Online gaming in relation to negative consequences and ill health among adolescents

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Licentiate exam

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“Logic will get you from A to B. Imagination will take you everywhere.”
Albert Einstein (1879-1955)
List of Papers

This thesis is based on the following papers.


II. Hellström, C., & Åslund, C. Motives for playing and online gaming time in relation to depression, musculoskeletal symptoms and psychosomatic symptoms: a population-based cross-sectional study of Swedish adolescents. Submitted

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# Abbreviations and glossary

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<th>Abbreviation</th>
<th>Definition</th>
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<tr>
<td>CI</td>
<td>Confidence interval</td>
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<tr>
<td>DALYs</td>
<td>Disability-adjusted life years</td>
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<td>DSM-IV</td>
<td><em>Diagnostic and Statistical Manual of Mental Disorders, 4th edition</em></td>
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<td>DSRS</td>
<td>Depression Self-Rating Scale</td>
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<tr>
<td>GAMING</td>
<td>Playing on video or computer games</td>
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<td>GAMBLING</td>
<td>Gaming with monetary reward features</td>
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<tr>
<td>HPA</td>
<td>Hypothalamic–pituitary–adrenal</td>
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<tr>
<td>IRL</td>
<td>In real life</td>
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<tr>
<td>LEVEL</td>
<td>The virtual world that exists within a game, often including different tracks or levels. To proceed in a game, a player “levels up” by moving up to the next level after finishing the level below.</td>
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<tr>
<td>MMORPG</td>
<td>Massively multiplayer online role-playing game</td>
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<td>MMOG</td>
<td>Massively multiplayer online game</td>
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<tr>
<td>ONLINE GAME</td>
<td>Video or computer games played online through the Internet</td>
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<tr>
<td>OR</td>
<td>Odds ratio</td>
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<tr>
<td>SALVe 2008</td>
<td>Survey of Adolescent Life in Vestmanland 2008</td>
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<tr>
<td>SD</td>
<td>Standard deviation</td>
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<tr>
<td>SES</td>
<td>Socio-economic status</td>
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<td>$\chi^2$</td>
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<td>WHO</td>
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Introduction

In 2003, when I was studying for my Master’s examination in Public Health, I did a literature study on adolescents’ video-gaming habits and the effects of playing video games. Worried parents and schoolteachers were alarmed that this new leisure activity among children and adolescents would lead to negative behaviours that influenced gamers’ lives. They were predicting unhealthy lifestyles in the long term. At the time, research in this field was limited and as I continued to investigate adolescents’ gaming habits, I found many contradictory results purporting to show that gaming was either “good” or “bad”. My curiosity made me wonder how to reconcile these two contradictory sets of findings.

General definitions

Play

Huizinga defines play as: “… a free activity standing quite consciously outside ‘ordinary’ life as being ‘not serious’, but at the same time absorbing the player intensely and utterly. It is an activity connected with no material interest, and no profit can be gained by it. It proceeds within its own proper boundaries of time and space according to fixed rules and in an orderly manner”, p.13 (1).

Game

According to Smed and Hakonen a “game” is defined as “a universal form of recreation generally including any activity engaged in for diversion or amusement and often establishing a situation that involves a contest or rivalry”, p.1 (2). Furthermore, a game seems to involve three components as illustrated in Figure 1. Gamers are willing to participate in the game’s challenges (e.g., for enjoyment, diversion or amusement) that are set by the rules defining the limits of the game and the goal of the game. Gamer participation includes an agreement to follow the rules. The goal motivates the gamers to continue playing and drives the game forward. However, these goals involve contradictions because they give rise to conflicts and rivalry among the players while influencing their motivations for gaming (2). An opponent obstructs the gamer from reaching the goal and because the gamer often does not have comprehensive knowledge about the opponent, he or she cannot determine the opponent’s
influence within the gaming process. Because the rules correspond to real-world objects, even if they are abstract, the representation concretizes the game for the gamers (2).

![Figure 1](image.png)

**Figure 1.** Freely interpreted model of components, relationships and aspects of a game. Original model in Smed and Hakonen (2).

**Gaming**

Different types and forms of games have always engaged people, from the early Romans playing *Ludi Romanus* through to football and, more recently, digital forms of games that players engage with on a screen. Games bring amusement to people’s lives because participation in them is fun and exciting. Today, digital technology is part of people’s lives. Many people use mobile smartphones and other types of electronic devices to go online, and some also play games in many situations and wherever they happen to be (3).

Over the last decade, there has been an increase in academic attention given to computer gaming as one of the most preferred leisure activities among adolescents. According to the Swedish Media Council (2012–2013), 62% of boys and 38% of girls aged 13–16 years in Sweden play computer games (4). In the United States of America, a nationally representative sample of 1491 children aged 10 to 19 years showed that 36% of them (80% of boys and 20% of girls) played computer games (5). Moreover, it is estimated that about 6–7% of adolescent gamers spent five hours or more each day gaming (6). Gaming is more common among boys than girls (7, 8). Millions of players worldwide play computer games every day and gaming online alone or with other gamers is the most common activity (3). Because computer games are interwoven into most adolescents’ leisure activities, it is important that researchers
understand what initiates different gaming behaviours to recognize and prevent problematic adolescent computer game use and its consequences.

Massively multiplayer online role-playing games
Among adolescents, one of the most preferred online game types is massively multiplayer online role-playing games (MMORPGs) (9, 10). These games are played online, alone or with/against other gamers. The years 1997–2001 have been referred to as the “golden age of multiplayer online role games”, mainly because of the growth and popularity of online games such as EverQuest and Asheron’s Call (11). The release of World of Warcraft in November 2004 changed the landscape of online gaming forever, and an indication of the game’s success is that it now has over 11 million paying subscribers worldwide (11).

Time spent gaming
Researchers have been debating whether excessive gaming time leads to negative consequences. The average MMORPG player spends about 20 hours a week playing (12, 13). The negative effects attributed to gaming seem to increase with more intense gaming time. In particular, more than five hours of online gaming per day in adolescence seems to increase the risk of negative consequences (6).

Dependence and addictive behaviour in relation to gaming
Dependence is described as difficulties in being without a habit or a need, for example the need for alcohol or a narcotic substance, shown by a continuous drug need and the inability to control drug use (14).

The American Society of Addictive Medicine describes addiction as a primary, chronic disease of brain reward, motivation, memory and related circuitry. The definition continues as follows.

“... dysfunction in these circuits leads to characteristic biological, psychological, social and spiritual manifestations. This is reflected in an individual pathologically pursuing reward and/or relief by substance use and other behaviors. Addiction is characterized by inability to consistently abstain, impairment in behavioral control, craving, diminished recognition of
significant problems with one’s behaviors and interpersonal relationships, and a dysfunctional emotional response. Like other chronic diseases, addiction often involves cycles of relapse and remission. Without treatment or engagement in recovery activities, addiction is progressive and can result in disability or premature death.” (14).

Although the term addictive behaviour is normally used to describe substance use, excessive gambling can be considered another type of addictive behaviour. Although it does not involve a chemical substance, addictive behaviour can lead to clinical presentations that are quite similar to substance abuse (15). In the fifth version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), the phenomenon of “gaming addiction” is described as not being an addictive disorder but rather an Internet gaming disorder and a condition warranting more clinical and evidence-based research (16). DSM-5 also includes gambling disorder as a new category within behavioural addictions, and gambling disorder is the only addictive disorder mentioned in DSM-5 as a diagnosable condition. Pathological gambling is also included. Findings from previous research have now established that gambling disorder is similar to substance-related disorders in clinical expression, brain origin, comorbidity, physiology and treatment (16).

The addiction-like behaviour seen in online gaming seems to have similar neurobiological mechanisms as substance use disorder (17, 18). For example, levels of reward neurotransmitters such as dopamine are decreased, while there is a release of corticotrophin and noradrenalin within the brain’s stress response system. The combination of loss of reward function and recruitment of brain stress systems provides a powerful neurochemical basis for the long-hypothesized opponent motivational processes responsible for the negative reinforcement driving addiction (19). Hence, it is suggested that playing games without monetary reward nevertheless meets the criteria for addiction (20). An experimental study using functional magnetic resonance imaging brain scanning technology with gamers and control groups demonstrated that brain activation patterns in addicted gamers were similar to those in people who suffered from substance addictions (17). Further, it is suggested that multiplayer online games have more addiction-forming components than single-player computer games (9).
Gambling

Gambling activities include many different forms of gaming, such as lotteries, casinos, bingo, Internet games and more, where participants risk losing money in exchange for the chance of winning more money than they paid to take part (21). This thesis does not investigate gambling, but it is mentioned because it shares mechanisms with gaming experiences that may involve negative consequences (16).
**Background**

Although the gaming world is one of the most preferred leisure activities among adolescents, the psychosocial effects and physical consequences of excessive gaming need more attention, and evidence-based research is important in preventing the possible negative consequences that gaming may cause (11). It is suggested that online gaming in itself appears to have very few negative consequences for average gamers and the vast majority of gamers state that the gaming activity has positive effects for them (22). Problems occur when gaming becomes an obsessive act, taking over gamers’ lives. As already noted, there are similarities between the brains of addicted gamers and those with substance addictions (17). When gaming becomes an addiction, the gamer focuses on the need for gaming as a predictor of the feeling of wellbeing, just like any other form of addiction (23, 24).

