Understanding the Development of Problem Gambling and Gaming: The Role of Externalizing and Internalizing Problems from Childhood to Emerging Adulthood

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Abstract

Background: Youth have been identified as being at an elevated risk of reporting symptoms of problem gambling (PG) and problem video gaming (PVG). Despite emerging research in the study of behavioral addictions, there are noteworthy gaps in the literature specific to identifying the classification of these problems within the broader hierarchical model of psychopathology while clarifying risk factors for PG and PVG from childhood to emerging adulthood.

Objectives: This thesis globally set out to investigate the association between externalizing problems, internalizing problems and PG/PVG from childhood to emerging adulthood. Four studies were conducted to address this primary objective. Study 1 aimed to provide an overview of peer-reviewed research identifying the relationship between externalizing problems (i.e., conduct problems), internalizing problems (i.e., depressive symptoms) and PG/PVG among adolescents and young adults. Study 2 aimed to investigate the fit of PG and PVG within the hierarchical structure of psychopathology among adolescents. Study 3 aimed to investigate how externalizing and internalizing problems in childhood and their trajectories across time predict PVG in mid-adolescence. Similarly, Study 4 aimed to investigate these same problems and trajectories in predicting gambling behaviors. A secondary objective was to identify sex or age differences in the association between externalizing/internalizing problems and PG/PVG.

Methods: In the first study, a systematic review was conducted including empirical studies investigating the association between conduct problems, depressive symptoms, PG and PVG from adolescence to emerging adulthood. For the second study, confirmatory factor analysis was utilized to model the fit of PG and PVG within the hierarchical structure of psychopathology within a large-scale cross-sectional study of high-school students. For the third and fourth study, in a separate sample of youth, with approximately half presenting with significant externalizing

behaviors, parallel process growth modelling was utilized to model trajectories of externalizing and internalizing problems from childhood to adolescence. The intercept and slope of these trajectories were then entered into linear regression models predicting PVG and gambling behaviors, respectively.

Results: Based on the 71 studies synthesized within the systematic review (Study 1), although both conduct problems and depressive symptoms were concurrently associated with PG and PVG, there was greater longitudinal evidence for an externalizing pathway towards PG and an internalizing pathway towards PVG. In investigating the fit of PG and PVG within the hierarchical structure of psychopathology (Study 2), both PG and PVG were optimally classified under the externalizing problems domain. In modelling the externalizing and internalizing trajectories towards PVG symptoms (Study 3), although baseline externalizing and internalizing problems were predictive of PVG, only a trajectory involving a slower decrease of internalizing problems was predictive of PVG. Finally, in modelling the externalizing and internalizing trajectories towards gambling behaviors (Study 4), both baseline externalizing problems and a trajectory involving a slower decrease of externalizing problems were predictive of gambling behaviors. Internalizing problems at baseline were negatively associated with later gambling. Across the empirical studies, no age or sex differences were reported in the association between externalizing/internalizing problems and PG/PVG.

Conclusions: Despite both PG and PVG being recognized as behavioral addictions, some noteworthy differences have been identified in how these behaviors as they are associated with externalizing and internalizing problems from childhood to emerging adulthood. Results from these studies indicate the importance of differentiating between distal and proximal risk factors for both gambling and video gaming behaviors.

Résumé

Contexte: Les jeunes présent un risque élevé de troubles liés au jeu de hasard et d'argent (TJHA) et au jeu vidéo (TJV). Malgré l'émergence de la recherche dans l'étude des addictions comportementales, il existe des lacunes notables dans la littérature spécifique à l'identification de la classification de ces problèmes dans le modèle hiérarchique de la psychopathologie, tout en clarifiant les facteurs de risque pour les TJHA et TJV.

Objectifs: Cette thèse se propose globalement d'étudier l'association entre les troubles extériorisés (TE), les troubles intériorisés (TI) et les TJHA/TJV de l'enfance à l'âge adulte émergent. Quatre études ont été menées pour répondre à cet objectif principal. L'étude 1 visait à fournir une revue de la littérature identifiant la relation entre les TE (troubles de conduites), les TI (symptômes dépressifs) et les TJHA/TJV. L'étude 2 visait à examiner l'adéquation des TJHA et TJV dans le modèle hiérarchique de la psychopathologie chez les adolescents. L'étude 3 visait à étudier comment les TE et TI de l'enfance et leurs trajectoires dans le temps prédisent les TJV au milieu de l'adolescence. De même, l'étude 4 visait à étudier ces mêmes troubles et trajectoires pour prédire les comportements de jeu de hasard et d'argent. Un objectif secondaire était d'identifier les différences de sexe ou d'âge dans l'association entre les TE/TI et les TJHA/TJV.

Méthodes: Dans la première étude, une revue systématique a été menée, incluant des études empiriques examinant l'association entre les troubles de conduites, les symptômes dépressifs, les TJHA et les TJV de l'adolescence à l'âge adulte émergent. Pour la deuxième étude, une analyse factorielle confirmatoire a été utilisée pour classés les TJHA et TJV dans la structure hiérarchique de la psychopathologie dans le cadre d'une étude transversale d'élèves du secondaire. Pour la troisième et quatrième étude, dans un échantillon distinct de jeunes, dont environ la moitié présentait des comportements extériorisés significatifs, un modèle de

croissance à processus parallèle a été utilisé pour modéliser les trajectoires de TE et TI de l'enfance à l'adolescence. L'intercept et la pente de ces trajectoires ont ensuite été introduits dans des modèles de régression linéaire prédisant respectivement les TJV et les comportements de jeu de hasard et d'argent.

Résultats: D'après les 71 études synthétisées dans le cadre de la revue systématique (Étude 1), bien que les troubles de conduites et les symptômes dépressifs soient associés concurremment aux TJHA et TJV, il existe davantage de preuves longitudinales d'une voie extériorisée vers les TJHA et d'une voie intériorisée vers les TJV. Lors de l'étude modélisant les TJHA et TJV dans la structure hiérarchique de la psychopathologie (Étude 2), les TJHA et TJV ont été classés de manière optimale dans le domaine de TE. En modélisant les trajectoires extériorisés et intériorisés vers les TJV (Étude 3), bien que les TE et TI de base soient prédictifs des TJV, seule une trajectoire impliquant une diminution plus lente de TI était prédictive des TJV. Enfin, dans la modélisation des trajectoires extériorisés et intériorisés vers les comportements de jeu de hasard et d'argent (Étude 4), les TE au départ et une trajectoire impliquant une diminution plus lente de TE étaient prédictifs des comportements de jeu de hasard et d'argent. Les TI au départ étaient négativement associés aux comportements de jeu de hasard et d'argent. Dans l'ensemble des études empiriques, aucune différence d'âge ou de sexe n'a été signalée dans l'association entre les TE/TI et les TJHA/TJV.

Conclusions: Bien que les TJHA et TJV soient tous deux reconnus comme addictions comportementales, certaines différences notables ont été identifiées dans la manière dont ces comportements sont associés avec les TE et TI de l'enfance à l'âge adulte émergent. Les résultats de ces études indiquent l'importance de différencier les facteurs de risque distaux et proximaux pour les comportements problématique de jeu de hasard et d'argent et de jeu vidéo.

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Contribution to Original Research and Contribution of Authors

This thesis is a culmination of my doctoral research work conducted between September 2018 to May 2023. All elements of the present thesis are considered original scholarship and represent distinct contributions to the advancement of knowledge in the field of behavioral addictions. The manuscripts included in this thesis are the result of collaborative work. Jérémie Richard is the primary author on all included manuscripts, and he is responsible for their content. An overview of each manuscript and the contribution of each author is presented below.

Richard, J., Fletcher, E., Boutin, S., Derevensky, J., & Temcheff, C. (2020). Conduct problems and depressive symptoms in association with problem gambling and gaming: A systematic review. *Journal of Behavioral Addictions, 9*(3), 497-533. doi:10.1556/2006.2020.00045

Contribution of authors: Jérémie Richard, Stéphanie Boutin, Jeffrey Derevensky, and Caroline Temcheff designed the study and wrote the protocol. Jérémie Richard conducted the literature search and Jérémie Richard and Émilie Fletcher selected the included articles and extracted the data. Jérémie Richard wrote the first draft of the manuscript. All authors reviewed the literature search, data extraction and contributed to the manuscript. All authors contributed to and have approved the final version of the manuscript.

Richard, J., Temcheff, C., Ivoska, W., & Derevensky, J. (2023). Adolescent problem gambling and gaming in the hierarchical structure of psychopathology. *International Journal of Mental Health and Addiction.* doi:10.1007/s11469-023-01032-y

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Other Publications and Contributions

Peer-Reviewed Articles

Richard, J., Deng, J., Ivoska, W., & Derevensky, J. (in press). Adverse childhood experiences, problem gambling and disordered gaming: The mediating role of internalizing and externalizing problems among adolescents. *International Journal of Mental Health and Addiction.*

Sciola, A., Marchica, L., **Richard, J.**, Kruse, J., & Derevensky, J. (2023). Exploring the precipitating events and gambling-related activities that prompt gamblers and spouses/cohabitants to contact a gambling helpline. *Journal of Gambling Studies.* https://doi.org/10.1007/s10899-023-10207-0

Valenciano Mendoza, E., Mora-Maltas, B., Mestre-Bach, G., Munguia, L., **Richard, J.,** Derevensky, J., Potenza, M., & Jiminez, S. (2023). Clinical correlates of sports betting: A systematic review. *Journal of Gambling Studies.* https://doi.org/10.1007/s10899-023-10196-0

Fletcher, E., **Richard, J.**, Boutin, S., Lemieux, A., Déry, M., Derevensky, J., & Temcheff, C. (2023). Trajectory classes of externalizing and internalizing symptoms to adolescent gambling participation: An exploratory study. *Journal of Gambling Studies,* 1-13. https://doi.org/10.1007/s10899-022-10182-y

Richard, J., Ivoska, W., & Derevensky, J. (2023). Understanding adolescent esports bettors: Are they a homogeneous group? *Addictive Behaviors, 140,* 1-7. doi:10.1016/j.addbeh.2022.107598

Richard, J., & King, S. (2022). Annual Research Review: Emergence of problem gambling from childhood to emerging adulthood: A systematic review. *Journal of Child Psychology and Psychiatry*, 1-44. https://doi.org/10.1111/jcpp.13713

Mestre-Bach, G., Granero, R., Mora-Maltas, B., Valenciano Mendoza, E., Munguia, L., Potenza, M., Derevensky, J., **Richard, J.,** Fernandez-Aranda, F., Menchon, J. M., & Jiminez, S. (2022). Sports-betting-related gambling disorder: Clinical features and correlates of cognitive behavioral therapy outcomes. *Addictive Behaviors, 133*, 107371. https://doi.org/10.1016/j.addbeh.2022.107371.

Marchica, L., **Richard, J.**, Nower, L., Ivoska, W., & Derevensky, J. (2022). Problem video gaming in adolescents: An examination of the Pathways Model. *International Gambling Studies, 22*(2), 282-299. https://doi.org/10.1080/14459795.2022.2055110

Derevensky, J., Marchica, L. & **Richard, J.** (2021). The migration between gaming and gambling: Our current knowledge. *Pediatric Research and Child Health, 5*(1), 1-9.

Richard, J., Ivoska, W., & Derevensky, J. (2021). Towards an understanding of esports gambling: Demographic and clinical characteristics of youth esports bettors. *Gaming Law Review, 25*(10), 426-434. https://doi.org/10.1089/glr2.2021.0013

Marchica, L., **Richard, J.**, Mills, D., Ivoska, W., & Derevensky, J. (2021). Between two worlds: Exploring esports betting in relation to problem gambling, gaming, and mental health problems. *Journal of Behavioral Addictions, 10*(3), 447-455. doi:10.1556/2006.2021.00045

Richard, J., Marchica, L., Sciola, A., Ivoska, W., & Derevensky, J. (2021). Adverse childhood experience and substance use: The mediating role of perceptions of harm and peer and parental attitudes. *International Journal of Child and Adolescent Resilience, 8*(1), 1-14. https://www.ijcar-rirea.ca/index.php/ijcar-rirea/article/view/247

Richard, J., Marchica, L., Ivoska, W., & Derevensky, J. (2021). Bullying victimization and problem video gaming: The mediating role of externalizing and internalizing problems. *International Journal of Environmental Research and Public Health, 18*(4), 1930. doi:10.3390/ijerph18041930

Fletcher, E., **Richard, J.**, Derevensky, J., Ivoska, W., & Temcheff, C. (2021). Nonmedical Benzodiazepine use in adolescents: Indirect effects of internalizing and externalizing symptoms. *International Journal of Mental Health and Addiction, 19*, 1410-1419. doi:10.1007/s11469-020-00233-z

Richard, J., Temcheff, C., & Derevensky, J. (2020). Gaming disorder across the lifespan: A scoping review of longitudinal studies. *Current Addiction Reports, 7*(4), 561-587. doi:10.1007/s40429-020-00339-3

Richard, J., Warith, H., Ivoska, W., & Derevensky, J. (2020). Vaping and smoking behaviors among adolescents: Associations with demographic factors and mental health symptoms. *Journal of Concurrent Disorders, 3*(3), 45-65.

