollatos, 2013) and negatively related to alexithymia, the inability to identify subjective experiences of emotions (Herbert, Herbert, & Pollatos, 2011).

We investigated whether the ability to recognize negative affective states during gameplay is related to healthy emotion-regulation strategies more generally. To determine this, we adapted a methodology developed by Gottman and Levenson (Gottman & Levenson, 1985; Levenson & Gottman, 1983). In this approach, people were videotaped while engaging in an emotionally-charged conversation; the tapes were then played back and people were asked to use an affect rating dial (Ruef & Levenson, 2007) to rate, moment to moment, how negatively aroused they felt over the course of the conversation. In our study, skilled video game players were invited to our lab to play a competitive, online video game. Each player’s competitive match was recorded and presented to the participant who used the dial while observing the match they had just played. Each participant’s moment-to-moment perceptions of negative emotional arousal were compared with the participant’s actual in-game emotional arousal, based on heart rate. Importantly, heart rate has been shown to be positively associated with anxiety in general (Kreibig, 2010) and specifically with in-game tension and negative affect (Drachen, Nacke, Yannakakis, & Pedersen, 2010); further we selected a notoriously stressful video game for study. We hypothesized that participants who were more accurate in perceiving in-game changes in negative arousal would show healthier emotion-regulation tendencies outside the gaming context.

Six emotion-regulation strategies were examined, each corresponding to a strategy described in a recent meta-analysis (Aldao, Nolen-Hoeksema, &
Schweizer, 2010). Healthy emotion regulation tendencies include problem solving, acceptance, and reappraisal. Problem solving can involve instrumental and emotional support seeking, as well as direct attempts to resolve stress. Acceptance refers to the non-judgmental recognition of negative affect (Hofmann & Asmundson, 2008). Reappraisal refers to patterns of thought which alter the way one views (the consequences of) an event. These positive strategies are associated with healthy functioning and effective decreases in negative affective states (Aldao et al., 2010).

Unhealthy emotion regulation tendencies, on the other hand, include withdrawal, rumination, and suppression. Withdrawal involves avoiding a source of negative affect. Rumination refers to repeatedly thinking about negative affect and situations and excessive worrying (Abela & Hankin, 2011). Suppression refers to patterns of thought or action that dull the intensity of an emotional experience (Gross & John, 2003). These negative strategies are associated with maladaptive functioning (e.g., depression) and even the exacerbation of negative affective states (Aldao et al., 2010). Given the regulatory benefits of interoceptive awareness, we expected greater interoceptive awareness of in-game negative arousal to be associated with more self-reported use of healthy and less use of unhealthy emotion-regulation strategies.

Method

Participants

26 male university students (age \( M = 24.51, SD = 2.57 \)) participated in exchange for a chance to win video game-related prizes. Participants were recruited through a local video game tournament (Nijmegen Student Starcraft League, 2012). This
sample was chosen because (a) they were proficient gamers, and (b) the tournament’s focal game—*Starcraft II: Wings of Liberty*—is notorious for producing negative affective states, particularly, anxiety. The study was approved by the Behavioral Science Institute’s ethical committee, and informed consent forms were collected.

**Procedure**

Participants indicated their interest for being a part of the study via an online emotion regulation questionnaire. In individualized lab sessions, participants watched a relaxing film clip (three minutes from the opening of *Baraka* [Magidson & Fricke, 1992]; participants were told to watch the screen and breath normally), played a competitive match of *Starcraft II* (mean duration = 15 m, 1.8 s, SD = 4 m, 22.8 s), and immediately thereafter viewed the match’s replay. Base heart rate was calculated during the film clip. Replays were exact recreations of the match, forcing players to observe their own in-game actions. During the replay, participants used an affect rating dial to provide continuous, retrospective ratings of their in-game negative affect. Players were briefed on these procedures beforehand.

*Starcraft II* is an ideal game for investigating players’ interoceptive awareness of in-game negative affective states. Played worldwide it is among the most popular professionally played video games today (E-Sports Eye, 2011). *Starcraft II*s primary mode of play situates two players as overseers of a virtual map where they each command their units—analogous to the pieces on a chess board—to procure resources, use those resources to construct an army, and defeat the army of the opposing player. This mode generates frustration and anxiety in at least three ways: First, players are blind to the actions of their opponents. Players can only see what occurs in the map areas which they control, forcing players to out-think their opponent without being sure of the other’s tactics. Second, it is
inherently competitive. Players are paired against opponents of comparable skill, thereby maintaining high engagement and challenge. Finally, *Starcraft II* players are publicly ranked in skill based on their success/failure in competitive matches they play against strangers. This public ranking system is widely considered among players to produce stress, termed, “ladder anxiety” (Team Liquid, 2010).

**Measures**

**Emotion-regulation questionnaire.** Five subscales of the COPE (Carver, Scheier, & Weintraub, 1989), the Ruminative Response Scale (RRS; a subscale of the Response Style Questionnaire Abela & Hankin, 2011), and the Emotion Regulation Questionnaire (ERQ) (Gross & John, 2003) comprised the online emotion regulation questionnaire.

The COPE subscales (4 items; 5-point Likert scale, “I usually don’t do this at all” to “I usually do this a lot”) measured the frequency with which participants manage stressful situations through (a) three forms of problem solving, namely, seeking instrumental social support (*I try to get advice from someone about what to do*, *α* = .90), seeking emotional social support (*I try to get emotional support from friends or relatives*, *α* = .89), and actively seeking a resolution (*I take additional action to try to get rid of the problem*, *α* = .74), (b) withdrawal (*I admit to myself that I can’t deal with it, and quit trying*, *α* = .82), and (c) acceptance (*I accept that this has happened and that it can’t be changed*, *α* = .85).

The RRS (22 items; 4-point Likert scale “Almost never” to “Almost always”) measured the frequency with which participants engaged in ruminative thinking (*Think about shortcomings, failings, faults, mistakes*, *α* = .82).

The ERQ (7-point Likert scale, “strongly disagree” to “strongly agree”) measured the extent to which participants regulate their emotions through (a)
Starcraft study

reappraisal (6 items; I control my emotions by changing the way I think about the situation I'm in, $\alpha = .83$) and (b) suppression (4 items; I control my emotions by not expressing them, $\alpha = .69$).

Heart rate. Electrocardiography (ECG) was recorded using a 2-Lead system configured to a BioPac MP30, sampled at 500Hz with AcqKnowledge. Electrodes were placed 2cm below the clavicle and 2cm medially from the anterior medial edge of the deltoid, and the other, half the distance between the final rib and the superior iliac crest.

Affect rating dial. The dial’s signal (range -4 to +4 volts) was sent to the BioPac MP30 system and was sampled by AcqKnowledge at 200 Hz.

Data preparations

ECG data from the baseline and game sessions were transformed using a 2 Hz High Pass Filter. Heart rate was then calculated in beats per minute, and manually cleaned of artifacts. Participants’ heart rate time series were resampled to a rate of 2 Hz, and a 3$\sigma$ Gaussian window was used to smooth the data. To control for individual differences in baseline heart rate, a time series representing in-game percent change in heart rate was calculated for each participant. This time series represents the percent change in heart rate from each participant’s baseline every 500$ms$. This time series is hereafter referred to as $HR$.

The dial ratings were also resampled to a rate of 2 Hz, and were smoothed using a 3$\sigma$ Gaussian window. This time series is hereafter referred to as $DIAL$. 
Analytic strategy

Interoceptive awareness was calculated based on differences between the change in HR and the change in DIAL along a sliding window. Figure 1 depicts a screenshot from a player’s game; the screenshot is overlaid with an image of the participant’s face the HR and DIAL values from a 50s segment of the game, during which this screenshot occurred. Figure 2 depicts the HR and DIAL time series and the interoceptive awareness score of two participants.

HR values were standardized; each participant's HR was rescaled to match the dial rating’s scaling. The rescaled HR and the DIAL were each segmented into 10s epochs with a 5s overlap. For each pair of epochs, the value at the beginning of the 10s epoch was subtracted from the value at the end of the epoch, rendering a difference score for both the rescaled HR and the DIAL epochs. The absolute value of the difference between these difference scores represents the discrepancy between actual and perceived change in negative affect over each 10s period. Interoceptive awareness was estimated by calculating the mean discrepancy between these measures across all epochs. Thus higher values indicated greater discrepancy between actual and perceived change in negative affect and therefore poorer interoceptive awareness. For ease of interpretation, we multiplied this value by -1, making higher values indicative of better interoceptive awareness. 10s was chosen as an appropriate epoch duration based on previous studies (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005; Sze et al., 2010), and because we expected a 5 to 10s lag between actual and perceived changes in negative affect as a result of participants having to process the affective significance of the in-game events which were unfolding during the dial rating session.
Results

To determine whether participants were on average able to correctly use the dial to indicate their negative affect, each participant’s HR was correlated with their DIAL. This correlation was significant (p ≤ .05) for all 26 participants (although negative in 2 cases), and a t-test confirmed that the average correlation was different from zero (mean r = 0.327, t (25) = 7.67, p < .001). Table 1 presents the means and standard deviations for interoceptive awareness and the emotion regulation questionnaires.