**Social experiences of gaming**

Gaming provides benefits including social communication with other gamers and educational, technical and spatial ability skills (25-27). The social experiences are often mentioned as one of the most valued ingredients within the gaming experience (28). However, the paradox is that even if gamers see online gaming as a social activity, excessive gaming can be seen as an antisocial activity from a real-life perspective (29, 30). It has been suggested that gamers’ social lives can be adversely affected by gaming, even if they often report a preference for IRL friendship. However, many gamers enjoy making friends online and may find conversations easier to conduct in the online fiction world (31-33). Ko et al. and Yee (10, 12) both reported positive social effects from gaming. Males in these studies reported that they found it easier to engage in conversations within the online environment than IRL situations (10, 12). The game also provides the opportunity to interact with other gamers worldwide and geographic limitations are expanded (9). However, it has been shown in other studies that increased frequency of time spent gaming leads to a decrease in the quality of interpersonal relationships, and further obsessive gaming leads to social withdrawal (34-36).

**Contradictions within the research field**

As mentioned earlier, there are conflicting findings about the social perspective of gaming. Differences also occur in other areas of gaming research, such as gaming time and negative
effects of gaming. Griffiths summarizes the issue when stating that gaming is good for the individual when it adds to life, but may lead to negative consequences when it takes from life (37). In randomized controlled trials, Smyth (32) and Ko et al. (10) found no evidence for a relationship between gaming time and level of life satisfaction. However, there was a positive relationship between time spent playing MMOGs (Massively Multiplayer Online Games) and poorer overall health and sleep quality. One of the debated issues is the relation between gaming and sleep. Previous research has found evidence both for and against a relation between time spent gaming and sleep (19). The evidence for a relation between gaming time and sleep might be questionable because of differences between the populations studied. Some studies based their data on young adults (38) or older male adolescents (39), while others used schoolchildren, who showed larger effects of gaming on sleep problems than the older study populations (40). However, in another study of boys aged 12–15 years, no effects from computer gaming on sleep were found, although results indicated that boys who played went to bed later than non-players (41). In each study, different measures were used to investigate relations between gaming and sleep.

Contradictory findings were also discussed in a systematic review investigating relations between time spent gaming and academic performance. There are many positive benefits of gaming and research has shown that online gaming can be educational (42, 43). On the other hand, in an American study with a representative sample of 1491 children aged 10 to 19 years, adolescent gamers were compared with non-gamers and results showed that gamers spent 30% less time reading and 34% less time doing homework than non-gamers (5). Another study of tenth-grade students at three different public high schools in Ohio investigated time spent on the Internet, including gaming, in relation to academic achievements. The students were asked to keep a log of their computer use for one week. The results showed no relation between time spent gaming and academic achievements (44). However, there is always a risk of bias in self-reports, including untruthful answers.

Another common explanation for contrary results in different studies is that studies often have small sample size or questionable study design (11), which reduces the ability to generalize results. Key variables such as academic achievement are measured by different indicators, making comparisons of results and conclusions difficult.
Criteria of gaming addiction related to multiplayer online gaming

Various criteria are used to define gaming addiction. The original definition was developed from the pathological gambling criteria given in the American Psychiatric Association’s *Diagnostic and Statistical Manual of Mental Disorders* in 1980, 1994 and 2000 (45-47), identified by Browns (1993) as gaming addiction (48) and further modified by Griffiths in 1996 and 2005 (49, 50).

These criteria are as follows.

- **Salience**: it is the dominating factor in the individual’s life.
- **Tolerance**: to feel satisfaction the amount or dose of the drug must be increased or the behaviour gets more and more intense.
- **Withdrawal**: only the drug or the behaviour provides feelings of well-being.
- **Conflict**: internal or external conflicts are common. The individual feels guilty for doing this and other people question the behaviour.
- **Relapse**: the individual has attempted to quit or to lower the dose, but without success.

The criteria are the same whether the addiction involves substance use disorders or behavioural disorders (20, 34), and computer gaming has been associated with addiction-like behaviour (9, 20, 25, 51-53).

When gaming has become the dominant activity in an adolescent’s life, the negative consequences should be taken seriously. The gamer feels bad when unable to play and quarrels with family and friends are common because of their obsessive gaming behaviour. The sense of time, space and mood can be altered while playing (52) and, for some gamers, online gaming becomes a mood modifier, which is one of the core components of addiction (52, 53). Gamers also report withdrawal symptoms and cravings for video gaming when playing is discontinued (32, 34). Additionally, Yee suggests that escapism is the best predictor for gaming-related problems (12). It has been suggested that compulsive use of online games stems from the relief of dissatisfaction rather than the pursuit of satisfaction, particularly among addicted players (54). The relief of dissatisfaction is even more important than the feeling of flow within the gaming experience (54).
Theoretical approach to understanding gaming addiction behaviour

Behaviourism

B. F. Skinner (1904–1990), a psychologist and early researcher in behaviourism, developed the theory of operant conditioning following his invention of the operant conditioning chamber, also known as the “Skinner Box”. Skinner believed that human free will was an illusion and that human actions were the result of external and internal rewards and expected consequences of that same action. If the consequences of an activity were bad, then the person was unlikely to repeat the action. However, if the consequences of the action were good, the action that led to it would be reinforced. Skinner called this the principle of reinforcement (55-57).

Negative and positive reinforcements are central concepts in behaviourism. A common misunderstanding is that negative reinforcement means some kind of punishment. While positive reinforcement strengthens a behaviour by providing a reward after it is performed, negative reinforcement strengthens the behaviour by allowing the actor to avoid something unwanted from happening. For example, a student who studies well will probably avoid failing a test in school. There is a distinction between the reinforcing event as something applied in positive reinforcement, or as something removed or avoided in negative reinforcement. Both positive and negative forms of reinforcement increase behaviour frequency (55).

Skinner’s theories of reinforcement are accepted and widely used, and have contributed to a better understanding of the development of gambling problems (58). In gaming, a rapid reward response enhances the activity. This suggests that the quick response becomes the reinforcer if a gamer does not have to wait for results, whether the response is a monetary reward or not (59). The short time between a behaviour and the positive reinforcement enhances the learning process for the behaviour. This may be why people enjoy a near win even if they do not actually win anything. Because these near-win situations (for example) reduce negative feelings, gambling becomes intermittent; the behaviour is negatively and positively reinforced, which contributes to positive feelings as arousal. This also explains some of the difficulties in ending the behaviour (55, 57).
Reinforcement within the gaming experience

Reinforcement means that “Something in the environment fortifies, or reinforces, a behavior. A reinforcer is an environmental consequence that occurs after an organism has produced a response and makes the response more likely to recur” (Kowalski & Westen, 2011, p. 174(56)). Similar to other forms of addiction-like behaviours, gaming is related to both positive reinforcement (mastery of challenges, winning against other players) and negative reinforcement (escape from situations and real-life problems). Even if a behaviour starts out as pure entertainment or as a coping strategy, it may develop into addiction-like behaviour if the person loses control over their behaviour (60).

Positive and negative reinforcement

Positive reinforcement consists of feeling a pleasant effect from an activity. Positive reinforcement is the process where presentation of a stimulus as a reward or a payoff after a behaviour makes the behaviour more likely to occur again (56). Negative reinforcement is negative only in the sense that something unpleasant is removed. According to Kowalski and Westen (2011, p. 175), a negative reinforcement is “an unpleasant stimulus that strengthens a behavior by its removal” (56). Furthermore, exposure to something unpleasant such as an electric shock leads to reinforcement of the behaviour, and it creates an avoidance of this kind of risk in the future (56). Gaming might bring both positive reinforcement, such as getting more friends through the gaming experience, or negative reinforcement, such as when the gaming experience includes social communication in order to avoid loneliness.

