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Problematic Gaming and Gambling among Adolescents

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Abstract
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The overall aims of this thesis were to develop and evaluate a screening instrument designed to detect gaming addiction symptoms in adolescents, to study associations between problematic gaming and psychiatric symptoms, to investigate the stability of problematic gaming, and to examine possible associations between gaming at baseline (W1) with problem gambling three years later (W2).

The study population consisted of adolescents from the Survey of Adolescent Life in Västmanland SALVe Cohort (adolescents in Västmanland born in 1997 and 1999, and their parents), in two waves (2012, n = 1887; 2015, n = 1576), and adolescents from child and adolescent psychiatric clinics in Västmanland (2014, n = 242).

The development of the Gaming Addiction Identification Test (GAIT) was based upon the research literature on gaming, gambling, and addiction. An expert panel estimated the content validity of the GAIT and found it to be excellent. Additional psychometric evaluations of the GAIT and the parent version, GAIT-P, were conducted and it was found that both versions showed promising psychometric results, with high internal consistency, high concurrent validity, high concordance, unidimensionality, and high factor loadings, although poor model fit in exploratory factor analysis. Self- and parent-rated prevalence of gaming addiction symptoms were estimated at 1.3% with the GAIT and 2.4% with the GAIT-P in 13- and 15-year-olds.

Self-rated problematic gaming above the cutoff had a boy to girl ratio of approximately 5:1 in both the SALVe Cohort and the clinical sample, whereas more girls than boys reported symptoms above the cutoff for ADHD, depression, anxiety, and psychotic-like-experiences. ADHD, depression, and anxiety symptoms were associated with odds ratios of 2.43, 2.47, and 2.06, respectively, in relation to coexisting problematic gaming. Furthermore, problematic gaming was stable over time, and problematic gaming at the first wave was associated with problem gambling three years later.

It is important to screen for possible co-occurring symptoms among those who seek treatment and among those who appear to have symptoms of gaming, gambling, or psychiatric symptoms. Ongoing evaluation of adequate screening and diagnostic measurements, and the development and evaluation of treatments for problematic gaming, gaming addiction, and comorbid conditions are needed.

Keywords: Adolescent, anxiety, attention deficit hyperactivity disorder, depression, gambling, gaming, psychometrics

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“Get the balance right”

Depeche Mode

To Magnus, Momo, Livia, and Scoobydoo

List of Papers

This compilation thesis is based upon the following papers, which will be referred to in the text by their Roman numerals (I, II, III, and IV).

I. Vadlin, S., Åslund, C., & Nilsson, K. W. (2015). **Development and content validity of a screening instrument for gaming addiction in adolescents: The Gaming Addiction Identification Test (GAIT)**. *Scandinavian Journal of Psychology*, *56*(4), 458–466. doi: 10.1111/sjop.12196.

II. Vadlin, S., Åslund, C., Rehn, M., & Nilsson, K. W. (2015). **Psychometric evaluation of the adolescent and parent versions of the Gaming Addiction Identification Test (GAIT)**. *Scandinavian Journal of Psychology*, *56*, 726–735. doi: 10.1111/sjop.12250.

III. Vadlin, S., Åslund, C., Hellström, C., & Nilsson, K.W. (2016). **Associations between problematic gaming and psychiatric symptoms among adolescents.** *Addictive Behaviors*, *61*, 8–15. doi: 10.1016/j.addbeh.2016.05.001.

IV. Vadlin, S., Åslund, C., & Nilsson, K.W. (2016). **A longitudinal study of the stability of problematic gaming and associations with problem gambling, among Swedish adolescents.** (Manuscript submitted).

Thesis at a glance

	Paper I	Paper II	Paper III	Paper IV
Aim	To describe the development of a screening instrument for measuring gaming addiction symptoms among adolescents.	To evaluate the psychometric properties of GAIT and its parent version (GAIT-P).	To investigate associations between problematic gaming and psychiatric symptoms among adolescents in two samples.	To investigate the stability of problematic gaming among adolescents, and whether problematic gaming at wave 1 was associated with problem gambling at wave 2.
Participants and Methods	The Gaming Addiction Identification Test (GAIT) was developed based on the research literature on gaming, gambling, and addiction. An expert panel ($N = 27$), consisting of professional-, adolescent-, and parent raters estimated the content validity of each item (I-CVI) as well as of the whole scale (S-CVI/Ave) and participated in a subsequent interview about the GAIT scale.	Data from the SALVe Cohort with adolescents and their parents were analyzed. Self- and parent-rated gaming addictive symptoms identified by GAIT and GAIT-P were analyzed for frequency of endorsement, internal consistency, concordance, factor structure, prevalence of gaming addiction, concurrence with the Gaming Addiction Scale (GAS) and the parent version of the GAS (GAS-P), and for sex differences.	Data from the SALVe Cohort and consecutive adolescent psychiatric outpatients in Västmanland were analyzed. Adolescents self-rated using the GAIT, ASRS-A, DSRS-A, SCAS, and PLE. Multivariable logistic regression analyses were performed, and adjusted for sex, age, study population, school bullying, family maltreatment, and interactions by sex, and with two-way interactions between psychiatric measurements.	Data from the SALVe Cohort were analyzed in two waves. Adolescents self-rated on the GAIT, PGSI, and on gambling frequencies. Stability of gaming was determined using Gamma correlation (γ) and Spearman's rho (ρ). General linear model (GLM) analysis and logistic regression analysis adjusted for sex, age, and ethnicity, with PGSI as the dependent variable, and GAIT as the independent variable, were performed to investigate associations between problematic gaming and problem gambling.
Results	The mean scores for the I-CVI and S-CVI/Ave ranged from 0.97–0.99 compared with the lowest recommended I-CVI value of 0.78 and S-CVI/Ave value of 0.90. There were no sex differences and no differences between expert groups regarding ratings in content validity, and no differences in the overall evaluation of the scale.	The 12-month prevalence of gaming addiction was found to be 1.3% with the GAIT and 2.4% with the GAIT-P. Promising psychometric characteristics were found, with high internal consistency, high concurrent validity with the GAS and GAS-P, and high concordance between adolescents' and parents' ratings, although moderate in girls.	Boys had higher self-rated problematic gaming in both samples, whereas girls self-rated higher in all psychiatric domains. ADHD, depression, and anxiety symptoms were associated with problematic gaming with ORs of 2.43, 2.47, and 2.06, respectively. Male sex was associated with problematic gaming.	Problematic gaming was stable over time, $\gamma = 0.810$, $P \leq 0.001$, and $\rho = 0.555$, $P \leq 0.001$. Problematic gaming at wave 1 was associated with problem gambling at wave 2, GLM $F = 3.357$, $\eta^2 = 0.255$, $P \leq 0.001$, and logistic regression OR = 5.078 (95% CI 1.388–18.575), $P = 0.014$. Male sex was associated with problem gambling.
Conclusion	The GAIT showed good content validity in capturing gaming addiction. The GAIT needs further psycho-metric evaluation in both clinical settings and in community settings with adolescents.	The GAIT and GAIT-P are suitable for continued use in measuring gaming addiction symptoms in adolescents. With the additional two items, they now cover all nine proposed criteria of the DSM-5's Internet Gaming Disorder (IGD).	Problematic gaming was associated with psychiatric symptoms in adolescents. Screening for problematic gaming along with psychiatric symptoms is important, to avoid overlooking the probability of coexisting symptoms.	Problematic gaming was found to be stable over time, and there were also associations between problematic gaming at wave 1 and problem gambling at wave 2, although present among few adolescents.

Contents

Abbreviations

ADHD	Attention-Deficit/Hyperactivity Disorder
APA	American Psychiatric Association
ASRS-A	The World Health Organization Adult ADHD Self-Rating Scale, Adolescent version
AUD	Alcohol Use Disorder
AUDIT	Alcohol Use Disorders Identification Test
CFA	Confirmatory Factor Analysis
CI	Confidence Interval
DALYs	Disability-Adjusted Life Years
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, fifth edition
DSRS-A	Depression Self-Rating Scale, Adolescent version
EFA	Exploratory Factor Analysis
EPIQ	Electronic Psychiatric Intake Questionnaire
GAIT	Gaming Addiction Identification Test
GAIT-P	Gaming Addiction Identification Test, Parent version
GAS	Gaming Addiction Scale
GAS-P	Gaming Addiction Scale, Parent version
GLM	Generalized Linear Model
ICD-10	International Classification of Diseases and Health Problems, tenth revision
IGD	Internet Gaming Disorder
K-SADS	Kiddie Schedule of Affective Disorders and Schizophrenia
OR	Odds Ratio
PABAK	Prevalence-Adjusted Bias-Adjusted Kappa
PGSI	Problem Gambling Severity Index
PLE	Psychotic-Like Experience
POGQ	Problematic Online Gaming Questionnaire
RDoC	Research Domain Criteria
SALVe Cohort	Survey of Adolescent Life in Västmanland Cohort
SCAS	Spence Children's Anxiety Scale
SD	Standard Deviation
SUD	Substance Use Disorder
YLD	Years Lived with Disability
YLL	Years of Life Lost

Introduction

In 2012, when I commenced my doctoral studies, relatively little was known about Swedish adolescents' gaming habits. No Swedish language screening measurements for gaming addiction had been developed for adolescents or their parents. There was no consensus on the definition of the phenomenon of "gaming addiction." However, several measurements had been developed. These were mainly scales based upon substance use disorders (SUDs) and gambling disorder criteria for adults, along with measurements for "Internet addiction," in which online gaming was seen as one area along with others such as online pornography and web-surfing addictions [1].

Therefore, I decided to develop a screening instrument for adolescents based upon current knowledge of gaming, addiction, and the proposed new diagnostic criteria for gambling disorder in the upcoming Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) [2], to include all criteria that we considered to be important in capturing the phenomena of "gaming addiction."

Because most studies to that point had been school-based or targeted studies through self-selection on online gaming sites [1], the Survey of Adolescent Life in Västmanland (SALVe) Cohort was thought to be important to the research field in that it would target adolescents derived from the general population. Furthermore, it is intended that the SALVe Cohort will be monitored for 20 years, providing the opportunity to obtain longitudinal data and perhaps the opportunity to study the development of addictive and psychiatric disorders. Possible associations with different psychiatric symptoms and the stability of the "gaming addiction" phenomena require further study, and we hoped to be able to explore these associations with the SALVe Cohort project. We also wanted to obtain enough data from girls to analyze sex differences because previous studies have mostly focused on men or boys [3-6].

Nowadays, most children and adolescents in Sweden have access to smartphones and computers, and they spend several hours a day behind these screens. Many children and adolescents also spend time playing various kinds of digital games [7]. During the information campaign for the upcoming data collection for the SALVe Cohort, parents and teachers expressed concerns about the possible negative consequences of the daily gaming activities of children and adolescents. These concerns have been raised internationally as

well [8]. Hopefully this thesis will answer some of the concerns regarding adolescent gaming activities, such as how many adolescents might be in danger of being addicted to gaming, whether gamers are more likely to have more psychiatric problems, and how parents, teachers, and staff within the school health-care system and psychiatric clinics can identify or detect adolescents at risk.

This thesis will focus on the problematic aspects of gaming, even though gaming for most individuals is a fun recreational activity associated with positive experiences.

Definitions of problematic gaming and gaming addiction

In this doctoral thesis, there is no differentiation between game genres or console types used when gaming, or whether the games are played online or offline, or with single- or multiplayers games. The studies include all types of digital games and the activity will be labeled simply as gaming. Throughout this thesis, concepts such as problematic gaming, gaming addiction, and Internet gaming disorder (IGD) will be discussed. The perspective taken is that problematic gaming and gaming addiction/IGD exist as different degrees upon a continuum of the same phenomenon, where gamers with few or no negative consequences are at one end of the continuum and gaming addiction and IGD are at the other (Figure 1).

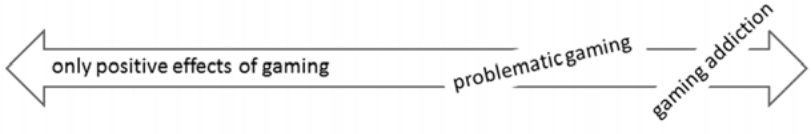

Figure 1. Continuum of problematic gaming and gaming addiction.

IGD was included in the DSM-5, section 3 as one of the "Conditions for further studies," and needs further research before being considered as an actual diagnosis. "Problematic gaming" could be viewed as subsyndromal gaming addiction symptoms, but there is no universally accepted or suggested definition of what it includes, except that some negative consequences possibly exist [9 10]. Gaming addiction, in my perspective, and used in this thesis, manifests through different aspects of addictive symptoms such as loss of control, the continuation of gaming despite negative consequences, and withdrawal etc. In Paper II, gaming addiction is defined as complete agreement with at least five criteria on the screening instrument developed to measure gaming addiction symptoms (see Appendix, the Gaming Addiction Identification Test, GAIT). The difference between IGD and gaming addiction is that gaming addiction is a somewhat wider concept that includes aspects

additional to those suggested as IGD criteria. The term "gaming addiction" was chosen and the reference to "Internet" excluded based on the assumption that the Internet *per se* is not necessary for developing gaming addiction and that gaming addiction can be related to any kind of digital game: online and offline, on computers, smartphones, tablets, TV, or any other console [11-14]. Technology development is rapid and we do not know what types of digital games will be developed or what trends may emerge. Therefore, the use of "Internet" in the label could be limiting.

The labels and definitions are important in comparing study results and in knowing whether the same or a different phenomenon is being studied; e.g., whether it is Internet addiction where anything on the Internet is included, or online but not offline gaming that is being studied [1]. The research field must continue to investigate the phenomenon of gaming addiction from different perspectives to be able to decide whether sufficient evidence is available for IGD to be classified as an authentic diagnosis and to be included in the next version of the DSM [9 13-17]. Currently, we do not know which criteria are truly relevant for gaming addiction. One possible additional criterion might be "craving," which is not presently included in the suggested criteria for IGD [6 17-19]. I theorize that craving could be a core criterion in addiction and that it seems unlikely to have an addiction without craving for a substance or behavior/activity.

Theoretical perspective of gaming addiction in this thesis

The theoretical perspective of gaming addiction in this thesis is that gaming could develop into an addiction in different ways in different individuals because of their different and dialectic biopsychosocial contexts [20-22]. There might be multiple components, such as structural characteristics within the games, intermittent rewards, and relief mechanisms using principles of operational conditioning, along with dialectical biopsychosocial processes, that are involved in the development and maintenance of addictions. Structural characteristics refers to features within the game itself that facilitate initiation, development, and maintenance of gaming over time [23 24]. Several areas have been suggested to be of importance in relation to structural characteristics of games, including social aspects of gaming, manipulation, and control features (e.g., the influence of gamers' input in relation to in-game outcomes), narrative and identity (e.g., interactivity and creation of in-game avatar characters), reward and punishment (e.g., the way gamers win and lose in games), and presentation features (e.g., auditory and visual appearances within the game) [23]. The game components that are essential differ depending on game genre and individual preferences [24]. Nevertheless, most digital games have components that could trigger individuals to develop gaming addiction, and some individuals might be more susceptible and vulnerable than others, depending on their unique combination of biopsychosocial traits [24].

Dialectic biopsychosocial processes will be described in subsequent paragraphs, as will the difficulties with the concept of "gaming addiction" and how it is measured. No distinction is made between "addiction" and "disorder," and these are used interchangeably to refer to gaming addiction.

Addiction and behavioral addiction

Currently there is no universally accepted definition of the concept of addiction; however, most researchers and clinicians agree that the etiology of addiction is multifaceted and conceptualized as a biopsychosocial process [5 6 20-22 25-27]. Some theories are general and broad, such as Jacobs' general theory of addictions [21], Shaffer and colleagues' syndrome model of addiction [20], and Griffiths' components model of addiction [27], while others have focused on various aspects of addiction, such as Blaszczynski and Nower's theory [22], which focused on different pathways of becoming addicted specifically to gambling. In addition to these theories, there are also sociocultural theories of addiction, although they are not described here.

Addiction has been defined by the American Society of Addiction Medicine as "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" [28]. Howard J. Shaffer suggests an operational definition of addiction using "three Cs" to describe behaviors that are motivated by emotions ranging along the 1) **C**raving to compulsion spectrum, 2) **C**ontinued use in spite of adverse consequences, and 3) Loss of **c**ontrol [29].

According to the DSM-5, behavioral addiction is characterized by failure to resist an impulse, or temptation to perform an activity despite negative consequences to the person or to others, and the most studied behavioral addition hitherto is gambling disorder [30]. In the DSM-5, gambling disorder has been relocated from a previous "Impulse control disorder" to the section of "Substance-related and addictive disorders" [30]. The rationale for suggesting that behaviors could develop into addictions is that they share important elements with substance addiction, and both similarities and differences are described in the research literature [5 6 14 18-21 25 27 31-47]. In the International Statistical Classification of Diseases and Related Health Problems (ICD-10), maintained by the World Health Organization (WHO), SUD is categorized as "Dependence syndrome." Compared with the DSM-5, the ICD-10 is more stringent and requires that at least three of the six criteria must be met for diagnosis, whereas the DSM-5 has a minimum of two of 11 criteria that need to be met for diagnosis [30 48]. In this thesis, the DSM-5 system will be used

because most screening instruments are based upon DSM systems, and most studies have used the DSM classifications for SUDs and gambling disorder.

Theoretical models of addiction

Jacobs' [21] general theory of addictions describes two sets of predisposing factors that combine to lead to the development of addictions: a physiological resting state of arousal that is chronic and either excessively depressed or excessively excited (e.g., either hypo- or hyperarousal), and early negative psychological experiences in childhood or adolescence that cause deep feelings of rejection, inadequacy, and low self-esteem. Addictive behaviors, such as gambling, serve as a way to relieve the chronic stress, escape from an adverse situation in life, or feel "alive," and thereby become positively and negatively reinforced, which makes it more likely that the behavior continues. However, both the physiologically and psychologically predisposed factors must be present to develop an addiction. Repeated and intense abuse of behavioral patterns or substances by themselves do *not* produce an addictive pattern according to the general theory of addictions [21].