Richard, J., Marchica, L., Ivoska, W., & Derevensky, J. (2020). Sports-related gambling among US adolescents: A comparison of 2018 and 2020 survey data. *Annals of Sports Medicine and Research, 7*(3), 1152.

Marchica, L., **Richard, J.**, Ivoska, W., & Derevensky, J. (2020). Adverse childhood experiences and addictive behaviors in adolescence: The moderating effect of internalizing and externalizing symptoms. *International Journal of Mental Health and Addiction, 20*, 31-43. doi:10.1007/s11469-020-00288-y

Grande-Gosende, A., **Richard, J.**, Ivoska, W. & Derevensky, J. (2020). The impact of bullying victimization and gambling problems among adolescents. *International Gambling Studies, 20*(1), 80-96. doi:10.1080/14459795.2019.1652669

Richard, J., Grande-Gosende, A., Fletcher, E., Temcheff, C., Ivoska, W. & Derevensky, J. (2020). Externalizing problems and mental health symptoms mediate the relationship between bullying victimization and addictive behaviors. *International Journal of Mental Health and Addiction, 18*(4) 1081-1096. doi:10.1007/s11469-019-00112-2

Derevensky, J., McDuff, D., Reardon, C., Hainline, B., Hitchcock, M., & **Richard, J.** (2019). Problem gambling and associated mental health concerns in elite athletes: A narrative review. *British Journal of Sports Medicine, 53*(12), 761-766. doi:10.1136/bjsports-2019-100668

Derevensky, J. & **Richard, J.** (2019). Response to commentary: "The future of gaming disorder research and player protection: What role should the video gaming industry and researchers play?". *International Journal of Mental Health and Addiction, 18*(3), 800-805. doi:10.1007/s11469-019-00111-3

Richard, J., Paskus, T., & Derevensky, J. (2019). Trends in gambling behaviors among NCAA college student-athletes: A comparison of 2004, 2008, 2012 and 2016 NCAA survey data. *Journal of Gambling Issues, 41*, 73-100. doi:10.4309/jgi.2019.41.5

Richard, J., Temcheff, C., Martin-Storey, A., Wilkie, E., Derevensky, J., & Paskus, T. (2019). Variations in gambling disorder symptomatology across sexual identity among college student-athletes. *Journal of Gambling Studies, 35*(4), 1303-1316. doi:10.1007/s10899-019-09838-z

Richard, J., Potenza, M., Ivoska, W., & Derevensky, J. (2018). The stimulating nature of gambling behaviors: Identifying the relationship between stimulant use and gambling

among adolescents. *Journal of Gambling Studies, 35*(1), 47-62. doi:10.1007/s10899-018-9778-7

Marchica, L., Zhao, Y., **Richard, J.**, Derevensky, J. & Shaffer, H. (2018). A comparative analysis of Canadian university policies towards alcohol, drugs and gambling use. *Canadian Journal of Addiction, 9*(1), 18-25.

Richard, J. & Derevensky, J. (2017). Identifying the relationship between mental health symptoms, problem behaviors and gambling among adolescents. *Annals of Behavioural Science, 3*(2), 1-9. doi:10.21767/2471-7975.100030

Peer-Reviewed Abstracts

Fletcher, E., **Richard, J.**, Derevensky, J., Ivoska, W., & Temcheff, C. (2019). Benzodiazepine use in adolescents: Associations with mental health symptoms and polysubstance use. *Pediatrics & Child Health, 24*(S2), 22-23. doi:10.1093/pch/pxz066.056

Book Chapters

Derevensky, J., Marchica, L., Gilbeau, L. & **Richard, J.** (2022). Behavioral addictions in children: A focus on gambling, gaming, internet addiction and excessive smartphone use. In Patel V.B. & Preedy, V. R. (Eds.) *Handbook of Substance Misuse and Addictions*. Springer, Cham. https://doi.org/10.1007/978-3-030-67928-6_161-1

Richard, J. & Derevensky, J. (2021). Counselling interventions for youth problem gambling. In M. Zangeneh, J. Landon, & S. Rodda (Eds.) *Counselling Approaches for Gambling Disorder: An Empirical Review*. Concurrent Disorders Society Press.

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Overview

Adolescents and emerging adults are at an elevated risk endorsing symptoms of problem gambling and problem video gaming. Both problem gambling and problem video gaming have been recognized as behavioral addictions sharing commonalities in disordered symptomatology and predisposing psychological vulnerabilities. Despite emerging research in the study of behavioral addictions, there are noteworthy gaps in the literature specific to the classification of problem gambling and problem video gaming within the hierarchical structure of psychopathology (i.e., externalizing and internalizing factors) and in understanding developmental risk factors of these problems from childhood to emerging adulthood.

The purpose of this thesis is to address the following four research questions: 1) What is the relationship between externalizing problems, internalizing problems and the development of problem gambling and problem video gaming from childhood to emerging adulthood? 2) What is the fit of problem gambling and problem video gaming within the hierarchical structure of psychopathology among adolescents? 3) How do externalizing and internalizing problems in late childhood and their trajectories predict problem video gaming and gambling behaviors in mid-adolescence? and 4) Are there sex or age differences in the relationship between externalizing problems/internalizing problems and problem gambling/problem video gaming?

To answer these research questions, four studies were conducted: 1) a systematic review of the literature including empirical studies investigating externalizing problems, internalizing problems, problem gambling and problem video gaming, 2) a large-scale cross-sectional study of high-school students utilizing a confirmatory factor analytic approach to analyse the association between externalizing problems, internalizing problems, problem gambling and problem video gaming, 3) a longitudinal study across childhood and adolescence measuring externalizing and

internalizing problems on a yearly basis over five years and problem video gaming at final follow-up, and 4) a longitudinal study across childhood and adolescence measuring externalizing and internalizing problems on a yearly basis over seven years and gambling behaviors at final follow-up.

This manuscript-based thesis is organized as follows. First, a comprehensive literature review is included, introducing the main concepts discussed in this thesis and a rationale for the four studies. Second, each of the studies are presented, with bridging texts in between each study highlighting how each manuscript is related to the other and how they fit within the larger framework of this thesis. Third, a comprehensive scholarly discussion is provided, including a summary of the research findings, a discussion of the differences between the four studies, a description of the research findings in line with the broader theoretical and empirical literature, and an elaboration of the theoretical, methodological, and clinical implications.

Comprehensive Literature Review

The capacity and desire for play among humans is a necessary precondition for the behaviors discussed throughout this thesis. Play behaviors have been identified as an adaptation evolved to develop motor, interpersonal, and problem-solving skills with clear costs and benefits associated with engagement (Jensen, 2021). Although an essential part of normal human development, large-scale industrialized societies have transformed play by normalizing and encouraging certain types of play based on age, ability, interests and availability. The cultural evolution of modern industrialized societies have created new play environments that have dramatically outpaced human evolution, resulting in the potential for play behaviors that are mismatched to our environment (Jensen, 2021). Specifically, some behaviors, especially those integrating novel technologies such as electronic gambling and gaming activities, have been identified as exploiting out innate desire for play, curiosity and risk-taking. This thesis will be focusing on two modern-day play behaviors, video gaming and gambling, as these behaviors have been identified as having the potential for problematic or disordered engagement as a result of excessive and/or maladaptive play.

Gambling and Gaming: Prevalence and Defining Problematic Engagement

A video game is an interactive playable form of digital entertainment that typically requires strategic or skillful engagement. Gaming, the act of playing video games, is a significant part of the leisure and social pursuits of children, adolescents, and adults. Gaming is one of the most widespread recreational activities across cultures (Király et al., 2014), with more than 2.9 billion people playing video games worldwide, and evidence that approximately 90% of individuals under the age of 24 in the United States and Canada have played video games (Gentile, 2009; McBride & Derevensky, 2016; Slack et al., 2022). On the other hand, gambling

activities, often defined by legislation that varies across jurisdictions, tends to refer primarily to activities where an individual wagers something of value, typically a monetary sum, upon the outcome of a contest of chance or future contingent event that is uncertain (King, 2018). In the event of a certain outcome, there is agreement or understanding that the person will receive something of value or lose their initial stake. Studies have identified that children as young as 7 years old have engaged in some form of gambling (Temcheff et al., 2016), although age of onset of gambling behaviors is most prevalent among individuals aged 14 to 15 years (Brezing et al., 2010; Livazović & Bojčić, 2019). A broad range of prevalence rates have been reported in the literature and these rates vary depending upon the country and sample characteristics. Generally, 35.7% to 79.1% of adolescents (aged 12 to 17) report having gambled over the past year (Calado et al., 2017; Derevensky, 2012; Elton-Marshall et al., 2016; Gonzalez-Roz et al., 2017). Comparatively, rates of gambling tend to be higher, if not more consistent among adults, with approximately 56% to 86% of adults reporting engaging in some form of gambling over the past year (Calado & Griffiths, 2016; Hing et al., 2022; Williams et al., 2020).

Gambling and gaming behaviors are generally described as being on a continuum ranging from non-engagement to occasional or recreational engagement, through to problematic, excessive, and disordered engagement (Griffiths et al., 2017; Shaffer & Korn, 2002). Differentiating between recreational, problematic, and disordered engagement in gaming or gambling is of critical importance as this differentiates between experienced harms as a result of these behaviors and levels of disordered symptom severity. The main features differentiating recreational to problematic engagement is the extent of time and/or money spent on gaming or gambling which can lead to harms at the level of the individual, significant others, communities and society (Hilbrechet et al., 2020; Neal et al., 2005). Moreover, problematic gambling or

gaming can also be understood as it corresponds to the diagnostic criteria for disordered engagement although the number of endorsed criteria may not necessarily cross the threshold required for it to be considered a disorder (Calado et al., 2017; Calado & Griffiths, 2016). Throughout this thesis, this latter description is what will be referred to as problem gambling (PG) and problem video gaming (PVG), respectively. Finally, as for disordered engagement in gambling or gaming, this would be inclusive of individuals meeting the diagnostic threshold for gambling disorder and (Internet) gaming disorder, respectively (additional details will be provided on the diagnostic criteria in the following section).

When discussing gambling and gaming disorder, a final concept that is important to introduce and briefly discuss is the concept of behavioral addictions. In their seminar work, Grant, Potenza, Weinstein and Gorelick (2010) described how certain behaviors, similar to psychoactive substances, produce short-term rewards that may generate persistent behavior despite adverse consequences. Ongoing research comparing substance use disorders to behavioral addictions have contributed to an expanding field identifying similarities between addictive behaviors (Alavi et al., 2012; Derevensky et al., 2019; Potenza, 2014, 2017). Behavioral addictions can be best understood from a biopsychosocial framework, with various biological, psychological, and social processes being associated with the risk of these behaviors developing into addictions (Derevensky et al., 2019; Griffiths, 2005). Importantly, for these behaviors to be considered behavioral addiction or disorder, there must be a pattern of symptoms or syndrome that leads to clinically significant distress or dysfunction (Petry et al., 2018).

To date, only two behaviors have been formally recognized as having the potential for addiction through decades of epidemiological, neuroscientific, and clinical research: gambling and video gaming (Billieux et al., 2015; Petry et al., 2018; Rumpf et al., 2019). Essential features

common to both PG and PVG include: salience (i.e., the activity is of high importance to the person and tends to dominate their thinking, feelings and behavior), mood modification (i.e., a positive emotional reaction to the behavior, often serving as a coping strategy or escape from adverse life events), tolerance (i.e., need for an increasing amount of the behavior to achieve the mood modifying effects), withdrawal (i.e., unpleasant emotional/physical state when trying to cut down or stop the behavior), conflict (i.e., increased discord between people around the individual and/or a negative impact to their social life, relationships, work, academics, hobbies), and relapse (i.e., reoccurring patterns of behavior after periods of control or abstinence) (Griffiths, 2005). Although there is increasing support for a transdiagnostic conceptualization of addictive behaviors, some unique indicators can be noted based on the specific addiction. Specifically, whereas individuals reporting PG are more likely endorse chasing losses and re-betting winnings, individuals reporting PVG are more likely to endorse patterns of playing all night and feelings of unreality (i.e., difficult separating fantasy from real life) (Kim et al., 2020).