Partial or intermittent schedule reinforcement

Partial reinforcement is a type of reinforcement that is delivered occasionally as part of the responses triggered by the individual performing different actions. This is more effective than regular reinforcement in sustaining the reinforced behaviour. Furthermore, partial irregular reinforcement is more effective than partial regular reinforcement. This may explain why gaming, which often has built-in triggers in the form of irregularly maintained rewards, is such a stimulating activity for gamers (56). As explained by King et al. (60) “a video game may be programmed to reward a particular item 5% of the time”. This type of reinforcement produces the most consistent and steady responses, because players believe that the desired rewards lie just a small distance ahead as a consequence of making efforts along the way. One
example may be that players have to collect needed items at one gaming level, and then at a higher level within the game they will be able to kill a creature.

**Reward-triggering ingredients in gaming**

The most common motive for playing is fun (61). The feeling of excitement that occurs when a gamer manages to solve a quiz, find a special well-hidden tool or succeed at a task might be the reason that gaming triggers stimulation and arousal. MMORPGs include many reward-triggering ingredients, including built-in triggers for rewards when gamers manage to solve a quiz or find hidden objects within the games environment (60). This suggests that many of the overall positive rewarding ingredients in games might also, conversely, lead to negative consequences when gaming becomes an obsessive activity (62). King et al. (60) present several structural aspects inherent in games that might contribute to the development of different effects of gaming.

- Social aspects such as communication, group membership, social competition, friendship and support (both technical and social) make the gamer feel good and part of a group.
- Control and manipulation features produce interaction with the game and with other gamers, and gamers are also able to save and correct mistakes and uncompleted achievements.
- Narrative and identity features create the possibility of being someone else. Gamers can create a character, be part of and affect the story within the game. Different genres of games create different triggers for gamers, and, for instance, gender swapping is quite common within MMORPGs.
- Rewards are provided in the form of more lives, points, resources, upgrades, levelling up, finding hidden treasures, get bonuses, manage achievements and winning.
- Negative reinforcement occurs when gamers increase the strength of their avatars and avoid near-miss situations or the death of their avatar, and these all trigger the gamer experience. Feedback from other gamers, for example when missing a target, is an example of negative reinforcement.
- Punishment occurs when gamers have to restart a level, lose their resources or points they have won, or fail in scenarios where other gamers are punished as a group if one gamer fails.
• Presentation features—music, sound and graphic experiences within the game—are of great importance to the gaming experience. They provide well-known stimuli for the brain’s reward system (60).

Motives for playing

According to McCrae and Costa, our personalities are driven by five central factors: neuroticism, extraversion, conscientiousness, agreeableness and openness to experience (63). Introverted personalities are often described by words such as shy, serious, rigid, cautious, socially inhibited and inward looking. Extroverted personalities are described by words like sociable, active and willing to take risks (56). What is experienced as reinforcing by one person may not be reinforcing for another, and even within the same individual, stimuli considered rewarding at one time might not be considered so at another (56, 64). It seems plausible that people with different personality types may use the gaming experience for different kinds of reinforcement.

The most common motive for playing is fun (61). Gaming provides a time for enjoyment and relaxation and is one of the most preferred leisure activities for many adolescents (3). There are differences between the sexes in motives for playing. Boys usually play MMORPGs to pursue feelings of achievement and for social motives, whereas females mostly play to pass the time and be entertained (10). We are born with different types of personalities. According to Lafrenière, excessive gaming may be identified by the explanation that playing with an “obsessive passion” is a predictor for negative outcomes, while a “harmonious passion” for playing accounts for more positive outcomes (62). Some gamers play online games because this provides anonymity. In the virtual life, the gamer can chose another identity to help cope with problems in everyday life and escape from reality (9, 52, 53). Escape is also a primary motive within the gambling experiences that facilitates the continuation of problem gambling (65). Many gamers prefer online socialization. These gamers rather spend time with friends online than offline, and it has been suggested that MMORPG players often play online to escape other problems in their lives (52, 53).

Consequences attributed to gaming

Computer gaming has been associated with addiction-like behaviour (9, 20, 25, 51-53), antisocial behaviour (66, 67), daily tiredness (40, 68, 69) and positive and negative effects on
academic achievement (5, 8, 9, 12, 13, 53, 68, 70). Adolescent gamers are more likely than adult gamers to sacrifice their education or work to play (9). They also spend less time doing homework than non-gamers (5). Furthermore, one-fifth of adolescents sacrifice sleep in order to play online games, which may have repercussions on productivity in other areas of their lives (9). Withdrawal, anxiety and other internalizing problem behaviours have also been suggested as negative effects of playing MMORPGs (58).

Online gaming in relation to health

Adolescent physical and mental ill health issues are growing in importance as public health problems (71, 72). Mental ill health is described in terms of the global burden of disease, with depression being the most frequent factor leading to reduced productivity and major suffering (72). This involves massive economic and social costs for affected individuals and society (71-74). Many major public health problems, including mental health symptoms, have their roots in the early years of life (75). Disability-adjusted life years (DALYs) is a measurement of the burden of disease in the form of death and disability to function. One DALY represents “one healthy living year” that is lost because of a disease. According to WHO (76), abuse and addictions are some of the most common but preventable determinants of ill health and together account for 19.2% of DALYs within developing developed countries. Because an addiction acquired in younger years tends to proceed into adulthood, it affects both the individual and society for a long period of time and represents as much as one-fifth of DALYs (76). Other health problems that appear during adolescence, such as musculoskeletal symptoms and psychosomatic symptoms, also often persist into adulthood and may be explained to some extent by lifestyle and psychosocial factors (77-79). As one of the most common leisure activities (10, 80, 81), frequent computer-related activities have been suggested as a new health risk factor associated with psychosomatic and physical complaints (82). However, it is not clear whether gaming leads to problems or, alternatively, if pre-existing problems lead gamers to engage more readily in computer gaming as an escape mechanism (77-79, 83). Regardless of the reason, one-third of gamers report having experienced negative consequences of online gaming (9). It seems plausible that these consequences may influence gamers’ health.

Excessive screen-based activities have also been associated with an increased risk for physical complaints among adolescents (82, 84, 85). According to research, physical (86) and psychosomatic (87) complaints among adolescents may be related to gaming. A relationship
between computer gaming and backache and headache was found in a study investigating screen-based activities and physical symptoms among 31 022 adolescents from the Nordic countries (86). Computer gaming was identified as a predictor of backache and headache experienced weekly among participating adolescents, especially among boys. Girls seemed to experience backache and headache for reasons other than gaming as a screen-based activity (86). Conversely, in Dutch adolescents (88), no relation was found between computer use in general and musculoskeletal pain. However, these results might have been different if researchers had separated working hours and gaming hours when measuring hours spent on the computer. In a Norwegian study (89), no relation was found between the amount of computer gaming and physical exercise; however, the low participation rate limited the reliability of the results. Another study (90) investigated associations between American children’s computer use at home and musculoskeletal discomfort. Their results indicated that there were associations; however, the musculoskeletal discomfort was discussed as a consequence of poor posture when using computers (90). Notably, the study had a small number of participants (n = 152), which limited generalization. Hakala et al. showed that ergonomic instructions on how to prevent computer-related musculoskeletal problems did not reach a substantial number of children (91).

Furthermore, it is suggested that musculoskeletal symptoms are related both to depression and computer use (88). According to Torsheim et al., excessive screen-based activity and somatic complaints might be viewed as causally unrelated markers of depressive symptoms or a general adaption to various stressful conditions (86). A relationship between computer gaming and anxiety and depression was found in a Norwegian study in 2011. However, the low frequency of responses meant generalization was not possible (89).

In summary, there is research evidence for and against associations between computer gaming and health outcomes, but the level of reliability of these conclusions varies (71, 82-91).

**Rationale for this thesis**

It is vital to understand how the motives for playing may influence the relationship between computer gaming, negative consequences, and ill health (92). In earlier research, gamers have often been investigated as a stereotypical group (12). This perspective may provide misleading conclusions because individuals choose to play for many different reasons, and in-game experiences vary substantially in their effects (12). The media often portray gamers as
young men who are pale from too much time spent indoors and socially incompetent, described as isolated and lonely “couch potatoes”. These men are the opposite of aspirational figures (93). However, the results of another study defy previous common gaming stereotypes. This study used a combination of survey and behavioural data from a virtual world operator with 7000 participating gamers. One finding was that average computer gamers were not teenagers, but were adults in their 30s (30), which is consistent with Griffiths (94). Moreover, in previous contradictory findings of gaming and health outcomes, the combined effects of motives for playing, gaming time and differences between weekday and weekend gaming have often been neglected. Furthermore, some earlier studies have been criticized because of small study populations and failure to eliminate supposed confounding factors, which reduces the ability to generalize results and conclusions to other populations (26, 95, 96). Several studies recruited participants from global Internet sites and hence the possibility of volunteer bias and untruthful answers from participants needs to be considered (11).