The syndrome model of addiction proposed by Shaffer and colleagues, describes the development of different addictions that share many of the same features as well as unique manifestations and sequelae [20]. As this model shows (Figure 2), the antecedents of the addiction syndrome include individual degrees of vulnerabilities, which interact with the substance/behavior. The process is ongoing, and the biological and psychological factors can change because of the interaction with substances/behaviors and the social environment. Depending on the vulnerability and exposure to substance/behavior, individuals who repeatedly use the substance/perform the behavior can experience a desirable subjective shift (e.g., "mood modification"), which in turn, and over time, can develop into an addiction. Individuals who have developed an addiction can also move across addictions and develop more than one addiction [20]. This model has been adopted in this thesis, and has been modified by adding "gaming addiction" as another possible behavioral addiction, as presented in Figure 2.

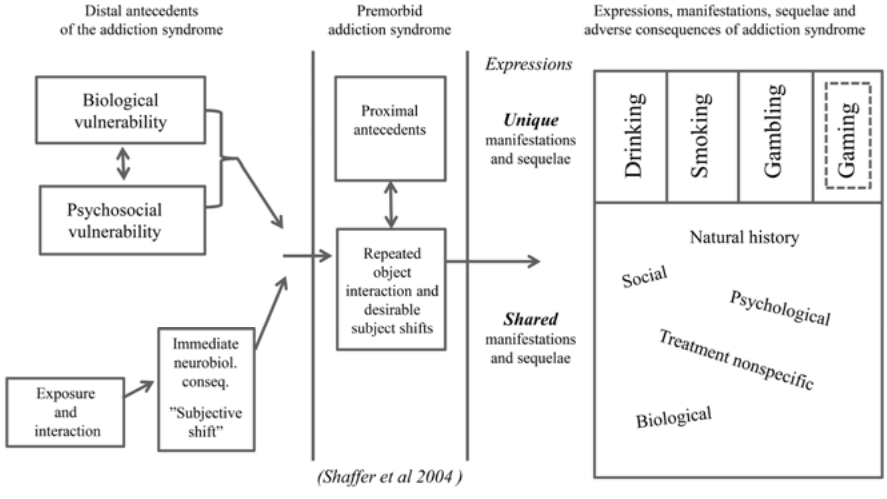

Figure 2. Modifications of the syndrome model of addiction by Shaffer et al., with the addition of gaming.

Blaszczynski and Nower [22] describe three different pathways of becoming addicted to gambling in the pathways model of problem and pathological gambling. It seems plausible that similar pathways could be relevant in the development of gaming addiction. Similarly to the syndrome model of addiction [20], and the general theory of addictions [21], the model includes a complex array of biopsychosocial determinants, and cognitive and learning theories, with the exception of the first pathway, which is the behaviorally conditioned pathway and is characterized by an absence of specific premorbid features of psychopathology [22]. The second pathway consists of emotionally vulnerable individuals with poor coping and problem-solving skills, and with a history of adverse life experiences. The third pathway includes individuals who are characterized by high impulsiveness, risk taking, and antisocial behaviors, often with comorbid SUDs [22]. However, this model needs to be explored further and tested along with different individual motives for gaming.

In the components model of addiction advocated by Griffiths, six core components are described—*salience*, *mood modification*, *tolerance*, *withdrawal*, *conflict*, and *relapse*—alongside the implicit addition of experiences of negative consequences [27]. These core components could be seen as "shared manifestations" in the model described by Shaffer and colleagues [20]. As for gaming, possible "specific unique manifestations" need to be explored further.

Similarities between substance and behavioral addictions

Similarities between substance and behavioral addictions have been described in several reviews of neurobiological and biochemical levels as well as natural history [14 18 19 34 37-39 44 45 49-51]. There is a high comorbidity between different SUDs, between SUDs and behavioral addictions, and between SUDs, behavioral addictions, and psychiatric disorders, and a large degree of shared genetic heredity has been suggested [52]. Among pathological gamblers, the lifetime prevalence for alcohol use disorder (AUD) and SUDs were 73.2% and 38.1%, respectively [53], and in other studies approximately 98% of pathological gamblers displayed co-occurring disorders [25 54]. Dysfunctions in similar brain areas along with similarities in impairment of key neurotransmitter systems (e.g., dopaminergic, serotonergic, and opioid systems) have been further described [25 34 38 39 42 52]. In SUDs and behavioral addiction, these systems seem to function in a similar way with more reward- and sensation-seeking behavior and less developed inhibition, which leads to more impulsivity and compulsive behavior [25 37-39]. The monoaminergic system has been shown to have a strong relationship with addiction [55-59]; therefore, several monoaminergic neurotransmitters are of interest.

The dopamine system in addiction

The dopamine system is evolutionarily essential for survival through seeking pleasurable activities associated with reproduction, food, and exercise [25 38 39 42 49 52 60], and the serotonergic system is important in inhibiting, planning, and controlling behavior [42 52]. The release of dopamine affects several areas in the brain, which are of relevance to reward, motivation, planning and self-regulation, memory, learning, and reward/motivational seeking behavior [25 38 39 42 49 52 60]. The prefrontal cortex and amygdala are two areas involved in motivation/expectation of reward and have an important role in impulse control and emotional processing, whereas the hippocampus is crucial for memory and learning [25 42 49 52]. Individual differences in dopamine release and reuptake, and anticipation of reward, along with the mesolimbic dopamine release resulting in the motivational "wanting and seeking" [61] might explain why some individuals never seem to give up, continuing activities that are repetitive and have low chance of winning, and why these behaviors are not extinguished.

In an evolutionary sense, dopamine had an important role in prompting hunter-gatherers not to give up seeking food, even when food was hard to find, or being novelty seeking enough to dare to try new things to eat [60-62]. Nowadays, individuals with these types of dopamine functions might be more susceptible to developing behavioral addictions; e.g., continuing to gamble even though the chance of winning is small, and despite negative consequences such as losing money [60-62]. The same individuals might also be more vulnerable to

"near wins," which appear to be even more "addictive" than actual rewards, since seldom-occurring conditioned stimuli result in more rapid learning than stimuli that occur more frequently and with more certainty [60-62]. Unpredicted rewards are highly motivating events; if they were not, the behaviors they follow would have been extinguished due to the high failure rate. Some individuals seem to be more aroused by and more interested in reward-seeking behavior with intermittent and uncertain rewards [60-62]. Adaptive problem solving has been suggested to be divided into: a) cognitive (related to learning to predict situations), and b) motivational (related to "wanting and seeking" in uncertain environments) categories, where the cognitive method could be seen as functionally higher. However, when the outcome cannot be predicted with enough certainty, individuals engage in motivational problem solving [61]. The "seeking-behavior" is an adaptable strategy for compensating in unpredictable environments and situations, and the individual continues "wanting and seeking" with a "chance" of gaining what they need or desire [60-62].

Neurobiology and addiction

In line with Jacobs' general theory of addictions [21] and Shaffer's syndrome model of addiction [20], there may be an underlying genetic endophenotype vulnerability in environment interaction in SUDs and in behavioral addictions [20 21 38 39 63 64]. Studies using positron emission tomography and functional magnetic resonance imaging have identified functional brain changes in gamblers and among excessive users of video games, including their reactivity to gambling/game cues, response inhibition, and reduction in error-related negativity, which are similar to changes observed in substance addiction [37 49 50]. Poor performance in neurocognitive tasks was identified specifically with regard to impulsiveness and compulsiveness, both in SUDs and gambling disorder [39]. Although there are many similarities, there are also differences, one of which is that there are no neurotoxic consequences in behavioral addictions, as there are in SUDs [5 19 37 38]. Alterations in the brain's reward circuitry (changes in the release of dopamine, serotonin, and other neurotransmitters) can occur in behavioral addictions because of the interactions with the behavior that produce desirable subjective shifts. These can lead to similar changes to those seen in SUDs [19 25 37 51].

Problem gambling and gambling disorder

Gambling as an activity can be characterized as placing something of value at risk in the hope of gaining something of greater value [44]. Like problematic gaming and gaming addiction, gambling can be viewed as a continuum, with gambling for recreation and fun at one end, problem gambling, where different negative consequences have arisen, further along the continuum, and

gambling disorder, where the diagnostic criteria must be met as mild, moderate, or severe, at the other end.

Gambling disorder, as it appears in the DSM-5 [30], is used throughout this thesis. In the ICD-10, section F63, "Habit and impulse disorders", it is labeled "Pathological gambling" [48]. The diagnoses in the DSM-5 and the ICD-10 differ in some respects; e.g., gambling disorder in the DSM-5 is seen as a behavioral addiction, whereas in ICD-10, pathological gambling is still seen as an impulse control disorder. Gambling disorder in the DSM-5 has 10 criteria, while pathological gambling in the ICD-10 has four criteria.

The prevalence of problem gambling and gambling disorder differ between studies. According to a systematic review of research among youth in Europe, 0.2–12.3% met the criteria for problem gambling [65]. Among Swedish adolescents aged 15–17 years, 5.1% were considered to have gambling problems, and among young adults 18–24 years old, 3.3% had gambling problems [66]. In another Swedish study, the incidence proportion of the first episode of problem gambling was found to be 2.26% among 16–18-year-old adolescents [67]. In a review by Volberg et al. [68], the prevalence for problem gambling among adolescents in North America, Europe, and Oceania was found to vary between 0.8% and 13%. Pathological gambling has been estimated to 0.6% in a US national study of adults [54], which is slightly higher than the prevalence of gambling disorder according to the DSM-5, which presents prevalence rates of 0.2–0.3% in the general population in the US [30].

Problematic gaming, gaming addiction, and IGD

Like addiction, there is no universally accepted definition of gaming addiction, and there is an ongoing debate regarding whether the phenomenon of gaming addiction actually exists [10 69]. However, in 2013, IGD was included in section 3, "Conditions for further studies" of the DSM-5 [30]. The rationale for including IGD was that there seemed to be increasing evidence of similarities with gambling disorder and SUDs, and that IGD was a candidate for behavioral addiction; however, there was not enough evidence to warrant inclusion as an actual diagnosis at that time.

The proposed criteria for IGD in DSM-5 are: 1) *preoccupation/cognitive salience*, 2) *withdrawal*, 3) *tolerance*, 4) *loss of control*, 5) *loss of interests/activities*, 6) *continue despite problems*, 7) *lie/deception*, 8) *mood modification*, and 9) *jeopardized or lost significant relationships, job/education* (see Table 1) [30]. Like SUDs and gambling disorder, specifications of degree—mild, moderate, and severe—are suggested depending on the level of disruption of normal activities [30].

As shown in Table 1, the overlap in criteria between gambling disorder and IGD is high, where only gambling criteria 6 (chasing losses) and 9 (relying on others economically) are missing from IGD, and IGD-criteria 5 (loss of interest/activities) and 6 (continue despite problems) are absent from gambling disorder. Perhaps one could consider chasing losses as a form of continuation despite harm in gambling, because the likelihood of losing more money increases when chasing losses.

Concordance between IGD and SUD criteria is likewise high, although SUD criteria 4 (craving), and 8 (use in situations that are physically hazardous…) are omitted from IGD, and IGD-criteria 7 (lie/deception), 8 (mood modification), and 9 (jeopardized or lost significant…) are not present in SUD. The fact that SUD does not have criteria for lie/deception, jeopardized, and mood modification (if criterion 11 is not seen as mood modification) might be viewed as odd for two reasons: 1) the negative reinforcement of taking drugs (mood modification to avoid dysphoria, or to achieve normal sensory mood) is an important maintenance factor, and 2) SUD often results in jeopardizing or the loss of significant relationships or work/school [39 70].

Table 1. Comparisons of DSM-5 diagnostic criteria for SUD, gambling disorder, and IGD.

SUD criteria no.	Substance use disorder (SUD)	Gambling disorder	Internet gaming disorder (IGD)
	A problematic pattern of usage leading to clinically significant impairment or distress, as manifested by at least two of the following, occurring within a 12-month period:	Persistent and recurrent problem gambling behavior leading to clinically significant impairment or distress, as indicated by the individual exhibiting four or more of the following in a 12-month period:	Persistent and recurrent use of the Internet to engage in games, often with other players, leading to clinically significant impairment or distress as indicated by five or more of the following in a 12-month period:
1	More intake or more time used than planned/*Loss of control*[c]	*Repeated unsuccessful efforts to control, cut back, or stop gambling/Loss of control (3)*[a, b, c]	*Loss of control (4)*[a, b, c]
2	Desire to cut down/**Loss of control**	Repeated unsuccessful efforts to control, cut, back or stop gambling/**Loss of control** (3)[a, b]	**Loss of control** (4)[a, b]
3	Increasing time spent obtaining substance/ **Preoccupation/cognitive salience**	**Preoccupation/cognitive salience** (4)[a]	**Preoccupation/cognitive salience** (1)[a]
4	Craving	---	---
5	Neglect of obligations school/work/home/**Loss of interest**	---	**Loss of interest** (5)[a]
6	**Continue use despite social or interpersonal problems**	---	**Continue use despite psychosocial problems/harm** (6)[a, b]
7	Give up or reduce important activities/**Loss of interest**	---	**Loss of interest** (5)[a]
8	Use in situations that are physically hazardous	---	---
9	**Continue use despite harm**	---	**Continue use despite psychosocial problems/harm** (6)[a, b]
10	**Tolerance**	Need to gamble with increasing amount of money to achieve desired excitement/**Tolerance (**1)[a]	**Tolerance** (3)[a]
11	**Withdrawal**	Is restless or irritable when attempting to cut down or stop gambling/**Withdrawal** (2)[a]	**Withdrawal** (2)[a]
	---	Often gambles when feeling distressed/**Mood modification** (5)[a]	Use of internet games to escape or relieve a negative mood/**Mood modification** (8)[a]
	---	**Lie/deception** (7)[a]	**Lie/deception** (7)[a]
	---	**Jeopardized or lost** significant relationship, job, education (8)[a]	**Jeopardized or lost** a significant relationship, job or school (9)[a]
	---	Chasing losses (6)[a]	---
	---	Rely on others financially (9)[a]	---
		Specification of current severity	
Mild: 2–3 symptoms Moderate: 4–5 symptoms Severe: 6 or more symptoms		Mild: 4–5 symptoms Moderate: 6–7 symptoms Severe: 8–9 symptoms	IGD can be mild, moderate, or severe depending on the degree of disruption of normal activities.

Note: [a] is the correct criterion number in parentheses to the specific disorder, [b] is a criterion used in two locations in comparison to other disorders, [c] is a criterion marked in italic nonbold text that could be interpreted as corresponding with other disorders' criteria.

IGD is in the DSM-5 also referred to as "Internet use disorder, Internet addiction, or gaming addiction" [30]. The different labels, presumably with different definitions, make it difficult to know which phenomenon is being studied under the IGD label. Therefore, it is important for researchers to specify their definition within their studies [1 9 13-15]. Unlike the DSM-5, there is no equivalent to the IGD in the ICD-10 [48]. The closest are F63.8, "Other habit and impulse disorders," and F63.9, "Habit and impulse disorder, unspecified," in which different forms of persistently repeated maladaptive behavior that are not secondary to an actual psychiatric syndrome, can be classified [48]. However in the upcoming ICD-11, it seems that gaming disorder will be included in the section "Disorders due to substance use and addictive behaviors," code 7D61 [71]. In this thesis, the DSM-5's IGD is used for comparisons with gaming addiction.

Prevalence of problematic gaming, gaming addiction, and IGD

Prevalence rates of gaming addiction range from 0.3% to 12% internationally [5], with the highest rates in Asian countries [30], although rates as high as 34–50% have been reported [72 73]. The differences in prevalence reflect variations in study design, sample, the use of different measurements and cutoffs, along with diverse classifications of gaming addiction versus problematic gaming [13]. Studies that evaluated the suggested IGD criteria have reported prevalence rates between 1.2% and 5.3%, with the highest rates among adult online gamers, 1.2% in a general adolescent population [74], 1.6% in a cross-national sample of European adolescents [75], 4–5% in a study of adolescents and adults [76], 5.3% among predominately male adult online gamers [77], and 2.5% among a nationally representative sample of adolescents in Slovenia [78].

Biological similarities between gaming addiction and substance addiction

Similarities and differences between substance and behavioral addictions have been presented in the literature, and several papers also describe similarities and differences in relation to gaming addiction and problematic gaming [5 6 14 18 19 35 51 79]. A study on attentional bias and disinhibition, which are characteristics of addictive disorders, discovered that male adolescents with high self-reported gaming problems displayed signs of error-related attentional bias toward gaming cues, which is similar to what has been noticed in SUDs [14 45]. Higher degrees of gaming problems were also related to more errors in response inhibition, although only when game cues were presented [45], and the same brain areas involved in substance dependence have been found to be involved in online gaming craving [14 17 19 36 79]. Moreover, IGD and AUD have been found to share deficits in executive functioning, including problems with self-control and adaptive responding [80]. Similarities in

dopaminergic functions have been found, as for the high likelihood that addicted gamers have the TaqA1 allele of the dopamine D_2 receptor, which indicates a biological predisposition to a lower number of D_2 receptors; however, it is not clear whether the games are the cause or the effect of the changes in the dopaminergic system [19 51 81]. Furthermore, the usual onset in late adolescence and early adulthood in males, and later onset and shorter period from initial engagement to addiction among females are similar between SUDs and gaming addiction [5 34]. Urges and cravings prior to initiating the behavior, a decrease in negative emotions, and a positive mood or "high" similar to those found in substance use have been reported [17 19 34 75]. High comorbidity between substance and behavioral addictions, and substance additions and psychiatric disorders, have been described along with natural history [19 34 39].