Diagnostic Criteria for Gambling and Gaming Disorder

In the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013), gambling disorder was reclassified as a non-substance-related disorder and Internet gaming disorder was included in Section III as a condition requiring further research (APA, 2013). According to the DSM-5 (APA, 2013), both disorders are defined as the persistent and recurrent engagement in the behavior (gambling or video gaming), leading to clinically significant distress or impairment in personal, familial and/or vocational pursuits. A majority of the nine diagnostic criteria for gambling disorder and Internet gaming disorder are similar, including the following: 1) tolerance (e.g., the need to spend more money on gambling or time engaged in gaming to get the desired level of excitement), 2)

withdrawal (e.g., irritability, anxiety or sadness when gambling/gaming is reduced or taken away), 3) repeated unsuccessful attempts to control, cut back or stop gambling/gaming, 4) preoccupation with gambling/gaming, 5) gambling/gaming when feeling distressed or to relieve a negative mood (e.g., depressed, anxious, helpless), 6) lying or deceiving others to conceal the extent of involvement in gambling/gaming, 7) jeopardized or lost a significant relationship, job, educational or career opportunity because of gambling/gaming. The remaining two diagnostic criteria differ, with gambling disorder including, 8) chasing losses (i.e., after losing money, returning to gamble to get even), and 9) relying on others to provide money to relieve a desperate financial situation caused by gambling, and Internet gaming disorder including, 8) a loss of interest in previous hobbies or entertainment with the exception of gaming, and 9) continued gaming despite knowledge of psychosocial problems. For each behavior, a total of five out of nine criteria have to be endorsed within a period of at least 12 months in order to meet the diagnostic threshold (APA, 2013).

As of May 2019, the World Health Organization (WHO) officially included gaming disorder in the International Classification of Diseases – Eleventh Edition (ICD-11) alongside gambling disorder as the two formally recognized behavioral addictions (WHO, 2019). Compared to the DSM-5 (APA, 2013), the ICD-11 emphasizes the following essential features of behavioral addictions: 1) impaired control over gambling/gaming, 2) increasing priority given to gambling/gaming behaviors, and 3) continuation or escalation of gambling/gaming behavior despite negative consequences. Specifically, symptoms of withdrawal, tolerance, preoccupation, deception, and escape are not included within the essential features of ICD-11 criteria but make up additional clinical features, which may or may not be present (WHO, 2019). Given the novelty of the modifications made in the criteria of gambling and gaming disorder in the ICD-11

and the predominance in the usage of the DSM-5 in North America for psychological and psychiatric research (Tyrer, 2014), the criteria of gambling and gaming disorder based on the DSM-5 were included as measures for the studies included within this thesis.

Prevalence and Sociodemographic Correlates of Problem Gambling and Gaming

Research into prevalence rates of PG and PVG have identified significant heterogeneity in findings based on country and age of the sample. Generally, 0.2% to 12.3% of sampled individuals have been identified as meeting the criteria for PG (Calado et al., 2017; Cox, 2005; Gabellini et al., 2022), whereas 0.3% to 17.7% have been identified as meeting the criteria for PVG (Fam, 2018; Kim et al., 2022a; Paulus et al., 2018; Stevens et al., 2021). Results from recent meta-analytic studies provide more moderate estimates, being closer to 3.72% for at-risk and problem gambling (Gabellini et al., 2022) and 3.05% to 3.30% for gaming disorder (Kim et al., 2022a; Stevens et al., 2021).

Specific to adolescents, greater rates of PG and PVG have been found among males and older adolescents, despite PVG also being quite prevalent among early adolescents (Calado et al., 2017; Derevensky, 2019; Livazović & Bojčić, 2019; Richard et al., 2020b; Richard & King, 2022). It is noteworthy to acknowledge that despite gambling being prohibited to adolescents based on legislative regulations and statutes, adolescents tend to report the highest rates of gambling-related problems (Derevensky, 2019; Derevensky et al., 2022; Williams et al., 2012). Moreover, research suggests that PVG is more prevalent among children and adolescents when compared to adults (Feng et al., 2017; Kuss & Griffiths, 2012a, 2012b). It is possible that these elevated rates of problematic engagement among youth are associated to the amount of free time and diminished sense of responsibility children and adolescents have, in addition to the increased rates of risky behaviors typically endorsed by adolescents (Jessor & Jessor, 1977).

Risk Factors for Problem Gambling and Gaming

Numerous overlapping risk factors have been identified as increasing the risk for PG and PVG (Brezing et al., 2010; Derevensky, 2019; Dowling et al., 2017; Johansson et al., 2009; Kuss & Griffiths, 2012a; Richard et al., 2020b; Shead et al., 2010; Sugaya et al., 2019). An ecologically-sensitive biopsychosocial model of addiction can provide the necessary framework for this discussion as these risk factors tend to be multidimensional and interactive (Bronfenbrenner, 1979; Marlatt et al., 1988; Skewes & Gonzalez, 2013). As a brief overview, Bronfenbrenner's (1979) ecological model discusses the interaction between individual factors (typically biological and psychological predispositions) and the microsystem, mesosystem, exosystem, and macrosystem, the latter four of which include social and environmental risk factors.

Based on this model, specific risk factors are listed in order, from individual (biological, psychological) to social and environmental influences based on available literature reviews, meta-analyses, and recent empirical studies. For PG, risk factors/correlates include being male, greater physiological arousal to gambling activities, impulsivity, sensation seeking, attention-deficit hyperactivity disorder, undercontrolled temperament, gambling-specific cognitive distortions, depression, anxiety, aggressive/violent behavior, delinquency, substance use, loneliness, peer antisocial behaviors, low parental supervision, academic difficulties, low socioeconomic status and a greater availability of gambling activities (Dowling et al., 2017; Johansson et al., 2009; Livazović & Bojčić, 2019; Schulter et al., 2019; Williams et al., 2021, 2022). For PVG, risk factors/correlates include being male, impulsivity, sensation seeking, attention deficit hyperactivity disorder, autistic traits, low empathy, low behavioral control, emotional dysregulation, maladaptive beliefs specific to gaming, conduct problems, relational

aggression, depression, anxiety, low self-esteem, substance use, social isolation, loneliness, poor parental relationships, problems with peers, and academic difficulties (Kim et al., 2022b; Kuss et al., 2012a, 2012b; Richard et al., 2020b; Ropovik et al., 2022; Sugaya et al., 2019; Tang et al., 2022).

Of these numerous risk factors, externalizing (i.e., conduct problems, antisocial behaviors, delinquency) and internalizing (i.e., depressive symptoms, anxiety) problems appear to be important risk factors for PG and PVG (Dowling et al., 2017; Kryszajtys et al., 2018; Kuss & Griffiths, 2012a, 2012b; Sugaya et al., 2019). Empirically, both conduct problems and depressive symptoms have been independently associated with PG (Giralt et al., 2018; Richard & Derevensky, 2017; Sagoe et al., 2017) and PVG (Müller et al., 2015; Myrseth & Notelaers, 2018), with the presence of both problems rendering youth at an even greater risk of addiction later in life (Giralt et al., 2018; Jessor & Jessor, 1977; Khoddam et al., 2016; Strittmatter et al., 2015; Wiesner et al., 2005). Moreover, these risk factors may underlie various motivational states including the desire for escape, distraction, emotion-focused coping, excitement-seeking, and competition that have been associated with the development of PG and PVG (Barrada et al., 2019; Dowling et al., 2017; Laconi et al., 2017; Shead et al., 2010; von der Heiden et al., 2019; Yip et al., 2011).

Hierarchical Structure of Psychopathology: Externalizing and Internalizing Problems

To provide additional detail on these two significant risk factors for PG and PVG, the constructs of externalizing and internalizing problems were initially derived from factor analyses of psychopathology phenotypes indicating that mental disorders can be organized into two higher-order factors representing different manifestations of intercorrelated core psychopathological processes (Gibbons & Hedeker, 1992; Krueger, 1999; Krueger & Markon,

2006; Lahey et al., 2012). These investigations were initially advanced due to issues concerning comorbidity in the study of psychopathology. Comorbidity, or the co-occurrence of two or more mental disorders, is typically referred to as the rule rather than the exception when investigating psychopathology across the lifespan (Caspi et al., 2020). Although comorbidity has been criticized as being an artifact of current diagnostic systems that impose categorical distinctions that do not exist in nature (Maj, 2005), various conceptual models of comorbidity have been proposed (Angold et al., 1999; Cicchetti & Rogosch, 2002). Such models include the: associated liabilities model (i.e., underlying liability factors are correlated and link different disorders), multiformity model (i.e., underlying liability factors are not correlated but cause symptoms of different disorders), causation model (i.e., one disorder causes the other), independence model (i.e., each disorder is influenced by its own unique underlying factor which creates another underlying factor resulting in a third disorder), and the spurious associations model (i.e., some external variable or set of variables create spurious associations between disorders) (Angold et al., 1999; Krueger & Markon, 2006). The hierarchical model of psychopathology representing externalizing and internalizing factors is derived from empirical findings supporting the associated liabilities model, in that specific syndromes or disorders share underlying maladaptive traits or liabilities that link these disorders.

Specifically, the overarching externalizing liabilities factor has been found to include at the syndrome level, substance use disorders, conduct disorder and antisocial personality disorder, which share associated underlying maladaptive traits such as impulsivity, risk taking and sensation seeking (Krueger et al., 2021). At the level of specific problems, the externalizing domain has also been found to include aggressive behaviors, antisocial behaviors, and violent or delinquent acts (APA, 2013; Fonagy & Luyten, 2018; Hawkins et al., 2002; Lahey et al., 2012).

Second, the overarching internalizing liabilities factor, has been found to include at the syndrome level, major depressive disorder, generalized anxiety disorder, social phobia, specific phobias, and panic disorder, which share associated underlying maladaptive traits such as neuroticism and emotion dysregulation (Krueger & Markon, 2006). In contrast to the externalizing domains, the internalizing dimension has been found to bifurcate into two subordinate liabilities; distress (representing major depressive disorder, dysthymia, and generalized anxiety disorder) and fears (representing phobias and panic disorder) (Krueger, 1999; Krueger & Markon, 2006; Lahey et al., 2012). At the level of specific symptoms, depression typically includes feelings of worthlessness, low mood, sadness, anhedonia, and difficulties concentrating, whereas anxiety typically includes physical and/or cognitive symptoms such as excessive worries, edginess, irritability, rapid heart rate, sweating, trembling or shortness of breath (APA, 2013; Dean & Keshavan, 2017; Rapee et al., 2019).

Beyond the two-factor model of psychopathology, an integrative model has been proposed including a single higher-order dimension of general psychopathology. This dimension, referred to as the *p* dimension or factor (*p* representing general psychopathology) has been hypothesized as measuring and explaining a person's general liability to mental disorder, comorbidity among disorders and persistence of symptom severity across time (Caspi & Moffitt, 2018). In this model, the *p* factor is hypothesized as representing one of four potential dimensions: (1) diffuse unpleasant affective states (i.e., neuroticism); (2) poor impulse control over emotions; (3) low cognitive ability; and (4) disordered form and content of thoughts. Initial empirical evidence supports the notion of this general psychopathology dimension as explaining variance in psychopathology beyond the externalizing and internalizing liability dimensions (Lahey et al., 2018).

A number of mental disorders have been empirically investigated in their fit within the hierarchical structure of psychopathology. These disorders include major depression, dysthymia, generalized anxiety disorder, agoraphobia, panic disorder, social phobia, specific phobia, post-traumatic stress disorder, conduct disorder, oppositional defiant disorder, antisocial personality disorder, alcohol use disorder, substance use disorders, attention-deficit hyperactivity disorder and obsessive-compulsive disorder (Caspi et al., 2020; Krueger et al., 2021; Krueger & Markon, 2006; Lahey et al., 2018). Despite this rapidly expanding literature, only two studies (King et al., 2020; Oleski et al., 2011) have investigated the fit of problem or disordered gambling within the hierarchical structure of psychopathology, and no studies have investigated the fit of problem or disordered gaming. This is a significant lacuna within this area of research, as proper classification has implications relevant to the clinical understanding of these disorders and can inform future research and intervention efforts. At present, gambling disorder appears to be best classified under the umbrella of externalizing problems (King et al., 2020; Oleski et al., 2011), with some potential overlap with internalizing problems among women (Oleski et al., 2011). For gaming disorder, although classified as a behavioral addiction with potential overlapping etiology with other addictive behaviors (Brezing et al., 2010; Potenza, 2014; Yakovenko & Hodgins, 2018), it has not been empirically evaluated whether gaming disorder fits best under the umbrella of externalizing or internalizing problems.