Table 1. Means and standard deviations

<table>
<thead>
<tr>
<th>Variable</th>
<th>IA</th>
<th>SIS^1</th>
<th>SES^1</th>
<th>ACT^1</th>
<th>ACC^1</th>
<th>REAPP^3</th>
<th>WIT^1</th>
<th>RUM^2</th>
<th>SUP^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.11</td>
<td>2.39</td>
<td>2.16</td>
<td>2.73</td>
<td>2.48</td>
<td>4.53</td>
<td>1.51</td>
<td>2.00</td>
<td>3.55</td>
</tr>
<tr>
<td>SD</td>
<td>0.22</td>
<td>0.77</td>
<td>0.71</td>
<td>0.53</td>
<td>0.71</td>
<td>1.16</td>
<td>1.67</td>
<td>0.42</td>
<td>0.89</td>
</tr>
</tbody>
</table>

Note. All scores based on mean score. 1. 5-point scale; 2. 4-point scale; 3. 7-point scale. IA = Interoceptive awareness; SIS = seek instrumental social support; SES = seek emotional social support; ACT = seek active resolution; ACC = acceptance; REAPP = reappraise; WIT = withdrawal; RUM = rumination; SUP = suppression.

Table 2 presents these correlations and their associated p-values. As hypothesized, interoceptive awareness was significantly positively related to actively seeking a resolution and the relation between interoceptive awareness and seeking instrumental social support showed a positive trend (p ≤ 0.10), Other correlations were not significant.
**Figure 1.** Screenshot of in-game session.

Legend, graph, participant’s face, and numbers are overlaid over the original screenshot. *HR* = percent change in participant’s heart rate. *DIAL* = negative emotional arousal self-reported while watching a replay of the game. *HR, DIAL*, and participant’s photograph are all taken from the same 50s portion of gameplay from which the screenshot was extracted. Participant consented to use of his photograph.

**Table 2.** Correlations: Interoceptive awareness and emotion regulation

<table>
<thead>
<tr>
<th></th>
<th>SIS</th>
<th>SES</th>
<th>ACT</th>
<th>ACC</th>
<th>REAPP</th>
<th>WIT</th>
<th>RUM</th>
<th>SUP</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>r</em></td>
<td>.335</td>
<td>-.181</td>
<td>.513</td>
<td>.170</td>
<td>.230</td>
<td>-.244</td>
<td>.076</td>
<td>.117</td>
</tr>
<tr>
<td><em>p</em></td>
<td>.095</td>
<td>.377</td>
<td>.007</td>
<td>.407</td>
<td>.259</td>
<td>.229</td>
<td>.713</td>
<td>.568</td>
</tr>
</tbody>
</table>

*Note.* *SIS* = seek instrumental social support; *SES* = seek emotional social support; *ACT* = seek active resolution; *ACC* = acceptance; *REAPP* = reappraise; *WIT* = withdrawal; *RUM* = rumination; *SUP* = suppression.
Figure 2. \( HR \) and \( DIAL \) from two participants’ full sessions.

\( HR \) = percent change in participant's heart rate. \( DIAL \) = negative emotional arousal self-reported while watching a replay of the game. \( IA \) = Interoceptive awareness score.

**Discussion**

The emotion-regulation benefits of interoceptive awareness provided the theoretical (Barrett et al., 2001) and empirical (Füstös et al., 2013; Herbert et al., 2011) impetus for the present study. Our primary goal was to determine whether the interoceptive awareness of in-game negative affective states might be indicative of emotion-regulation strategies. On self-reported emotion-regulation measures, we expected interoceptive awareness of negative in-game affect to be related to healthier reactivity to real world stress. Only the relationship between interoceptive awareness and actively seeking a resolution was significant; the relationship between interoceptive awareness and seeking instrumental support showed a trend in the hypothesized direction.
These findings indicate that interoceptive awareness of negative affect during stressful gameplay may be uniquely related to regulatory strategies that are more problem-focused than emotion-focused (see Lazarus & Folkman, 1988), and that are relevant for in-game success. In games such as *Starcraft II*, negative emotional arousal during gameplay is a direct consequence of a player's in-game choices. Win-lose states are clearly linked to the decisions players make of which resources they procure, how they invest their resources, and how they manage offensive rallies against their opponents. To prevent future negative emotional arousal, players must therefore learn how to make better in-game decisions. It is therefore logical that recognizing negative emotional arousal in these contexts would relate to emotion-regulation strategies that are action and problem-solving focused, and which lead to improvements in in-game performance.

Albeit speculative, this reasoning may also account for why the other emotion-regulation strategies measured in this study showed no association with interoceptive awareness. Regarding other healthy emotion-regulations strategies, seeking emotional social support – such as comfort – does not seem to be an effective strategy for relieving in-game stress. Likewise, acceptance would prove maladaptive should it constitute “giving up” (Wilson, 1996), and withdrawal is antithetical to the game’s core goal – to engage and defeat one’s opponent. Finally, rumination and reappraisals are likely to be too cognitively demanding for players to engage in during such fast-paced games as *Starcraft II*. As player’s attention is most demanded for making the best in-game decisions as quickly as possible, in-game negative affect is not likely to inspire players to halt and re-examine (the reasons for) their negative state. Our results therefore seem to indicate that player’s interoceptive awareness of in-game negative affect may be specifically related to problem-focused strategies that are relevant to in-game success.
Methodological contribution

One of the main goals of the current paper was to introduce an innovative methodology to study the associations between in-game and everyday emotion-regulation strategies. In light of our small sample size, we consider our findings a promising first step; our findings support the possibility that particular emotion-regulation skills may be engaged and even trained during stressful video game play.

The method employed in this study seems promising for diverse avenues of future research. First, this method may be tested with other video games, particularly those in which more cognitive and emotion-focused regulatory strategies are promoted. Such studies could help determine whether in-game interoceptive awareness specifically relates to emotion-regulation strategies that are contextually relevant. Second, longitudinal research is critical to conduct in order to better understand the causal link (if there is one) between in-game interoceptive awareness and emotion-regulation skills. It may be worthwhile to identify video games which implicitly promote interoceptive awareness and to track whether such games lead to improvements in in-game success and in everyday emotion-regulation skills. Lastly, as this study only included self-report measures, future research would benefit significantly from using behavioral measures of emotion regulation. These suggestions highlight this study’s limitations. The correlational design makes it impossible to determine whether overcoming in-game experiences of negative affect is beneficial for managing everyday experiences of stress and negative affect. Second, recall and social desirability biases somewhat impugn the validity of self-report measures.
Video game playing has become ubiquitous. Researchers have only begun to investigate the relationships between in-game emotional states, the regulation of those states, and individuals' patterns of emotional reactivity in everyday life. The method we presented here is unobtrusive, easy to implement, engaging for participants, and shows promise. It seems likely that the relevance of research into gaming and emotion regulation will only increase as gaming technology evolves. For instance, the upcoming Xbox One's Kinect will be able to detect heart rate and facial expressions (Stuart, 2013), allowing designers to construct games where players' emotional reactions dynamically interact with the gamespace. This will allow emotion regulation to become an explicit component of gameplay. In this line, our hope is that this study provides a springboard from which more in-depth research can be conducted into the role of video game play and (the development of) emotion-regulation tendencies.
Chapter VII
Designing and utilizing biofeedback games for emotion regulation: The case of Nevermind

Published as:
Biofeedback games have the potential to make gaming a deeply personal experience by linking the gamespace to each player’s physiological state. First, this paper describes the psycho-educational potential of the horror-themed biofeedback game *Nevermind*. In *Nevermind*, players’ heart rate is continuously read into the game which in turn adapts to the player’s momentary levels of negative affective arousal. Greater negative arousal causes the game and its horror-themed settings to become more disturbing. As a result, *Nevermind* challenges players to improve their emotion regulation skills by encouraging them to healthily down-regulate their negative affective states in the face of stressful situations. Second, we share how *Nevermind* implements two valuable design principles to maximize player engagement. Finally, we describe a recent study conducted on 47 players. We discuss potential physiological metrics which may be useful for understanding how behaviors in the real world relate to those in biofeedback games like *Nevermind*.
Introduction

Developed by Flying Mollusk, *Nevermind* is a horror-themed biofeedback game played from the first person perspective. The game casts players in the fictional role of a Neuroprober, a therapist of the future. As a Neuroprober, players enter the minds of Clients who suffer from life hindering psychological distress. Each Client serves as a self-contained level whose completion is achieved when players discover the root cause of their Client’s distress. To do so, players must navigate each Client’s nightmarish subconscious, solving puzzles to unlock fragmented memories. Players must think like a detective by attending to the game’s details which help illustrate how these fragmented memories fit together to tell each Client’s true story. Thus, at the conclusion of each level, players must identify and correctly order five of the Client’s ten memories. Doing so reveals the root cause of their Client’s anxiety, and brings closure for player and Client alike.