Positive aspects of gaming

In addition to being a fun and recreational activity, gaming has several well-known positive aspects such as being used in education and as a teaching tool for individuals with visual and cognitive processing deficits, in rehabilitation in the health-care system, in treatments for a variety of specific diseases and health-related conditions, for exercising memory and cognitive abilities among the elderly, in teaching job-related skills to surgeons and pilots, and enhancing motor skills and physical activity [82-84]. Furthermore, gaming in itself has been found to have several beneficial properties for improving eye-hand coordination, reaction time, and visual spatial performance, and promoting learning, memory, and multitasking [82-84].

Comorbidity

High comorbidity exists between psychiatric disorders, SUDs, and behavioral addictions [5 52 54 85-90]. Among adolescents with comorbid substance use/abuse, or dependence and psychiatric comorbidity, behavioral addiction rates as high as 60% have been reported [91]. Among individuals with pathological gambling, approximately 98% have shown co-occurring mental disorders and SUD, and the co-occurring disorders precede or emerge simultaneously with the pathological gambling [25 54]. Comorbidity is associated with greater severity of illness, greater impairment, lower treatment response, and worse prognosis [85 90 92 93].

Psychiatric symptoms and diagnoses

Attention-deficit/hyperactivity disorder (ADHD)

ADHD is a neurodevelopmental disorder consisting of a persistent pattern of inattention and/or hyperactivity/impulsivity that interferes with functioning in at least two or more settings (e.g., at home, school/work), with symptoms present prior to the age of 12, according to the DSM-5 [30]. The prevalence of ADHD in general child and adolescent populations ranges between 3.4% and 20.9% [30 94-96]. The DSM-5 suggests the prevalence of ADHD is about 5% in most cultures [30], although a national US sample of adolescents had a prevalence of 8.7%, and was three times more common in boys than girls [97].

Depression

Major depressive disorder is characterized by the core criteria of depressed mood, anhedonia, and/or irritability (which is common in adolescents and males), along with at least four of another seven symptoms in the DSM-5 [30]. In a meta-analysis among children and adolescents, the worldwide prevalence of major depressive disorder was 1.3% [94]; however, in the US national study, 11.7% of the adolescents met the criteria for major depressive disorder [97]. In a Swedish study of adolescents in the general population, the self-rated prevalence was 12.9% [96].

Anxiety

Anxiety disorders are characterized by excessive fear, anxiety, and related behavioral disturbances, such as avoidance behavior in relation to different situations or objects. Fear is the emotional response to a real or perceived threat, while anxiety is the anticipation of future situations or objects that are interpreted as threatening. There are several different anxiety disorders, and they are often comorbid and overlapping [30]. In the US national sample of adolescents, the prevalence of any anxiety disorder was 31.9%, ranging from 2.2% for generalized anxiety disorder to 19.3% for specific phobia. Of the total US sample, 8.3% had severe anxiety disorders [97]. In contrast, a meta-analysis of children and adolescents gave a worldwide prevalence rate of any anxiety disorder as 6.5% [94].

Psychotic-like experiences (PLEs)

PLE is a concept that describes different experiences such as seeing or hearing things that other people cannot, or having unusual beliefs or ways of thinking that are not part of a diagnosable psychotic experience in terms of frequency and duration. PLEs are quite common; a meta-analysis of adolescents in the general population reported a prevalence of 7.5% [98]. However, psychotic

disorders are rare in children and adolescents, and the lifetime prevalence of schizophrenia in adults range between 0.3% and 0.7% [30]. PLE symptoms have been suggested, not only to be important in detecting early signs of psychotic symptoms, but also as an indicator and a marker of severity of psychopathology [99].

Substance use disorders

SUDs are the dependence on a substance leading to effects that are harmful to the individual's physical and mental health, and often the welfare of others [30]. SUDs are characterized by a pattern of continued pathological use of substances that alter the state of mind (e.g., "subjective shift"/"mood modification"), despite different substance-related problems such as adverse social consequences, failure to meet work, family, or school obligations, and interpersonal conflicts [30]. The DSM-5 combines the DSM-IV categories of substance abuse and substance dependence into a single SUD disorder measured on a continuum from mild to severe (Table 1). In the US national sample of adolescents, the prevalence rates were 11.4% for SUDs, 6.4% for alcohol abuse/dependence, and 8.9% for drug abuse/dependence, with all three disorders more frequent in males [97].

Functional impairment, consequences, and costs

Clinically significant impairment or distress is needed before considering a diagnosis of SUD, behavioral addiction, or psychiatric disorder. Just having a particular number of symptoms is not enough. Specifications of the degree of severity due to impairment are included in SUDs, gambling disorder, and IGD [30]. Distress is often a subjective individual negative emotion whereas impairment often can be measured by loss of income or unemployment due to disability or the disruption of normal activities.

To compare distress and disabilities in psychiatric and somatic disorders, and between countries, different measurements and calculations have been developed. One common way to measure burden and disability due to somatic and psychiatric disorders is years lived with disability (YLD). YLD and years of life lost (YLLs) due to premature mortality are components in the Disability-Adjusted Life Years (DALYs) matrix [100]. Data from the Global Burden of Disease study [100] found that from 0–24 years of age, mental disorders, and SUDs are the leading cause of disability using YLDs. When using DALYs, mental disorders and SUDs ranked as the sixth leading cause in high-income countries, and the ranking rose to fifth when suicidality was included. Major depressive disorder created the highest level of disability, schizophrenia was fourth, anxiety disorders were fifth, ADHD was eighth, and AUD was seventeenth [100].

Gambling and gaming have not yet been measured in YLDs; therefore, they cannot be estimated other than in a theoretical and hypothetical way. However, a report of total costs of adults' problem gambling in Sweden estimated the cost to society to be 2.3–4.5 billion SEK a year [101]. It was also stated that the costs were probably underestimated because some indirect costs were not included. The conclusions were that problem gambling is associated with high costs to society and that the largest costs were indirect due to loss of production [101].

Like problem gambling, problematic gaming and gaming addiction is thought to cause loss of production in adults and loss of study in school-years in adolescents [30], along with relationship problems, conflicts, and depressive, anxious, and/or irritable moods. The extent of the costs and disability due to problematic gaming or gaming addiction is not known.

Compared with other common diseases such as asthma and diabetes mellitus, psychiatric diseases have considerably higher proportions of YLDs; in 15–29 year olds in Sweden the YLDs were 8.6 in asthma and 1.0 in diabetes mellitus compared with 83.2 for mental and behavioral disorders taken together, 22.9 for unipolar depressive disorder and 26.0 for AUD [102]. As previously stated, there is a high comorbidity between psychiatric disorders, SUDs, and behavioral addictions, and although it seems fair to hypothesize that YLDs for comorbidities would be higher than for them separated, no total YLD for comorbidity has yet been estimated.

Adolescence: a sensitive period in life

Adolescence is a time of important mental, physical, social, and behavioral changes. Usually these changes are beneficial and optimize the adolescent brain for the upcoming challenges in life, but they can also yield a vulnerability to certain types of psychopathology [103]. Major changes occur in the neural systems and affect cognitive functioning, reasoning and interpersonal interactions, emotion regulation, risk–reward appraisal and motivation, and these changes can also increase the risk of psychiatric and addictive disorders, especially if these changes occur during troublesome circumstances in the adolescent's life [103].

Several psychopathologies, such as anxiety disorders, ADHD, and depression, have their common onset in adolescence [103]. Substance use is usually initiated during adolescence, is most intense in early adulthood, and usually declines with age [104]. An early introduction could project a higher risk of developing problems. However, taking risks is simultaneously also a part of the normal transition from adolescence to adulthood [105] [106]; adolescent risk-taking

behaviors can be viewed as functional, intentional, and goal-directed, with the "goals" often central in normal adolescent development [106]. Those risk-taking behaviors can be important in gaining the respect and acceptance of peers, coping with frustrations in life, affirming maturity, and marking a transition from childhood toward a new adult identity [105 106].

Risk-taking behaviors peak during adolescence and thereafter decrease with age and with increasing responsibilities in school, at work and when starting to build a family [106]. During adolescence, intense interests and risky behaviors can shift rapidly, including the element of "outgrowing" activities and interests. This makes studying these types of phenomena among adolescents more difficult, especially when using cross-sectional studies where it is not possible to examine developments or trajectories of problematic behaviors or disorders.

In 2013, 45% of two-year-old children in Sweden had used the Internet, and a quarter of four-year-old children used the Internet daily [7]. From five years of age, virtually all children played some sort of game on tablets or computers [7], and over 80% of 12–15-year-old adolescents use the Internet for school work. The positive and negative long-term effects of such an early introduction to the Internet and to gaming are still unknown.

Background to the development of the GAIT

In a systematic review by King and colleagues' in 2013 [1] 18 different measures of pathological video gaming and Internet addiction, available since the year 2000, was presented. Most measures were in English [107-117], some were in other native languages [118-121], and five measures were available in at least two languages [109 111-113 115-117], although none were in Swedish. The criteria included in the measures differed in components and ranged in number from two [108] up to nine [107]. It was often unclear which phenomena the measures had been designed to capture, with variations ranging from problematic gaming and online gaming addiction to measuring activities on the Internet. Furthermore, the items included in the different measures ranged from six [110] to 40 [118], and from being dichotomous [107 112 116] to having a range of seven possible item responses [108]. Several measures reported no timeframe [1 108-110 113-122], and no suggested cutoff or age-appropriate level [107-110 114 116-118 120 122]. None of the measurements had included craving as a criterion, an aspect that might be important in a screening measurement for capturing gaming addiction symptoms among adolescents, and for proxy reports. Because of the inconsistencies of these measures, a decision was made to develop a screening instrument (GAIT) to capture the phenomenon of gaming addiction in adolescents based upon the current knowledge of gaming, gambling, and addiction.

Psychometrics: measuring latent constructs

Psychometrics involves the development and evaluation of rating scales and measures of theoretical phenomena (i.e., latent constructs) [123]. A latent construct cannot be observed or measured directly in the way that height and weight can, so indicators that are thought to represent the underlying construct are used instead. These indicators are directly observable and are thought to be an accurate representation of the variables that cannot be observed. In the research field of psychiatry, most disorder definitions are based on symptoms and information regarding disorders is often gathered from self-reports, proxy informants, and observations. Therefore, the use of screening instruments and diagnostic tools is an important part of the clinician's information gathering about the patient and his/her symptoms of disorders, and the measurements used must be valid and reliable. Valid measurements are those that measure what they intend to measure and reliable measurements produce similar results repeatedly under consistent conditions. Psychometric evaluation consists of a validation process as well as a reliability process; these are related to each other and are not to be seen as separate [123].

Validity

Validity can be divided into three main types: content, criterion-related, and construct validity [123]. Content validity (internal validity) refers to the extent to which the items within a measurement, taken together, represent a sufficient operational definition of the latent construct that they are designed to measure. An expert panel may rate the items in the measure, and judge whether the latent construct is being accurately captured with the measurement to determine content validity. Criterion-related validity (external validity) concerns the measurement results in relation to external criteria, and is often subdivided into concurrent and predictive validity. Concurrent validity can be evaluated by comparing or correlating the measurement with a similar instrument designed to measure the same latent construct. With predictive validity, the evaluation pertains to the measure's ability to predict an outcome with its test scores (e.g., when high scores predict the risk of having a disorder). Construct validation (external validity) refers to methods used to evaluate whether the measurement captures what it is intended to capture, rather than something else (e.g., measuring anxiety rather than ADHD). By comparison with other measurements, one can detect whether the measurement can discriminate between groups (e.g., people who drink alcohol excessively are more likely to score highly on an alcohol-screening test than those who do not drink alcohol).

Reliability

Reliability is evaluated by performing tests of the stability and reproducibility of the measurement [123]. Tests often used for this purpose are interrater reliability, test–retest, and internal consistency. Interrater reliability determines whether different raters rating the same person get the same result using the same measurement simultaneously. High correlations between scores indicate high interrater reliability. With test–retest, the same person uses the same measurement at two different times and a high consistency in test results indicates a high level of stability in the measurement (e.g., high reliability). Internal consistency concerns the consistency within a measurement; how well the items measure the same latent construct and can be evaluated with inter–item correlation, item–total correlation, split-half, and coefficient alpha.

Aims

The overall aims of this thesis were to develop and evaluate a screening instrument designed to detect gaming addiction symptoms in adolescents, to study associations between problematic gaming and psychiatric symptoms, to investigate the stability of problematic gaming, and to examine possible associations between gaming at baseline (W1) with problem gambling three years later (W2).

Paper I

Development and content validity of a screening instrument for gaming addiction in adolescents: The Gaming Addiction Identification Test (GAIT)

Aim: To describe the development of a screening instrument for gaming addiction in adolescents—the Gaming Addiction Identification Test (GAIT).

Paper II

Psychometric evaluation of the adolescent and parent versions of the Gaming Addiction Identification Test (GAIT)

Aim: To evaluate the psychometric properties of the Gaming Addiction Identification Test (GAIT) and its parent version (GAIT-P), in a community sample of adolescents and parents in Västmanland, Sweden.

Paper III

Associations between problematic gaming and psychiatric symptoms among adolescents in two samples

Aim: To examine associations between problematic gaming and psychiatric symptoms in two adolescent samples in Västmanland, Sweden.

Paper IV

A longitudinal study of the stability of problematic gaming and associations with problem gambling, among Swedish adolescents

Aim: To investigate the long-term stability of problematic gaming among adolescents, and whether problematic gaming at wave 1 is associated with problem gambling at wave 2, three years later.

Method

The present thesis is a compilation thesis of four papers and a thesis frame. The thesis is based on the licentiate thesis conducted in 2015, which includes the first two papers (I and II) described in this compilation thesis. There may be similarities between the thesis frame, descriptions of the methods, results, and conclusions in the licentiate thesis and this compilation thesis, because these two incorporated papers are identical, and thus the conclusions drawn from the results are alike.

Study design and population

Paper I

The study design of Paper I contains a quantitative and a qualitative design since it contains elements of both in the psychometric evaluation. The use of an expert panel in the evaluation of the content of the GAIT and cognitive interviews thereafter were qualitative in those matters where there were subjective assessments of the content validation of the items and of the scale. The developmental process also has qualitative elements; however, when calculating the content validity indices (I-CVI and S-CVI/Ave), a quantitative approach was used.

Instrument development

The Gaming Addiction Identification Test (GAIT) was developed in 2012 based on previous research on gaming, gambling, and alcohol/substance addiction. Measurements such as the Alcohol Use Disorders Identification Test (AUDIT) [124], the Problematic Online Gaming Questionnaire (POGQ), including six proposed dimensions/factors (*preoccupation*, *overuse*, *immersion*, *social isolation*, *interpersonal conflicts*, and *withdrawal*) [114], and Griffiths' six core components (*salience*, *mood modification*, *tolerance*, *withdrawal*, *conflict*, and *relapse)* [27] were used as models.

The intention was to develop a screening tool for measuring gaming addiction symptoms in adolescents from the age of 12 years to be used in screening within school health care, in the community, and in different clinical settings. By combining questions intended to capture different aspects of gaming addiction, all presumed relevant aspects were represented by a question with

a response on a five-point scale ranging from “disagree” to “completely agree.” Fifteen questions, all pertaining to the last 12 months, were included in the GAIT. The first two items, concerning frequency and duration, are not included in the scoring, giving a maximum score of 52 points.

Content validation

The participants in Paper I consisted of professional expert raters chosen to evaluate the GAIT and to participate in a subsequent cognitive interview. A panel of 27 raters participated: seven were professional expert raters (three women), ten were adolescents (five girls), and ten were parents (five mothers). The professional expert raters were selected because of their expertise in the fields of addiction, adolescents, and gaming problems. The professional raters included one child and adult psychiatrist, two alcohol and drug counselors, one family therapist, one psychiatric social worker, one clinical child and adolescent psychologist, and one PhD researcher in addiction. The adolescent raters and the parent raters were a native Swedish-speaking convenience sample of lay people with equal sex representation. The adolescents were aged between 13 and 20 years (mean age = 15.5, median age = 15) with different degrees of engagement in gaming activity (range = 0–8 h/day). The parent raters were aged between 31 and 52 years (mean age = 40.9 years, median age = 40.5 years) and all had experiences of gaming in their youth, from occasional to excessive (more than 5 h/day). Five of the parents played for about 1 h/day and one played excessively a few times a month (more than 10 h/day).

Paper II

The study design of Paper II was cross-sectional and the psychometric evaluation was quantitative.

The participants in Paper II were derived from the SALVe Cohort consisting of adolescents in Västmanland born in 1997 and 1999, and their parents (Figure 3). The participants were contacted by regular mail and asked to participate in the study by completing a 20-page self-report questionnaire, including questions on gaming, mental health, family, school, and leisure activities, using paper and pencil. The questionnaire took approximately 45 minutes to complete. Parents were asked to complete a questionnaire with similar questions regarding their adolescent. Adolescents were also asked to produce a saliva sample. The total response rate was 40%.

One year after inclusion in the SALVe Cohort study, a computerized, stratified, and randomized subsample of participants was contacted and invited to participate in a follow-up study regarding gaming behavior, psychiatric symptoms, and sociodemographic data (Figure 3). The stratification was made by classifying participants into quartiles, based upon

symptom severity in psychiatric screening instruments (for depression, anxiety disorders, ADHD, exposure to domestic violence within the family, conduct problems and GAIT-scores) by quartiles. Q1 was individuals with overall low scores, Q2–Q3 had mild to moderate scores, and Q4 had overall high scores. The categorization was distributed equally across all four quartiles. All participants were contacted by telephone and invited to participate. The adolescents and parents answered a computer-assessed self-report questionnaire at the Centre for Clinical Research, Västmanland Hospital Västerås, with a following semi-structured diagnostic interview (the Kiddie Schedule of Affective Disorders and Schizophrenia, K-SADS) and a semi-structured diagnostic interview developed for gaming addiction including all proposed criteria for IGD. However, in Paper II, only gaming addiction with GAIT/GAIT-P and GAS/GAS-P was investigated.