Development of Problem Gambling and Gaming

As gambling and gaming disorder have been reported as being progressive in nature (Griffiths et al., 2017; Reith & Dobbie, 2013), it is important to consider how these disorders may be linked to normal and abnormal developmental processes and trajectories (Dosman et al., 2012; Krossbakken et al., 2017; Reith & Dobbie, 2013; Steinberg & Morris, 2001). Indeed, the

time at which an individual begins developing symptoms of gambling or gaming disorder may be related to the presence of certain risk factors or vulnerabilities. As rates of PG and PVG are elevated among youth, research examining how adolescents and emerging adults can develop problematic patterns of engagement in gambling and gaming is of utmost importance.

A developmental psychopathology approach can provide a framework to understanding the complexity of human development. Cummings and colleagues (2020) describe human development as a dynamic transaction between the person and the environment, with connections between biological, psychological, social, and cultural aspects of normal and abnormal development. This framework is aligned with previously described ecologically-sensitive biopsychosocial model of addiction which considers various risk factors that contribute to the progression of addictive behaviors (Skewes & Gonzalez, 2013). Similar to other mental disorders, examining developmental trajectories while measuring both distal and proximal risk factors (Loeber et al., 1998) is necessary when attempting to understand how behavioral addictions develop. For instance, it is possible that the developmental pathways to PG and PVG begins with predisposing genetic and environmental factors which interact with childhood and adolescent developmental processes (e.g., neuromaturation, identity formation), predisposing personality traits (e.g., impulsivity, sensation seeking, neuroticism) and neurocognitive/ motivational profiles (e.g., poor response inhibition, stress reactivity), culminating in problematic patterns of engagement in gambling and/or gaming.

Several theories or models have been advanced to explain the development of PG and PVG. Beginning with PG, Blaszczynski and Nower (2002) formulated the pathways model to PG and identified three subgroups of gamblers that represent different pathways towards PG: (1) behaviorally conditioned (BC) problem gamblers; (2) emotionally vulnerable (EV) problem

gamblers; and (3) antisocial impulsivist (AI) problem gamblers. Individuals within the first pathway (BC) have an absence of specific premorbid psychopathology and gamble largely as a result of behavioral conditioning and distorted cognitions. Individuals within the second pathway (EV) generally present with anxiety and/or depression, a history of poor coping and problem-solving skills, in addition to sharing the behavioral conditioning patterns of the first pathway. Finally, individuals within the third pathway (AI) possess similar psychosocial vulnerabilities as individuals in the second pathway and behavioral conditioning patterns of the first pathway, but are distinguished by a high degree of impulsivity, antisocial traits, and attention deficits. In 2022, Nower and colleagues provided an update and minor modification to this model, noting how AI problem gamblers had fewer symptoms of depression and anxiety that initially thought, while endorsing predominantly heightened levels of impulsivity and antisocial traits.

As for PVG, Lee, Lee, and Choo (2017) developed a typology of gaming disorder based on the pathways model of problem gambling (Blaszczynski & Nower, 2002). In this model, the authors propose that there are three types of problem gamers based on the salience of biological, psychological, and social vulnerabilities. These include impulsive/aggressive (IA) problem gamers, emotionally vulnerable (EV) problem gamers, and socially conditioned (SC) problem gamers. Based on this model, the IA subgroup of problem gamers play video games as a way to release aggressive impulses, seek sensations to alleviate boredom, the EV subgroup plays video games as a way to temporarily escape from negative feelings and for mood-modification purposes and the SC subgroup play video games as a means to socialize and reduce feelings of loneliness. The SC subgroup can be further differentiated into covert (i.e., displaying high levels of harm avoidance are social withdrawn and fear social rejection) and overt (i.e., displaying

narcissistic personality traits, have a high need for stimulation and seek the attention of others within games) types.

More recently, Benarous and colleagues (2019) outlined an internalized and an externalized pathway to gaming disorder based on two case reports. In their description, the internalized pathway leads to gaming disorder via attachment issues during infancy, internalizing symptoms (i.e., anxiety, depression) during childhood and early adolescence, and behavioral avoidance and social withdrawal as a young adult. Although the externalized pathway also leads to gaming disorder via attachment issues during infancy, instead of internalizing symptoms, the child exhibits externalizing symptoms (e.g., conduct and aggressive problems), experiences severe family conflicts and school difficulties, has poor emotion regulation and impulsive traits as an adolescent, and exhibits reactive aggressive behaviors as a young adult. Although the exact etiology of gaming disorder proposed in this model is far from being conclusive, this model presents an initial framework for understanding the development of PVG, which is consistent with the associated literature investigating the temporal sequencing of risk factors for gaming disorder (Paulus et al., 2018; Richard et al., 2020b).

Despite these models providing useful typologies and explanations of risk factors related to the development of PG and PVG, other than the proposed model by Benarous and colleagues (2019), they do not provide a descriptive approach of the specific vulnerabilities contextualized within a developmental framework. Specifically, these models do not specify in which stages of development (e.g., childhood, adolescence, adulthood) these problems may manifest themselves and how interactions between these risk factors may occur based on their temporal sequencing. Given the limitations of these theories, models for the development of substance use disorders (SUDs) may provide a more descriptive developmental rationale as to which vulnerabilities are

predominant in the development of PG and PVG. The potential generalizability of substance use models to explain the development of behavioral addictions is based on research demonstrating etiological, neurobiological, clinical, and phenomenological similarities between substance and non-substance addictions (Brezing et al., 2010; Kim & Hodgins, 2019; Potenza, 2014; Yakovenko & Hodgins, 2018). As stated by Yakovenko and Hodgins (2018), given that the substance use field is "more mature" (p. 156), conceptual models derived from this field may compliment efforts to advancing the field of research into gambling disorder, and quite possibly the behavioral addictions field as a whole.

Based on a developmental psychopathology framework, three pathways have been proposed to explain the development of SUDs: the externalizing pathway, internalizing pathway, and combined externalizing-internalizing pathway. These pathways overlap with the general psychopathology literature, considering the role of proximal and distal risk factors (Cicchetti & Rogosch, 1999; Dodge et al., 2009), environmental factors (Masten et al., 2009; Oshri et al., 2011), and common underlying vulnerabilities consistent with the hierarchical structure of psychopathology (Caspi & Moffitt, 2018; Krueger & Markon, 2006; Mueser et al., 1998).

First, the externalizing pathway suggests that early externalizing problems and behavioral disinhibition predict later SUDs (Zucker, 1994; Zucker et al., 2011). This pathway is also described as the undercontrol-disinhibition pathway to SUDs emphasizing externalizing problems as an early etiological factor (Zucker et al., 2011). Based on the framework provided by Zucker and colleagues (2011), common difficulties encountered by youth falling on this pathway include an inability to inhibit undesirable, inappropriate, or socially disapproved actions. These difficulties are related to elevated levels of impulsivity and impaired impulse control which have been associated with certain neurobiological and characterological

predispositions. A final noteworthy feature of the externalizing pathway is its fit within the risk-cumulation additive framework or developmental cascade proposed by Dodge and colleagues (2009), suggesting that the greater the number and severity of risk factors present (i.e., temporal stability and severity of externalizing problems), the more likely an individual is to develop a SUD.

Second, the internalizing pathway proposes that early internalizing problems and difficulties with emotional coping predict later SUDs (Hussong et al., 2011; Trucco et al., 2018). The risk-cumulation additive framework also applies to the internalizing pathway yet the internalizing-specific risks across developmental periods differ. As described by Hussong and colleagues (2011), the internalizing pathway represents a propensity towards negative affect SUDs which begins in infancy as a behaviorally inhibited or reactive temperament which progresses into internalizing problems and social withdrawal in childhood. By late childhood and adolescence, the internalizing pathway is marked by positive expectations for the effect of substances, interpersonal skill deficits, and coping motives for substance use. Following this trajectory, it is hypothesized that the risk of developing a SUD significantly increases in a bi-directional and cumulative fashion that is prone to more rapid development if a greater number of risk factors are present (Hussong et al., 2011).

Lastly, the combined externalizing-internalizing pathway proposes that a combination or interaction of externalizing and internalizing problems predict the later development of SUDs (Englund & Siebenbruner, 2012; Maslowsky et al., 2014). In this trajectory, mechanisms involved in both pathways are relevant which further enhance the cumulative risk for the development of SUDs. Alternatively, it is possible that shared mechanisms or common risk factors underlying both externalizing and internalizing liabilities are relevant to the development

of SUDs based on this externalizing-internalizing pathway (Caspi & Moffitt, 2018; Hussong et al., 2011).

Returning to non-substance addictions (i.e., behavioral addictions), although these specific developmental pathways have not been directly investigated with regards to PG, the internalizing and externalizing pathways appear to parallel the two subgroups of problem gamblers with psychosocial and biological vulnerabilities identified within the pathways model to PG (Blaszczynski & Nower, 2002; Nower et al., 2022), namely, the emotionally vulnerable (Pathway 2) and antisocial impulsivist (Pathway 3) problem gamblers, respectively. The presence of these subgroups of problem gamblers has been empirically validated using cross-sectional community (Gupta et al., 2013; Nower et al., 2013), clinical (Moon et al., 2017; Valleur et al., 2016), and longitudinal data (Allami et al., 2017; Dowd et al., 2018; Mader et al., 2019).

The subgroups identified within the pathways model for PG have also been conceptually discussed and empirically validated in studies investigating PVG (Lee et al., 2017; Marchica et al., 2022). Moreover, as highlighted in the model by Benarous and colleagues (2019), the internalizing and externalizing pathways have been indirectly adapted to explain the development of PVG from childhood to emerging adulthood. Indeed, cross-sectional studies have identified associations between greater aggressive and/or depressive symptoms and PVG (Myrseth & Notelaers, 2018; Lemmens et al., 2015; Sanders & Williams, 2019; Yu & Cho, 2016), with longitudinal studies identifying the role of greater internalizing and externalizing problems in predicting PVG (Krossbakken et al., 2018; Liu et al., 2018; Richard et al., 2020b).

Lastly, as a combined externalizing-internalizing pathway has been identified within the SUD literature, it is possible that comorbid externalizing and internalizing problems may also be related to the development of PG and PVG. This combined pathway would be consistent with the

subgroup of adolescent problem gamblers identified by Allami and colleagues (2017) and Gupta and colleagues (2013) reporting higher levels of both externalizing and internalizing problems, and the subgroups of adolescent problem gamers identified by Marchica and colleagues (2022) reporting elevated emotional vulnerabilities and aggressive/oppositional behaviors.

Limitations of Previous Research and Present Objectives

Overall, the study of behavioral addictions appears to be lagging behind the study of SUDs with regards to having a nuanced understanding of the relationship between externalizing problems, internalizing problems and both PG and PVG. Understanding the classification of PG and PVG within the broader structure of psychopathology utilizing a variable-centered approach has the potential to inform our understanding of these behaviors within the larger context of psychopathology while informing the classification and clinical understanding of these problems among youth. Moreover, results from research empirically evaluating the externalizing and internalizing pathways can have major implications for early identification of at-risk youth and the development of targeted evidence-based prevention and intervention efforts.

Given the limitations of the current evidence-base, the primary objectives of this thesis are as follows: 1) review the available peer-reviewed literature on the demonstrated relationships between externalizing problems, internalizing problems, PG and PVG, 2) identify where PG and PVG fit within the two-factor (i.e., externalizing and internalizing) hierarchical structure of psychopathology, and 3) evaluate the externalizing and internalizing pathways to the development of youth PVG and gambling behaviors. A secondary objective of this thesis is to explore age and sex differences within these investigations, with an emphasis on understanding the manifestation of these problems across childhood, adolescence, and emerging adulthood while accounting for potential differences between males and females respectively.

Overview of Studies

To achieve these objectives, four studies were conducted. For the first objective, a systematic review was conducted to summarize and synthesize research literature identifying the relationships between conduct problems, depressive symptoms, and PG and PVG among adolescents and emerging adults. Although the broader purpose of this thesis is to investigate externalizing and internalizing problems, in order to design a high-quality systematic review following standardized methodological guidelines (Bramer et al., 2018) conduct problems and depressive symptoms were chosen to improve the specificity of the review questions, inclusion and exclusion criteria, and to limit the scope of the review.