While *Nevermind* can be played as a traditional video game, the game also prominently utilizes biofeedback. Biofeedback refers to a system whereby the player’s physiology provides the game with input, and then reacts to this input, in turn providing feedback to the player. Supporting a variety of input devices (e.g. Intel RealSense cameras, Garmin Heart Rate Chest Strap; a full list is available on the *Nevermind* website’s support page), *Nevermind*’s biofeedback system utilizes players’ heart rate. More specifically, by capturing heart rate variability, *Nevermind* continuously tracks players’ degree of negative physiological arousal as a proxy for levels of player stress. The more stress players experience, the more difficult the game becomes. Thus, increases in player stress are matched by the screen becoming progressively obscured by static; also, many environments in the game
become hostile to the player, obstructing his/her movement or visibility, and sometimes dealing damage to the player (Figure 1).

Of course, being a horror-themed video game, *Nevermind* is designed to evoke stress, suspense, and even mild discomfort. In this way, the game challenges players to manage their physiology in the face of negatively arousing circumstances. Herein rests the promise of *Nevermind* to experientially teach players how to manage stressful situations in their everyday lives. In linking players' physiological states to the gamespace, *Nevermind* seems to engage players' interoceptive awareness.

**Figure 1.** An example of *Nevermind*’s biofeedback system.

From left to right, as the player’s stress increases, the screen becomes increasingly distorted, and milk incrementally rises in the room. In this scenario, the player’s character can drown, forcing him/her to restart the challenge. However, returning to a relaxed state causes the milk to subside.

Interoceptive awareness (IA) refers to the ability to recognize one's own physiological states (Mehling et al., 2012). This skill underlies our ability to determine things like hunger, muscle fatigue, or the accurate source of physical pain. But IA is also valuable in the domain of emotion regulation, that is, the conscious and unconscious means by which we manipulate our experience of emotions. This is because – as long argued by important theorists in psychology (Damasio, 1994; Gross & John, 2003; Niedenthal, 2007) – emotional states are inherently linked to physiological states. Increases in IA may therefore boost
emotion regulation skills and therefore better equips individuals for dealing with negative emotional experiences (Lobel, Granic, Stone, & Engels, 2014). Several recent studies support this: (1) IA has been positively associated with the ability to recognize one's emotions (Sze, Gyurak, Yuan, & Levenson, 2010); (2) IA has been negatively associated with Alexithymia, the inability to recognize one's emotions (Herbert, Herbert, & Pollatos, 2011); (3) IA has been positively associated with the ability to down-regulate negative affect by better reappraising negative emotional experiences (Füstös, Gramann, Herbert, & Pollatos, 2013); and (4) people with a greater IA experience less negative affect when being socially excluded (Pollatos, Matthias, & Keller, 2015). Regarding *Nevermind*, because the game encourages players to recognize and healthily manage their physiological states, it may therefore be beneficial for IA, and by extension, for a player’s ability to manage stress in their everyday life.

**Design principles**

*Nevermind*’s biofeedback mechanic helps make the game feel like a personalized experience. How each individual player feels while playing the game makes for a unique experience. However, this design feature would likely not be enough to engross players and carry the gameplay on its own. Therefore, before we discuss the potential insights afforded by in-game data we collected in a recent study, the two following sections highlight the game’s design principles which help make *Nevermind* a compelling experience. We call these design principles thematic congruence and environmental storytelling.

To concretely demonstrate these design principles, we draw on examples from the Client #251 level. In this level, players inhabit the subconscious of a
middle-aged woman whose father passed away when she was very young — there was a fatal car accident, her mother told her. With the recent passing of her mother, however, the Client reports sudden feelings of guilt and anger. Related to this, she also reports anxiety coming from the belief that people stare at her, seemingly in judgment. In the Client’s nightmarish subconscious, the idyllic suburban home from her childhood becomes a dark, dilapidated house of horrors. There are signs of financial insecurity and marital unrest. Over the course of the level, the player discovers that the story about Client #251’s father dying in a car accident was a lie. [SPOILER ALERT / MATURE CONTENT WARNING:] In actuality, when Client #251 was a little girl, she mistakenly entered her parent’s bedroom just as her father was committing suicide, and witnessed him firing a gun into his head.

In the following two sections, we discuss some ways in which the game uses thematic congruence and environmental storytelling to engage players by making the clues and themes of this level central to the gamespace in the Client #251 level.

**Design principles:**

**Thematic congruence**

Thematic congruence means that there is an overlap between the themes of the game — for Client #251, these are things like social anxiety, domestic unrest, and separating fact from fiction — and the player’s visual experience. This means that *Nevermind*’s art, colors, and assets are meant to be in line with the messages which its designers want to convey. This creates a very singular design.

Some examples: The idea that Client #251’s family unit corroded is depicted by a literally broken home (Figure 2). Also, Client #251 spoke about an intense guilt she feels when she is being looked at; so not only do family portraits
in the home have blank faces, but in the nightmare version of the home, these faces are blotched out aggressively (Figure 2, right-most images, top versus bottom panel). These images recur throughout the game, and in some cases, blank faces follow the player, staring in judgment (Figure 3).

**Figure 2.** Environmental storytelling in Client #251’s childhood home.

Players first experience a non-threatening version of Client #251’s home (top row), before solving puzzles in the dilapidated nightmare version (bottom row). The contrast and/or brightness of these images have been altered for visibility.

**Figure 3.** Thematic congruence: Blank and blotched out faces

Blank or blotched out faces are a recurring visual motif in the Client #251 level. This motif reflects the Client’s anxiety experienced when seeing people look at her. The contrast and/or brightness of these images have been altered for visibility.
Design principles: Environmental storytelling

As consequence of Nevermind having consistent thematic congruence, the act of exploring the gamespace comes to have meaning for the player. The more players explore, the more they are rewarded with details that help tell a story. Moreover, because much of the exploration is voluntary, the things that players discover feel special. Players experience a sense of ownership. "Oh wow – I found this!" Nevermind was designed with this in mind; thus, because Nevermind's design strives for thematic congruence, Nevermind is also able to tell its stories via the game's world. For example: Although not legible here, the bold red text "Past Due" is easily readable in-game on the envelope in Client #251's mailbox (Figure 2, top panel) – at least for those curious enough to attune to it. Also conveying domestic unrest, the titles of board games which are featured in the living room subtly change when players explore the home's nightmare version (e.g. "Family Games, Inc." becomes "Fractured Family, Inc."). Nevermind features a great many more of these subtle environmental clues for eager players to discover on their own initiative. Crucially, these instances of environmental story-telling not only compel players to explore, but with each discovery, these discoveries help players increasingly feel like they are cultivating their own personalized understanding of Client #251.

Observational study

We recently conducted an observational study to examine potential connections between Nevermind players’ in-game and real world behaviors. This study was motivated by the observations that (1) Nevermind’s biofeedback mechanic seems
capable of engaging (and perhaps training) interoceptive awareness, and (2) *Nevermind*'s design principles help make it a highly engaging experience. Forty-seven participants (38 males) aged 18 to 24 took part. The study was conducted at The University of Southern California, and was approved by the university's ethical review board. Below, we describe our procedures and showcase heart rate data collected in-game to discuss potential analysis strategies and potentially valuable insights that this data could afford.

Participants completed an online questionnaire to assess how they manage their emotions in everyday stressful situations. The questionnaire consisted of the Emotion Regulation Questionnaire (ERQ) (Gross & John, 2003), five subscales of the COPE (Carver, Scheier, & Weintraub, 1989) – instrumental social support, emotional social support, active coping, withdrawal, and acceptance – and the Ruminatory Response Scale (RRS) (Roelofs, Muris, Huibers, Peeters, & Arntz, 2006). Participants then came to the lab to play through *Nevermind*'s Client #251 level while wearing a Garmin Heart Rate Chest Strap. Playtime was restricted to 45 minutes, with 34 participants (72.4%) managing to complete the game within the allotted time. Participants then completed an exit questionnaire assessing their experience when playing the game; the questionnaire consisted of subscales from the Intrinsic Motivation Inventory (IMI) (McAuley, Duncan, & Tammen, 1989), namely Interest/Enjoyment, Effort/Importance, pressure/tension, and value/usefulness.

**Future steps and potential insights**

Our next goal is to explore whether associations can be drawn between how participants regulated their physiology while playing *Nevermind* and how they manage their emotions during everyday stress. We therefore intend to extract a
number of metrics from players' in-game heart rate (variability) data. The hope is that we can identify metrics that are informative with regards to how players deal with stress in their everyday lives.