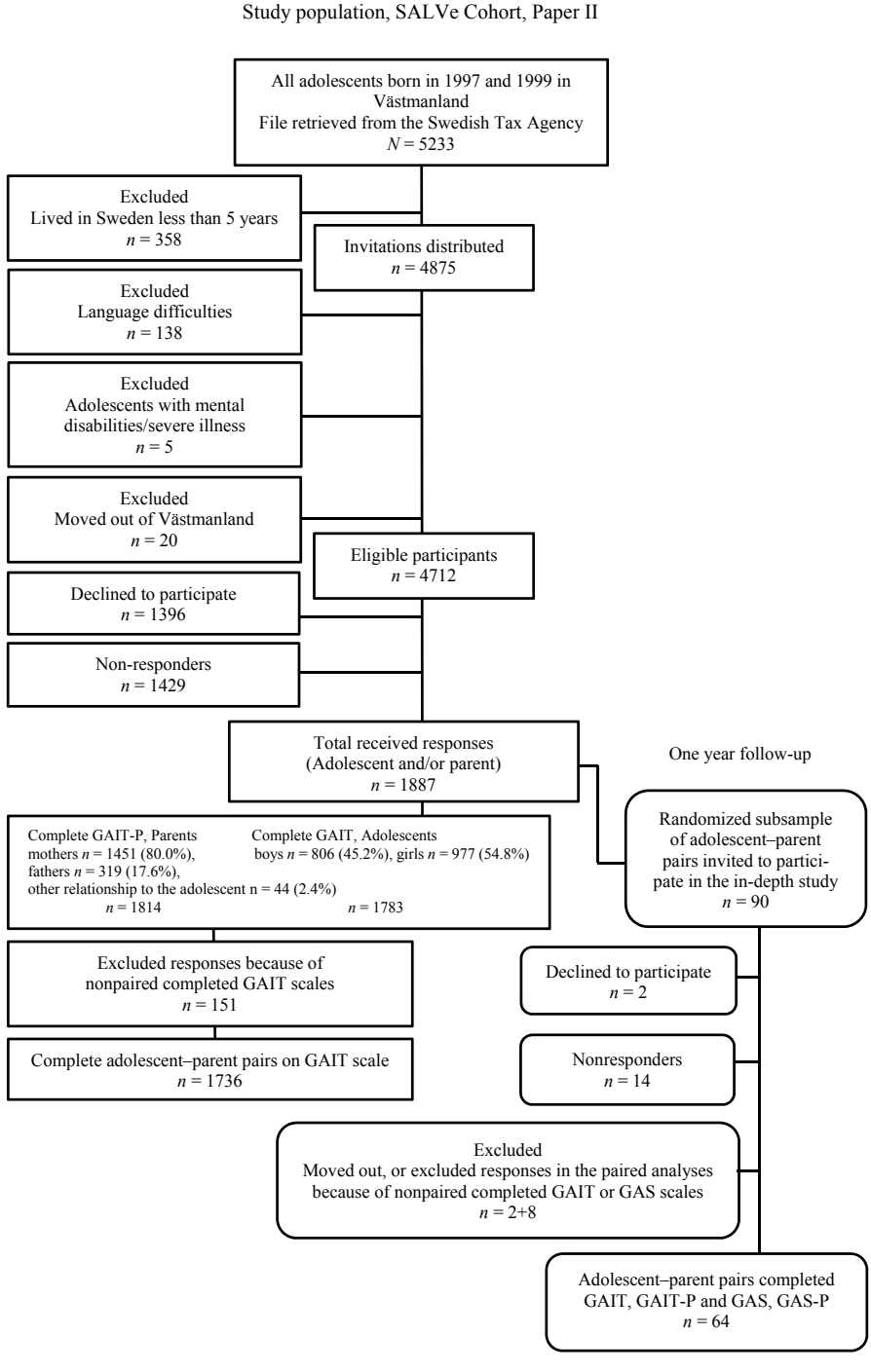

Figure 3. Flowchart of study population in Paper II.

Paper III

The study design of Paper III was cross-sectional and included two adolescent samples, both derived from Västmanland, Sweden.

The first sample was the adolescents from the SALVe Cohort as used in Paper II (Figure 4). The second sample was a consecutive sample of 242 adolescents (169 girls, 69.8%) aged 12–18 years (mean age = 15.39 years, median age = 15 years) from the child and adolescent psychiatric clinics in the county of Västmanland, Sweden (Figure 4), who answered the Electronic Psychiatric Intake Questionnaire (EPIQ). The EPIQ is a computer-assessed self-report questionnaire including psychiatric screening measures and questions regarding gaming, family situation, and school and leisure time, and is completed as a standard procedure at the psychiatric clinics in Västmanland. The total response rate was 65% in the clinical sample.

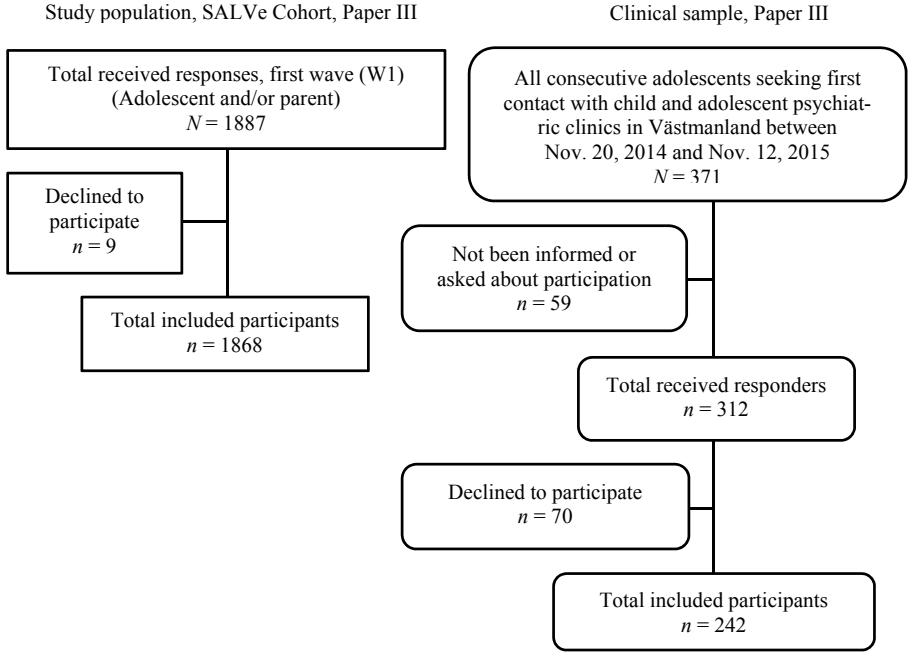

Figure 4. Flowchart of study populations included in Paper III.

Paper IV

The study design of Paper IV was longitudinal and included adolescents from the SALVe Cohort at two waves.

The study population at wave 1 (W1) was the same as in Papers II and III (Figure 5). In the second wave (W2), starting in the fall of 2015, the adolescents were contacted by regular mail and asked to answer a second self-report questionnaire similar to the one in W1 (Figure 5). The total study population at W2 consisted of 1576 adolescents (914 girls, 58%). Of those, 797 (50.6%) were born in 1997, and 314 (20%) were classified as being of non-Scandinavian ethnicity. The total response rate was 84% at W2.

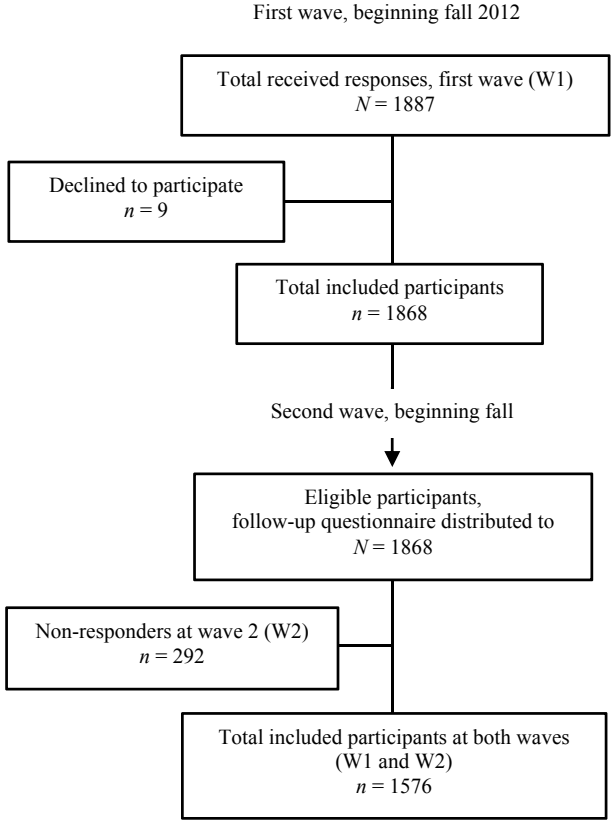

Figure 5. Flowchart of study population included in Paper IV.

Measurements

The following measurements have been used in this thesis: GAIT, GAIT-P, Gaming Addiction Scale (GAS), Gaming Addiction Scale-Parent version (GAS-P), The World Health Organization Adult ADHD Self-Rating Scale-Adolescent version (ASRS-A), Depression Self-Rating Scale, Adolescent version (DSRS-A), Spence Children's Anxiety Scale (SCAS), Psychotic like experience (PLE), Problem Gambling Severity Index (PGSI), gaming and gambling time per week, and measurements regarding school bullying and family maltreatment, as described below.

The Gaming Addiction Identification Test (GAIT) (see Appendix) is a screening instrument for identifying addictive factors within the last 12 months that are related to gaming addiction symptoms in adolescents. The development of the GAIT was based upon criteria from the DSM-5 gambling disorder published on May 1, 2012 [2], items from AUDIT [124], the six core components suggested by Griffiths [27], and the six dimensions/factors from the POGQ [114]. The GAIT consists of 15-items, has a five-point scale (ranging from 0 = *disagree* to 4 = *completely agree*), with a maximum score of 52 points; however, the first two items are not included in the scoring. In the original version, the GAIT covers seven of the nine proposed IGD criteria of the DSM-5: *preoccupation*, *withdrawal*, *tolerance*, *unsuccessful attempts to control gaming*, *loss of interests due to gaming*, *continued excessive use despite harm*, and *jeopardized or lost significant relationship or educational opportunity due to gaming.* Questions regarding escape/mood modification and lying/deception to hide the gaming are not included in the original version of the GAIT. Additional items in the GAIT (not included in the IGD criteria) are questions regarding *losing track of time*, *craving*, *chasing losses*, *insights to their own problems*, and *whether parents or other adults are worried about their gaming*.

After Paper II, revisions of the GAIT and GAIT-P were made and two additional items were included to cover all the suggested IGD-criteria: "*I lie or try to hide the amount of time that I am playing*," and "*I play in order to forget or escape problems I have in my ordinary life or to escape negative emotions*" (for the parent version, these were rephrased to start with "*My son/daughter…*" instead of "*I*"). All the previous items are retained in the new 17-item versions of the GAIT and GAIT-P, and the maximum score is 60 points. However, in this thesis, only the original versions of GAIT and GAIT-P were used (Papers I–IV). In the thesis (Paper II), a cutoff of ≥5 criteria endorsed by "completely agree" was set as an indication of gaming addiction, and a cutoff of 19 points (mean + 1SD) was used (Papers III-IV) as indication of symptoms of problematic gaming. A split-half version of the GAIT (e.g., divided by the mean) was used in the logistic regression analysis in Paper IV.

The Gaming Addiction Identification Test, parent version (GAIT-P) is the parent version of the GAIT and consists of the same questions, but is rephrased so that the questions start with "*My son/daughter…*" instead of "*I*."

The Gaming Addiction Scale (GAS) measures gaming addiction in adolescents, based upon the criteria for pathological gambling in the DSM-IV. The seven-item version is derived from the original 21-item version [111], and has a five-point scale (ranging from 1 = *never* to 5 = *very often*), with a total of 35 points. Each item is preceded by the words "*How often during the last six months…?*" The GAS contains seven of the proposed nine IGD criteria in the DSM-5, but it does not cover questions regarding loss of interest because of gaming or lying/deception.

The Gaming Addiction Scale, parent version (GAS-P) is the parent version of the seven-item version of GAS. It consists of the same questions, but is rephrased so that the questions start with "*My son/daughter…*" instead of "*I*."

Proportion of gaming time was measured with questions regarding gaming time (hours) per week and was included to measure the proportion of gaming time in the descriptive analysis.

The World Health Organization Adult ADHD Self-Rating Scale-Adolescent version (ASRS-A) is an 18-item self-rating scale on the symptoms of ADHD, with response options ranging from 0 = *never* to 4 = *very often* [125]. The ASRS-A was validated in a Swedish adolescent psychiatric population with an internal consistency of $\alpha = 0.92$ [126]. In the thesis (Paper III), the clinically significant level of ADHD symptoms was defined by a cutoff ≥9 points for the ASRS-A [126].

The Depression Self-Rating Scale-Adolescent version (DSRS-A) is a self-rating scale based on the DSM-IV criteria for major depressive disorder and consists of 22 dichotomous items, including DSM-IV A, B, C, and E criteria [127]. An additional question regarding irritability was included because irritable and/or dysphoric mood are often present in adolescent depression as one core criteria [96]. The DSRS has shown good psychometric properties among adult psychiatric patients [127], and in a Swedish study of adolescents in the general population, internal consistency of DSRS-A using the DSM-IV criteria A and C was $\alpha = 0.796$ and 0.807 in the two groups [128]. In the thesis (Paper III), indications of depressive symptoms were defined as meeting the DSM-IV A-criteria, including at least one of the general criteria and at least four other symptoms.

Spence Children's Anxiety Scale (SCAS) is a self-rating scale designed to measure anxiety symptoms in children and adolescents [129]. It consists of 44 items (six items are included as positive filler to reduce negative bias and are

not included in the scoring), with response options from 0 = *never* to 3= *always*, and a possible total of 114 points. The SCAS provides a total score as well as scores on six different subscales: panic attacks and agoraphobia, separation anxiety, physical injury fears (specific phobias), social phobia, obsessive-compulsive, and generalized anxiety. In the original study, internal consistency for the total scale was $\alpha = 0.92$ [129], and in a study of adolescent psychiatric outpatients in Västmanland, Sweden, internal consistency for the total scale was $\alpha = 0.94$ [130]. In the thesis (Paper III), we used a cutoff ≥33 points as an indication of a clinically significant level of anxiety symptoms [130].

Psychotic-Like Experience (PLE) is a scale developed for early detection of PLEs in child and adolescent populations [131]. The PLE scale consists of nine items, with the three response options of 0 = *not true*, 1 = *somewhat true*, and 2 = *certainly true*, and a possible total score of 18 points. A cutoff ≥4 points was set as "at risk of PLE," and internal consistency was $\alpha = 0.82$ [131]. We added three additional dichotomous items to the PLE to detect impairment in everyday life within the last 12 months ("*Have you been worried because of your experience?*", "*Have these experiences caused problems for you at home or in school?*", and "*Have you had these experiences within the last year?*"). A cutoff of ≥4 points, symptoms within the last 12 months, and at least one type of impairment were used as clinical indications of PLE symptoms in the thesis (Paper III).

The Problem Gambling Severity Index (PGSI) is a nine-item self-rating scale developed to measure symptoms of problem gambling [132]. It has response options of 0 = *never* to 3 = *almost always* and a total of 27 points. In the thesis (Paper IV), a cutoff of ≥3 points was set as an indication of problem gambling, as previously suggested by the Public Health Agency of Sweden [133].

Gambling activities were measured by four questions regarding frequency of gambling on 1) online casino or poker, 2) offline casino or poker, 3) offline slot machines, and 4) sports betting. All questions had seven response options ranging from never to 5–7 days a week (*0 = never*, *1 = a few times a year*, *2 = a few times a month*, *3 = 2–4 times a month*, *4 = 2–3 days a week*, *5 = 4–5 days a week*, and *6 = 6–7 days a week*) (Paper IV).

School bullying was measured by two questions regarding experiences of victimization in school in relation to peers: "*Have you been beaten, kicked or been the victim of any other violence from any of your peers at school during the last year?*" and "*Have you been seriously teased, e.g., accused of some things you have not done, been threatened, or been called names by any of your peers at school during the last year?*" Both questions had response options of "yes" or "no." An index was made and school bullying was coded

as present (= 1) if both conditions were met, or not present (= 0) if one or no criteria were met (Paper III).

Family maltreatment was measured by four questions regarding experiences of threats and violence between parents, and between parents and the adolescent: "*Have there ever been any severe, heartrending quarrels between your parents?*", "*Have either of your parents ever pushed, beaten, or used any other kind of violence against the other?*", "*Have you ever been treated badly psychologically (e.g., taunted, scorned, outraged) by either of your parents?*", and "*Have either of your parents ever pushed or beaten you, or used any other kind of violence against you?*" The response options were "*No, has not occurred*," "*Yes, less than once a year*," "*Yes, a few times a year*," "*Yes, a few times a month*," "*Yes, a couple of times a week*," and "*Yes, daily or almost daily*," for all but the third question, which had response options of "*yes*" and "*no*." A cutoff was set for each question as present, if the response was "*Yes, a few times a year*" or more. An index was made with this cutoff for all questions, and with "*yes*" for the third question, where family maltreatment was coded as present (= 1) if two experiences had occurred, and as not present (= 0) if one or no criteria were met (Paper III).

Control variables Age was coded as the age of the adolescent when completing the questionnaire in Paper III and as year of birth in Paper IV. Sex was coded as girls = 0, boys = 1 in Paper III and IV. Ethnicity was coded as 0 = Scandinavian, 1 = non-Scandinavian. Participants whose parents were both born in Sweden or Scandinavia were classified as Scandinavian, while those with at least one parent born outside Scandinavia were coded as non-Scandinavian.