For the second objective, a large-scale cross-sectional study of high-school students was conducted to identify where PG and PVG fit within the hierarchical structure of psychopathology as represented by the externalizing and internalizing liability factors. A two-factor confirmatory factor analysis including PG and PVG was conducted, while loading depressive and anxious symptoms onto the internalizing factor, and aggressive problems and delinquent behaviors onto the externalizing factor. Moreover, this study aimed to identify whether there are sex differences in the fit of PG and PVG within this hierarchical structure. It was hypothesized that PG would be optimally identified under the umbrella of externalizing problems whereas PVG would be optimally identified under the umbrella of internalizing problems. Regarding sex differences, it was hypothesized that no sex differences would be present in this classification.

For the third objective, a longitudinal study of children and adolescents was conducted. Parallel process growth modelling was used to identify trajectories of externalizing and internalizing problems from childhood to adolescence while examining the association between these trajectories and the later development PVG and youth gambling behaviors. Given that these

two outcomes were measured at different time points, this objective was separated into two studies, one investigating gaming behaviors, the other investigating gambling behaviors. For the study on gaming behaviors, it was hypothesized that greater baseline scores and a trajectory of increasing externalizing and internalizing problems would be predictive of PVG. Furthermore, it was hypothesized that there would be no sex differences in the predictive role of internalizing and externalizing problems on PVG. For the study on adolescent gambling behaviors, greater externalizing problems at baseline and a trajectory involving an increase in externalizing problems over time would be predictive of past year gambling. Moreover, it was hypothesized that baseline scores and the trajectory of internalizing problems would not be predictive of past year gambling. Lastly, it was hypothesized that there would be no sex differences in the predictive role of internalizing and externalizing problems on past year gambling.

For all three objectives, it is important to note that sex, and not gender was measured. Whereas gender refers to the feelings, attitudes, and behaviors that a given culture associates with a person's biological sex, sex (e.g., male/female) refers to biological distinction of sex assignment at birth (APA, 2012). The decision was made to look at sex instead of gender due to the importance of considering the potential impacts of biological sex differences in puberty (Marshall, 1970), hormones and brain development (Lenroot & Giedd, 2010; Martel, 2013) on the development of adolescent externalizing and internalizing problems and PG/PVG.

Taken together, this research project aims to provide a clear, concise, and comprehensive summary of the empirical literature relevant to the association between externalizing problems, internalizing problems, PG and PVG among youth; investigate the fit PG and PVG within the broader context of youth psychopathology; and evaluate the externalizing and internalizing pathways to youth PVG and gambling behaviors.

Study 1

Conduct Problems and Depressive Symptoms in Association with Problem Gambling and Gaming: A Systematic Review

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Abstract

Background and aims: Behavioral addictions such as gambling and gaming disorder are significant public health issues that are of increasing importance to policy makers and health care providers. Problem gambling and gaming behaviors have been identified as being associated with externalizing and internalizing problems, with theoretical models suggesting that both conduct problems and depressive symptoms may be significant risk factors in the development of problem gambling and gaming. As such, the purpose of this systematic review is to provide an overview of research identifying the relationship between conduct problems, depressive symptoms and problem gambling and gaming among adolescents and young adults. Methods: Systematic literature searches in accordance with PRISMA guidelines found 71 eligible studies that met the inclusion criteria, 47 for problem gambling, 22 for problem gaming and one for both problem behaviors. Results: Based on cross-sectional evidence, both problem gambling and gaming are consistently concurrently associated with conduct problems and depressive symptoms. Longitudinal evidence appears to be clearer for conduct problems as a risk factor for problem gambling, and depressive symptoms as a risk factor for problem gaming. However, both risk factors appear to increase the risk for these problem behaviors. Discussion and Conclusions: Results from the literature review suggest that problem gambling and gaming are associated with the presence of conduct problems and depressive symptoms, with the potential of sharing common etiological factors. Additional research is necessary to confirm these longitudinal relationships with an emphasis on investigating the interaction of both early conduct problems and depressive symptoms.

Introduction

Gambling and gaming behaviors are generally described as being on a continuum ranging from occasional or recreational participation, through to problematic, excessive and disordered engagement (Shaffer & Korn, 2002; Griffiths et al., 2017). In the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association [APA], 2013), gambling disorder was reclassified as a non-substance-related disorder and Internet gaming disorder was included in Section III as a condition requiring further research (APA, 2013). Moreover, as of May 2019, the World Health Organization (WHO) officially included gaming disorder in the *International Classification of Diseases – Eleventh Edition* (ICD-11; WHO, 2018) alongside gambling disorder as the two formally recognized disorders due to addictive behaviors (WHO, 2019). According to the DSM-5 (APA, 2013), both disorders are defined as the persistent and recurrent engagement in the behavior (gambling or video gaming), leading to clinically significant impairment or distress. Recent research has identified that rates of problematic participation in both gambling and gaming are higher in adolescents and young adults, with 0.2-12.3% reporting problem gambling (PG; Calado et al., 2016) and 5-10% reporting problem video gaming (PVG; Fam, 2018; Paulus et al., 2018; Turner et al., 2012).

Gambling and gaming have been found to share a number of similarities with both activities holding the potential for convergence (Griffiths, 2008b; King et al., 2010). Indeed, multiple similarities have been noted at the structural (e.g., variable reinforcement schedules), aesthetic (e.g., exciting and stimulating sounds and light effects) and motivational (e.g., escapism, socializing) levels (Hilgard et al., 2013; King et al., 2015). The distinction between gambling and gaming has been muddled even further with the integration of microtransactions and “loot boxes” in many mobile and console games, allowing gamers to spend money for a

chance at acquiring random virtual items of differing value or benefit (Griffiths, 2018; Li et al., 2019; Richard, 2018; Zendle et al., 2019). However, some differences between both behaviors are also present. For one, video games do not have any formally legislated age restrictions, whereas gambling is legally restricted to adults in most jurisdictions. Additionally, video games are most often played for points and/or status, with skill determining one's performance, whereas gambling can be engaged in for money with the outcome being predominantly random (Griffiths, 2005). Lastly, although variable reinforcement schedules in gambling and gaming can make these activities more addictive, some video games do not utilize immediate reinforcement, with more delayed rewards being presented to the player after long periods of strategic and goal-directed engagement (James & Tunney, 2017).

Various psychosocial risk factors for the development of problematic engagement in both gambling and gaming have been identified. However, a significantly greater amount of research has investigated problem gambling as the growth of studies investigating problem gaming largely begun in the 2000s with the rise of online gaming (Griffiths et al., 2012). Recent literature reviews have indicated that males (Brezing et al., 2010; Dowling et al., 2017) and younger individuals (Derevensky, 2019; Johansson et al., 2009) are at an increased risk of PG and PVG. Moreover, high sensation seeking (Dowling et al., 2017; Shead et al., 2010), emotion-focused coping styles (i.e., suppressive and reactive; Johansson et al., 2009; Kuss & Griffiths, 2012), depressive symptoms (Johansson et al., 2009; Kuss & Griffiths, 2012), attention problems (Shead et al., 2010; Sugaya et al., 2019), delinquency (Johansson et al., 2009; Shead et al., 2010), and conduct problems (Dowling et al., 2017; Sugaya et al., 2019) have been identified as risk factors for both PG and PVG. As numerous risk factors have been identified, there is a serious

need to understand which of these are of critical importance when investigating the development and maintenance of these problem behaviors.

Theoretical models for the development of substance use disorders and non-substance addictive behaviors can provide a rationale to specify which risk factors are predominant in the development of PG and PVG. The potential generalizability of these models is based on research demonstrating that there are etiological, neurobiological, clinical, and phenomenological similarities between substance and non-substance addictions (Brezing et al., 2010; Potenza, 2014; Yakovenko & Hodgins, 2018). Based on a developmental psychopathology framework, various pathways have been suggested to explain the development of substance use disorders (SUDs) including the externalizing pathway, internalizing pathway, and combined pathway. The externalizing pathway suggests that early externalizing problems (e.g., conduct problems) and behavioral disinhibition predict later SUDs (Zucker, 1994; Zucker et al., 2011). The internalizing pathway proposes that early inhibited temperament, internalizing symptoms (e.g., depression) and difficulties with emotional coping predict later SUDs (Hussong et al., 2011; Trucco et al., 2018). Lastly, the combined pathway proposes that a combination or interaction of externalizing and internalizing problems leads to the development of SUDs (Englund & Siebenbruner, 2012; Maslowsky et al., 2014), which may be explained by the presence of shared mechanisms underlying psychopathology (Angold et al., 1999; Caspi & Moffitt, 2018).

Recently, two of these pathways have been indirectly adapted to explain the development of gaming disorder. Based on case reports, Benarous and colleagues (2019) identified an "internalized pathway" (involving depressive symptoms during adolescence) and an "externalized pathway" (involving conduct problems during adolescence) towards the development of gaming disorder in young adulthood. Indeed, subtypes of problem gamers have

been identified depicting greater aggressive and/or depressive symptoms (Myrseth & Notelaers, 2018; Lemmens et al., 2015; Sanders & Williams, 2018; Yu & Cho, 2016), with longitudinal studies identifying the predictive role of greater internalizing and externalizing symptoms for problem gaming (Krossbakken et al., 2018; Liu et al., 2018).

Although these specific developmental pathways have not been empirically or theoretically investigated with regards to problem gambling, Yakovenko and Hodgins (2018) discuss the potential for the SUD literature to act as a model for future research related to gambling disorder. Linking these pathways to what has been theoretically established for problem gambling, these appear parallel the two subgroups of problem gamblers identified within the *Pathways Model* (Blaszczynski & Nower, 2002), namely, the antisocial impulsivist (Pathway 3) and emotionally vulnerable (Pathway 2) problem gamblers. Importantly, the presence of these subgroups of problem gamblers has been empirically validated using cross-sectional community (Gupta et al., 2013; Nower et al., 2013), clinical (Moon et al., 2017; Valleur et al., 2016), and longitudinal data (Allami et al., 2017; Dowd et al., 2018; Mader et al., 2019). Lastly, as a combined pathway has been identified within the SUD literature, it is possible that comorbid externalizing and internalizing problems may also be related to the development of behavioral addictions. This combined pathway would be consistent with the subgroup of adolescent problem gamblers identified by Gupta and colleagues (2013) reporting higher levels of both externalizing and internalizing symptoms. This combined pathway presently remains unexplored with regards to PVG.

Based on this theoretical rationale, conduct problems (CP) and depressive symptoms (DS) appear to be critical risk factors in the development of PG and PVG. CP typically include symptoms and problem behaviors associated with conduct disorder such as aggression, rule-

breaking, antisocial behaviors and violent or delinquent (e.g., theft, vandalism) acts (APA, 2013; Fonagy & Luyten, 2018; Hawkins et al., 2002). As for DS, these typically include symptoms associated with major depressive disorder such as low mood, anhedonia, and feelings of worthlessness (APA, 2013; Dean & Keshavan, 2017; Rapee et al., 2019). Empirically, both CP and DS have been associated with PG (Giralt et al., 2018; Richard & Derevensky, 2017; Sagoe et al., 2017) and PVG (Müller et al., 2015; Myrseth & Notelaers, 2018), with the presence of both CP and DS rendering youth at an even greater risk of addiction later in life (Giralt et al., 2018; Jessor & Jessor, 1977; Khoddam et al., 2016; Strittmatter et al., 2015; Wiesner et al., 2005).

Given the theoretical and empirical associations between CP, DS and behavioral addictions, a review of the literature investigating the role of these problems in the development of PG and PVG is deemed necessary. Previous reviews have broadly examined the role of various risk and protective factors for PG (Dowling et al., 2017; Johansson et al., 2009; Lorains et al., 2011; Yakovenko & Hodgins, 2018) and PVG (Burleigh et al., 2019; Cheng et al., 2018; González-Bueso et al., 2018; Mihara & Higuchi, 2017). However, these reviews have not investigated both PG and PVG together, with an emphasis on DS and CP. With the inclusion of gaming disorder as the second formally recognized behavioral addiction (WHO, 2019), reviews investigating both PG and PVG are necessary to assess for similarities and differences in the risk factors and mechanisms underlying the development of each problem behavior (Marchica et al., 2019). Furthermore, as adolescents and young adults present with a higher risk for the development of these problem behaviors, a review targeting this demographic is of primary interest. Several reviews have limited their sample to adolescents and young adults, yet these are limited in their broad examination of factors associated with PG (Calado et al., 2017) or PVG (Paulus et al., 2018; Sugaya et al., 2019), with no focus on CP and DS. As such, the purpose of

the present systematic review is to provide an overview of research identifying the relationship between CP, DS and both PG and PVG among adolescents and young adults.