Figure 4 presents heart rate data from three different participants. While Nevermind utilizes heart rate variability for its biofeedback mechanic, heart rate is plotted here for ease of discussion and readability. The data from these participants were specifically selected to demonstrate the general variety in physiological reactions across participants, and to help illustrate the metrics we think may be informative:

- **Frequency of spikes in negative physiological arousal** – Comparing Participant 26 (P26) to P25, it seems that there is variability in the number of times which Nevermind caused players' heart rates to spike. This may be an indication of (over-)sensitivity to negative emotional stimuli.

- **Speed of recovery** – Perhaps more important than the number of times Nevermind evoked negative arousal, is the speed with which participants are able to recover from spikes in arousal. Thus, the slopes of the lines coming off of a spike may be important. This could be a metric of an ability to healthily down-regulate negative arousal after highly stressful experiences.

- **Frequency of dramatic drops in negative physiological arousal** – Again comparing P26 and P25, P25 seems to more frequently have dramatic drops in heart rate. These may be indicative of freeze responses, or perhaps to an ability to quickly regulate physiology when the situation requires it.

- **Intensity of negative physiological arousal** – Finally, negative arousal may vary in intensity across participants. For example, P42 seems to show a resting
heart rate of about 80 beats per minute, while her heart rate exceeded 110 beats per minute on a number of occasions. This too may be an indication of (over-) sensitivity to negative emotional stimuli.

Figure 4. Heart rate data from three participants

The y-axis represents heart rate in beats per minute on, and the x-axis represents time in minutes. Each graph plots a single play session from a single participant. While Nevermind utilizes heart rate variability for its biofeedback mechanic, heart rate is plotted here for ease of discussion and readability. Gaps in lines represent missing data. Participant 26 did not complete the level, Participant 25 did, and Participant 42 requested to end the session early due to duress. (This was the only participant in our sample to do so.)

Closing remarks

This work describes the biofeedback game Nevermind, and argues for its potential to help train emotion regulation skills. It is our hope that Nevermind becomes just one of many interactive experiences to engage users’ emotion regulation capacities. To that end, we have recruited established psychological research to argue for the value of its biofeedback mechanic. We have also highlighted design characteristics which may be beneficial for future like-minded projects. Finally, we have discussed some of the various ways in which physiological data recorded in-game can be of value for understanding human behavior outside of the game. We invite others to think together with us about how biofeedback games can be of both value and entertainment, and how physiological data from such games may be of value.
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Chapter VIII
General discussion
Summary and general discussion

The three arms of research presented in this dissertation investigated whether video games afford players a domain for developing healthy emotion regulation skills. This investigation was primarily inspired by (a) parallels between modern gaming and traditional forms of play, suggesting a common set of psychosocial benefits; (b) a lack of longitudinal studies investigating the role of gaming in pre-adolescent children's normative development; and (c) a lack of research focusing on gaming as a stressful context that may facilitate emotion regulation training and development. Each arm of research in this dissertation emerged from one of these observations.

First, a review chapter presented classic psychological theories of play and modern research on the benefits of gaming. This review provided compelling theoretical and empirical support for researching the psychosocial benefits of gaming. Second, studies derived from a longitudinal design investigated how various forms of gaming may influence pre-adolescent children's psychosocial development. In one study, gaming was associated with an increase in internalizing problems but with no other changes in children's psychosocial health. Also, a high frequency of competitive gaming was associated with a decrease in prosocial behavior; but in a subsequent study, children's preference for competitive games was associated with improvements in conduct problems and peer relationships. Third, a pair of observation studies investigated the relationships between emotion regulation processes during stressful gaming and in the real world. Interoceptive awareness was associated with an active resolution strategy in one study; in another study, several physiological processes were identified as being potentially valuable for emotion regulation while gaming. This
Discussion reviews these research outcomes in greater detail, describing how they relate to one another and past research.

**Review.** Chapter II highlighted research showing the cognitive, motivational, emotional, and social benefits of gaming. For instance, playing fast-paced action video games have been experimentally shown to improve spatial skills (Uttal et al., 2012). The frequency of other forms of video game playing has also been associated with greater creativity (Jackson, 2015) and problem-solving skills (Adachi & Willoughby, 2013). Motivationally, video games show potential to promote an incremental theory of intelligence (Molden & Dweck, 2006), whereby the repeated failure that occurs while gaming may teach players that failure is necessary in order to experience growth. Emotionally, gaming’s mood benefits (Russoniello, O’Brien, & Parks, 2009; Ryan, Rigby, & Przybylski, 2006) and the ability of gaming to facilitate flow states (Csikszentmihalyi, 1988) may promote positive affect and inspire players to broaden their behaviors and build social relationships (Fredrickson, 2001). Finally, regarding social benefits, cooperative gaming has been shown to promote prosocial behaviors (Ewoldsen, Eno, & Okdie, 2012).

Studies have continued to demonstrate the benefits of video game playing in these four domains in the years since this review. Recent research on cognitive skills indicates that playing action video games not only enhances a suite of cognitive skills, but may also aid cognitive flexibility (Green & Bavelier, 2015) – this means that playing action games may help individuals become quicker at mastering novel cognitive challenges (Bejjanki et al., 2014). Researchers have also begun to harness these benefits by designing serious games for cognitive enhancement. For instance, in *Neuroracer*, players must multitask between driving...
on a winding track and a signal detection task. A recent randomized control trial showed that elderly participants (aged 60 to 85) who played the game showed marked improvements in their multitasking ability, "attaining levels beyond those achieved by untrained 20-year-old participants, [and] with gains persisting for 6 months" (Anguera et al., 2013, p. 97).

Motivationally, several initiatives have emerged looking to utilize gaming’s potential to promote persistence. Extending their research showing a positive association between persistence and gaming (Ventura, Shute, & Zhao, 2013), Shute and colleagues demonstrated that playing the three-dimensional puzzle game Portal 2 resulted in stronger improvements in persistence than playing the serious game Lumosity (Shute, Ventura, & Ke, 2015). Based on this research, and because a core tenant of game design is to progressively ramp up a game’s degree of challenge, educators have begun utilizing games as assessment tools for persistence and learning (Ventura, Shute, & Small, 2014; Shute, Ke, & Wang, In Press).

Emotionally, several recent studies depict how gaming may influence emotional functioning. Among adolescents, Coyne and colleagues observed that the more siblings played video games together, the more affection they held for each other (Coyne, Jensen, Smith, & Erickson, 2016). Additionally, the more adolescents played violent video games with a male sibling, the less siblings experienced conflict with one another. This may reflect a catharsis effect, whereby male siblings may resolve their aggressive inclinations through aggressive play (see Ferguson & Rueda, 2010). In a similar vein, researchers have also highlighted that video games which trigger negative emotions such as fear, anger, sadness, and loss may ultimately provide positive emotional experiences (Bopp, Mekler, &
Opwis, 2015; Triberti, 2016). This is because these negative experiences may trigger personal insights, with players coming to recognize their ability to overcome in-game challenges, or feeling gratitude for the chance to experience the journey of a game's poignant story.

Socially, the prosocial influence of playing cooperatively has continued to gain support. In a recent experiment, participants who played a violent game cooperatively showed no increase in aggressive behavior in the short-term whereas participants who played the same game competitively did show increases in aggressive behavior (Velez, Greitemeyer, Whitaker, Ewoldsen, & Bushman, 2014). This indicates that cooperative gaming may buffer against the effects of violent video game playing. Moreover, cooperative video games have been shown to facilitate intergroup relations. In a pair of recent studies, participant who played cooperatively with a believed outgroup member showed more positive attitudes towards the outgroup than participants who played the same game alone (Adachi, Hodson, & Willoughby, 2015). Research on cooperative video gaming therefore continues to demonstrate the prosocial benefits of this form of play.

However, despite the advancements in research in these domains, the review in Chapter II also raised several gaps in our knowledge which remain largely unaddressed. Therefore, the other two arms of research in this dissertation were designed in light of: (1) a lack of longitudinal research that investigates gaming as a potential benefit to children’s psychosocial development; and (2) a lack of research into gaming’s potential to train emotion regulation skills by making players more aware of their internal states and by challenging players to downregulate negative affect during play.
Longitudinal research. Described in Chapters III, IV, and V, the second arm of research in this dissertation was comprised of studies whose data was collected longitudinally in three waves over a three-year span. Chapter III describes correlations at the first wave of data collection. Parents and children reported on each child’s gaming frequency, and parents reported on children’s psychosocial health. While parent reports indicated that children’s gaming was associated with more conduct problems, poorer peer relations, and less prosocial behavior in children, no associations were found between children’s self-reported gaming frequency and any measures of children’s psychosocial health. These different outcomes may have been the result of a single source bias, with parents potentially holding negative attitudes towards gaming. However, this hypothesis was not confirmed because no differences were observed in the strength of the correlations based on parent versus child reports.