Statistical analysis

The content validity index was used in Paper I and the calculations of the content validity index on item level (I-CVI) and on scale level (S-CVI-Ave) were made manually using a calculator. With a four-point scale, the raters assessed each item as 1 = *not relevant*, 2 = *somewhat relevant*, 3 = *quite relevant*, or 4 = *highly relevant*. The items were then dichotomized (1 and 2 = "not relevant" and 3 and 4 = "relevant"), before calculation, as described by Polit and Beck [134].

The I-CVI was then computed as the sum of all items of relevance (3 or 4) divided by the number of raters for each item:

$$ICVI = \Sigma \frac{\text{ratings with 3 or 4}}{\text{number of raters}}$$

The S-CVI/Ave was computed as the mean of all I-CVI [134]:

$$SCVI/Ave = \Sigma \frac{\text{ICVI}}{\text{items}}$$

Statistical significance was set at $p < 0.05$ in Papers II–IV, except interaction effects in the multivariable logistic regression analysis in Paper III, which were set at $p < 0.10$, as suggested by Fleiss [135].

Descriptive statistics, including measures such as the mean, standard deviation (SD), median, n, percentage, and Q1–Q3 were all used when describing quantitative data. Frequency of gaming time per week, frequency of gambling activities, and frequency of endorsement of GAIT and GAIT-P items were all measured with these descriptive statistical measures.

Cronbach's alpha (α) is a reliability measure of internal consistency that assesses the extent to which each item within a scale is related to the scale as a whole. In Papers II–IV, the internal consistency was used to evaluate measurements in this regard.

Corrected item–total correlation is a measure of correlation between each item and the total score from the scale. If a measurement is reliable, the items should correlate with the total scale between 0.3 and 0.8. A range outside these parameters would indicate that the item has a correlation that is too low (perhaps not measuring the same construct) or too high, which would indicate that the items are too similar to one or more other items in the scale (p. 713) [136]. Corrected item−total correlation was used in Paper II in evaluating internal consistency in GAIT and GAIT-P.

Spearman's rho (ρ) is a nonparametric reliability measure used to investigate the strength and direction of the correlation or association between two variables (e.g., measurements at scale level). Different divisions are used depending on the setting, with higher reliability required in clinical usage than in research [123]. However, some rules of thumb for interpreting the size of the correlation coefficient have been stated: 0.00–0.29 is negligible, 0.30–0.49 is low, 0.50–0.69 is considered moderate, 0.70–0.89 is high, and 0.90–1.00 is very high [137] [138]. A more commonly used interpretation has been made by Cohen [139] where 0.00–0.25 shows little/no correlation, 0.25–0.50 is fair, 0.50–0.75 is moderate to good, and above 0.75 is considered good to excellent.

Recently a new rule of thumb has been suggested by Gignac and Szodorai [140], based upon 708 meta-analytically derived correlations; where the 25th, 50th, and 75th percentiles corresponded to correlations of 0.11, 0.19, and 0.29, respectively, they recommend correlations of 0.10 as small, 0.20 as typical, and 0.30 or higher as relatively large [140]. Spearman's rho can also be performed when evaluating the criterion-related, construct (convergent), and concurrent validity between two independent measurements. In Paper II, Spearman's rho was performed when measuring the concurrent validity/concordance between the GAIT and GAIT-P, GAIT and GAS, GAIT-P and GAS-P, and also for analyses divided by sex. In Paper IV, Spearman's rho was used to analyze correlations between the GAIT at W1 and W2.

Gamma correlation (γ) is a nonparametric reliability measure used to investigate the strength and direction of association between paired and symmetrical ordinal or dichotomous nominal variables. Gamma is based on two methods of prediction, where the first method ignores the relative order of pairs on the independent variable (only untied pairs are included in the computation of gamma), whereas the second method considers the relative order of pairs. Gamma can detect curve linearity in associations and is suitable when the measurements are highly skewed. This method is especially useful when there might be bias or dependency between the measurements (e.g., measurements that are related or measurements with known sex bias) [141]. For example, if a participant scores 1 for smoking tobacco, the probability that they also have 1 for smoking hashish is much greater than if they have 0 for smoking tobacco. However, if they have 0 for smoking hashish, the probability that they also have 0 for smoking tobacco is not equal to the opposite. Like other measures of association, γ can vary between 0 and ±1. Gamma correlation was used in Paper IV when analyzing the stability of problematic gaming between the first and second waves.

Prevalence-adjusted bias-adjusted kappa (PABAK) was used in Paper II to evaluate the concordance of interrater agreement in the GAIT and GAIT-P. This type of reliability measure can be used when evaluating interrater agreement in severely skewed and zero-inflated data. PABAK takes into account that the phenomena being measured are rare, and also adjusts for chance agreement [142].

Chi-square test (χ^2) was used in Papers III–IV for analyzing differences in dichotomous variables (e.g., sex differences, and differences between groups).

Mann–Whitney* U *test was performed in Paper III for analyzing differences in the number of psychiatric symptoms between problematic and nonproblematic gamers, and in Papers II–III for analyzing sex differences.

Wilcoxon signed-rank test was used in Paper II when investigating differences between the dependent groups (i.e., the adolescents' ratings of themselves with the GAIT compared with their parents' ratings with the GAIT-P).

Fisher's exact test was performed in Paper II to compare the sex differences in the dichotomized GAIT and GAIT-P (using a monothetic approach with a cutoff of ≥5 criteria endorsed by "completely agree").

Polychoric-based exploratory factor analysis (EFA) is a construct validity measurement that is usually performed when the unidimensionality of a measurement is unknown and when no earlier investigations have been made with a measurement. When the data are ordinal, ordinary methods of analysis using Pearson-based correlations are not suitable. Polychoric correlation differs from Pearson-based correlations in its mathematical approach and is suitable for nonparametric statistics and ordinal data [143]. Weighted least squares can be used when the sample size is relatively large and when there are not too many variables in the model [143]. Oblimin rotations presume some inter-correlation between factors and are standard in evaluating almost all psychiatric measurements. Inter-correlation is when it can be assumed that the factors (items) somewhat "overlap" and measure similar, but not identical, aspects of the latent construct. In Paper II, polychoric-based EFA using weighted least squares, and oblimin rotation were conducted when investigating factor structure in the GAIT and GAIT-P along with sex differences and evaluating construct validity.

Generalized linear model (GLM) was used in Paper IV to analyze problematic gaming and frequency of gambling activities at W1, adjusted for sex, age, and ethnicity, in the prediction of problem gambling at W2.

Logistic regression was performed in Papers III and IV. In Paper III, we used a forward stepwise conditional model of multivariable logistic regression with dichotomized variables, where the GAIT was the dependent variable, and ASRS-A, DSRS-A, SCAS, and PLEs were included in the model as independent variables. We adjusted for sex, age, sample, school bullying, family maltreatment, and interactions by sex, two-way interactions between the psychiatric variables, and interactions between school bullying and family maltreatment. Univariable logistic regression analysis was used in Paper III (see online supplementary material in Paper III) when analyzing ASRS-A, DSRS-A, SCAS, sex, age, school bullying, and family maltreatment in relation to problematic gaming separately.

In Paper IV, binary logistic regression analysis was performed using problematic gaming measured by the dichotomized split-half version of the GAIT and frequency of gambling activities, and adjusted for sex, age, and

ethnicity to predict problem gambling measured by the dichotomized version of the PGSI, with ≥3 points as the cutoff.

Table 2. Statistical analyses used in the papers included in the thesis.

Statistical method	Paper I	Paper II	Paper III	Paper IV
I-CVI and S-CVI/Ave	X			
Mean, and/or median	X	X	X	X
Cronbach's alpha (α)		X	X	X
Spearman's rho (ρ)		X	X	X
Gamma correlation (γ)				X
PABAK		X		
Chi-square-test (χ^2)			X	X
Mann–Whitney *U* test		X	X	
Wilcoxon signed-rank test		X		
Fisher's exact test		X	X	
Polychoric-based exploratory factor analysis		X		
Generalized linear model				X
Logistic regression analysis			X	X

Statistical programs

The Statistical Package for Social Sciences (version 22; IBM SPSS, Armonk, NY, USA) was used to compute descriptive statistics, reliability coefficients, *t*-tests, analyses of variance, GLM (multivariable) logistic regression analysis, and correlations. The statistical program WINPEPI (version 11:44) [144] was used to compute PABAK. For the EFA, the statistical package "R" (version 3.1.2), Package "psych" [145 146] was used. An electronic calculator was used for manual calculation of the content validity indices.

Ethical considerations

In Paper I, the participants did not answer questions regarding themselves, but instead were asked to evaluate a measurement. According to Swedish regulations, this type of study does not require an approval from an ethical committee. However, it was important to ensure the participants' confidentiality; therefore, a minimum of background data was presented [147].

In Papers II–IV, the participants in the SALVe Cohort were informed in writing, as well as through links to videos on the Centre for Clinical Research's website and on YouTube, that participation was confidential and voluntary. A consent form was sent home along with the questionnaires to the adolescents and their parents. This study was conducted with ethical approval from the Ethical Board of Uppsala, Dnr 2012/187. The participants from the psychiatric outpatient clinics in Västmanland (Paper III) were informed in writing, as well as through a video included in the EPIQ, that participation was confidential and voluntary, and that declining to participate would not in any way influence their care and treatment at the clinics. Ethical approval from the Ethical Board of Uppsala, Dnr 2008/214, was received. All studies included in this thesis (Papers I–IV) were conducted in accordance with the Declaration of Helsinki [148].

Results

Paper I

Content validity of the GAIT

The measures of content validity of the GAIT in Paper I, by I-CVI and S-CVI/Ave, resulted in mean scores of 0.97 and 0.99, respectively, in all expert groups (see Table 3). In the cognitive interviews, it was stated that the items in the GAIT were considered important, clear, representative, and comprehensive. All raters agreed that the latent construct of gaming addiction was captured with the GAIT, and there were no comments regarding any missing items. The difficulty level was considered as low and the GAIT was thought to be easy to answer from the age of 12 years.

Table 3. I-CVI and S-CVI/Ave means for the expert panels ratings of GAIT.

Expert rater group	n	GAIT I-CVI[a] Mean[c]	GAIT I-CVI[a] Range	GAIT S-CVI/Ave[b] Mean[c]	GAIT S-CVI/Ave[b] Range
Professional	7	**.99** (.78)[c]	.86–1.00	**.99** (.90)[c]	.92–1.00
Adolescent	10	**.97** (.78)[c]	.90–1.00	**.97** (.90)[c]	.77–1.00
Parent	10	**.97** (.78)[c]	.90–1.00	**.97** (.90)[c]	.85–1.00

Note. [a] Item-Content Validity Index; [b] Content Validity for Scales/Average proportion of items rated as relevant across expert raters; [c] The numbers in parentheses are the recommended lowest values [134 149 150].

Paper II

Psychometric properties of the GAIT

The GAIT has shown high degrees of internal consistency in all analyses, ranging from α = 0.890 to 0.906 (Papers II–IV). In the factor analysis, all items in the GAIT and GAIT-P had high standardized factor loadings (GAIT = 0.665–0.857; GAIT-P = 0.769–0.932) (Paper II). The overall highest factor loadings were for items 5 (preoccupation), 6 (craving), and 15 (parents/others worried), and the lowest were for items 9 (chasing losses) and 3 (tolerance). Items 10 (loss of interest) and 7 (withdrawal) were in the middle range of loadings in all analyses. Of the additional items in the GAIT/

GAIT-P, items 6 (craving) and 15 (parents/others worried) were among the three highest in all analyses, whereas item 9 (chasing losses) was within the two lowest loadings in all analyses. Although the model fit was poor, both GAIT and GAIT-P were unidimensional, indicating that they measure one single latent construct.

Furthermore, high concordance was found between GAIT and GAIT-P ($\rho = 0.704$), with higher concordance between boys and parents' ratings of boys ($\rho = 0.689$), than between girls and parents' ratings of girls ($\rho = 0.460$). The agreement between the GAIT and GAIT-P was also high when using a dichotomous version of the GAIT, with a cutoff of ≥5 criteria (PABAK = 0.950).

Concordance between the GAIT and GAS was high ($\rho = 0.834$), with correlations of $\rho = 0.923$ for boys and $\rho = 0.643$ for girls when analyses were separated by sex. Likewise, the concordance was high between the parent versions of the GAIT-P and GAS-P ($\rho = 0.884$), with correlations of $\rho = 0.889$ for parents' rating of boys and $\rho = 0.664$ for their ratings of girls with sex-separated analyses.

Frequency of endorsement, prevalence of problematic gaming, and gaming addiction

The most common response alternative for all items in the GAIT and GAIT-P was "disagree" (range = 37.9–87.9%). Item 4 in the GAIT (losing track of time), and item 5 in the GAIT-P (preoccupation) had the highest proportion of "completely agree" responses. As shown in Table 4, the highest GAIT mean, SD, and Q1–Q3 were all in boys and parents' ratings of boys. There was a wider interquartile range, although the CI and α were similar in both sexes.

Table 4. Descriptive statistics of the GAIT and GAIT-P, Paper II.

	N	Mean	SD	Median	Q1–Q3	α (95% CI)	Corrected item–total correlation range, low–high
GAIT	1783	6.706	8.346	3.000	.000–10.000	.906 (.899–.912)	.528 (item 11)–.746 (item 5)
GAIT boys	806	10.464	9.176	9.000	3.000–16.000	.886 (.874–.897)	.482 (item 3)–.693 (item 6)
GAIT girls	977	3.605	6.037	1.000	.000–4.000	.897 (.888–.907)	.525 (item 11)–.733 (item 8)
GAIT-P	1814	7.708	10.346	3.000	.000–12.000	.946 (.943–.950)	.619 (item 14)–.866 (item 6)
GAIT-P boys	817	13.535	11.352	11.000	3.000–21.000	.934 (.928–.941)	.581 (item 14)–.829 (item 6)
GAIT-P girls	997	2.999	6.269	.000	.000–3.000	.929 (.923–.936)	.627 (item 9)–.819 (item 6)

The mean of the total gaming time per week was approximately 16 h/w in the SALVe Cohort at W1, with 21% of the adolescents spending more than 30 h/w gaming.

Using a cutoff of five or more criteria endorsed by "completely agree" (monothetic approach) in the GAIT, 23 of the 1783 adolescents, all boys, were classified as having symptoms of gaming addiction, with a prevalence rate of 1.3% in this population. With the GAIT-P, parents rated 45 of the 1814 adolescents as gaming addicted, with a prevalence of 2.4%; of those 45 adolescents, four (8.9%) were girls.

There were more similarities in factor loadings and sequences between boys and parents, although girls had overall higher factor loadings than boys did.

Boys self-rated spending more time gaming than girls, both in the SALVe Cohort (both waves) and in the clinical sample (Papers II–IV). In the SALVe Cohort at W1, 10% of the boys spent more than 60 hours a week gaming compared with 10% of the girls who only gamed for 16 hours a week, and only 0.2% of the girls played for more than 60h/w (Paper II). The mean gaming time per week for boys and girls was 29.53 hours and 4.69 hours, respectively. Of the boys that self-rated gaming addiction symptoms (monothetic approach with a cutoff of 5), 91% spent more than 30h/w gaming. The differences between boys and girls in time spent gaming at W1 are presented in Figure 6.

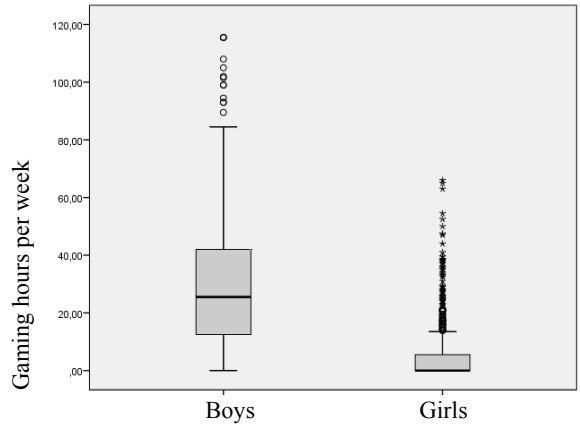

Figure 6. Sex differences in amount of self-rated gaming time per week.

Paper III

Problematic gaming

When using a wider cutoff for problematic gaming symptoms (mean +1.5 SD of GAIT) (Papers III and IV), problematic gaming was 9.8% among adolescents in the SALVe Cohort (17.3% for boys and 3.7% for girls) and 11% (25% boys, 4.9% girls) in the clinical sample (Paper III). In the SALVe Cohort, almost one in ten had problematic gaming, with a sex ratio of 4.6:1 for boys, and in the clinical sample, more than one in ten had problematic gaming, with a sex ratio of more than 5:1 for boys.

Comorbidity

Problematic gaming was approximately four times more common among boys than among girls at both waves in the SALVe Cohort and five times more common in boys than in girls in the clinical sample. In the SALVe Cohort, more than one in ten reported symptoms of ADHD, depression, and anxiety above cutoff, and approximately 7% reported PLE symptoms. Among those with concurrent problematic gaming symptoms, 21% were girls, while among those with ADHD symptoms, 59% were girls. Of those with symptoms of depression, anxiety, and PLE above the cutoff, 75%, 79%, and 70% were girls, respectively. In the clinical sample, more than half the adolescents reported ADHD symptoms and approximately six in 10 reported depression and anxiety symptoms. PLE symptoms were reported by more than 20%. Of those with problematic gaming symptoms, 31% were girls, whereas among those with ADHD symptoms, over 82% were girls. In the depression symptom group, 79% were girls; in the anxiety symptom group and among those with PLE symptoms, 83% were girls. Girls in the SALVe Cohort reported higher overall rates of psychiatric symptoms than boys did, although the difference in ADHD symptoms was not significant. Girls had higher rates of experiences of bullying at school; in family maltreatment, however, there were almost equal rates for boys and girls in the SALVe Cohort. Girls self-rated higher in all psychiatric domains by a ratio of approximately 2:1.