Methods

Study Selection

The methodology employed in this review is compliant with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA; Moher et al., 2009). Electronic databases including PsychINFO, Medline, Social Work Abstracts, Scopus and Web of Science, were searched. Searches in all databases utilized a combination of Medical Subject Headings (MeSH) and multi-purpose terms where applicable, searching for the keywords in the title, abstract, keywords, headings and subject headings of articles. The search terms used a combination of keywords and Boolean terms relating to gambling, gaming, CP and DS. Keywords for the searches are presented in Table 1. The search was restricted to articles published from January 1994 to October 2019, to coincide with the publication of the DSM-IV (APA, 1994) which introduced a scientific and empirically-based understanding of pathological gambling (National Research Council, 1999, p. 18). The search strategy was peer-reviewed by a university librarian with experience conducting systematic reviews. The search parameters yielded the following number of results in each database: PsychINFO (296), MEDLINE (945), Social Work Abstracts (22), Scopus (1623), and Web of Science (915).

Inclusion criteria were developed for the title/abstract screening stage and full text screening stage. Studies were considered eligible at the title/abstract stage if they were: (1) original peer-reviewed publications in English or French; (2) providing an estimate of the presence of CP (i.e., physical or verbal aggression, delinquency, antisocial behavior, externalizing problems) or DS (i.e., low mood, negative affect, anhedonia, internalizing

Table 1

Keywords for database searches

Grouping terms	Keywords
Gambling or gaming	(gambl* OR gambling OR "problem gambling" OR "disordered gambling" OR "gambling disorder" OR "pathological gambling" OR "video game" OR videogame OR games OR gamer OR "problem* use of video games" OR "internet gaming disorder" OR "gaming disorder") AND
Conduct problem or depressive symptoms	(conduct* OR "conduct problems" OR "conduct disorder" OR delinquency OR aggression OR externaliz* OR "externalizing problems" OR "externalizing symptoms" OR "oppositional defiant disorder" OR "antisocial personality disorder" OR "antisocial behavio*r" OR depression OR "major depression" OR "major depressive disorder" OR "major depressive episode" OR dysthymia OR "mood disorder" OR internaliz* OR "internalizing problems" OR "internalizing symptoms")

symptoms) in association with either PG or PVG; (3) observational and descriptive studies (e.g., cross-sectional, case–control, longitudinal); (4) reviews if they included the calculation of new data (i.e., meta-analysis). Studies were not eligible at the title/abstract screening stage if they were: (1) validating the development of a psychometric measure/scale; or (2) investigating the impact of a treatment intervention.

Studies were included at the full-text screening stage if: (1) participants were between the ages of 12 and 25 years; (2) the study included a measure specific to problem/disordered gambling or problem/disordered gaming as the dependent variable; and (3) the study included a measure specific to CP or DS as the independent variable. Studies were excluded at the full-text screening stage if they: (1) only included a measure for impulsive behavior, sensation seeking or substance use (and not CP more specifically); (2) only included a measure of emotional problems

based on a composite of both anxious and depressive symptoms without isolating the effect of DS; or (3) investigated internet addiction/problems without isolating the effect of PVG.

Study Assessment

A PRISMA flow diagram of the search results is displayed in Figure 1. A total of 2,549 articles were identified after duplicate records were removed. Rayyan QCRI (Ouzzani et al., 2016) was utilized to perform the blind screening of identified articles. To ensure reliable title and abstract screening, approximately 20% (n = 527) of the titles and abstracts were randomly selected and reviewed by JR and EF. The inter-rater agreement across the reviewers was 95.64%. After the title/abstract screening, 571 full-text articles were deemed potentially eligible and were retrieved for review. To ensure reliable full-text screening, approximately 20% (n = 114) of the full-texts were randomly selected and reviewed by JR and EF. The inter-rater agreement across the reviewers was 94.74%. Discrepancies were resolved through group discussion with a third reviewer (CT) as arbiter and inclusion/exclusion criteria were specified or adjusted as necessary. After the full-text screening, 71 articles met the inclusion criteria for the study.

Data Extraction

JR and EF extracted data from the included studies. The following data were extracted from each of the included studies: (1) type of study (and study duration/number of time-points if longitudinal); (2) independent/predictor, dependent/outcome and control variables; (3) population source; (4) number of participants; (5) age and sex/gender of participants; (6) participant inclusion and exclusion criteria; (7) statistical analyses; and (8) main findings.

Results

Sample Characteristics

Sample characteristics of selected studies are presented in Tables 2, 3 and 4.

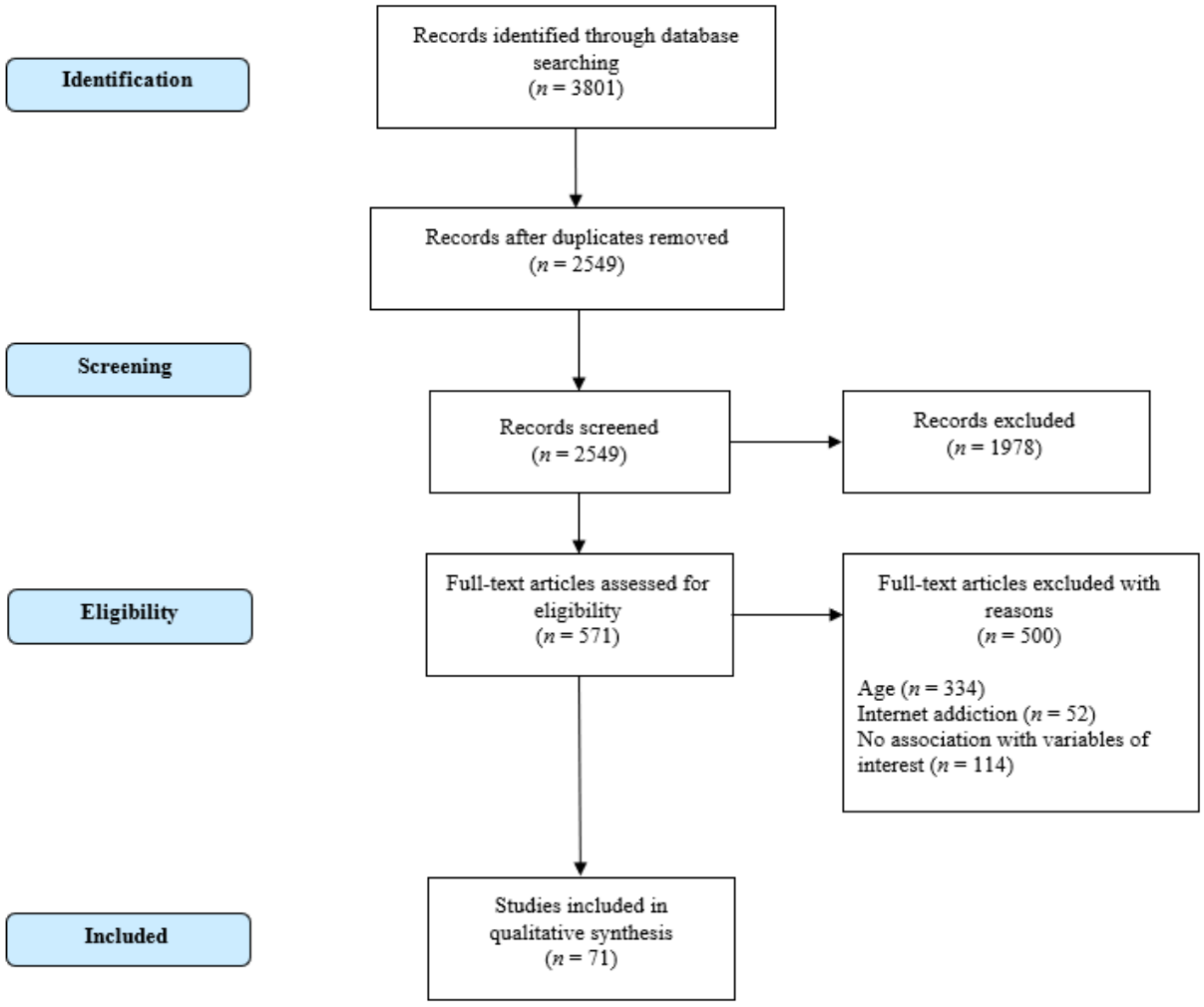

Figure 1. Flow diagram of paper selection process for the systematic review.

Approximately 59% of the studies were published within the past five years (2014-2019), with the majority of the studies being carried out in Canada (*n* = 22), Europe (*n* = 22), and the United States (*n* = 16). Forty-seven studies examined PG (33 cross-sectional and 14 longitudinal), 22 studies examined PVG (18 cross-sectional and five longitudinal) and one cross-sectional study investigated both PG and PVG. A majority of the studies utilized convenience sampling methods (*n* = 49), with others applying random, stratified, or cluster sampling methods. As for the gender

of individuals in study samples, 15 studies reported samples that were more than 60% males and seven studies reported samples that were more than 60% female. The most commonly sampled populations included high-school students (*n* = 23), adolescents/young adults (*n* = 14), and university students (*n* = 11).

Measures

Problem Gambling and Problem Video Gaming. Commonly used measures for PG include: adolescent and adult versions of the South Oaks Gambling Scale (SOGS; Lesieur & Blume, 1987; Winters et al., 1993) (*n* = 20), Diagnostic and Statistical Manual of Mental Disorders-Fourth edition-Multiple Response-Juvenile for pathological gambling (DSM-IV-MR-J; Fisher, 2000) (*n* = 12), Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001) (*n* = 9), and Massachusetts Gambling Screen DSM-IV subscale (MAGS; Shaffer et al., 1994) (*n* = 5). For PVG, the most commonly used measures include: Game Addiction Scale (GAS; Lemmens et al., 2009) (*n* = 5), Internet Gaming Disorder Scale (IGDS; Lemmens et al., 2015) (*n* = 3), DSM-5 criteria for Internet Gaming Disorder (APA, 2013) (*n* = 2), and pathological gaming based on the DSM-IV-R criteria for pathological gambling (APA, 2000) (*n* = 2). Compared to PG, there appeared to be a greater variation in the instruments used to assess PVG, with multiple studies using scales developed specifically for the study in question.

Depressive Symptoms and Conduct Problems. Of the included studies, 20 measured CP, 28 measured DS, and 23 measured both CP and DS. The most commonly used measures for CP include: youth, young adult, and parent versions of the Child Behavior Checklist (CBCL; Achenbach 1997; Achenbach et al., 1991; Achenbach & Edelbrock, 1987) (*n* = 6), Buss-Perry Aggression Questionnaire (BPAQ; Buss & Perry, 1992; Diamond & Magaletta, 2006) (*n* = 6), Diagnostic Interview Schedule for Children for Conduct Disorder (DISC-C; Shaffer et al., 2000)

(*n* = 6), and the Reynolds Adolescent Adjustment Screening Inventory (RAASI; Reynolds, 2001) (*n* = 2). As for DS, commonly used measures include: Composite International Diagnostic Interview-Short Form (CIDI-SF; Kessler et al., 1998) (*n* = 5), Hospital Anxiety and Depression Scale (HADS, Zigmond & Snaith, 1983) (*n* = 5), Depression Anxiety Stress Scale (DASS-21; Lovibond & Lovibond, 1996) (*n* = 4), Beck Depression Inventory I & II (BDI; BDI-II; Beck & Beck, 1972; Beck et al., 1996) (*n* = 4), Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1997) (*n* = 3), and Reynolds Adolescent Depression Scale (RADS; Reynolds, 1987) (*n* = 2).

Conduct Problems

Problem Gambling. A total of 15 studies (11 cross-sectional and four longitudinal) were included investigating the relationship between CP and PG (Appendix A). Seven cross-sectional studies indicated that problem gamblers experienced greater CP compared to those with no gambling problems, with relative risk or odds ratios ranging from 1.01 to 19.6 (Barnes et al., 2011; Brunelle et al., 2012a; Cheung, 2014; Cook et al., 2015; Hayatbakhsh et al., 2013; Welte et al., 2009; Willoughby et al., 2004). Additionally, Brunelle and colleagues (2012b) reported that CP were related to an increased severity of PG in both Internet and non-Internet gamblers. Terrone et al. (2018) investigated the relationship between CP and PG while measuring the moderating role of attachment style. The authors reported that although CP were associated with PG among those with a dismissing-detached attachment style, this was not the case among those with a fearful-avoidant attachment style. The remaining two studies reported non-significant associations between CP and PG (Pace et al., 2013; Widinghoff et al., 2019).