Despite a lack of evidence for the single source bias, the findings from this and other recent studies signal the importance for gaming studies to use multiple reporters when self-report data are being collected. This study did not find any statistical difference between the correlations derived solely from parent reports versus the correlations derived from both parent and child reports; however, the interpretation of the observed correlations were categorically different in these cases. In the case of children reporting the frequency of their gaming behavior – where a single source bias could not be a factor – gaming and psychosocial health were unrelated. As discussed in Chapter III, given the small size of the correlations based solely on parental reports ($r < .02$), the margin of influence of parental bias may have been small and therefore difficult to detect. Importantly, recent studies indicate that parents may be more likely to hold negative opinions about the effects of gaming. For instance, compared to 18 to 35 year olds, adults above 35 years old
in a nationally representative sample reported less experience playing video games and a stronger belief that gaming is associated with aggressive outcomes (Przybylski, 2013). Looking specifically at parents in a separate study, those who reported co-playing with their children were more likely to expect video games to have a positive influence (Przybylski & Weinstein, 2016). Taken together, the findings in Chapter III and these studies on gaming exposure and attitudes indicate relevant reporter biases which researchers should take into account.

Future gaming studies that use self-reports should therefore control for participants' exposure to video games (Przybylski & Weinstein, 2016), and more directly, their beliefs about the effects of video gaming. Researchers may also consider directly investigating whether parental attitudes towards video games influences parents' perceptions of the frequency of their children's gaming. This could be done by acquiring objective measures of children's gaming frequency and seeing whether parents holding negative attitudes towards the effects of gaming are more likely to over-report their children's gaming frequency. An objective measure of gaming frequency could for example be derived from video games themselves; this is because many modern games track how long players spend in-game. Going one step further, teachers or clinicians could also provide ratings of children's psychosocial health (these participants would have to be blind to the study's interest in gaming). Together, an objective measure of children's gaming frequency and measures of children's psychosocial health from multiple reporters would allow researchers to compare the association between children’s gaming and their psychosocial health based on multiple sources. Parental attitudes towards gaming could be examined as a moderating factor in the strength or direction of these associations.
Building on the cross-sectional research in Chapter III, Chapter IV describes a series of cross-lagged panel models that tested the longitudinal relationships between gaming and children's psychosocial health. Following the suggestions from Chapter III to use multiple reporters, children's psychosocial development was assessed in these models with parental reports, and children's gaming frequency and preferences were based on child self-reports. These models also tested the longitudinal relations between psychosocial health measures and changes in gaming frequency; however, no indication for such selection effects were observed. None of the negative associations between gaming and psychosocial health that were observed cross-sectionally in Chapter II were observed longitudinally; however, no positive associations were observed either. This undercuts the notion that video games are detrimental to children's development, but also does not support the hypothesis that playing video games is beneficial.

The more children played video games at this study's first wave, the more likely they were to show an increase in internalizing problems. It should first be noted that the observed association was small, with a standardized regression coefficient below 0.2. Although small in size and in the opposite direction from what was hypothesized, this finding nevertheless indicates the importance of research into gaming's influence on children's emotion regulation skills. Research in adolescents and adults indicates a heightened prevalence of depression and anxiety among a subset of gamers, so-called “pathological gamers” (Lemmens, Valkenburg, & Peter, 2011). These are individuals whose gaming habits impair their normal healthy functioning and who therefore also tend to play video games excessively (Petry et al., 2014). Importantly, however, pathological gaming has almost exclusively been identified among those playing online games, and
Massively Multiplayer Online Roleplaying Games (MMORPG’s) in particular. This is because online games, and particularly those with the persistent, socially active worlds seen in MMORPG’s, may provide an escape for individuals dealing with depression and anxiety (Kuss & Griffiths, 2012).

In children, however, these gaming patterns are less common. While online games were popular among the children in our sample, the types of online games that children tended to nominate do not seem to share the same features as those games popular among pathological gamers. The most popular online games in this sample were either casual games designed to be played in short sessions, or the widely popular *Minecraft*. While *Minecraft* shares some design features of MMORPG’s – e.g. *Minecraft* allows many players to play together in a single virtual space – unlike MMORPG’s, *Minecraft* can be played alone; moreover, even when played with others, the game does not give explicit challenges which are designed for group play. This indicates that *Minecraft*’s design is less encouraging of the type of extensive, recurring social play which is often observed among MMORPG’s players with internalizing problems. Therefore, whereas gaming may be associated with internalizing problems among adolescents and adults for whom gaming is done compulsively, among children, the association between gaming and internalizing problems may be driven by a different mechanism.

Parental monitoring may play an important role here. In a recent study, the amount and type of gaming were together predictive of children’s internalizing problems. Children aged 10-11 who both (a) played for more than 14 hours per week and (b) predominantly played violent video games, also reported the presence of more depressive symptoms (Tortolero et al., 2014). The authors argued that just as witnessing real world violence has negative emotional
consequences for children (Osofsky, 1999), so too should witnessing virtual violence in video games. An alternative explanation could however be that these children faced no restrictions regarding their gaming habits – this lack of restrictions may be indicative of these children having neglectful or less emotionally involved parents. In other words, children who were free to play both what and whenever they wanted may have had parents who did not play active roles as caregivers. It is clear that neglectful and permissive parenting are associated with a host of negative psychosocial outcomes (Knutson, DeGarmo, & Reid, 2004; Norman, Byambaa, De, Butchart, Scott, & Vos, 2012). Thus, the presence or lack of parental mediation in children’s gaming may be important to consider when investigating the links between gaming and internalizing problems.

Finally, the findings in Chapters IV and V seem at odds with one another regarding the influence of competitive gaming. Between waves 1 and 2 of data collection (Chapter IV), children who both (a) played video games for more than approximately 8.5 hours per week (nearly one standard deviation above the sample’s mean) and (b) tended to play competitively, showed a decrease in prosocial behavior. However, between waves 2 and 3 (Chapter V), children who nominated competitive games as being among their favorites showed no changes in their prosocial behavior and were more likely improve in their antisocial behavior and peer relations. While there is a lack of research investigating cooperative and competitive gaming in children (see: Gentile et al., 2009), the prevailing view among researchers based on adolescent and adult research is that competitive gaming instills antisocial tendencies. Taken together, however, the findings in Chapters IV and V seem to indicate that competitive gaming’s influence in children may be more nuanced.
Specifically, the influence of competitive gaming may be related to players' motives for play. From a Self-Determination Theory perspective, (competitive) video games provide enjoyment because they fulfill players' needs for autonomy, competency, and relatedness (Ryan et al., 2006). In terms of these motivations for play, competitive gaming may serve a different function at different stages of development. For example, as children near puberty, there may be a shift in motivation from using games to experience autonomy to using games to experience relatedness. Compared to older children who experience more autonomy in their everyday lives (Davies, 2010), younger children may particularly look to competitive gaming to fulfill their need to feel in control of their actions. Competitive games may particularly help fulfill this by allowing players to impose their will over their opponents. Playing competitively based on this motive may make children less inclined to help others in real world situations. This is because competitive gaming may be a context where younger children look to assert their autonomy at the cost of their opponents.

As children grow older, competitive games may be enacted more to fulfill relatedness needs. Supporting this, while only 13% of children reported playing a competitive game at the study's first time point, more than 30% did at the study's second and third waves. This may reflect an increased interest in games as a means of feeling connected to others, and may therefore coincide with the increasing importance of peer relationships as children develop (Davies, 2010). Given that as children grew older more of their peers seemed to play competitive video games, and that peers become a more central aspect of children's lives as they enter puberty, competitive gaming may have increasingly become a means of children being connected with others. In Chapter V, therefore, children's motives for competitive gaming may have therefore been more as a means to experience
relatedness than to experience autonomy. This difference in motives may have influenced the manner in which they played with friends, and the consequences of competitive play.

Methodological differences may also account for the different outcomes reported in Chapters IV and V. For instance, the analyses in Chapter IV relied on children's self-reports of how often they played competitively. This subjective measure of competitive play may have introduced a reporter bias: Children who considered themselves more competitive in general may have inflated their response; likewise children who did not consider themselves generally competitive may have underestimated their competitive gaming habits. Another difference between these studies concerns cooperative gaming. The research in Chapter IV simultaneously examined the potential influence of cooperative and competitive video games, whereas the research in Chapter V focused solely on competitive gaming. Future research could examine whether children are motivated to play competitive games for different reasons at different periods of development, and whether different motives translate into different behaviors during play as well as different psychosocial outcomes.

In sum, the research presented in Chapters III, IV, and V, indicate that gaming's influence on child development may depend on a variety of factors. First, parents may play an important role; parental attitudes towards gaming may influence study outcomes, and parental involvement in moderating children's gaming may have consequences for children's emotional development. Second, age and motives for play may also have consequences for the role of gaming in development. This may particularly be the case for those playing competitive video
games, as different motives may influence whether competitive gaming decreases prosocial behaviors, or helps bring peers closer together.