Generalized statements about the negative consequences and the positive effects of gaming are often made without consideration of different gaming types or gamers’ different motives for playing, which may result in incorrect conclusions. Because the studies included in this thesis are based on a large number of adolescents drawn from the general population in Sweden, it has the potential to make an important contribution to knowledge in this research field and also to explain earlier contradictory conclusions about whether computer gaming is good or bad for players. It is vital to understand how the motives for playing may influence the relationship between computer gaming and ill health (92). The growing interest in adolescents’ gaming habits has many different perspectives and there is need for further knowledge to establish what the gaming culture brings (3).
Overall and specific aims

The overall aim of this thesis was to provide further knowledge about adolescents’ online gaming time, motives for playing and any social and health consequences.

The specific aims were as follows.

**Paper I**

1. To investigate the amount of time spent playing MMORPGs among boys and girls. 2. To investigate the motives to play MMORPGs among boys and girls. 3. To investigate the relation between time spent gaming, the motives to play MMORPGs, and experienced negative consequences among boys and girls.

**Paper II**

To investigate adolescents’ motives for playing and online gaming time in relation to depression, musculoskeletal symptoms and psychosomatic symptoms.
Method

Study design and study population

The including studies were part of the biennial Survey of Adolescent Life in Vestmanland, a population-based, cross-sectional study based on self-reported data, conducted in 2008 in Västmanland County, Sweden (SALVe 2008). The respondents completed the questionnaire (SALVe 2008) during school time and answered questions about their demographic background, computer-gaming habits and negative consequences attributable to gaming. Questions about psychosomatic, musculoskeletal and depressive symptoms were also included.

Participants

The target population was all students in the seventh grade (13–14 years) and ninth grade (15–16 years) of compulsory school and the second year of upper secondary school (17–18 years) in Västmanland. A detailed flow chart of the study population is presented in Figure 2.
**Figure 2.** Flow chart of the study population. Administrative non-respondent refers to classes or schools that did not participate in SALVe 2008. External non-respondent refers to students who were absent on the day of the investigation, and did not return their questionnaire by mail or declined to participate. Internal non-respondent refers to those who did not complete the questionnaire satisfactorily.

All 13–18-year-old adolescents registered in seventh and ninth grades and in their second year of upper secondary school in Västmanland, \( n = 10\,281 \)

- **Moved/dropouts**  \( n = 170 \)
- **All students**  \( n = 10\,111 \)
- **Administrative non-respondents**  \( n = 348 \)
- **Students eligible for the study**  \( n = 9763 \)
- **External non-respondents**  \( n = 1857 \)
- **Completed questionnaire**  \( n = 7906 \) (78.2%)
- **Internal non-respondents**  
  - Questionnaire  \( n = 108 \)
  - Gender  \( n = 41 \)

**STUDY 1**

- **Total study population**  \( n = 7757 \)
  - Boys  \( n = 3872 \)
  - Girls  \( n = 3885 \)

- **Play MMORPGs**  \( n = 3464 \)
  - Boys  \( n = 2763 \)
  - Girls  \( n = 701 \)

**STUDY 2**

- **Total study population**  \( n = 7757 \)
  - Boys  \( n = 3872 \)
  - Girls  \( n = 3885 \)
Ethical considerations

Participants were given written information about the study and they were assured that participation was voluntary, anonymous and that they could end their participation at any time. The Swedish guidelines for studies of social science and humanities, in line with the Declaration of Helsinki were followed.

Measurements

Computer use. Participants were asked: “On average, how many hours a day do you use a computer during your leisure time (not at school)?” Response alternatives were: (1) Do not use a computer, (2) Less than one hour, (3) One to two hours, (4) Two to five hours, and (5) More than five hours.

Single-player frequency. Participants were asked: “How often do you play single-player computer games, such as The Sims, Resident Evil, Super Mario, Tomb Raider, Quake, Doom, Tetris or similar?” Response alternatives were: (1) Never, (2) A few times a year, (3) Occasionally every month, (4) 2–4 times a month, (5) 2–3 days a week, (6) 4–5 days a week, and (7) 6–7 days a week.

Multiplayer online frequency. Participants were asked: “How often do you play multiplayer online computer games, such as World of Warcraft, Counter-Strike, Guild Wars, EverQuest, StarCraft, Battlefield or similar?” Response alternatives were: (1) Never, (2) A few times a year, (3) Occasionally every month, (4) 2–4 times a month, (5) 2–3 days a week, (6) 4–5 days a week, and (7) 6–7 days a week.

Online gaming time on weekdays. Participants were asked: “If you play online computer or other games on the Internet, how long do you play on average on an ordinary weekday (Monday to Friday)?” Response alternatives were: (1) Do not play, (2) Less than one hour, (3) 1–2 hours, (4) 2–5 hours, and (5) More than five hours. Participants who did not play were considered to be non-gamers (1), response alternatives 2 and 3 were classified as ≤ 2 hours (2), response alternative 4 was classified as 2–5 hours (3), and response alternative 5 was classified as > 5 hours (4).

Online gaming time on weekends. Participants were asked: “If you play online computer or other games on the Internet, how long do you play on average on an ordinary weekend
(Saturday to Sunday)?” Response alternatives were: (1) Do not play, (2) Less than one hour, (3) 1–2 hours, (4) 2–5 hours, and (5) More than five hours. Participants who did not play were considered to be non-gamers (1), response alternatives 2 and 3 were classified as ≤ 2 hours (2), response alternative 4 was classified as 2–5 hours (3), and response alternative 5 was classified as > 5 hours (4).

**Online gaming motives.** Fifteen affective measurement variables were used to assess aspects that predicted participants’ motives for playing online computer games (Figure 3). These measures were extracted from a qualitative study where online gamers explained their motives for playing (97). We then tested these motives in a quantitative study with a larger study sample to generalize the result to other populations. Participants were given the statement: “If you play online computer or other multiplayer games on the Internet, what are your reasons for doing so?” Statement response alternatives for each of the fifteen variables were: (1) Strongly agree, (2) Agree to some extent, (3) Neither agree nor disagree, (4) Disagree to some extent, and (5) Strongly disagree. Cronbach’s alpha for the 15 items was 0.880. We used factor analysis (Varimax with Kaiser normalization) to examine the relationship between the variables for motives to play. Three components with an eigenvalue over 1 emerged: factor one was Fun/Social, factor two was Demand/Status, and factor three was Escape. The three factors accounted for 65.9% of the total variance. Factor one (eigenvalue 6.764) accounted for 45.1% of the variance, factor two (eigenvalue 2.096) accounted for 14.0% of the variance and factor three (eigenvalue 1.024) accounted for 6.8% of the variance. These three components revealed by the factor analysis were then used as summation indexes, each divided by quartiles. The lowest quartile in the Fun/Social index was defined as low Fun/Social and quartiles 2–4 were defined as medium–high Fun/Social. The highest quartile in the Demand/Status index was defined as high Demand/Status and quartiles 2–4 were defined as low–medium Demand/Status. The highest quartile in the Escape index was defined as high Escape and quartiles 2–4 were defined as low–medium Escape.
**Figure 3.** Illustration of motives to play, divided into the three factors: Fun/Social, Demand/Status and Escape.

**Negative consequences of gaming.** Seven variables for problems were created, based upon the self-evaluated negative consequences described by Linderoth and Bennerstedt (97). This study used a qualitative approach with a small number of participants, but further generalization from the results was obtained by quantifying the measures. We asked: “Has your computer gaming/Internet use led to any problems in your everyday life?” Response alternatives were: (1) Do not have time to spend with my friends, (2) Do not have time/forget to eat, (3) Quarrels and troubles with parents or siblings because of gaming, chatting or use of the Internet, (4) Stayed home from school to play/chat/use the Internet, (5) No time to do school assignments, (6) Less sleep because of gaming/time spent on computer late in evenings and nights, and (7) Other consequences. Answer categories were: (0) Never, (1) Seldom, (2) Occasionally, (3) Often, and (4) Almost always. We also created a negative-consequences index as a summation of the seven questions (range from 0 to 28; mean value = 11.99; median = 11.0; SD = 5.10; Q1–Q3 = 8.0–14.0). Cronbach’s alpha for the seven questions was 0.844. The index was divided by standard deviations, where –1 SD was the cut-off point for few negative consequences, +1 SD was the cut-off point for many negative consequences, with an intermediate group that was labelled a medium number of negative consequences. We then
created a dichotomous variable with few–medium negative consequences (0) and many negative consequences (1).