There were similar occurrences in problematic gaming in the SALVe Cohort and the clinical sample, and sex ratios were also similar. However, the clinical sample had overall higher rates of psychiatric symptoms, reported more experiences of school bullying and family maltreatment, and included a larger proportion of girls (clinical sample, $n = 169$, 69.8%; SALVe, $n = 1034$, 55.4%) and had a broader age range than the SALVe Cohort.

Furthermore, in the clinical sample, there were no differences in the number of psychiatric symptoms between problematic and nonproblematic gamers, in contrast to the community sample, where problematic gamers had more

psychiatric symptoms than nonproblematic gamers did (Z = -5.551, $P = < 0.001$). The differences between number of psychiatric symptoms above cutoff among problematic gamers in SALVe Cohort and the clinical sample are displayed in Figure 7.

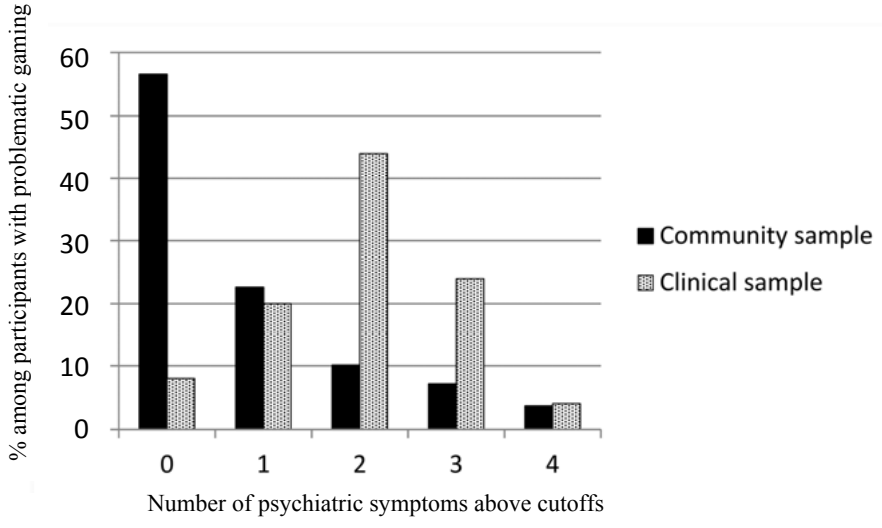

Figure 7. Number of psychiatric symptoms above cutoff, among problematic gamers.

Boys had an eight times increased probability for problematic gaming compared with girls (Table 5). Having ADHD, depression, or anxiety symptoms roughly doubled the probability of having coexisting problematic gaming symptoms. There was no significant effect of sample, which suggests that there was no difference in the probability of problematic gaming due to belonging to the SALVe Cohort or the clinical sample. Interaction between symptoms of ADHD and depression (the only significant interaction in the model), showed a decreased probability of problematic gaming, and when plotted, it was found that those with ADHD symptoms and additional depressive symptoms had a lower degree of problematic gaming than those with ADHD symptoms without depressive symptoms (figure not shown). The final model explained approximately 21% of the variation in problematic gaming (Paper III).

Table 5. Multivariable logistic regression analysis, including the two samples, investigating ASRS-A, DSRS-A, SCAS, sex, age, school bullying, family maltreatment, and interactions with ASRS-A and DSRS-A in relation to problematic gaming.

	df	OR	95% CI for OR	*P*
Male sex	1	8.683	5.780–13.045	< .001
Age, increasing	1	.850	.736–.982	.027
School bullying	1	1.472	1.005–2.158	.047
Family maltreatment	1	2.516	1.766–3.583	< .001
Clinical sample	1	.695	.392–1.234	.214
ASRS-A	1	2.431	1.440–4.105	< .001
DSRS-A	1	2.473	1.439–4.250	< .001
SCAS	1	2.059	1.273–3.329	.003
ASRS-A by DSRS-A	1	.316	.137–.729	.007
Nagelkerke R^2			.214	

Paper IV

Stability of problematic gaming

The stability of self-rated problematic gaming was analyzed with Spearman's rho (ρ) for the GAIT scale, $\rho = 0.555$ ($P \leq 0.001$), and with Gamma correlation (γ) for problematic gaming using cutoff +1.5 SD, $\gamma = 0.818$ ($P \leq 0.001$) (Table 6). A majority (95.3%) of the nonproblematic gamers at W1, reported no problematic gaming at W2, and 4.7% reported problematic gaming at W2. Of the problematic gamers at W1, 66.9% had no problematic gaming at W2, and 33.1% were still problematic gamers. Of the problematic gamers at W2, 41.3% also had problematic gaming at W1 (not shown in the table).

Table 6. Stability of problematic gaming, at baseline (W1) and three years later (W2).

	No problematic gaming W2, n (%)	**Problematic gaming W2, n (%)**	**Total, n (%)**
No problematic gaming W1	1292 (95.3)	64 (4.7)	1356 (100)
Problematic gaming W1	91 (66.9)	45 (33.1)	136 (100)
	1383 (92.7)	109 (7.3)	1492 (100)

Gamma correlation $\gamma = 0.818$, $P \leq 0.001$

Frequency of gambling activities and prevalence of problem gambling

The overall frequency of gambling activities within the last 12 months was low in the SALVe Cohort at baseline (W1), where most adolescent had never gambled online or offline. Three years later (W2) the overall frequency was still low. Of all adolescents at W1, 96.3% had never played online casino/poker or offline casino/poker compared with 93.7% and 86.5% respectively at W2, 89.5% had never played offline slot machines compared with 85.2% at W2, and 77.2% had never participated in sports betting compared with 88.3% at W2 (not shown in table). Boys had higher rates than girls did in online and offline casino or poker and offline slot machines. The analysis for sex differences in frequency of sports betting presented nonsignificant results (not shown in table).

The self-rated prevalence of problem gambling measured by PGSI using ≥3 points as the cutoff at W2, was 6.6% ($n = 26$), although most of the adolescents had no problem gambling (93.4%, $n = 369$). Boys had higher rates of problem gambling (10.1%, $n = 23$) than girls did (1.8%, $n = 3$).

Association between problematic gaming and later problem gambling

In the second wave (W2) of the SALVe Cohort in 2015, 7.4% (14.1 boys, 2.4 girls) were considered to have problematic gaming. Problematic gaming at baseline (W1) and male sex were the only significant variables in the GLM for predicting problem gambling three years later (W2), and the model explained approximately 21% of the variation in problem gambling (Table 7). The explained variance for problematic gaming alone was $\eta^2 = 25.5\%$ of the 21% explained variance in the total model.

Table 7. Generalized linear model (GLM) and multivariable logistic regression of frequency of gambling activities and problematic gaming at W1 as predictor of problem gambling at W2.

	GLM			Logistic regression	
	F	***P***	**η^2**	**OR (95% CI)**	***P***
GAIT[a, b]	3.357	< .001	.255	5.078 (1.388–18.575)	.014
Male sex	5.081	.025	.015	3.083 (.850–11.179)	.087
Age (increasing)	2.492	.115	.007	.452 (.168–1.219)	.117
Non-Scandinavian ethnicity	3.015	.083	.009	2.621 (.961–7.150)	.060
Online poker, or casino, W1	2.085	.150	.006	1.140 (.133–9.787)	.905
Offline poker, or casino, W1	.085	.771	.000	.626 (.146–2.694)	.530
Offline slot machines, W1	.059	.809	.000	2.155 (.698–6.655)	.182
Sports betting, W1	.965	.327	.003	1.159 (.595–2.258)	.664
	Adj. R^2 = .206			Nagelkerke R^2 = .171	

[a] GAIT scale in GLM; [b] GAIT split-half in logistic regression.

Furthermore, in the logistic regression analysis a split-half version of the GAIT (e.g., divided by the mean) was used, and adolescents with problematic gaming at W1 had a five times greater probability of problem gambling at W2 (Table 7). In contrast to the GLM, only problematic gaming at W1 was significant in relation to problem gambling. In a univariate binary logistic regression, using only problematic gaming at W1 as a predictor of problem gambling at W2, the probability was increased (OR = 6.586; 95% CI 1.930–22.469; *P* = .003), giving an explained variance of 9.1% (not shown in table). Of the problem gamblers, 10.1% also had gaming problems according to the GAIT split-half division. Despite what might have been expected, no significant results for gambling activities at W1 were found. However, this might partly be explained by low occurrence and low power in the sample, which is a potential type-2 error.

Discussion

This thesis attempts to fill some of the gaps that exist and hopefully will contribute to increase the knowledge within the research field of problematic gaming and gaming addiction. The overall aims of this thesis were to develop and evaluate a screening instrument designed to detect gaming addiction symptoms in adolescents, to study associations between problematic gaming and psychiatric symptoms, investigate the stability of problematic gaming, and to examine possible associations between problematic gaming at baseline (W1) with problem gambling three years later (W2). Most adolescents and parents in the samples included in the studies within the thesis reported no problem gaming at all. This is important to bear in mind because the thesis focuses on the problematic aspects of gaming. Throughout this discussion section, "GAIT" is used to refer to both the GAIT and the GAIT-P.

GAIT

The psychometric evaluations conducted thus far indicate that the GAIT seems to capture the phenomenon of gaming addiction sufficiently within the samples used (Papers I–II). However, there is still a need for several additional evaluations with the new version of the GAIT, which includes all of the suggested IGD criteria.

The heterogeneous expert panel had adolescent and parent raters in addition to the professional raters, and an even sex representation. These are strengths because they broaden the evaluation to include the target group for the use of the GAIT in practice, and allow for more generalization in the understanding of the GAIT as a measure of gaming addiction symptoms (Paper I).

The adolescent raters' mean gaming time per week was 18.9 h/w (range = 0–8 h/day, mean = 2.7 h/day), which was higher than the SALVe Cohort mean of 16 h/w. In this regard, the adolescent raters in Paper I are quite representative, consisting of both nongamers and adolescents who gamed excessively. However, although the group of raters considered that no aspect of gaming addiction was missed in the GAIT, two of the proposed IGD criteria in the DSM-5 were not included in GAIT at that time ("lie/deception" and "mood modification"). Perhaps this could have been avoided if we had also

used adolescents identified as problematic gamers and their parents in the content validation.

A possible translational issue is that the English version of the GAIT might have a different interpretation in the five-point answer alternatives: "stämmer inte alls" has been translated into "disagree," but "strongly disagree" or "completely disagree" might have been more appropriate, although it is the Swedish version that has been evaluated.

The use of proxy informants for comparison and the even sex representation in the adolescent population in the SALVe Cohort enabled analysis of sex differences and comparisons between parents' ratings of their sons versus their daughters (Paper II). The finding that boys play more and have higher prevalence in gaming addiction and problematic gaming is consistent with previous research [111 151-153] (Papers II–IV).

The parents' different ratings of their sons versus their daughters were also not surprising (Paper II). Although the concordance was high in parents and their sons, it was just moderate for their daughters, using Cohen's rules of thumb [139]. If using the proposed rules of thumb suggested by Gignac and Szodorai [140], the concordance between parents and daughters would be considered high. Despite different rules of thumb, there was a noteworthy sex difference in the concordance of parents and their offspring. The internal consistency was similar and high in both adolescent and parent versions of the GAIT (Paper II).

There was a large similarity in endorsement in both GAIT versions, where the overall most common response on all items was "disagree." The comparison between the GAIT and GAS indicated high concurrent validity (and criterion-related and construct validity), and the GAS is a well-used measurement in gaming addiction in adolescents (Paper II). Both measurements have been developed to measure gaming addiction symptoms in adolescents; however, they only cover seven of the nine proposed IGD criteria. The additional criteria (other than the proposed IGD criteria) that are included in the GAIT could not be compared with any other measurements because they were not included elsewhere at the time. The DSM-5 states that 30 h/w or 8–10 h/day is an indication of IGD [30], and in that regard, it seems that most of those classified as gaming addicted in Paper II meet that criteria because 91% of them spent more than 30 h/w gaming. Frequency and duration are measured in the first two items in the GAIT and even though they are not included in the scoring, it may be important to evaluate these to get a sense of the intensity of gaming and the amount of time spent on gaming, in addition to functional impairment.

When the GAIT was developed in 2012, the research landscape in gaming addiction was quite different. The proposed IGD in the DSM-5 was not available and knowing what we know now, we should have included all nine IGD criteria in the GAIT, along with the additional ones such as craving. We would have included additional identified problematic gamers and nonnative Swedish-speaking individuals in the content validation process. Other aspects of gaming addiction as a latent construct might then have been addressed and the evaluation regarding language might have been slightly different. If we had completed the in-depth study using the semi-structured diagnostic interview regarding gaming addiction, an empirical clinical assessment for comparison would have given a clearer counterpart in evaluating the arbitrary cutoffs in the GAIT in Papers II–IV (even though there is currently no actual IGD diagnosis). Despite this, the GAIT was intended to screen for gaming addiction symptoms in adolescence in several different settings, and the evaluation conducted here is a starting point.

The advantage of the current GAIT 17-item version is that it includes all suggested IGD criteria along with additional possible important aspects of gaming addiction. When using different scoring and cutoffs with different included items, the GAIT can be compared with only IGD measurements, or addition analysis can be performed with the other included items. Moreover, the current Swedish wording in the GAIT has been validated by an expert panel and the received excellent CVI scores on both individual items and on the scale as a whole (Paper I).

Further psychometric evaluations of the GAIT should include the performance of test–retest reliability, investigation of predictive validity, divergent and convergent validity using other measurements compared with the GAIT, and comparisons of the GAIT with a semi-structured diagnostic interview. Investigations of motives for gaming, exploration of subtypes of gamers and different negative consequences as well as comorbidities between gaming addiction, problematic gaming, and psychiatric symptoms are also needed within different age groups and settings (i.e., clinical, targeted gamers). However, based upon the available data in the samples included in this thesis, only a certain amount of psychometric evaluation was possible. Despite this limitation, it is important to present the relevant data, and we concur with Rehbein and colleagues [154] that systematic evaluation must start somewhere.

Problematic gaming, gaming addiction, and IGD

Since the suggested criteria of IGD was published in the DSM-5 in 2013, several different measurements using the proposed IGD criteria have been developed and revealed that some of the criteria seems more suitable than others [13 17 74 76 77 155 156]. However, the criteria that appear to be relevant or

problematic differ among the studies [13 17 74]. It has been suggested that the core criteria for addiction (i.e., conflict, withdrawal, relapse, reinstatement, and behavioral salience) should be separated from more peripheral criteria (i.e., cognitive salience, tolerance, and euphoria) [5]. Similarly, criteria such as relapse, withdrawal, conflict, and problems have been proposed as core features among addicted gamers, but not enthusiastic gamers who more commonly experience symptoms such as salience, mood modification, and tolerance [155].

In three recent studies, the criterion of "escape" was found to be less suitable [13 17 74], along with "preoccupation" in two of the studies [13 74]. The same two studies found that the criteria "giving up other activities" and "tolerance" seemed to be key aspects in IGD [13 74], whereas "loss of control" was considered important in a study by Király and colleagues [13], and "withdrawal" was considered important in a study by Rehbein and colleagues [74]. The criteria "deception" was found in the study by Ko and colleagues [17] to have a low accuracy of identifying IGD, whereas the opposite was found in other studies [13 74]. In addition to this, Ko and colleagues [17] suggested "craving" as a candidate criterion and an important aspect to include regarding IGD. Craving has also been suggested as a core criterion by other studies [6 18 19], which is also consistent with the results from Paper I, where craving was considered to be an important aspect of gaming addiction by the expert panel, and in Paper II, where craving (item 6 in the GAIT) was found to have high factor loadings. Furthermore, "immersion" as a motive for gaming, and "obsessive passion" have been found to have significant predictive value for problematic gaming [157], and the authors suggests that motives to game and type of "passion" should be considered as criteria in IGD [157].

There is still no international consensus on the conceptualization of "gaming addiction," "IGD," or on the wording of the suggested IGD criteria in the DSM-5 [10]. Disagreement between researchers regarding the importance, wording, and meaning of each suggested IGD criteria is currently debated [9 10]. Griffiths and colleagues [10] have expressed concerns and skepticism towards specific wording and aspects of IGD such as "withdrawal," "tolerance," and "deception," which they thought of as being less important and clear in relation to IGD. A comment and reflection on this debate is that some of this might be avoided if the current IGD self-report measurements (and GAIT) are used as an interview base instead. Then, it would be possible to ensure that the individuals (e.g., "patients") understand the questions as they are intended and can give their own examples for the clinician to determine whether they are relevant or not. If used in this way, the specific items, wording, and contents could be evaluated in more depth, and comparison between different samples, ages, and countries would yield the empirical data required for further study.

The research community should strive to share the same definition of the latent construct of gaming addiction, and should have similar and comparable measurements, although this is not the case at this stage. Moreover, it is premature to exclude other possible contributing criteria in capturing gaming addiction, such as craving in the GAIT, as mentioned previously.

The stability of gaming addiction and IGD has been described as fairly transient by some researchers [158-160], whereas others have found it highly persistent [8 161 162]. The findings in Paper IV lie at an intermediate point compared with these studies, which indicates that problematic gaming seems fairly stable within this sample as those with problematic gaming at baseline (W1) showed an increased risk of having problematic gaming three years later (W2). However, regression towards the mean must be considered in this regard, because low/high or extreme values on any measure tend to move closer towards the mean at the second measuring point [163].

Future measuring and cutoffs

It is important to recognize that self-rating symptom measurements are not developed for diagnostic purposes and should not be viewed as such. An individual can have symptoms above a specific cutoff of a disorder and still not meet the criteria for a diagnosis because most of the time clinically significant distress and/or impairment also must be present to qualify for diagnosis [30]. Self-rated screening measures are often used to screen for possible diagnosable conditions and are easy to administer. If above the cutoff, the person can be referred to a professional who can make a clinical assessment.