Evidence from cross-sectional studies indicate strong evidence for a positive association between CP and PG. The two cross-sectional studies that did not report significant associations

between CP and PG were similar in that they included a relatively small sample size of males. In their study, Pace and colleagues (2013) report that at-risk (M = 1.09, SD = 0.54) or pathological gamblers (M = 1.19, SD = 0.68), did not differ from non-gamblers (M = 1.11, SD = 0.55) with regards to CP. However, CP did differentiate between at-risk and pathological gamblers. Given the study's small sample size, it is possible that the non-significant difference was related to the lack of statistical power within the analyses. As for Widinghoff et al. (2019), they investigated violent offenders in prison where rates of conduct disorder in the overall sample was of 79.2%. Due to the elevated rates of conduct disorder in the non-PG (77.4%) and PG (88.4%) groups, it is possible that there was a ceiling effect associated with abnormally elevated levels of CP.

Two out of the four longitudinal studies reported significant relationships between CP and PG. Martins et al. (2013) reported that boys with chronically high CP throughout adolescence were more likely to be at-risk or problem gamblers by early adulthood. Martins et al. (2014) expanded on these findings by noting that problem gamblers in early adulthood were more likely to have been arrested before the age of 23 compared to social or non-gamblers. In contrast to these results, two studies of a duration of 2- and 7-years, respectively, reported that CP at age 16 did not predict PG at age 17 (Vitaro et al., 2001) or 23 (Wanner et al., 2009). All four studies sampled predominantly male youth from disadvantaged neighborhoods, with some overlap in the included samples (i.e., Wanner et al., 2009 and Vitaro et al. 2001). As there were differences in the times at which CP was measured between the studies and differences in the types of CP measured, it is possible that the presence of CP (primarily aggression) in early adolescence (Martins et al., 2013), as opposed to CP (primarily delinquency) in later adolescence (Vitaro et al., 2001; Wanner et al., 2009), is of greater importance when predicting PG in young adulthood.

Problem Video Gaming. A total of five studies (four cross-sectional and one longitudinal) investigated the relationship between CP and PVG (Appendix A). All four cross-sectional studies reported significant associations, with three studies finding a positive association between CP and PVG (Kim et al., 2018; Tejeiro et al., 2012; Wartberg et al., 2017), and one study finding that those with a history of CP were less likely to be problem gamers (Ong et al., 2016). Differing results may have been reported in the study by Ong and colleagues (2016) because they investigated a relatively small sample of adolescents presenting at an addiction treatment center in Singapore. Moreover, the authors measured CP dichotomously which does not account for the severity of the behaviors when compared to the other three studies that measured CP continuously.

Only one longitudinal study investigated the prospective relationship between CP and PVG. This study was an extension of Wartberg and colleagues (2017) and they reported that CP at baseline did not predict PVG one year later when accounting for other psychosocial predictors (Wartberg et al., 2019). Overall, there is a paucity of research investigating the association between CP and PVG. Although cross-sectional results are encouraging, longitudinal findings do not confirm the presence of a prospective relationship between CP and PVG.

Depressive Symptoms

Problem Gambling. A total of 18 studies (12 cross-sectional and six longitudinal) investigated the relationship between DS and PG (Appendix B). Ten cross-sectional studies reported significant positive associations between DS and PG. Notably, greater DS were reported among problem gamblers compared to non-problem gamblers (Dowd et al. 2018; Ellenbogen et al., 2007; Martin et al., 2014; Nower et al., 2004; Sanscartier et al., 2018; Stuhldreher et al., 2007; Wohl et al., 2008). Moreover, in linear and logistic regression analyses, DS were

associated with greater PG severity after controlling for various psychosocial and demographic variables (Cosenza et al., 2019; Molde et al., 2009; Nigro et al., 2017).

The remaining two cross-sectional studies reported non-significant associations between DS and PG (Delfabbro & Grabosky, 2016; Pascual-Leone et al., 2011). Pascual-Leone and colleagues (2011) reported a non-significant correlation in their sample which may have been a result of the study's small sample size (N = 200) of university students, with low overall levels of PG (15 reported at-risk or probable pathological gamblers) and DS (23 reported moderate to severe depression). Further, although Delfabbro & Grabosky (2016) reported a moderate effect size of DS on the presence of PG (d = 0.49), this effect became non-significant when controlling for other psychosocial factors including self-esteem and social alienation (correlation coefficients not reported in the study). Overall, based on the cross-sectional studies, there appears to be good evidence for a positive association between DS and PG.

In the six longitudinal studies, two report significant relationships whereby DS predicted PG one-month (Bilevicius et al., 2018), and six-years later (Dussault et al., 2011). Although the remaining four studies indicated cross-sectional associations between DS and PG (Afifi et al., 2016; Chinneck et al., 2016; Edgerton et al., 2018; Edgerton et al., 2015), these relationships were non-significant in the prospective analyses. It is important to note that all four of these studies utilized the same cohort (Manitoba Longitudinal Study of Young Adults) over time periods ranging from one to five years. Furthermore, Bilevicius and colleagues (2018) only had a one-month period between both time points which brings into question whether these results would be maintained over longer periods of time. Lastly, as Dussault and colleagues (2011) focused solely on males living in economically disadvantaged areas, it is possible that these individuals present with different psychosocial developmental trajectories compared to young

adults in the general population. Overall, longitudinal evidence for the relationship between DS and PG is mixed, with a trend towards DS being a poor predictor of PG.

Problem Video Gaming. A total of 10 studies (seven cross-sectional and three longitudinal) investigated the relationship between DS and PVG (Appendix B). To begin, two studies reported that problem gamers endorsed greater DS compared to non-problem gamers (Givron et al., 2018; Van Rooij et al., 2014). Additionally, three studies indicated significant positive associations between DS and PVG when controlling for demographic characteristics and other psychosocial factors (Bonnaire & Baptista, 2019; Männikkö et al., 2015; Vadlin et al., 2016). As for structural equation models, Li and colleagues (2011) report that although the direct path between DS and PVG was non-significant, an indirect path existed via escapism and actual-ideal self-discrepancies. However, Kircaburun and colleagues (2019) identified that DS were a non-significant mediator in the relationship between emotional intelligence and PVG.

All three longitudinal studies reported significant relationships between DS and PVG. Investigating the cross-sectional associations between DS and PVG at each time point, Dang and colleagues (2019) report these associations were significant at baseline and one-year later. As for the prospective results, Guillot and colleagues (2016) report that anhedonia predicted greater levels of PVG one year later (OR = 1.33). Similarly, Liu et al. (2018) report that greater DS at baseline were associated with greater PVG one, two, three and four years later. Given these consistent positive associations in both the cross-sectional and longitudinal research, there appear to be good evidence for the concurrent and temporal associations between DS and PVG.

Conduct Problems and Depressive Symptoms

Problem Gambling. A total of 14 studies (10 cross-sectional and four longitudinal) investigated the relationship between both CP, DS, and PG (Appendix C). Three cross-sectional

studies reported that at-risk and problem gamblers endorsed greater DS and CP compared to low and no risk gamblers (Giralt et al., 2018; Potenza et al., 2011; Yip et al., 2011). Furthermore, in the two studies utilizing latent class analyses, problem gamblers could be separated based on the presence of greater CP or greater DS (Gupta et al., 2013; Kong et al., 2014). Moreover, Gupta and colleagues (2013) also identified a class of problem gamblers with higher levels of both CP and DS.

Alternatively, three cross-sectional studies reported that although the association between CP and PG was significant, the association between DS and PG was not. Although Hardoon and colleagues (2004) reported that problem gamblers endorsed greater levels of CP and DS, only CP were significantly associated with at-risk/probable problem gambling. In the other two studies, problem gamblers were more likely to endorse greater severity of CP but not DS compared to non-problem gamblers (Langhinrichsen-Rohling et al., 2004; Petry & Tawfik, 2001).

As for the remaining studies, Tackett and colleagues (2017) investigated these relationships by gender and reported that although both DS and CP were correlated with PG among women, only CP were significant for men. Finally, Kaminer and colleagues (2002) reported no significant association between either DS and PG, and CP and PG. It is important to note that the study included a small number ($N = 97$) of adolescents diagnosed with psychoactive substance use disorders, where only nine individuals were identified as being at-risk/pathological gamblers. Overall, results from the cross-sectional studies indicated that both CP and DS are generally positively associated with PG, with other studies indicating that only CP were associated with PG. None of the cross-sectional studies indicated that DS was solely associated with PG.

In the four longitudinal studies, two studies reported significant relationships between both DS, CP, and PG. Allami et al. (2017) identified two classes of problem gamblers with higher levels of CP and DS, respectively, and that membership within these classes at age 12 was a significant predictor of PG at age 23. Additionally, Sagoe and colleagues (2017) report that at-risk and PG classes had greater concurrent levels of CP and DS from age 17 to 19. In contrast to these findings, although Allami et al. (2018) utilized the same samples reported in their 2017 study, they identified a third comorbid (high CP and DS) class of adolescents. However, only the high CP and comorbid classes had greater levels of PG at age 16 and 23. Finally, in a 6-year longitudinal study, no significant overall differences in DS and CP were noted across different levels of gambling risk across time. However, sex-dependent effects were identified whereby greater levels of parental-reported CP predicted PG among females, and lower levels of parental-reported CP predicted PG among males (Yücel et al., 2015). Overall, longitudinal findings appear to have established a greater consistency regarding the predictive role of both CP and DS for later PG, followed by CP.

Problem Video Gaming. A total of eight studies (seven cross-sectional and one longitudinal) investigated the relationship between both CP, DS, and PVG (Appendix C). Generally, problem gamers reported greater CP (η^2 = .03-.08; d = 0.71) and DS (η^2 = .03-.15; d = 0.58) than non-problem gamers (Müller et al., 2015; Myrseth & Notelaers, 2018; Stockdale & Coyne, 2018; Torres-Rodrígez et al., 2018; Yu & Cho, 2016). Furthermore, two studies reported that after controlling for psychosocial variables, DS (OR = 3.62; RR = 1.25) and CP (OR = 2.97; RR = 1.24) were significantly associated with PVG (Desai et al., 2010; Strittmatter et al., 2015).

One longitudinal study investigated the predictive role of both CP and DS on later PVG. In this study, Krossbakken and colleagues (2018) reported that both DS (β = .11-.12) and CP (β

= .08) predicted PVG. Moreover, both CP (OR = 1.10-1.11) and DS (OR = 1.11) predicted membership to the group of problem gamers one year, but not two years later. Overall, all seven cross-sectional studies and the one longitudinal study reported significant associations between both DS, CP and PVG. Although there is strong cross-sectional evidence, with results indicating that the association may be stronger for DS compared to CP, the paucity of longitudinal research limits the extent to which conclusions can be drawn regarding the predictive role of CP and DS on PVG.

Problem Gambling and Problem Video Gaming. One cross-sectional study measured both PG and PVG, in addition to CP and DS (Appendix C). In a sample of German students (Walther, Morgenstern, & Hanewinkel, 2012), multivariate analyses controlling for demographic characteristics and parental monitoring indicated that problem gamers reported greater CP, but not greater DS compared to non-problem gamers. However, problem gamblers did not report greater CP or DS in the multivariate models, even if those with problem gambling reported greater CP in the univariate model. It is noteworthy that in this study, only a small proportion of individuals were identified as problem or probable pathological gamblers (1.3%).

Discussion

The aim of this systematic review was to provide an overview of research identifying the relationship between CP, DS and both PG and PVG among adolescents and young adults. Overall, the results from these studies indicate important distinctions in the role of CP and DS as risk factors for PG and PVG. Present findings are consistent with the wider literature identifying both CP and DS as significantly associated with PG (Dowling et al., 2017; Johansson et al., 2009; Shead et al., 2010) and PVG (Brezing et al., 2010; Kuss & Griffiths, 2012; Sugaya et al., 2019). What is novel in the present review is the identification of the extent to which these

claims can be made among adolescents and young adults, with an emphasis on the quantity and methodological quality of studies and the differences between the concurrent and prospective associations. Based on theoretical models for the development of addictive behaviors, there appears to be greater evidence for a combined pathway (Englund & Siebenbruner, 2012; Maslowsky et al., 2014) for the development of both PG and PVG, an externalizing pathway (Zucker, 1994; Zucker et al., 2011) for the development of PG, and an internalizing pathway (Hussong et al., 2011; Trucco et al., 2018) for the development of PVG. These results suggest that although both CP and DS are generally associated with PG and PVG, they may exert different effects on the development of these problem behaviors.