**Depressive symptomatology.** We used the Depression Self-Rating Scale (DSRS) of DSM-IV to measure depression symptoms. The general A-class criterion for major depression is defined as two weeks of either dysphoric mood, loss of interest or pleasure in most activities, or, in children and adolescents, irritated mood, accompanied by at least four other symptoms such as sleep disturbances, feelings of worthlessness or guilt, concentration disturbances, weight loss or gain/appetite disturbances, fatigue or loss of energy and suicidal ideation (98). In the analyses, we used a depression index as a summation of the reported symptoms in accordance with the DSRS, with each symptom category counting only once (0–9 points). A dichotomous variable was created, in which subjects fulfilling the DSM-IV A-class criterion were classified as depressed. Cronbach’s alpha for the DSRS was 0.84. The A-class criterion has a reported sensitivity of 96.1% and a specificity of 59.4% for major depression [28, 29].

**Musculoskeletal symptoms.** The participants were asked: “How often during the last three months have you had the following symptoms? (1) Pain in the shoulders/neck, (2) Pain in the back/hips, or (3) Pain in the hands/knees/legs/feet.” Response alternatives were: (0) Never, (1) Seldom, (2) Occasionally, (3) Often, and (4) Always. The internal consistency (Cronbach’s alpha) for these questions was 0.68. A summation index was created with a range of 0–12 points. The index was divided by standard deviations, where –1 SD was the cut-off point for few musculoskeletal symptoms, +1 SD was the cut-off for many musculoskeletal symptoms, with an intermediate group that was labelled medium number of musculoskeletal symptoms. We then created a dichotomous variable, with few–medium symptoms (0) and many symptoms (1).

**Psychosomatic symptoms.** The participants were asked: “How often during the last three months have you had the following symptoms? (1) Headache, (2) Stomach ache, (3) Feelings of nervousness, (4) Feelings of irritation, or (5) Sleep problems.” Response alternatives were: (0) Never, (1) Seldom, (2) Occasionally, (3) Often, and (4) Always. The internal consistency (Cronbach’s alpha) of the questions about psychosomatic symptoms was 0.75. A summation index was created with a range of 0–20 points. The index was divided by standard deviations, where –1 SD was the cut-off point for few psychosomatic symptoms, +1 SD was the cut-off for many psychosomatic symptoms, with an intermediate group that was labelled medium
number of psychosomatic symptoms. We created a dichotomous variable with few–medium symptoms (0) and many symptoms (1).

**Demographic variables.** We measured the demographic variables for sex, age, parents’ country of birth and subjective SES.

**Statistical analysis**

All analyses were performed using IBM SPSS Statistics software (v.18/20; IBM Corporation, Armonk, NY).

**Table 1.** Statistical analyses used in the thesis.

<table>
<thead>
<tr>
<th></th>
<th>Paper I</th>
<th>Paper II</th>
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</thead>
<tbody>
<tr>
<td><strong>Descriptive analyses</strong></td>
<td>Frequency, prevalence, percentages, M, SD.</td>
<td>Frequency, prevalence, percentages, M, SD.</td>
</tr>
<tr>
<td><strong>Identifying components or higher-order groups of motives</strong></td>
<td>Factor analysis (Varimax with Kaiser normalization)</td>
<td></td>
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<tr>
<td><strong>Differences between groups</strong></td>
<td>Pearson’s chi-squared test</td>
<td>Pearson’s chi-squared test</td>
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<tr>
<td><strong>Reliability</strong></td>
<td>Cronbach’s alpha</td>
<td>Cronbach’s alpha</td>
</tr>
<tr>
<td></td>
<td>Nagelkerke $R^2$</td>
<td>Nagelkerke $R^2$</td>
</tr>
<tr>
<td><strong>Associations</strong></td>
<td></td>
<td>Spearman’s rank correlation</td>
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<tr>
<td><strong>Regression</strong></td>
<td>Binary logistic regression</td>
<td>Multivariate binary, logistic regression</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Six-quadrant models analysed in three separate univariate categorical binary logistic regressions</td>
</tr>
<tr>
<td><strong>Significance</strong></td>
<td>For all statistical tests, a two-sided $p$ value &lt; 0.05 was considered significant.</td>
<td></td>
</tr>
</tbody>
</table>
Summary of the results

(Paper I)

Half of the students, mostly boys, played MMORPGs. It was more common to spend many hours gaming on weekends (20.9%) than on weekdays (11.6%) and almost one-quarter of boys (24.2%) and one-tenth of girls (8.0%) spent more than five hours a day gaming on weekends. Of those who played more than five hours a day on weekdays, 13.2% were boys and 5.2% were girls. Boys played MMORPGs more often and for more hours than girls ($p < 0.001$), both during weekdays ($p < 0.001$) and weekends ($p < 0.001$).

The motives for playing MMORPGs differed to some extent between boys and girls. The most common motives for both sexes were to play for fun, followed by “my friends play”, “it is exciting” and “I have many friends in the game”. Half of the participants (both boys and girls) reported playing to pass the time because they had nothing that was more enjoyable to do. Furthermore, more than one-quarter of participants, both boys and girls, played to get away from problems in their ordinary lives or because they did not have to think about all the worries in their ordinary life. Moreover, it was nearly twice as common for boys to play because they became restless and irritated when they did not play.

Most of the adolescents who played MMORPGs reported that they had experienced negative consequences from their gaming habits, and the most common negative consequence from gaming for both boys and girls was less sleep. The second most common negative consequence was not having the time to do school assignments, and the third was conflicts with parents and/or siblings, which had a higher prevalence among girls. Boys reported gaming-related consequences such as “do not have time to spend with my friends”, “stayed home from school to play”, “no time to do school assignments” and “other problems” more often than girls. However, girls more often reported negative consequences of gaming such as “do not have time or forget to eat” and “getting less sleep”.

In a binary logistic regression of time spent playing MMORPGs on weekdays and weekends in relation to the different negative consequences, we found that boys who played for more than five hours on weekdays had elevated odds ratios (OR 4.9–17) for negative consequences, compared with those who played for less than two hours on weekdays. The highest ORs for
boys were found for “stayed home from school to play” followed by “do not have time or forget to eat” and “getting less sleep”. The same pattern was found among boys for online playing over weekends, but the elevated ORs on weekends were noticeably lower than those for playing on weekdays.

Girls who played for more than five hours on weekdays had elevated ORs (4.5–29) for negative consequences compared with those who played for less than two hours. The highest ORs were for “stayed home from school to play” followed by “other problems” and “getting less sleep”. A similar pattern to gaming on weekdays was found for online playing over weekends. The elevated ORs were also noticeably lower among girls compared with when playing on weekdays, especially for “do not have time to spend with my friends”.

The relationship between the higher-order motives for gaming (Figure 3), discerned by factor analysis, and the dichotomized index of negative consequences showed that gaming for fun and social motives was associated with a reduced risk of negative consequences (OR = 0.734, 95% CI = 0.658–0.820, $p < 0.001$). Gaming in response to demands from others or to gain status increased the risk for negative consequences (OR = 1.835, 95% CI = 1.670–2.017, $p < 0.001$). Moreover, escape as a motive for gaming was an even stronger predictor of negative consequences (OR = 2.100, 95% CI = 1.904–2.316, $p < 0.001$).

In a multivariate model, adjusted for time spent gaming, the initial relationships were confirmed (Table 1). The adjustment for time strengthened the association between gaming for fun and social motives and less risk of negative consequences, whereas it weakened the associations between gaming in response to demands from others and escaping in relation to negative consequences.
Table 2. Results from multivariate logistic regression of motives for playing in relation to risk of negative consequences, adjusted for time spent gaming ($R^2 = 26.5\%$) (92).