Video games have long been a source of social concern, and such concern seem magnified when considering gaming’s presumed negative influence on children. However, put into historical perspective, such presumptions may be a product of how foreign video gaming seems to members of the older generation. That is, like film and television before it, gaming may in large part evoke mass skepticism largely because it is a new form of popular media. Again, as Przybylski’s research demonstrates, negative attitudes towards video games may be linked to one’s level of experience with video games (2013). Given this perspective and these findings, the social concern surrounding video games may therefore reflect a “moral panic” (Ferguson, 2008; 2011) more than the objective presence of danger. This conclusion seems warranted given the findings in Chapters III, IV, and V. Gaming was ubiquitous among children in these studies, and gaming frequency was associated with little to no detrimental outcomes. Instead, concern regarding gaming’s negative influence may be warranted in cases where children are given free rein to play as often and as aggressively as they want. Such children may be at risk for playing games that are inappropriate for their developmental stage. These studies therefore seem to indicate that unless left greatly unfettered, gaming is a healthy fit in children’s normative psychosocial development.

**Stressful gaming.** Described in Chapters VI and VII, the third arm of research in this dissertation used stressful video games to investigate emotion regulation processes during gaming. In Chapter VI, experienced gamers played the competitive real-time strategy game *Starcraft 2*. In line with past research that interoceptive awareness aids emotion regulation processes (Füstös, Gramann,
General discussion

Herbert, & Pollatos, 2013; Kever, Pollatos, Vermeulen, & Grynberg, 2015; Pistoia et al., 2015), participants showing higher interoceptive awareness during play were more likely to actively seek resolutions to negatively arousing real world situations. Chapter VII describes *Nevermind*, a biofeedback game where players are explicitly challenged to manage their negative physiological arousal in the face of stress. This chapter also describes game design elements in *Nevermind* which may be valuable for game designers. Finally it presents several patterns of physiological change during gameplay which may be valuable for drawing parallels between in-game and real world emotion regulation skills – for example, the amount of time players need to return to their base heart rate after periods of elevated stress.

This arm of research intersects with the games for health field described in Chapter II. Games for health are games designed to promote knowledge, skills, or psychosocial wellbeing. For example, Chapter II describes *Re-Mission*, a game that encourages cancer patients to adhere to their treatment protocol (Kato, Cole, Bradlyn, & Pollock, 2008), and this chapter describes *NeuroRacer*, a game that helps train cognitive skills (Anguera et al., 2013). Related to the studies in Chapters VI and VII, biofeedback has been utilized by several noteworthy games to train emotion regulation skills: In *Rage-Control* players lose their ability to fire at enemies when their heart rate exceeds a threshold. When the game was added to a cognitive behavioral therapy protocol, children and adolescents with anger management problems showed additional improvements in their state and trait anger scores (Kahn, Ducharme, Rotenberg, & Gonzalez-Heydrich, 2013). In *Dojo*, cognitive behavioral therapy principles are translated into mini-games where players must also keep their heart rate below a threshold in order to succeed. Finally, in *Mindlight*, remaining calm produces a bright aura around the player's character, which is needed to stave off enemies and solve puzzles. Early trials of
Dojo and Mindlight have produced promising results about their potential effectiveness, warranting ongoing research. In a pilot study among adolescents in a resident care facility, playing Dojo demonstrated decreases in internalizing and externalizing problems (Schuurmans, Nijhof, Vermaes, Engels, & Granic, 2015). Also, a school-based randomized controlled trial among adolescents with elevated signs of anxiety, showed that playing Dojo led to decreases in anxiety symptoms (Scholten, Malmberg, Lobel, Engels, & Granic, 2016); however, adolescents who played a commercial video game in the control condition showed identical improvements. Similarly, anxious children who played Mindlight over a three-week period showed decreases in symptoms, with the study's control game also showing the same effect (Schoneveld, Malmberg, Lichtwark-Aschoff, Verheijen, Engels, & Granic, 2016).

The studies in Chapter VI and VII highlight two design features found in these biofeedback games which are likely important for their success. First, games using biofeedback to train emotion regulation skills should be designed to promote interoceptive awareness. To do so, games should provide a visual analogue for describing a player's physiological state during play. Repeated exposure to a visual representation of their physiological states may scaffold players' ability to recognize their physiological states in the real world. Second, these games should induce stress as a means of challenging players to regulate their physiological states. For instance, the different areas in Nevermind are designed to provoke anxiety, with each offering their own unique nightmarish atmospheres. Importantly, the successful down-regulation of negative affect is rewarded by the game's areas becoming less frightening. This repeated challenge to remain calm in the face of stressful experiences may impress upon players the value of managing their physiological states.
While these design features are found in *Rage-Control*, *Dojo*, and *Mindlight*, these titles differ in how these design features are implemented. This may have important implications for the effectiveness of these and other biofeedback games designed to train emotion regulation skills. One design difference concerns how meaningfully a game's biofeedback mechanic is linked to the core act of play. For example, in *RAGE-Control*, there seems to be little rationale for why experiencing an elevated heart rate in the real world should strip players of their ability to attack in-game. Similarly, while the game overtly displays the player's heart rate, this information appears on a portion of the screen that is outside where players are engaging the game's enemies. In comparison, *Mindlight*'s narrative and mechanics make biofeedback central to gameplay. The game's protagonist is a boy equipped with a cap that grants him the ability to produce light around himself; for a bright light to shine, players must remain calm. Thus, the player's central point of focal attention in the game – the boy under the player's control – gives immediate feedback regarding the player's affective state. Further, the relationship between remaining calm and emitting a brighter light has meaning relevant to the game's world and story. This method of embedding biofeedback mechanics into the game may make interoceptive awareness and emotion regulation more central to the experience of play. As a result, biofeedback games with these designs may be more effective.

Finally, while Chapters VI and VII focused on the importance of stress for games to train emotion regulation skills, other approaches may be valuable as well. For example, games aiming to promote interoceptive awareness may wish to follow a mindfulness approach. Set in the depths of a calming blue sea, the virtual reality game *DEEP* is a noteworthy example of this approach. The game provides no challenges or opportunities for failure; instead, players are free to explore its
soothing landscape. However, the game uses a breathing monitor and instructs players to take slow, deep breaths in order to stay afloat and navigate the game's world. An indicator in the center of the player's screen grows and shrinks as the player breathes in and out. By design, the game therefore aims to make players mindful of their breathing patterns. *DEEP* has been researched as a means to help children better perform cognitive tasks, but future studies will soon examine its potential to help children cope with anxiety problems (van Rooij, Lobel, Harris, Smit, & Granic, 2016).

Designing and testing video games designed to improve emotion regulation seems highly worthwhile. Moreover, given the emotion regulation benefits of interoceptive awareness, biofeedback presents itself as a particularly valuable technology to incorporate in such games. Video games may be an especially valuable tool for training interoceptive awareness and emotion regulation because well-designed games keep players engaged and intrinsically motivated to take on increasingly larger challenges (Gee, 2005). Games can also be designed so that they adapt in difficulty to suit each player's level of skill and speed of progression. In this way, such games can automatically fine tune themselves to suit the needs of all players. As indicated in Chapters VI and VII, regulating the physiological stress induced by games may be analogous to real world emotion regulation processes. The research and game design principles described in Chapters VI and VII therefore offer further encouragement and directive for the development of serious games that train emotion regulation skills.

**Limitations**

The research in this dissertation contributes to the extant literature in important ways. The review and empirical research presented here are among the first to
signal the importance of investigating video games as a domain for healthy emotion regulation development (see also: Adachi & Willoughby, 2013; Ferguson & Garza, 2011). More specifically, the research in Chapters III, IV, and V, helps address the lack of longitudinal gaming research conducted among pre-adolescent children; based on Ferguson's meta-analysis (2015), only 12 longitudinal studies have been conducted on this population, and half of these focused specifically on aggressive outcomes. Further, the observational research presented in Chapters VI and VII signal the relevance of looking at games as a domain where stress induction can be relevant to real world emotion regulation skills. Despite these important contributions, several limitations are important to consider.

First, regarding the longitudinal research, children’s emotion regulation skills were not directly measured. Rather, children’s psychosocial development was measured as a proxy for emotion regulation. That is, the research here presumes that healthy psychosocial development is a marker for healthy emotion regulation development (Gross, 1998; Jordan & Troth, 2004). In this research, three aspects of psychosocial development were given particular attention, namely, conduct problems, peer relations, and prosocial behavior; however, the latter two may be influenced more strongly by factors other than children’s emotion regulation skills. For instance, the link between conduct problems and emotion regulation seems strong; children who can healthily regulate their experience of negative emotions are also less likely to behave rashly or aggressively (Cole, Teti, & Zahn-Waxler, 2003). However, for peer relations, the link may not be as straightforward. While children who are better able to regulate their emotions should be better able to connect with others (Hubbard & Coie, 2014; Kim & Cicchetti, 2010), difficulties with forming strong connections with others may
also be due to other issues, such as loneliness (Lodder, Goossens, Scholte, Engels, & Verhagen, 2016), or simply having different interests than peers. Similarly, the extent to which children behave prosocially may have little to do with emotion regulation. This is because prosocial behavior seems to develop as part of children’s moral reasoning and out of children’s perceived necessity to reciprocate prosocial behaviors in order to foster social bonds (Eisenberg, 2000; Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992). To better understand the link between gaming and the development of emotion regulation skills in children, future research should therefore incorporate direct measures of children’s emotion regulation skills – for example, the Emotion Regulation Questionnaire for Children and Adolescents (Gullone & Taffe, 2011), the Emotion Awareness Questionnaire (Rieffe et al., 2007), and the recently developed Children’s Emotion Regulation Inventory (Callear, 2014).