Most symptoms are continuous in their manifestations and cutoffs are used to divide those "without" from those "with" a diagnosis. More or fewer individuals may be included, depending on where we choose to set the cutoff. Individuals that are near a specific cutoff point are more alike than those further apart on the continuum, indicating that an individual just above a cutoff could have more in common with an individual without a diagnosis than with an individual who has received a diagnosis with severe symptoms. Additionally, one set of symptoms might be the most relevant for one individual, whereas for another a different set of symptoms might be more related to impairment within the same disorder. Furthermore, it is important to distinguish between what applies at a group level compared with an individual level, and this relates to both somatic and psychiatric disorders.

In Paper II, we used a monothetic approach with a cutoff of five or more criteria of the total 13 scored items in the GAIT endorsed by "completely agree" for the self-rated prevalence and categorizing of gaming addiction in

adolescents. Among those 13 items, seven are comparable with the proposed IGD criterion, whereas the other items have no corresponding item in IGD. Therefore, there is a risk of overinclusion because the GAIT has more items in total. Further, there are also more possible profiles when there are additional items that can be endorsed, although this might not be problematic.

In Papers III and IV, we used an even wider categorizing to set a cutoff for problematic gaming using the mean +1.5 SD. The reason for this categorization was to evaluate subclinical problems for early detection in the general population (SALVe Cohort) and to compare the two samples regarding problematic gaming and its associations with psychiatric symptoms in a clinical setting. This method can be debated; however, since our intention was not to imply or determine a true cutoff, it could be considered an appropriate method in that particular regard. The use of SD or percentiles always means a certain proportion of the sample will be above the specific cutoff employed, and furthermore assumes that a certain percentage of participants have the phenomena being studied.

Despite the arbitrary cutoffs of GAIT used in Paper III, we found a similar prevalence of "problematic gamers" in both samples, which indicated that similar rates of self-reported answers were found regardless of the accuracy of the cutoff we used. To determine whether the cutoff of the GAIT is relevant and whether the answers indicate the phenomena, a clinical assessment and a gold standard approach must be performed for comparison.

As a comparison to the monothetic approach used in Paper II, major depressive disorder in DSM-5 [30] have nine criteria, of which at least one of the two core criteria and four of the other criteria must be met. Depending on which criteria an individual meets, depression manifests itself differently within the same diagnosis. For example, one person might have the core criteria of irritability along with significant weight gain, insomnia, psychomotor agitation, indecisiveness, and recurrent suicidal ideation, whereas another person might have the core criteria of depressed mood along with hypersomnia, psychomotor retardation, fatigue, and diminished ability to concentrate. The same might be true in gaming addiction where different individuals could have different profiles or manifestations of the same disorder—one person might have symptoms of preoccupation, withdrawal, tolerance, loss of control, and craving, and another person might have symptoms of withdrawal, loss of interest, mood modification, lie/deception, and jeopardized or lost significant relationship. Because IGD is still not included in the DSM-5 as an actual diagnosis, and as the research field of problematic gaming, gaming addiction, and IGD is nascent, there is much more to explore about the phenomenon of gaming addiction and IGD before excluding other possibly relevant criteria. Age and sex biases may have led to the currently proposed IGD criteria because most research has been done in

males, adolescents, and younger adults [151 152], and self-referred participants from online gaming sites [1] who might not be representative. Possible different subtypes of gamers (based on their different motives) might also be important to incorporate, along with the use of proxy informants by parents, teachers, and spouses, additional research in gaming behavior, neurobiological differences in substance use and behaviors, neuroimaging, and treatment studies, which will provide an important addition to the present knowledge of the latent construct gaming addiction. These subtypes might relate to neurobiological differences that make some individuals use substances or behaviors to "slow down the system," relax and reduce negative emotions such as anxiety or depression, while others have the opposite need and use substances or behaviors to "get the system started," to experience excitement and reduce feelings of boredom. Both approaches are used to achieve a mood modification (i.e., a subjective shift).

One possible way to manage the problem with arbitrary cutoffs could be to use a "gated" diagnostic approach that differentiates between the symptoms/diagnostic criteria in a hierarchical way instead of using all criteria with equal weight [20]. However, a problem with this approach is that, at this point, there are no certain core criteria or established "gates" in gaming addiction, although there have been different proposals of core criteria [5 155]. Instead of having different types of "addiction disorders" such as SUD, AUD, and gambling disorder, the syndrome model of addiction [20] suggests that these could be classified as one disorder with "core features" of addiction independent of the different objects (substances or behaviors) of addiction [25]. That would shift the focus toward patients' needs instead of focusing upon the specific (or multiple) sources of addiction objects [25].

Additionally, a new framework for organizing research, which goes beyond symptom-based diagnostics, is the research domain criteria (RDoC) [164 165]. In RDoC, the research focus is upon different levels of information that, taken together, are thought to represent different constructs that go beyond current diagnoses, both somatic and psychiatric, to better understand the basic dimensions of functioning that underlie the whole range of human behavior, from normal to abnormal [165]. RDoC research might revolutionize our ability to understand mechanisms in human behavior, and in somatic and psychiatric disorders [164]; however, it may be decades before the RDoC results can be used in clinical practice. Meanwhile, another more pragmatic way to deal with the GAIT and the additional items (and all other self-rating measurements), is to acknowledge that there might be overinclusion, and to view the outcome as a screening result, rather than interpreting it as a diagnosis.

Thus far, the conclusion regarding GAIT is to retain all items. Now that the two previously omitted items, "lie/deception" and "mood modification," have been included, the new version of the GAIT covers all nine proposed IGD

criteria along with the additional ones from the original version. It is still possible to reevaluate the additional items, such as craving, in further evaluations, in different samples, within different settings, and in comparison with clinical assessments or semi-structured diagnostic interviews. As discussed previously, it is important that researchers continue to investigate the suggested IGD criteria along with other possible candidates. As there is no gold standard for problematic gaming, gaming addiction, or IGD, arbitrary cutoffs are used [13 17 74] and we cannot rely solely upon self-rating scales. Instead, semi-structured diagnostic interviews might be used for comparison. In light of new research findings and new knowledge, and with a critical approach, the continuing reevaluation of essential criteria in gaming addiction and IGD is crucial and an ongoing process.

Addiction models in relation to gaming addiction and IGD

Theoretical models must be empirically evaluated for validation and to be adjusted, modified, or rejected partly or completely. The RDoC approach can be one way to test these models. The models described in this thesis are based upon empirical findings and decades of clinical descriptions. Some attempts have been made to try to verify the models [25 166-169]. Support has been found for the general theory of addictions [166 167] even though no direction of associations could be made because of its cross-sectional design. The pathways model of problem and pathological gambling [22] has also gained research support; however, similar to the general theory of addictions [21], no direction of association could be determined because of the cross-sectional designs of the studies and the inclusion of problem gamblers at baseline [168 169]. The syndrome model of addiction [20] is based upon clinical findings in neurobiological systems, genetic overlap, shared psychosocial antecedents, and shared manifestations and sequelae. Research has repeatedly found similarities between SUDs and behavioral addictions [5 6 14 18 19 24 51 79].

Regarding problematic gaming, gaming addiction, and IGD there is still much to explore. Several researchers have reported negative consequences, including symptoms of anxiety and depression, lower scores of life satisfaction, sleep disturbances, musculoskeletal problems, poor personal hygiene, and impaired school performance [5 24 161 170-172]. If speculating, “loss of time” might be one unique manifestation giving negative consequences in everyday life. Nevertheless, in SUDs, there might also be much “time” spent on getting money for drugs, with negative consequences. As for gambling disorder, adverse negative consequences such as debts could arise in a short time, but the individual may still be able to attend school or work, and would not necessarily lose a lot of time. Perhaps there are no truly unique

manifestations and sequelae in gaming addiction, and the gaming activity, like other behaviors, might just share the common core manifestations and sequelae? This is an important aspect to explore further.

Comorbidity and sex differences

The existence of comorbidity between gaming addiction, IGD, and other psychiatric symptoms or disorders has been described consistently. Most researchers in the field highlight the importance of investigating possible comorbid conditions among individuals with problematic gaming, gaming addiction, and IGD [4 5 19 85 86 170 172-176]. However, the questions regarding the associations and direction of the coexistence of disorders are not clear, and the importance of conducting longitudinal prospective studies is often described [4 5 15 73 161 177-179].

Problematic gaming was approximately four times more common among boys than girls at both waves in the SALVe Cohort, and five times more common in boys than girls in the clinical sample (Paper III). Furthermore, boys had eight times the probability of having self-rated problematic gaming than girls (Table 5) (Paper III). However, girls had higher overall self-rated symptoms of ADHD, depression, anxiety, and PLE in both the SALVe Cohort and the clinical sample, although the ratings of ADHD in the SALVe Cohort were not significantly higher (Paper III).

Similarly to the results in other studies [3 4 6 180], girls consistently self-rated higher in psychiatric symptoms whereas boys rated higher on gaming, problematic gaming, gaming addiction, and problem gambling (Papers III–IV). The finding in Paper II that parents rate their sons and daughters differently, with the concordance between parents and daughters lower than between parents and sons, is important when using parents as proxy informants. Since parents rated their daughters lower than the girls themselves did, it could be that the girls have more problematic gaming or gaming addiction symptoms that might be overlooked if their self-ratings were not used. One possible reason for the difference in concordance might be that the parents assume that boys play more than girls and have more problems related to gaming, and do not perceive girls to play in the same way as boys. Another possibility is a sex bias in the self-rating where girls might be more prone to report symptoms than boys might. Discrepancies between parents or proxy informants and children and adolescents are common, especially with regard to internalizing symptoms [181].

More research is needed to explore the different subtypes of gamers and differences in motives further [4 24 157 174 182-185]. Although associations between problematic gaming, gaming addiction, and IGD, and negative consequences

and coexisting psychiatric symptoms have been found, association is not the same as causality [3-5 15 73 161 170 177-180 186]. For some individuals, gaming could be an adequate coping strategy for managing a stressful situation in life or just a fun recreational activity; however, the same overt behavior in others could be a maladaptive coping or escape strategy. Clinically, a functional behavioral analysis should be conducted to understand the individual motives and thereafter treatment strategies can be introduced.

To our knowledge, disability and costs related to problematic gaming, gaming addiction, and IGD have never been addressed or described. Social costs include the loss of income for adults, and extra assigned resources for trying to get students "sitting at home gaming" back to school, and individual costs include those due to lack of salary, or retracted student grants in Sweden (for those who graduated ninth grade). It is impossible to calculate the costs (both direct and indirect), because there is currently no information about the number of individuals affected in Sweden (or elsewhere). If the negative economic impacts on the society were actually present, politicians and clinicians might be motivated to study the phenomena of problematic gaming, gaming addiction, and IGD further. As we know that there is high comorbidity, many individuals are probably already known by the society, and already in treatment for other symptoms or disorders. This area also needs further exploration.

Gaming and associations with gambling

Thus far, studies regarding associations between problematic gaming and problem gambling have given ambiguous results [187-191]. In Paper IV, an association was found between previous problematic gaming and problem gambling three years later in the GLM analysis with an explained variance of approximately 21%, and problematic gaming alone explained approximately 26% of the variation in the total model, which indicated that problematic gaming appears to be a large contributor to later problem gambling. However, problem gambling in this sample was rare. Studying rare phenomena is difficult because the number of possible statistical analyses decreases with the unevenly distributed (e.g., zero-inflated) samples available. The severely skewed distribution limited the possible statistical analysis; hence, the wide cutoff in the logistic regression analysis with the split-half version of the GAIT (e.g., divided by the mean). Despite this and similar to the results in the GLM analysis, problematic gaming was found to be a predictor and its presence presented an increased probability of later problem gambling.

The risk of type II error is high when there are low occurrences in a sample, and this could indicate that the results of associations between problematic gaming and later problem gambling found in Paper IV might have been even

stronger if older individuals or more adolescents in total had been included. Even though further studies are needed to investigate the associations found in larger samples, among different age groups and between sexes, as well as in different countries, it is still important to be aware that adolescents with problematic gaming might have, or are at risk of developing, problem gambling.

Current measures of gaming addiction and IGD

In recent years, measures developed for gaming addiction have rapidly progressed. There are several new measures based on the proposed IGD criteria in the DSM-5, and additional measures and evaluations will likely continue to emerge. Several measures [74 76 77 155 156] have adopted the timeframe of symptoms within the last 12 months, and include all nine suggested criteria for IGD [30]. None of the measures have included additional criteria or aspects.

In 2014, Pontes and colleagues [155] developed the IGD-20 Test and evaluated the scale in a population of 1003 gamers (85.2% males, mean age = 26) recruited via online gaming forums. The scale has three items for IGD criteria 1, 2, 3, 4, and 8, and five items for the other IGD criteria. It has a five-point scale with response options ranging from 1 = *Strongly disagree* to 5 = *Strongly agree*. An empirical cutoff was made through a latent profile analysis, which indicated that 71 points seemed to be adequate, and the authors concluded that the measure is a psychometrically robust instrument for assessing IGD [155].

In 2015, a short version of the IGD-20 Test was developed, the IGDS9-SF [77], and this scale was evaluated in a population of 1060 online gamers (85.1% males, mean age = 27 years) recruited through online gaming forums. The IGDS9-SF consists of nine items with response options ranging from 1 = *Never* to 5 = *Very often.* Scores range from 9 to 45 points with a cutoff of 36 points suggested for the classification of disordered gamers. After psychometric evaluations, the authors concluded that the IGDS9-SF is a valid and reliable measurement [77].

Similarly, the IGDT-10 measurement was developed [156] using a sample of 4887 online gamers (92.5% males, mean age = 22.2 years) recruited through Facebook and a gaming-related website. The measurement consists of ten items, one for each IGD criteria except for criterion 9, which has two items (item 9 and 10 are combined in the scoring). The response options range from "Never" to "Often," although "Often" was coded as 1 = *yes* in the study to set the cutoff of 5 or more criteria, as suggested in the DSM-5 [30]. The authors concluded that the IGDT-10 is a valid and reliable measurement for IGD and that the suggested cutoff of five criteria appears to be sound. Furthermore, the

criteria "preoccupation" and "escape" were suggested to be replaced or excluded from IGD since they seemed to be less relevant [156].

Lemmens and colleagues [76] developed the Internet Gaming Disorder Scale and used a representative sample of 2444 adolescents and adults (approximately 50% males, mean age approximately 24 years) in the evaluation. This scale is available in a polytomous 27-item version with six response options ranging from 0 = *Never* to 5 = *Every day or almost every day*, and also has a dichotomous 9-item version with a cutoff of five or more criteria as suggested in the DSM-5 [30]. Both versions of the measure are considered to be reliable and valid by the authors [76].

Rehbein and colleagues [74] adapted the Video Game Dependency Scale to include all IGD criteria, and used a school-based sample of 11,003 adolescents (51.1% males, mean age = 14.9 years). The measure consists of 18 items, two for each IGD criteria, with response options on a four-point scale ranging from 1 = *Strongly disagree* to 4 = *Strongly agree*. A cutoff of five or more criteria, as suggested in the DSM-5 [30], was set where one of the two items for each criterion had been endorsed by "Strongly agree." The authors suggest that further psychometric evaluations should be performed with the measure, in other age groups, populations, and cultures and that the study provides an initial attempt to evaluate the IGD criteria. The authors also suggest that further investigations regarding unique aspects of IGD in relation to other behavioral addictions and SUDs should be performed [74].

The IGD-20 Test, the IGDS9-SF, and the IGDT-10 were all developed and evaluated based upon predominately male gamers in contrast to the Internet Gaming Disorder Scale and the IGD-adapted Video Game Dependency Scale, which had an equal distribution of males and females, and used general populations and school-based samples. The study population in the evaluation of the IGD-adapted Video Game Dependency Scale had a lower mean age than the other four studies and is the only study to use only adolescents. The studies also differ in assessment of cutoff and classification of gaming addiction.

Whether using an empirically estimated cutoff in a specific sample, or using a cutoff as suggested in the DSM-5, without an external clinical assessment it is difficult to be certain if the measure is relevant for classifying the phenomena. Likewise, when other measures are used to evaluate criterion-related validity, it is unclear whether they will be relevant to IGD. The symptoms may be more related to co-occurring depression, which could be, but may not be exclusively related to the IGD. This approach of using other measures for evaluating criterion-related validity needs to be investigated further in several different samples, age groups, cultures, and with both sexes.

In addition to self-reports, proxy information from parents or spouses might be useful in some cases, and adding a semi-structured diagnostic interview for gaming addiction would probably be even more informative. However, all these approaches still have to be evaluated and replicated because no gold standard comparison exists.

Methodological considerations

There are several limitations in the thesis that need to be addressed, along with some strengths. First and foremost, throughout this thesis "problematic gaming," "gaming addition," and "problem gambling" have been used to categorize the adolescents in the SALVe Cohort and the clinical sample of adolescents derived from the child and psychiatric clinics in Västmanland (Papers II–IV). However, because self-rating scales and not clinical assessments were used, we cannot know if those adolescents are accurately classified. This is important to bear in mind, although we chose not to write "self-rated symptoms of" before each instance of "problematic gaming," "gaming addition," and "problem gambling," to facilitate the flow of the thesis.

Moreover, self- and proxy-reports include some well-known possible biases, such as social desirability, recall bias, and the difficulties of proxy informants reporting on the internalization symptoms of others, which need to be acknowledged [123]. Self-selection bias might also be relevant. Even though the invitations to participate were sent to all adolescents born in 1997 and 1999 and their parents (in contrast to school-based studies), we do not know if the participants are representative of all adolescents born in those years in Västmanland because the response rate was 40% within the SALVe Cohort (W1). It is plausible that those who chose to participate might be more resourceful than those who chose not to participate because of the amount of work it took to answer the survey questionnaires (which took approximately 45 minutes) and for the adolescents to submit a saliva sample and send back all material to the research clinic. Yet, this is still unknown, which makes the results less generalizable even within the age range. The generalization problem also applies to the clinical sample.