<table>
<thead>
<tr>
<th>Motive/Time</th>
<th>OR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fun/Social</td>
<td>0.679</td>
<td>0.596–0.774</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Demand/Status</td>
<td>1.547</td>
<td>1.423–1.740</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Escape</td>
<td>1.855</td>
<td>1.673–2.056</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Gaming time (hours spent gaming a day)</td>
<td>2.110</td>
<td>1.829–2.434</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

(Paper II)

Depression, musculoskeletal symptoms and psychosomatic symptoms were most common among those aged 15–18 years. The 15–16-year-old age group had the highest proportion of individuals who played for more than five hours a day on both weekdays and weekends. The motives for playing differed to some extent between the age groups. Adolescents aged 15–16 years more often reported playing because of demands, to gain status and to escape other problems in their ordinary lives, than either the younger or the older adolescents. Neither single-player frequency (i.e., gaming occasions per week/month/year) nor multiplayer online frequency was associated with depression, musculoskeletal symptoms or psychosomatic symptoms, except for a weak association between single-player frequency and musculoskeletal symptoms. Increased gaming time (i.e., gaming hours per day) on weekdays elevated the ORs for depression, musculoskeletal symptoms, and psychosomatic symptoms. However, the effects of time spent gaming were further explained by motives for playing. Online gaming time on weekends was not related to musculoskeletal symptoms or psychosomatic symptoms and was only weakly related to depression. There were increased odds for depression when the motives for playing were characterized as low Fun/Social, high Demand/Status and high Escape. High scores on the Escape motive for playing were associated with increased odds for musculoskeletal symptoms and psychosomatic symptoms.

Playing for more than five hours on weekdays increased the ORs for gamers considerably. When compared with non-gamers, individuals who played for more than five hours with medium–high Fun/Social motives had nearly three times the odds for depression, whereas playing for the same amount of time with low Fun/Social motives increased the odds nearly fivefold. Individuals who played for more than five hours with low–medium Demand/Status motives had more than double the odds for depression, whereas playing for the same amount of time with high Demand/Status motives increased the odds by a factor of four. Individuals
who played for more than five hours with low–medium Escape motives had nearly double the odds for depression, whereas individuals who played for the same amount of time with high Escape motives had odds nearly five times greater. Similar patterns were found for musculoskeletal symptoms and psychosomatic symptoms (Table 2).
Table 3. Binary logistic regression analyses for the motives for playing (Fun/Social, Demand/Status and Escape) combined with gaming time on weekdays (< 2 h, 2–5 h, > 5 h) in relation to depression, musculoskeletal symptoms, and psychosomatic symptoms, presenting percentages, p values, ORs and 95% CIs. The three different motives for playing are presented in three separate analyses.

<table>
<thead>
<tr>
<th>Fun/Social motive</th>
<th>%&lt;sup&gt;a&lt;/sup&gt;</th>
<th>p</th>
<th>OR (95% CI)</th>
<th>%&lt;sup&gt;a&lt;/sup&gt;</th>
<th>p</th>
<th>OR (95% CI)</th>
<th>%&lt;sup&gt;a&lt;/sup&gt;</th>
<th>p</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-gamers</td>
<td>22.5</td>
<td>1.0</td>
<td>12.4</td>
<td>1.0</td>
<td>18.3</td>
<td>1.0</td>
<td></td>
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</tr>
<tr>
<td>High–medium Fun/Social, &lt; 2 h</td>
<td>21.1 &lt; 0.001</td>
<td>1.624 (1.348–1.958)</td>
<td>11.5 &lt; 0.002</td>
<td>1.433 (1.140–1.802)</td>
<td>13.3 &lt; 0.002</td>
<td>1.416 (1.140–1.760)</td>
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<tr>
<td>High–medium Fun/Social, 2–5 h</td>
<td>20.6 &lt; 0.001</td>
<td>1.734 (1.381–2.176)</td>
<td>13.8 &lt; 0.001</td>
<td>1.925 (1.475–2.510)</td>
<td>12.8 &lt; 0.001</td>
<td>1.617 (1.234–2.120)</td>
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<tr>
<td>High–medium Fun/Social, &gt; 5 h</td>
<td>26.9 &lt; 0.001</td>
<td>2.895 (2.187–3.833)</td>
<td>12.7 &lt; 0.001</td>
<td>1.844 (1.283–2.649)</td>
<td>18.7 &lt; 0.001</td>
<td>3.231 (2.345–4.453)</td>
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<tr>
<td>Low Fun/Social, &lt; 2 h</td>
<td>28.9 &lt; 0.001</td>
<td>1.476 (1.189–1.834)</td>
<td>13.2 &lt; 0.001</td>
<td>1.135 (0.860–1.499)</td>
<td>23.2 &lt; 0.001</td>
<td>1.491 (1.180–1.885)</td>
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<tr>
<td>Low Fun/Social, 2–5 h</td>
<td>38.9 &lt; 0.001</td>
<td>2.749 (1.725–4.381)</td>
<td>19.1 &lt; 0.001</td>
<td>2.008 (1.155–3.491)</td>
<td>29.2 &lt; 0.001</td>
<td>2.584 (1.560–4.279)</td>
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<tr>
<td>Low Fun/Social, &gt; 5 h</td>
<td>42.6 &lt; 0.001</td>
<td>4.858 (2.729–8.650)</td>
<td>27.9 &lt; 0.001</td>
<td>4.200 (2.273–7.759)</td>
<td>31.1 &lt; 0.001</td>
<td>4.180 (2.248–7.773)</td>
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<table>
<thead>
<tr>
<th>Demand/Status motive</th>
<th>%&lt;sup&gt;a&lt;/sup&gt;</th>
<th>p</th>
<th>OR (95% CI)</th>
<th>%&lt;sup&gt;a&lt;/sup&gt;</th>
<th>p</th>
<th>OR (95% CI)</th>
<th>%&lt;sup&gt;a&lt;/sup&gt;</th>
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<td>18.3</td>
<td>1.0</td>
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<tr>
<td>Low–medium Demand/Status, &lt; 2 h</td>
<td>21.0 &lt; 0.001</td>
<td>1.353 (1.144–1.601)</td>
<td>12.4 &lt; 0.005</td>
<td>1.333 (1.089–1.632)</td>
<td>16.9 &lt; 0.001</td>
<td>1.471 (1.225–1.767)</td>
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<tr>
<td>Low–medium Demand/Status, 2–5 h</td>
<td>19.2 &lt; 0.001</td>
<td>1.517 (1.189–1.935)</td>
<td>13.6 &lt; 0.001</td>
<td>1.758 (1.331–2.323)</td>
<td>13.3 &lt; 0.002</td>
<td>1.568 (1.185–2.075)</td>
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<td>Low–medium Demand/Status, &gt; 5 h</td>
<td>24.8 &lt; 0.001</td>
<td>2.438 (1.690–3.518)</td>
<td>14.9 &lt; 0.002</td>
<td>2.008 (1.294–3.116)</td>
<td>17.3 &lt; 0.001</td>
<td>2.610 (1.722–3.957)</td>
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<tr>
<td>High Demand/Status, &lt; 2 h</td>
<td>33.7 &lt; 0.001</td>
<td>3.641 (2.706–4.900)</td>
<td>10.0 &lt; 0.005</td>
<td>1.236 (0.800–1.908)</td>
<td>14.2 &lt; 0.005</td>
<td>1.747 (1.186–2.574)</td>
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<tr>
<td>High Demand/Status, 2–5 h</td>
<td>32.4 &lt; 0.001</td>
<td>3.715 (2.647–5.213)</td>
<td>15.6 &lt; 0.001</td>
<td>2.380 (1.572–3.603)</td>
<td>17.9 &lt; 0.001</td>
<td>2.644 (1.748–3.997)</td>
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<tr>
<td>High Demand/Status, &gt; 5 h</td>
<td>32.7 &lt; 0.001</td>
<td>4.325 (3.100–6.034)</td>
<td>14.6 &lt; 0.001</td>
<td>2.292 (1.498–3.507)</td>
<td>23.9 &lt; 0.001</td>
<td>4.793 (3.308–6.945)</td>
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</table>

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<thead>
<tr>
<th>Escape motive</th>
<th>%&lt;sup&gt;a&lt;/sup&gt;</th>
<th>p</th>
<th>OR (95% CI)</th>
<th>%&lt;sup&gt;a&lt;/sup&gt;</th>
<th>p</th>
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<td>18.3</td>
<td>1.0</td>
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<tr>
<td>Low–medium Escape, &lt; 2 h</td>
<td>18.2 0.099</td>
<td>1.159 (0.972–1.382)</td>
<td>10.7 0.178</td>
<td>1.159 (0.935–1.435)</td>
<td>14.2 0.031</td>
<td>1.238 (1.019–1.503)</td>
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<tr>
<td>Low–medium Escape, 2–5 h</td>
<td>15.2 0.180</td>
<td>1.202 (0.918–1.574)</td>
<td>11.3 0.010</td>
<td>1.492 (1.099–2.027)</td>
<td>9.4 0.297</td>
<td>1.187 (0.860–1.640)</td>
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<tr>
<td>Low–medium Escape, &gt; 5 h</td>
<td>19.1 0.001</td>
<td>1.812 (1.239–2.649)</td>
<td>12.6 0.019</td>
<td>1.718 (1.095–2.695)</td>
<td>16.3 &lt; 0.001</td>
<td>2.657 (1.765–3.999)</td>
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<tr>
<td>High Escape, &lt; 2 h</td>
<td>44.0 &lt; 0.001</td>
<td>4.371 (3.355–5.696)</td>
<td>17.3 &lt; 0.001</td>
<td>2.012 (1.453–2.787)</td>
<td>26.0 &lt; 0.001</td>
<td>2.954 (2.190–3.984)</td>
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<tr>
<td>High Escape, 2–5 h</td>
<td>40.2 &lt; 0.001</td>
<td>4.236 (3.136–5.722)</td>
<td>20.7 &lt; 0.001</td>
<td>2.868 (2.028–4.057)</td>
<td>26.4 &lt; 0.001</td>
<td>3.426 (2.434–4.821)</td>
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<tr>
<td>High Escape, &gt; 5 h</td>
<td>39.3 &lt; 0.001</td>
<td>5.335 (3.825–7.442)</td>
<td>17.0 &lt; 0.001</td>
<td>2.614 (1.722–3.968)</td>
<td>25.5 &lt; 0.001</td>
<td>4.814 (3.304–7.016)</td>
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</table>