Several characteristics of the longitudinal study’s sample are also important to consider. First, participants were recruited from a convenience sample. As described in Chapter III, participants were invited to participate in this study after their involvement in a previous three-year longitudinal study conducted by Stone and colleagues (Stone, Otten, & Engels, 2010). While these families resided in diverse locations across the Netherlands, the recruited participants likely reflect a biased subset of Dutch families. Demonstrated by their willingness to be consecutively involved in two three-year studies and a low dropout rate, this sample showed high intrinsic motivation and dedication. Likewise, parents allowed data collection to be performed in their homes. Along these lines, the parents in this sample were of relatively higher socio-economic status than the average Dutch family; for instance, while approximately 30% of Dutch adults in general are reported to have attained higher education (Centraal Bureau voor de Statistiek
(Central Bureau for Statistics, 2013), 60% of the parents in this study's sample had.

Similarly, the children in this sample were predominantly normative in their psychosocial development. Demonstrating this, Figure 1 depicts the outcome of a growth mixture modeling analysis which clustered children into groups based on the total difficulties score reported on the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) at each of the study's three waves. This analysis indicates that nearly 90% of children could be classified as showing a healthy and stable number of psychosocial problems, whereas a group of approximately 10% of the children showed elevated problem scores over time\(^9\). In sum, this indicates that only a small number of children in this sample showed psychosocial difficulties, and that among this small number, the overall trend was for these difficulties to lessen over time.

In sum, children in this sample tended to (a) have parents strongly motivated to participate in research, (b) come from above average SES homes, and (c) exhibit low signs of psychosocial problems. As a result, the findings of this research should not be generalized to children from low SES homes, or among populations of children with non-normative levels of psychosocial wellbeing. Compared to children in our sample, these more at-risk populations may prefer different games, may play in a different manner, or may be motivated to play for different reasons. For example, children in low SES homes may be more exposed to real world violence (Cox, Kotch, & Everson, 2003). For these children and for children who show heightened aggressive tendencies from a young age, violent or competitive video games may be a means to reenact the violence seen in their

\(^9\) The outcomes of this analysis are available on request.
everyday lives. Also, similar to the pattern seem among “pathological” adolescent and adult gamers, children in low SES homes and those already with elevated psychosocial problems may turn to video games as an escape from dealing with real world problems. Whether such children are at greater risk for gaming leading to negative development outcomes remains an empirical question worth testing.

Figure 1. Trajectories of change from a growth mixture modeling analysis

Children were classified as belonging to one of two classes based on parent reports of children's total difficulties. The figure is depicts a sketch of the developmental trajectories of these two groups. The analysis outcomes are available by request.

A final point regarding this dissertation’s longitudinal research concerns gender. Boys and girls showed different patterns in their gaming and psychosocial health. Across all time points, boys gamed more than girls. Moreover, boys showed a stronger preference for competitive games than girls. This is in line with past research where boys similarly showed a stronger preference not only for gaming, but for violent and for social video games as well (Greenberg, Sherry, Lachlan, Lucas, & Holmstrom, 2010). This indicates that boys and girls may be motivated
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to play video games for very different reasons, with boys more interested in competition and establishing dominance, and girls more interested in the social interactions elicited by play. The studies in this dissertation and generally throughout the gaming literature have therefore used gender as a control variable. However, rather than merely control for gender differences, future research may benefit from generating separate hypotheses for the effects of different forms of gaming on boys or girls.

Several limitations are also important to consider regarding the research in Chapters VI and VII. First, these studies used novel methods for assessing psychophysiological processes during stressful video game play. The focal measure in Chapter VI was players’ interoceptive awareness while gaming; the method for assessing this – comparing participants’ (a) subjective ratings of stress provided by a dial measurement with their (b) objective levels of stress provided by heart rate measures – was closely based on psychophysiological literature (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005), and on established methods from Gottman and Levenson (1985). Still, our application of these methods in the context of video game play was novel. Moreover, the ratings of participants’ interoceptive awareness derived from this method was not compared against ratings from existing, validated measures of interoceptive awareness. The validity of the method used in this study therefore merits scrutiny, and replication and validation studies are encouraged. Similarly, Chapter VII describes several potential methods for using physiological measures to assess how well players are able to downregulate their negative affect while gaming. These methods are posited more as suggestions for future research, than as valid assessment approaches.
Second, Chapters VI and VII were conducted among populations of experienced gamers. While, this was a product of the research questions in both studies, this limits these studies' generalizability. Importantly, game-induced stress may be experienced and managed differently depending on players' level of expertise. Future studies could therefore consider whether players' experience levels influence the intensity of negative affective arousal experienced during stressful gaming, and the types of regulation strategies these players are likely to call on.

Finally, these studies leave open the question as to whether stressful video games can train emotion regulation skills. This is because these studies did not employ an experimental or longitudinal design. Randomized control trials are the ideal method for investigating whether stressful games like Starcraft or biofeedback games like Nevermind can boost real world emotion regulation skills. Chapters VI and VII have made the case for interoceptive awareness being the core mechanism by which biofeedback games can successfully training emotion regulation skills. Randomized control trials make it possible to test this hypothesis with rigor. One method of doing so would be to include pre- mid- and post-measures of interoceptive awareness and test interoceptive awareness as a mediator between the study's treatment versus control variable and the outcome measure(s). Interoceptive awareness is commonly assessed with a heartbeat detection task (Stevens et al., 2011). Another method for testing the importance of interoceptive awareness could be to randomly assign participants to play a biofeedback game with either an active or a sham biofeedback mechanic. In such a study all participants would play a biofeedback game, but for half of these participants, the game would secretly react not to the players' physiological states,
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but instead to pre-programmed input. In this way, half of the participants would be actively training their interoceptive awareness, while the other half would not be.

Closing remarks

Video games are a cultural mainstay. Like more traditional games, video games afford rich social and emotional experiences. Despite this, scant research has investigated video games from an emotion regulation perspective. This dissertation offers important avenues for future research by signaling several ways in which video games may foster the development of emotion regulation skills. One such avenue is social: video games may offer a social context for emotion regulation. Gaming may bring peers together and allow them to work through negative emotions such as loss and jealousy. Another such avenue is more internal: video games may offer a psycho-physiological context for emotion regulation. Gaming may bring people better in touch with the physiological processes underlying emotion and emotion regulation. Two pathways seem important to best maximize these possibilities. First, future research should work towards theories that emphasize the processes that occur during video game play as well as the inter-individual and contextual variables surrounding video game play. Second, researchers and game designers should partner in order to marry the evidence-based practices that promote healthy emotional development together with the game design practices that have helped make gaming a cultural fixture.
EXTRAS

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Glossary

**Action games.** An umbrella term for video games where players must quickly react to what occurs on-screen. Often fast-paced, many of these games center around combat and they typically require players to avoid threats while collecting beneficial items.

**Adventure games.** An umbrella term for video games where players assume control of a protagonist on a quest. These games often strive to immerse players in environments that are designed to stimulate a sense of awe and the motivation to explore.

**Fighting games.** A genre of action games where players choose from a cast of characters before fighting against human or computer opponents. Characters in these games tend to each have their own set of unique abilities. In most fighting games, players and their opponents compete in rounds, each player being granted a life meter. During the round, each side must deplete the other’s meter by landing attacks. Players try to fluidly chain attacks together for so-called “combos” that, once started, are difficult or impossible for their opponent to defend against. Popular fighting games include games from the *Street Fighter* and *Mortal Kombat* series.

**First-person shooter games.** A genre of action and/or adventure games where players shoot enemies from the first-person perspective. Violent in nature, these games vary in how graphically and realistically the violence is portrayed. Today’s most popular first person-shooters are designed around their multiplayer
functionality. These games enable lone players or teams of players to compete in fast-paced, well-balanced contests of, precision, planning, and teamwork. Popular first-person shooter games include entries from the *Halo*, *Call of Duty*, and *Battlefield* series.

**Hack ‘n slash games.** A genre of action and/or adventure games that pit players against hordes of enemies. These games were traditionally designed as “side-scrollers” where players moved in segmented chunks across a two-dimensional space; each segment would serve as a sort of arena, with players only being able to progress to the next segment after defeating a fixed number of enemies. In the more modern, three-dimensional version of these games, players have a third-person view and more freedom of movement, but this arena-style design of having to defeat enemies in a fixed area remains a design cornerstone. The primary challenge in these games is for players to avoid strikes from the often numerous on-screen enemies while players attempt to strike enemies in long, free-flowing chains of attacks. Popular hack ‘n slash games include entries from the *Devil May Cry* and *Bayonetta* series.