An additional limitation was the low occurrence of the studied phenomena, resulting in highly skewed data, which limited the number of possible statistical analyses. Specifically, in Paper II, we used a polychoric-based EFA, and even though we performed a number of sensitivity analyses (removed items, tried different types of estimations, such as maximum likelihood and weighted least squares, evaluated the preceding correlation matrix, and also tried with different fixed factors), we still could not find the cause of the poor model fit. The poor fit might just be due to the severe zero inflation. The

rationale for performing an EFA was that no previous evaluation had been made and we had a theoretical hypothesis that the GAIT was unidimensional. In hindsight, performing confirmatory factor analysis (CFA) might have been more appropriate, or dividing the sample into two subgroups; however, the evaluation of the GAIT will continue with the use of different samples and additional CFA.

Furthermore, longitudinal studies are important in exploring developments and trajectories of phenomenon, especially among children and adolescents. However, measuring rapidly changeable phenomena can be difficult because they could appear and disappear between measuring points, which is the case even among adults. Furthermore, it is difficult to distinguish between self-reported symptoms that might be problematic and symptoms that are temporary or rapidly transient.

This thesis also has some strengths that deserve to be acknowledged. First, the topic is highly relevant and important and not many studies have been performed in Swedish settings. A screening measure with a proxy version that has been evaluated by professional raters and additional adolescent and parent raters for content validity (Paper I) was developed. Additional psychometric evaluations of the measure within the SALVe Cohort were performed, which indicate that the measure is sufficient for continued use and evaluation (Paper II).

The SALVe Cohort was derived from the general population, and not performed within the school systems, which makes it possible for those not attending school to participate. This thesis included the first attempt to estimate the prevalence of gaming addiction in the general adolescent population using self-ratings of problematic gaming among adolescents in the general population and in a clinical sample (Papers II–III). In Paper III, we used the same measurement in both samples for comparison and both groups self-rated symptoms that we could compare. Although there were slightly more girls, the samples had a sufficiently even sex distribution.

Conclusions

The vast majority of individuals that regularly use digital games have no problems related to the activity and cannot be categorized as either problematic or addicted gamers. This thesis has focused upon the problematic side of gaming. Even though the prevalence of problems related to gaming is low, it seems that for a minority, there are serious problems. For those, we need to continue to evaluate adequate screening and diagnostic measures, and develop and evaluate treatments for problematic gaming and gaming addiction as well as for comorbid conditions.

An increasing number of studies acknowledge gaming addiction as a behavioral addiction. It appears to be possible to measure gaming addictive symptoms in adolescents and adults. Although no fully accepted definition of the phenomenon yet exists or there is no consensus on the methods best suited for measuring this phenomenon in the scientific community, it is still important to continue this research to advance our knowledge.

One important conclusion that can be drawn from this thesis is that there appears to be a high prevalence of co-occurring symptoms among those with problematic gaming and gaming addiction, including psychiatric symptoms such as ADHD, depression, or anxiety. Problematic gaming might also be an indicator for later development of problem gambling. Therefore, it is important to screen for possible co-occurring symptoms among those who seek treatment and among those who appear to have symptoms of gaming, gambling, or psychiatric symptoms. Treating only one condition when there is comorbidity rarely gives good results. The same overt behavior (gaming or gambling activities) could be an adequate coping strategy for some individuals and a maladaptive coping or escape strategy for others. Therefore, a clinically assessed functional behavioral analysis should be conducted (after the differential screening/diagnosis) to understand the individual motives. Treatment strategies can then be introduced for the problem or problems identified for the specific individual.

Svensk sammanfattning (Summary in Swedish)

Det övergripande syftet med avhandlingen har varit att utveckla och utvärdera mätinstrument för att identifiera ungdomar med symtom på problematiskt dataspelande och dataspelberoende, att undersöka om det finns en samsjuklighet med andra psykiatriska tillstånd, undersöka om problem med dataspelande är ett ihållande eller övergående problem, samt undersöka om det kan finnas kopplingar mellan ett problematiskt dataspelande och att senare utveckla problem med spel om pengar.

År 2012 fanns det inte något screeninginstrument för att mäta symtom på dataspelberoende för ungdomar på svenska och inte heller någon föräldraversion. Mot bakgrund av detta utvecklade vi i **studie I** ”Gaming Addiction Identification Test (GAIT)” samt en motsvarande föräldraversion baserat på dåvarande forskning kring beroende, spel om pengar och dataspel samt teoretiska modeller för beroendeutveckling. Ambitionen var att inkludera alla relevanta aspekter av fenomenet ”dataspelberoende”.

En expertpanel bestående av 7 professionella-, 10 ungdoms- och 10 föräldraskattare bedömde skalans innehållsvaliditet (content validity) genom att bedöma varje frågas relevans, tydlighet, enkelhet, representativitet, omfattning, och innebörd samt om någon viktig aspekt saknades i skalan i dess helhet. Beräkning av innehållsvaliditeten gjordes dels för varje enskild fråga (I-CVI) och dels för skalan i dess helhet (S-CVI-Ave).

Resultaten visade att samtliga bedömargrupper i panelen ansåg att GAIT fångade in fenomenet dataspelberoende, att den var lämpligt från 12-13 år, var lätt att förstå och lagom lång. Både de enskilda frågorna och skalan sammantaget hade mycket bra värden, med medelvärde för I-CVI på 0.97 och S-CVI/Ave på 0.99 jämfört med de lägsta rekommenderade värdena på 0.78 respektive 0.90. Det framkom inte några skillnader i bedömningarna beroende på grupp eller kön. GAIT bedömdes sammanfattningsvis ha en god innehållsvaliditet av expertpanelen.

I **studie II,** som påbörjades 2012, genomfördes ytterligare psykometriska utvärderingar av GAIT och föräldraversionen GAIT-P med hjälp av deltagare i SALVe Kohort bestående av ungdomar födda 1997 och 1999 (n = 1783) boende i Västmanland samt deras föräldrar (n = 1814). Data avseende tid och

omfattning av dataspel samt GAIT/GAIT-P från deltagarna användes i analyserna. Utöver detta användes data från en fördjupningsstudie där ett stratifierat, randomiserat urval av deltagarna från SALVe Kohort ett år senare erbjöds att delta (n = 64 ungdom-föräldrapar). Dessa deltagare besvarade då databaserade frågeformulär med bl a psykiatriska symtom (depression, ångest och ADHD etc) samt GAIT respektive GAIT-P. En liknande skala för ungdomar framtagen i Tyskland ”Gaming Addiction Scale (GAS) och en föräldraversion av den (GAS-P) ingick även i dataformuläret.

De psykometriska utvärderingarna i **studie II** visade att även om GAIT och GAIT-P i faktoranalyserna hade dålig model fit så hade båda skalorna höga faktorladdningar och var unidimensionella, vilket indikerar att de mäter ett och samma underliggande latent konstrukt (”dataspelberoende”). Både GAIT och GAIT-P hade hög intern konsistens, korrelationerna mellan GAIT och GAIT-P var goda liksom den samtidiga validiteten med GAS och GAIT respektive GAS-P och GAIT-P. Den självskattade prevalensen av dataspelberoende för ungdomarna var 1.3 % (n = 23, samtliga pojkar) och 2.4 % (n = 45) när föräldrarna skattade ungdomarna (av dessa 45 var 4 flickor).

Sammantaget bedömdes GAIT och GAIT-P uppvisa lovande psykometriska egenskaper i denna population vilket motiverar till fortsatt användning och vidare utvärderingar av skalorna. Efter utvärderingen (studie II), då DSM-5s föreslagna kriterier för Internet gaming disorder (IGD) publicerades 2013, lades två frågor till i GAIT/GAIT-P, frågor som saknades utifrån de föreslagna IGD-kriterierna i DSM-5. I den nya versionen av GAIT/GAIT-P finns nu utöver de tidigare frågorna även samtliga IGD-kriterier vilket gör att GAIT och GAIT-P kan jämföras med andra skalor som är baserade på DSM-5s IGD-kriterier.

I **studie III** undersöktes associationer mellan problematiskt dataspelande och samtidiga symtom på depression, ADHD, ångest samt psykosliknande upplevelser (PLE) i SALVe Kohort (n = 1868) 2012, samt bland en population barn- och ungdomspsykiatriska patienter ifrån Västmanland (n = 242) under perioden 2014-11-20 till 2015-11-12. Självskattad problematiskt dataspelande hade en köns-ratio för pojkar jämfört med flickor på omkring 5:1 i både SALVe Kohort och i den kliniska gruppen. Däremot var det fler flickor än pojkar som rapporterade symtom på ADHD, depression, ångest och psykosliknande upplevelser. I den kliniska gruppen rapporterades genomgående fler upplevelser av mobbning i skolan och familjeproblem utöver fler psykiatriska symtom.

Association mellan självskattade symtom på ADHD, depression och ångest och självskattade symtom på problematiskt dataspelande förelåg. Bland de ungdomar med självskattad problematiskt dataspelande i SALVe Kohort fanns fler som rapporterade psykiatriska symtom över cutoff jämfört med de

utan problematiskt dataspelande, däremot hittades inte någon sådan skillnad i den kliniska gruppen. Självskattade symtoms över cutoff avseende ADHD, depression och ångest var associerade med mer än två gånger ökad sannolikhet för samtidiga symptom på problematiskt dataspelande.

I **studie IV** undersöktes stabiliteten av problematiskt dataspelande från baslinemätningen (W1) jämfört med tre år senare (W2) 2015. Associationer mellan att ha problematiskt dataspelande vid baslinjemätningen och eventuella problem med pengaspel tre år senare undersöktes också.

Få ungdomar i SALVe Kohort hade spelat om pengar (online eller offline) på kasino eller poker, på slotmaskiner eller någon form av sportspel vid första mätningen (W1). Signifikant fler pojkar än flickor hade spelat om pengar på kasino och poker, både online och offline. Fler pojkar än flickor hade även spelat om pengar på slotmaskiner och sportspel men där var skillnaderna inte statistiskt signifikanta.

Tre år senare (W2) självskattade 10 % av pojkarna problematiskt pengaspelande jämfört med ca 2 % av flickorna. Fler pojkar än flickor rapporterade problematiskt dataspelande även i W2, omkring 14 % av pojkarna jämfört med 2.4 % av flickorna. Att ha självskattade symtom på dataspelande i W1 samt att vara pojke var signifikant associerat med problem med pengaspel tre år senare. Problematiskt dataspelande var stabilt över tid och en majoritet av ungdomarna i SALVe Kohort hade inte problem med dataspelande vid någon av mätpunkterna.

Sammanfattningsvis bedömdes GAIT och föräldraversionen GAIT-P vara psykometriskt tillräckligt goda screeninginstrument för att mäta symtom på problematiskt dataspelande och dataspelberonde bland ungdomar. Problematiskt dataspelande är lika vanligt förekommande i SALVe Kohort som bland ungdomarna i den kliniska gruppen. Komorbiditet med psykiatriska symtom var högre bland de med problematiskt dataspelande i SALVe Kohort och fenomenet problematiskt dataspelanade tycks vara stabilt över tid samt vara associerat med problem med pengaspel tre år senare.

Konklusion

Förekomsten av personer som har problem med dataspelande eller som skulle kunna definieras som dataspelberoende är få i förhållande till den stora andel som spelar dataspel. Trots detta behöver vi ändå utveckla bra screeninginstrument och diagnostiska mätmetoder för att upptäcka och kunna hjälpa den minoritet av personer som de facto har reella problem med sitt dataspelande. Vi behöver också utveckla och utvärdera behandlingsmetoder för problematiskt dataspelande, dataspelberoende samt för komorbida tillstånd.

I allt fler studier har det konstateras att dataspelberoende tycks vara en form av beteendeberoende och att det är möjligt att mäta symtom på beroende när det gäller dataspel hos ungdomar och vuxna. Även om den exakta definitionen av dataspelberoende, eller vilka metoder som är bäst lämpade för att mäta detta fenomen inte har nått någon enighet i forskarsamhället, är det ändå viktigt att fortsätta forskningen för att lära oss mer.

En viktig konklusion som kan dras utifrån denna avhandling är att det tycks finnas en koppling mellan att ha symtom på problematiskt dataspelande och samtidiga andra psykiatriska symtom så som ADHD, depression eller ångest. Problematiskt dataspelande kan även vara en indikator för att senare utveckla problem i relation till att spela om pengar. Att behandla endast ett tillstånd när det finns komorbiditet ger sällan bra resultat. Det är därför viktigt att undersöka förekomst av samtidiga symtom bland de personer som söker stöd eller behandling samt bland de som tycks ha symtom på antingen problematiskt dataspelande, problem med pengaspel eller andra psykiatriska symtom.

Samma beteende (att spela dataspel eller spela om pengar) kan för en person vara en adekvat copingstrategi samtidigt som det för en annan skulle kunna vara en maladaptiv copingstrategi eller sätt att fly. Därför behövs, utöver en differentialdiagnostisk bedömning, även en funktionell beteendeanalys för att förstå de individuella motiven för att kunna sätta in adekvata behandlingsstrategier för det aktuella problemet/problemen som konstaterats för just den specifika individen.

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Appendix

The Gaming Addiction Identification Test (GAIT)

Vadlin S, Åslund C, Nilsson KW

Included below are several questions about computer and video games. The questions address all forms of gaming on PCs, mobile phones, or TV that can be performed alone or with others. Examples of such games are World of Warcraft, Counter-Strike, The Sims, Super Mario, Tetris, Wordfeud, etc.

The questions pertain to games played by you in the last 12 months. Place a check mark on the option that suits you the best.

1. How often do you play?	Never, almost never ☐	1-2 times/ month ☐	> 2-4 times/ month ☐	2-3 times/ week ☐	4 times or more/week ☐
2. For how long do you play on the days that you play?	No time ☐	1-2 h/ day ☐	> 2-3 h/day ☐	4-5 h/day ☐	More than 6 h/ day ☐
3. I play more often and/or for longer periods now, compared with previously	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
4. It often happens that I play more than I had planned	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
5. I often think about games or about gaming, even when I am not playing	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
6. I often feel that I "have to" play	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
7. Sometimes I feel bad if I have not played for a day (e.g. feel sad, stressed out, anxious, irritated, angry)	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
8. I have tried to cut back on my playing, but with no success	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐

9. If things go badly when I play, sometimes I have to keep playing until things are going better	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
10. Sometimes I skip leisure activities or refrain from spending time with friends in order to be able to play	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
11. Sometimes I neglect my school work or skip class in order to play	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
12. Sometimes there are problems or conflicts at home because of my playing	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
13. My health has been negatively affected by my playing (e.g. I have felt anxious, sad, and irritated and I have had trouble sleeping or experienced pain)	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
14. I am worried/concerned about my playing	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
15. My parents/other adults are worried/concerned about my playing	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
16. I lie or try to hide the amount of time that I am playing	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐
17. I play in order to forget or escape problems I have in my ordinary life or to escape negative emotions	Disagree ☐	Somewhat disagree ☐	Neither agree nor disagree ☐	Somewhat agree ☐	Completely agree ☐

GAIT

The Gaming Addiction Identification Test

Vadlin S, Åslund C, Nilsson, K W, Centrum för klinisk forskning 2012

Här kommer ett antal frågor som handlar om *dataspel och TV-spel.* Frågorna handlar om alla former av spel på dator, mobil eller TV både där man spelar ensam eller med andra. Exempel på sådana spel är World of Warcraft, Counter-Strike, The Sims, Super Mario, Tetris, Wordfeud med flera.
Frågorna handlar om hur det varit för dig de senaste 12 månaderna. Sätt ett kryss för det alternativ som passar bäst för dig;

1. Hur ofta spelar du?	Aldrig, nästan aldrig ☐	1-2ggr/ mån ☐	> 2-4ggr/ månad ☐	2-3ggr/ vecka ☐	4ggr eller mer/vecka ☐
2. Hur länge spelar du de dagar du spelar?	Ingenting/ nästan ingenting ☐	1-2 timmar/ dag ☐	> 2-3 timmar/ dag ☐	4-5 timmar/ dag ☐	Mer än 6 timmar/ dag ☐
3. Jag spelar oftare och/eller längre tid nu jämfört med tidigare	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
4. Det händer ofta att jag spelar mer än jag hade tänkt mig	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
5. Jag tänker ofta på spel eller på att spela, även när jag inte spelar	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
6. Jag känner ofta att jag ”måste” spela	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
7. Det händer att jag mår jag dåligt om jag inte spelat på en dag (t ex känner mig ledsen, stressad, orolig, irriterad, arg)	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
8. Jag har försökt minska mitt spelande, utan att lyckas	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐

9. Det händer att jag måste fortsätta spela tills det går bra igen om det gått dåligt	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
10. Det händer att jag hoppar över fritidsaktiviteter eller låter bli att träffa kompisar för att kunna spela	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
11. Det händer att jag låter bli att göra skolarbete eller att jag skolkar för att kunna spela	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
12. Det händer att det blir problem eller konflikter hemma för att jag spelar	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
13. Min hälsa har påverkats negativt för att jag spelar (t ex har känt mig orolig, ledsen, irriterad, haft svårt att sova eller fått ont någonstans)	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
14. Jag är bekymrad/orolig över mitt spelande	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
15. Mina föräldrar/andra vuxna är bekymrade/oroliga över mitt spelande	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
16. Jag ljuger eller försöker tona ner för andra hur mycket jag spelar	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐
17. Jag spelar för att glömma problem jag har i mitt liv eller för att slippa undan jobbiga känslor	Stämmer inte alls ☐	Stämmer ganska dåligt ☐	Stämmer varken bra eller dåligt ☐	Stämmer ganska bra ☐	Stämmer mycket bra ☐

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