<sup>a</sup> Percentages within each subgroup within each model with depression, many musculoskeletal symptoms and many psychosomatic symptoms.

<sup>b</sup> Adjusted for sex, age, ethnicity, SES.
Among the weekend gamers, the highest odds for depression symptoms were found in the high Escape group. These players had odds that were four times greater for depression and two to three times greater for musculoskeletal and psychosomatic symptoms, compared with non-gamers. However, time spent gaming had little influence on the results for high Escape weekend gamers. The associations between gaming time and motives for playing in relation to depression, musculoskeletal and psychosomatic symptoms were more evident among the weekday gamers than among weekend gamers.
Discussion

In the present we study found that about half of all adolescents were playing MMORPGs, gaming online was three times more common among boys than girls, and boys also spent more time playing than girls did. The highest proportions of individuals who played for more than five hours a day on weekdays or weekends were found among those aged 15–16 years. Our results show that boys and girls also game for various reasons, which is in line with earlier findings that girls play MMORPGs mostly to pass the time whereas boys play to pursue feelings of achievements (10).

In the first paper (92), gaming motives were classified into three categories: Fun/Social, Demand/Status and Escape. The gamers who had fewest problems because of gaming had Fun/Social motives, those who played for Demand/Status had more problems, and problems were highest among those whose motive for playing was Escape. Problematic gaming is described as especially common among adolescents who use online gaming as a way to cope with or to escape from reality (29, 53). Within the gaming experience, involvement through participation, rules and goals (Figure 1) might be easier to adapt to and handle than in real-life settings. These gamers are high-risk gamers who are in need of attention to prevent escalation towards addictive behaviour. The characteristics of MMORPGs readily engage gamers and trigger increased playing time. Mediating factors such as the social aspects of gaming, different rewards, reinforcements, music and sounds may all be contributors to the development of negative effects from gaming (60, 99). These features are inherent in MMORPGs and are well known stimulators for our reward system (56). The social and psychological factors of the MMORPG experience might function as dopamine triggers. Furthermore, for someone having problems in real life, the virtual world offers anonymity and the opportunity to create a different identity in an environment that is free of prejudice. Conversely, a virtual world can create exciting adventures that trigger arousal stimulation, possibly allowing more extroverted individuals to use gaming as a way to calm down. In light of Skinner’s theory about the way positive reinforcement may influence individual behaviour, anonymity might operate as a positive reinforcer that contributes to the escalation of the behaviour because of its benefits (57). The intermittent reward features of the gaming experience suggest that the way in which a gamer is rewarded for playing is more important than the reward in itself (100). It is very interesting to speculate about which factors within
the gaming experience function as triggers for introverted individuals compared with extroverts, and which of the various structural characteristics make the games addictive for persons with these different personality traits (60).

Gaming for fun or social reasons does not seem to lead to negative consequences as much as gaming for escape motives (92). Hence, the positive benefits from gaming should be acknowledged. Most gamers not report negative consequences from gaming. Furthermore, the same game probably provides a wide range of different stimuli for individuals with different gaming motives. Therefore, it is not defensible to analyse gamers as a homogeneous group in future studies without consideration of how individuals’ different gaming motives might influence results.

Adolescent online gaming behaviour may lead to negative consequences for some gamers, especially those who play for excessive amounts of time and with escape motives. Previous studies (6) have found that gaming problems increase in line with more time spent on gaming, and our results support these conclusions. We found that time spent sleeping was reduced when gaming time increased, which supports previous research (9) suggesting that gaming may lead to less sleep with subsequent attention problems and poorer school achievement (5).

However, we suggest that time should not be used as the only measure for gaming related problems because one group of players, those who play for fun and social reasons, can play for many hours a day without developing negative consequences from gaming. For gamers, MMORPGs can offer socialization, a good way to make new friends and a place where gamers might express themselves in ways that, for various reasons, they do not do in real life (101). Among the various factors influencing online gamers, anonymity gives people with low self-confidence and lack of social skills the desire to create a virtual life for themselves. In some cases, online gaming becomes a substitute for social interactions in real life, providing the gamer with an escape from reality (53). However, notably, many gamers also play together with their friends in real life.

Hakala et al. suggest that computer-related activities have become a new health risk (82). The results presented in paper II support these suggestions. We found clear associations between excessive online gaming and depression, psychosomatic and musculoskeletal symptoms. These relations became stronger when gaming time increased, and were further explained when the motives for playing were included. Similar to earlier findings, the biggest problems
were found among gamers who spent more than five hours a day gaming or who had escape motives for playing. There were higher odds for negative health effects for weekday gaming than for weekend gaming, suggesting that further research on gaming time should analyse weekday gaming separately from weekend gaming. Not distinguishing between these might affect the results and lead to false conclusions. The relation between computer gaming and musculoskeletal symptoms might be explained by consecutive periods of screen-based activities leading to sustained muscle tension and lack of recovery (102). In view of the cross-sectional nature of many studies, it is difficult to determine if the relation between depression and musculoskeletal pain is a consequence or cause of gaming activity. They may also be components of other confounding factors.

While we can only speculate on the possible direction of the relationships found between online gaming and depression, it is clear that depression symptoms were more common among those who played online games than among those who did not. Similar results were also found for psychosomatic symptoms. A possible explanation could be that many gamers have pre-existing problems such as depression and they use gaming as a coping strategy. In the longer perspective, this might isolate these individuals even more and additionally lead to increasing feelings of loneliness. Recognizing the motives for online gaming may help to identify problem gamers in need of intervention to reduce their unhealthy gaming behaviour. Further research on health issues in relation to online gaming should consider the combined effects of time spent gaming and gaming motives, and analyse weekday gaming separately from weekend gaming.

**Methodological considerations**

The studies included in this thesis have strengths, particularly in the large number participants from the general population and the high response rate. These provide an opportunity to generalize the results to other adolescent populations. Previous studies of adolescents’ computer gaming habits and their effects have been criticized because of small study populations and the failure to eliminate confounding components in the relationship between gaming and negative consequences (6, 26, 96, 103). In paper I, we attempted to avoid this problem by asking participants about negative consequences as a direct effect of playing computer games.
Several limitations should be acknowledged. Both studies in the thesis had a cross-sectional design that excludes the possibility of discerning causal mechanisms. All analyses were based on self-reports that involve the risk of inaccurate answers. However, the questions were not of a sensitive nature and were not complicated to understand or answer and participants were able to seek clarification from their teachers if they did not understand the questions.

We were aware of the risk of interpreting incorrectly what the participants meant by each answer item when we merged the fifteen affective variables used to assess aspects of participants’ motives to play into three higher-order motive variables: Fun/Social, Demand/Status and Escape. However, our measurement of motives to play was based upon the results from a qualitative study (97) that investigated gaming habits and motives and which was well suited for our aims. By quantifying the qualitative variables used in this study to measure adolescents’ different motives to play online games, we were able to investigate further online motives in a larger population study with the possibility of generalizing the results to other adolescent groups.

The aim of the study was exploratory so we did not state a hypothesis in paper I. In paper II, we further investigated the different motives to play, time spent gaming and health outcomes.