**Massively Multiplayer Online Role-Playing Games or MMORPG’s.** Video games that allow dozens or hundreds of players to share a large world at any given time. The worlds in MMORPG’s are persistent, meaning that the game’s virtual space is always present and able to host whomever wishes to play. The role-playing aspect of these games comes from allowing players to create their own unique in-game character and from often having a fantasy/science-fiction setting. Players create their character(s) from a generally colorful cast of races, and depending on each player’s interests, he/she can customize the character’s aesthetics and skills to his/her own liking. Many MMORPG’s are played from the
third-person perspective, allowing players to see their customized character designs. MMORPG's commonly promote teamwork by making the game's greatest challenges insurmountable by a single player or by groups of players with identical attributes. By design these games therefore encourage players to form teams consisting of characters who complement each other's strengths and weaknesses. As a result, closely-knit teams – called guilds or clans – typically form to tackle the game's hardest challenges and to compete in rivalries against other groups. Popular MMORPG's include *World of Warcraft* and *Destiny*.

**Multiplayer Online Battle Arenas** or **MOBA's**. Action video games that place two small teams of players on opposite ends of a map, pitting them against each other to conquer one another's home base. Each player is able to choose from a large cast of characters, each with their own unique abilities. Successful teams are ones that are comprised of characters who foil one another, especially when players work together. These games demand quick reflexes, strategic thinking, and teamwork. Popular MOBA's include *League of Legends* and *Dota II*.

**Party games.** Video games (primarily) designed for a group of players to energetically compete against one another. Competitions are generally brief and have rules and systems that are easy to understand. Party games therefore tend to keep a fast pace by quickly awarding points to encourage players to remain excited. Popular party games include games from the *Mario Party, Wii Party,* and *Wii Sports* series.

**Platformers.** Action and/or adventure video games that require players to collect items while maneuvering through environments that are laden with traps and enemies. The genre's name is derived from its earliest games which primarily required players to move from platform to platform without falling between them.
Having featured iconic characters like Mario and Sonic the Hedgehog, the protagonists in these games are generally designed to be playful and endearing. Popular platformers include games from the *Super Mario Bros.* and the *Ratchet and Clank* series.

**Puzzle games.** Video games that require players to solve interactive brain teasers. In general, puzzles in these games progressively increase in difficulty. Puzzle games can be designed for a wide variety of play types. For example, they can be “casual games” when designed as a quick distraction for short-term play, or they can require long periods of focused attention. Visually, these games also range from using rudimentary two-dimensional spaces and objects to using highly detailed three-dimensional worlds. Popular puzzle games include *Candy Crush Saga* and *Portal 2*.

**Racing games.** Video games that pit players in racing competitions. These games can generally be seen as resting on a continuum between an arcade style game and a simulation style game. At the arcade extreme, little emphasis is placed on realism and instead players maneuver their racer through fantastical environments and in exaggerated ways that seem to defy real world physics. At the simulation extreme, realism is made paramount as the game strives to be as accurate a facsimile of real world racing as possible. A popular arcade style racing series is the *Mario Kart* series, and a popular simulation style racing series is the *Gran Turismo* series.

**Rhythm games.** Video games often designed as party games that require players to rhythmically provide the game with input. The challenge in these games comes from rhythms that are complex and/or require a high frequency of input. The popular rhythm games in the *Just Dance* series use players’ body movements for
input, whereas the popular rhythm games in the *Guitar Hero* and *Rock Band* use players' inputs on instrument-like controllers for input.

**Sandbox games.** Video games that are designed to maximize player freedom. These games typically feature large, sometimes endless maps for players to explore. Sandbox games encourage experimentation by allowing players to test the limits of the game world and its systems. These games are found across a variety of genres, such as role-playing games (see *Massive Multiplayer Online Role Playing Games*, above) as in *Fallout 4* and *The Witcher 3*, action games as in *Infamous 3* and *Grand Theft Auto V*, and simulation games as in *Sim City 4* and *The Sims*.

**Social media games.** Games that are embedded in social media networks. These are typically multiplayer games that encourage players to collaborate and/or compete with others in their social network. Most of these games follow a free-to-play model where playing the game is free but where certain features or in-game advantages can only be unlocked by paying the developers. Popular social media games include *Farmville* and *Mafia Wars*. 
Publications in this thesis
(by date, from most recent)

Lobel, A., Granic, I., Stone, L. L., & Engels, R. C.M.E. (Submitted to Psychology of Popular Media Culture). Gaining a competitive edge: Longitudinal associations between children’s competitive video game playing, conduct problems, peer relations, and prosocial behavior.


**Other publications**
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Publications


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CREDITS

Martin Scorsese: *Celebration of a beginning or an end?*
Robbie Robertson: *Beginning of the beginning of the end of the beginning.*

–excerpt from *The Last Waltz* (Scorsese, 1978)

*It's a dangerous business, Frodo, going out your door. You step onto the road, and if you don't keep your feet, there's no knowing where you might be swept off to.*


It’s often difficult to tell where one thing ends and the other begins. Presenting this work offers a moment of clarity: After a life at school, the training wheels are off. From the yeshiva bochur’s bedroom overlooking Brooklyn’s F train, to the game designer’s bedroom overlooking the mountains of the Jura, the *road* has certainly swept me some places.\(^\text{10}\) May this work reflect all the kindness I received along the way. To everyone who believed in me.

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_Rutger*, loyal, true, and kind of heart. Thank you for your patience and honesty.

_Marientina*, the woman with the golden touch. Thank you for showing me the power of compassion.

\(^\text{10}\) *Bochur*. Yiddish word for boy/young man.
Credits

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My Rebbeim, thank you for nurturing my will to challenge and to seek deeper understanding.

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Eric-Jan ‘EJ’ Wagenmakers, thank you for treating me as an equal, and for being there whenever I called on you.

Conor Dolan, thank you for making me feel like one of the big boys.

---

11 Chinuchim. Plural Hebrew word for something between an educator and an upbringer.
12 Rebbeim. Hebrew word for the plural of Rabbi, a moral, philosophical, and spiritual mentor.
Collaborators

I've had the fortune of working with many tremendous people, without whom this work would not have been possible. Thank you: Lisanne Stone, for the astronomical amount of effort you put into recruiting and maintaining good relations with the families in our longitudinal study, and for your input on our manuscripts; Michel Failing, for all the help you lent to making the Starcraft study possible; Gerard van Oijen, for your hands-on assistance with the Starcraft study; Ronny Jansen for being a true pro at managing the BSI labs; Bill Burk, for the patience with which you shared your expertise and the confidence you placed in me; Erin Reynolds & Michael Annetta, for your endless graciousness in making our Nevermind research as meaningful and beautifully-presented as possible, and for all the kindness you've shown me; Paulien Dresscher, for making me and Marieke one of Cinekid's own; Owen Harris for the fearlessness with which you bare your art; Niki Smit for proving that there is a way.

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In Another Time
In Another Place

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**Mishpacha**

Where are the words? Lieve, adored, Anna, Joshua, Jacqueline, & Josh, my brothers and sisters. May we forever beat with one heart. Thank you for reminding me who I am, where I come from, and what I am capable of.

Abba & Mark, thank you for our Mishpacha. Thanks to your endless love and sacrifices. You make everything possible.
Love and only love will endure

The world is turning.
Hope it don’t turn away.
—Neil Young (1975)

Finally, I would like to acknowledge the existential crisis in us all. Own it. And let us take comfort in knowing that ends and beginnings occur simultaneously.
CURRICULUM VITAE

Adam Michael Lobel was born in Brooklyn, New York on July 13th, 1987. He completed his primary and secondary education at yeshivas in Brooklyn, NY, Elizabeth, New Jersey, and during a year abroad in Jerusalem, Israel. His enthusiasm for psychology was sparked by the inspiring faculty at Brooklyn College’s Psychology Department, and his relationships there helped secure him a scholarship to spend a semester abroad at the University of Amsterdam. There, he met dr. Kai Jonas who brought Adam in on his work with prof. dr. Bertjan Doosje researching humiliation. Their research together – an investigation into New Yorkers’ emotional reactions to 9/11 – formed the basis for a prestigious Huygens Scholarship, allowing Adam to enroll in the University of Amsterdam’s Research Master’s Psychology program. He graduated cum laude. As a PhD Candidate, Adam has been a vocal proponent of the potential of using (video) games for healthy emotional development. To this end, Adam has delivered over 40 presentations, workshops, and lectures on this topic to audiences of diverse backgrounds. As a Visiting Scholar at the University of Southern California’s prestigious Interactive Media and Games Division, he also worked closely with game designer and lecturer Marientina Gotsis, and the game studio Flying Mollusk. Adam is currently based at the Swiss Center for Affective Sciences in Geneva, Switzerland where he is designing an analog game to teach emotion regulation skills to school-children.

You can follow Adam on Twitter @GrowingUpGaming