In paper I, when looking at the negative consequences of gaming, we included playing MMORPGs and other uses of the Internet in one question. Thus, we chose to include only participants who stated that they played MMORPGs in the analyses. Despite the fact that we had a large population, the subgroups for some variables were still rather small, which may have affected the results. There may be implications for the results in paper II because gaming activities are more common among boys, whereas girls more often suffer from mental ill health. However, potential confounding variables such as sex, age, ethnicity and SES had no major influence on the results of the outcome variables of depression, musculoskeletal and psychosomatic symptoms. We did not investigate these confounding variables in our first study because the dependent variable was defined as negative consequences in causal relation to gaming. However, this could be done, and it would be of interest to investigate socio-demographic factors in relation to adolescents’ gaming habits, motives and negative effects of gaming in future studies.
Conclusions

- One-half of students play MMORPGS. More boys than girls play MMORPGs, and boys play more often and spend more time gaming than girls.
- The most common motive for playing is to play for fun. Half of the adolescents (both boys and girls) report playing to pass the time because they have nothing that is more fun to do. Girls who play MMORPGs mostly do so to pass the time whereas boys play to pursue feelings of achievement. Boys are twice as likely to play MMORPGs to avoid getting restless or irritated by not playing. Furthermore, more than one-quarter of adolescents play to escape problems in their ordinary life.
- Motives for playing are the dominant factor while time spent playing is of less importance in relation to depression, musculoskeletal and psychosomatic symptoms.
- Excessive gaming time in combination with Escape motives for gaming is the strongest predictor for negative consequences and health problems in relation to gaming.
- The relations between gaming and negative consequences, and gaming and depression, musculoskeletal and psychosomatic symptoms were stronger for gamers who played on weekdays than for those who played on weekends.
- Motives to play should be considered as a prime indicator for negative consequences, of greater importance than time spent gaming.

By adding to the body of knowledge on the negative consequences of online gaming among adolescents and prevention strategies to reduce problems, the results can help parents, teachers, psychologists, social workers and others who are involved in adolescents’ health development, especially in the identification of gamers who are in risk, in order to prevent addiction-like behaviour.
Svensk sammanfattning

Trots att online dataspelande har utgjort en av de vanligaste fritidssysselsättningarna för ungdomar under många år, är effekterna av spelandet ännu inte fastställt. Debatter har förts under de senaste 20 åren om huruvida dataspelande leder till positiva eller negativa effekter och det är problematiskt att forskningsfältet ger så motsägande slutsatser gällande positiva effekter och negativa konsekvenser av dataspelandet. Dessutom ges även allt fler bevis för olika negativa hälsoeffekter som en följd av dataspelande. En av de spelformer som lockar flest ungdomar är MMORPGs (Massively Multiplayer Online Role-Playing Games). Dessa spelformer innehåller många olika varianter av belöningsfaktorer i form av det inkluderade sociala utbytet med andra spelare och i möjligheten att inom spelens värld finna föremål, spelbonusar eller andra former av vinster som aktiverar delar av hjärnans belöningssystem vilket gör att spelet upplevs som lustfyllt. Dataspelens inkluderade sociala inslag och kommunikation identifieras av många spelare som några av de främsta motiven till spel. Vidare finns argument för att de sociala delarna inom dataspelen kan vara bidragande faktorer till utvecklandet av beroendeliknande beteenden. Vissa forskare menar att frekvent datoranvändning, inklusive dataspelande, bör ses som ett nytt folkhälso problem, relaterat till negativa psikosomatiska och fysiska effekter.

Det övergripande syftet med denna avhandling är att öka den nuvarande kunskapen om ungdomars dataspelande i relation till sociala och hälsomässiga konsekvenser, samt att försöka ge möjliga förklaringar till de inom forskningsområdet tidigare inkonsekventa slutsatserna kring vad spelandet kan ge för effekter. Syftet med delarbete I var att dels undersöka i vilken omfattning pojkar och flickor spelar MMORPGs, dels att undersöka spelmotiv och dels att undersöka om det fanns samband mellan speltid, spelmotiven och upplevda negativa konsekvenser till följd av spelandet. Syftet med delarbete II var att undersöka eventuella samband mellan spelmotiv och speltid hos ungdomars online dataspelande, i relation till depression, muskuloskeletala symtom och psikosomatiska symtom. Både i delarbete I och i delarbete II medverkade 7757 Västmanländska ungdomar i åldrarna 13-18 år. Av dessa spelade 2763 pojkar och 701 flickor MMORPGs. Designen var en tvärsnittstudie inom vilken ungdomarna fick besvara ett enkätformulär under skoltid. Enkäten inkluderade bland annat frågor om deltagarnas ålder, kön, demografiska variabler,
dataspelsvanor, motiv för dataspelande, konsekvenser av dataspelande, depressions symtom, muskuloskeletala symtom och psykosomatiska symtom. Deltagandet var frivilligt och anonymt och ingen enskild individ kan identifieras utifrån sitt deltagande.

Resultaten i delstudie I visade att det var fler pojkar än flickor som spelade och att pojkarna även spelade oftare och längre tid än flickorna. Dessutom framgick att speltid var associerat med negativa konsekvenser. Dessa samband kunde ytterligare styrkas och förklaras i kombination med spelmotiv. I en faktoranalys av femton spelmotiv framträdde tre olika grupper av spelmotiv: Roligt/Socialt (Fun/Social), Krav/Status (Demand/Status) och Flykt (Escape). De ungdomar som spelade för att spelandet upplevdes som roligt och socialt hade minskade odds för negativa konsekvenser medan de som spelade för att fly problem, för att de kände krav av andra att spela eller för att uppnå status inom eller utanför spelet hade ökade odds för negativa konsekvenser. Högst odds för negativa konsekvenser fanns hos de spelare som spelade mest tid och tillhörde flyktgruppen. En slutsats av resultaten i den första delstudien var att hänsyn bör tas till spelmotiv och inte främst till speltid när konsekvenser av online dataspelande studeras.

I delstudie II studerades speltid och spelmotiv i relation till depression, muskuloskeletala symtom och psykosomatiska symtom. Samtliga av dessa hällosymtom ökade vid ökad speltid och kunde ytterligare förklaras i kombination med spelmotiv. Speltid över fem timmar per dag under veckodagar i kombination med spelmotivet att fly från problem var associerat med de högsta oddsen för depressions symtom (OR=5.334, p<0.001), muskuloskeletala symtom (OR=2.614, p<0.001), och psykosomatiska symtom (OR=4.814, p<0.001). Bland helgspelande ungdomar påvisades lägre odds för depression, muskuloskeletala symtom och psykosomatiska symtom i jämförelse med vardagsspelande ungdomar. Resultaten visade att spelmotiv var den främsta faktorn i relation till depression, muskuloskeletala symtom och psykosomatiska symtom, medan speltiden i sig hade mindre betydelse. Om spelandet utgör de dominerande delarna av livet kan överdrivet spelande bland unga ge konsekvenser både ur ett kortsiktigt och långsiktigt perspektiv. Det är troligt att både spelmotiv och spelartyp är förutsägande faktorer för utvecklandet av negativa konsekvenser av online dataspelande. Vid analys av spelrelaterade problem bör även olika speltyper och personlighet hos individen som spelar studeras.
Konklusion:

- Det är fler pojkar som spelar dataspel än flickor. Pojkarna spelar ofta och under längre tid än flickorna.
- Vid ökad speltid ökas även oddsen för negativa konsekvenser av spelandet.
- Det finns olika motiv till varför ungdomar spelar dataspel. Högst odds för negativa konsekvenser av spel finns bland de som spelar längst tid under veckodagar i kombination med att spela för att fly problem.
- Depression, muskuloskeletala symtom och psykosomatiska symtom hos unga kan associeras till online dataspelande. Högst odds för depression, muskuloskeletala symtom och psykosomatiska symtom fanns hos vardagsspelande som spelar längst tid i kombination med motivet att spela för att fly från problem.
- Motiven till ungdomars onlinespelande kan identifiera de spelare som har en ökad risk för att utveckla negativa konsekvenser till följd av spelandet.
- Framtida forskning om ungas online spelande och dess effekter bör ta hänsyn till den kombinerade effekten av speltid och spelmotiv, skilja på vardags- och helgspelande samt undvika att undersöka spelare som en homogen grupp.
Forthcoming research

The relationships between adolescents’ gaming habits and health need further study to increase knowledge within this research field. We know that there are similarities between gaming and gambling, which is why we will investigate these two activities in parallel in relation to adolescent health in our future research. The aims of our forthcoming research are to investigate psychosocial factors in relation to gaming and gambling among adolescents, and to investigate relations between adolescents’ gaming and gambling habits and their norm-breaking behaviours. These are cross-sectional studies based on SALVe 2012. All students in Västmanland County, aged 13–18 years, in seventh and ninth grade in compulsory school and second grade in upper secondary school comprise the target study population.
References