The difference in the extent to which CP and DS are related to PG and PVG warrants further discussion. To begin, CP were identified as a greater risk factor for PG when compared to PVG. In the broader literature, CP have been frequently associated with PG under a general pattern of co-occurring problem behaviors as a result of shared etiological factors (Blaszczynski & Nower, 2002; Jessor & Jessor, 1977; Welte et al., 2004). For instance, risk factors for antisocial behaviors and conduct problems include impulsivity and behavioral disinhibition, which may explain why these individuals are at a greater risk for later PG. As impulsivity has been identified as increasing the risk for both adolescent PG (Secades-Villa et al., 2016) and conduct problems (Ahmad & Hinshaw, 2017; Olson et al., 1999), it may be an important factor in the etiology of both behaviors. Overall, these predispositions would be consistent with what has been identified for the externalizing pathway (Zucker, 1994; Zucker et al., 2011).

As for gaming, PVG has not typically been associated with CP, nor included under the classic umbrella of the problem behaviors (Welte et al., 2004). Indeed, there are noteworthy differences between gambling and gaming which may differentiate the two including the legality

of the activity for adolescents and the close connection of youth gambling with other delinquent acts (Burleigh et al., 2019; Welte et al., 2004). An important point of distinction here may be that video game playing in youth is not as strongly associated with delinquency when compared to gambling. Additionally, all five included studies investigating PVG and CP were comprised primarily of samples of youth in early adolescence, with aggressive behaviors being more prominent in childhood and early adolescence and delinquent behaviors typically peaking in late adolescence (Fonagy & Luyten, 2018; Hawkins et al., 2002). As such, the age of the samples could potentially explain why evidence for the association between delinquency and PVG is mixed. Nevertheless, it is possible that specific conduct problems such as aggression and rule-breaking may pose a higher risk for PVG compared to others including violent or delinquent behaviors. A potential common factor underlying aggression, rule-breaking and problem gaming could be impulsivity (specifically, impulsive decision making and urgency), which has been found to be more prominent among problem gamers (Billieux et al., 2011, 2015; Tian et al., 2018). Given the paucity of research in this domain, further research is necessary to elucidate the differences between specific conduct problems and their predictive value for PVG.

DS appear to be more consistently associated with PVG in both cross-sectional and longitudinal studies. For one, it is possible that the difficulties with emotional coping and emotional dysregulation experienced by those with elevated DS is related to the development of PVG. As the included studies investigating DS and PVG were comprised of samples ranging from early adolescence to young adulthood, it would appear as though these associations are present across these developmental periods. These predispositions and risk factors would be consistent with the internalizing pathway (Hussong et al., 2011; Trucco et al., 2018). Moreover, symptoms of PVG as outlined in the DSM-5 (APA, 2013) and ICD-11 (WHO, 2019) include a

loss of interest in previous hobbies/activities, negative emotions (e.g., irritability, sadness) when gaming it taken away, and the use of games to relieve a negative mood (e.g., guilt). These symptoms have important overlaps with those of depression, which include anhedonia, depressed mood, and feelings of worthlessness or inappropriate guilt (APA, 2013). As such, it is possible that these two disorders share symptomatology in a manner that creates a downward spiral of DS and PVG, leading to a significant deterioration of psychological wellbeing over time. However, evidence for these temporal relationships are limited to samples of university students and emerging adults, with additional research being necessary to establish these links in early adolescents. Although similar claims could be made for PG and DS, temporal interrelationships remain inconclusive with stronger evidence for their concurrent associations. Given that gambling is an age-restricted activity in most jurisdictions, it is possible that these prospective associations become clearer later in adulthood.

Based on the included studies, the presence of both CP and DS appear to increase the risk for the development of PG and PVG. Although CP and DS are etiologically heterogeneous (Angold et al., 1999), this would be consistent with the combined pathway (Englund & Siebenbruner, 2012; Maslowsky et al., 2014). A potential hypothesized mechanism underlying this comorbid association could be the role of poor impulse control and emotion dysregulation (Angold et al., 1999; Caspi & Moffitt, 2018). Of note, poor impulse control and emotion dysregulation could explain the shared variance of internalizing (e.g., depression) and externalizing (e.g., conduct) problems, their continuity over time, and the later emergence of addictive behaviors due to poor behavioral inhibition and continued engagement in the behavior as a maladaptive learned coping strategy. Moreover, it is also possible that the predisposition towards poor impulse control or emotion dysregulation is related to gender, with Tackett and

colleagues (2017) reporting that PG among young adult males could be related to risk-taking and impulsivity (as represented by CP) and PG among young adult females being related to affective dysregulation (as represented by DS). However, heightened CP among females may also be indicative of maladjustment (Crick, 1997), which is consistent with the findings by Yücel et al. (2015) identifying that higher levels of aggressive behavior in early adolescent females predicted PG in late adolescence. Overall, further research investigating the effect of CP and DS at different time-points across adolescence and young adulthood, while isolating the effects for males and females, will be essential to understand whether the presence of these symptoms at different times represents a greater or lesser risk for the development of PG and PVG.

A major limitation of the included research studies is the shortage of longitudinal research investigating PG and PVG. Although 14 studies were included investigating the predictive role of CP and/or DS on later PG, only five studies were included with regards to PVG. As such, additional studies are necessary to draw clear conclusions regarding the predictive role of both of these risk factors for later PVG. Furthermore, there is a pressing need for greater consistency in the instruments used to measure PVG in order to ensure that different researchers are measuring the same latent construct. Additionally, there is a need to investigate the interaction of these two variables in the way they predict PG or PVG. Understanding the interaction CP and DS in predicting PG and PVG will lead to important insights regarding the complexity of these symptoms with the potential of identifying youth at the highest risk for these problem behaviors and more concrete evidence for the combined pathway. Moreover, only one study investigated both PG and PVG among adolescents and young adults (Walther, Morgenstern, & Hanewinkel, 2012). Further research is necessary to clarify the developmental pathways of behavioral addictions and whether youth who report problems with one behavior are

at a greater risk of experiencing problems with another at the same or a later time. Although gambling and gaming disorder are the only two formally recognized behavioral addictions (APA, 2013; ICD, 2018), other potential behavioral addictions such as problematic use of the Internet, sex, shopping, tanning, and exercising (Grant et al., 2010; Petry et al., 2018) could be considered in relation to the risk factors examined in this review in addition to their potential co-occurrence with PG and PVG.

Limitations

Although the present review identified and clarified the role of CP and DS on the development of PG and PVG, it is subject to a number of limitations. First, it is possible that some articles were missed in the systematic search due to relevant terms (i.e., keywords for CP and DS) not being included in the areas searched by the MeSH and multi-purpose terms. Although the present study sought to identify articles with CP and DS as independent variables, it is possible that some published articles did not mention these terms in the title, abstract, keywords, headings and/or subject headings, although they were included in the study. As such, certain articles may have been omitted although they could have reported on the associations between the variables of interest. Second, the methodology used in the present review was primarily descriptive with the aim of investigating a breadth of literature. As such, no statistical conclusions can be drawn from the results. Third, the review was limited to English and French peer-reviewed journal publications identified on the five selected databases. Given these criteria, the authors may have omitted studies from other countries that were unavailable through the selected databases. Fourth, although clear inclusion and exclusion criteria and a high inter-rater reliability was established, the review, screening, and selection process is subjective and prone to certain biases. Fifth, a diversity of instruments measuring the constructs of interest (i.e., CP, DS,

PG and PVG) were utilized which may have resulted in the measurement of slightly different constructs between studies. Finally, this review focused on adolescents and young adults and did not include children or older adults. Future reviews should aim to investigate the relative role of CP and DS in predicting PG and PVG across the lifespan.

Conclusions

While research in the domain of behavioral addictions is still in its early stages, the results of this review provide preliminary evidence regarding the role of CP and DS as risk factors for PG and PVG. Additionally, this review presents a novel way of investigating the development of PG and PVG, by drawing from a theoretical framework informed by the SUD literature and applying it to non-substance addictive behaviors. Presently, it appears as though there is significant evidence suggesting the importance of a combined pathway, including the presence of both CP and DS, in the development of PG and PVG. However, there also appears to be some evidence for an externalizing pathway for PG, and evidence for an internalizing pathway for PVG. Given the potential for adolescents and young adults to experience early CP or DS, prevention and intervention efforts should focus on intervening in an integrative manner in order to address multiple, potentially interacting problems simultaneously.

References

Achenbach, T. M. (1997). *Manual for the Young Adult Self-Report and Young Adult Behaviour Checklist.* Burlington (VT): Department of Psychiatry, University of Vermont.

Achenbach, T. M., & Edelbrock, C. (1987). *The Manual for the Youth Self-Report and Profile.* Burlington: University of Vermont.

Achenbach, T. M., Howell, C. T., Quay, H. C., Conners, C. K., & Bates, J. E. (1991). National survey of problems and competencies among four- to sixteen-year-olds: Parents' reports for normative and clinical samples. *Monographs of the Society for Research in Child Development, 56*(3), 1–130. 10.2307/1166156

Afifi, T. O., Nicholson, R., Martins, S. S., & Sareen, J. (2016). A longitudinal study of the temporal relation between problem gambling and mental and substance use disorders among young adults. *Canadian Journal of Psychiatry - Revue Canadienne de Psychiatrie, 61*(2), 102-111. doi:10.1177/0706743715625950

Ahmad, S. I., & Hinshaw, S. P. (2017). Attention-deficit/hyperactivity disorder, trait impulsivity, and externalizing behavior in a longitudinal sample. *Journal of Abnormal Child Psychology, 45,* 1077–1089 (2017). https://doi.org/10.1007/s10802-016-0226-9

Allami, Y., Vitaro, F., Brendgen, M., Carbonneau, R., Lacourse, É., & Tremblay, R. E. (2017). A longitudinal empirical investigation of the Pathways Model of problem gambling. *Journal of Gambling Studies, 33*(4), 1153-1167. doi:10.1007/s10899-017-9682-6

Allami, Y., Vitaro, F., Brendgen, M., Carbonneau, R., & Tremblay, R. E. (2018). Identifying at-risk profiles and protective factors for problem gambling: A longitudinal study across adolescence and early adulthood. *Psychology of Addictive Behaviors, 32*(3), 373-382. doi:10.1037/adb0000356

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders: DSM-IV* (4th ed.). Washington, DC: American Psychiatric Association.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders: DSM-IV-R* (4th ed., text rev.). Washington, DC: American Psychiatric Association.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed.). Washington, DC: American Psychiatric Association.

Angold, A., Costello, E. J., & Erkanli, A. (1999). Comorbidity. *Journal of Child Psychology and Psychiatry, 40*(1), 57-87. doi:10.1111/1469-7610.00424

Barnes, G. M., Welte, J. W., Hoffman, J. H., & Tidwell, M. C. O. (2011). The co-occurrence of gambling with substance use and conduct disorder among youth in the United States. *American Journal on Addictions, 20*(2), 166-173. doi:10.1111/j.1521-0391.2010.00116.x.

Beck, A. T., & Beck, R. W. (1972). Screening depressed patients in family practice: A rapid technique. *Postgraduate Medical Journal, 52,* 81–85.

Beck, A.T., Steer, R.A., Ball, R., & Ranieri, W. (1996). Comparison of Beck depression inventories -IA and -II in psychiatric outpatients. *Journal of Personality Assessment, 67* (3), 588–597.

Benarous, X., Morales, P., Mayer, H., Iancu, C., Edel, Y., & Cohen, D. (2019). Internet gaming disorder in adolescents with psychiatric disorder: Two case reports using a developmental framework. *Frontiers in Psychiatry, 10*(336). doi:10.3389/fpsyt.2019.00336

Bilevicius, E., Single, A., Bristow, L. A., Foot, M., Ellery, M., Keough, M. T., & Johnson, E. A. (2018). Shame mediates the relationship between depression and addictive behaviours. *Addictive Behaviors, 82,* 94-100. doi:10.1016/j.addbeh.2018.02.023

Billieux, J., Chanal, J., Khazaal, Y., Rochat, L., Gay, P., Zullino, D., et al. (2011). Psychological predictors of problematic involvement in massively multiplayer online role-playing games: Illustration in a sample of male cybercafe players. *Psychopathology, 44,* 165–171. doi: 10.1159/000322525

Billieux, J., Thorens, G., Khazaal, Y., Zullino, D., Achab, S., & Van der Linden, M. (2015). Problematic involvement in online games: A cluster analytic approach. *Computers in Human Behavior, 43,* 242-250. doi:https://doi.org/10.1016/j.chb.2014.10.055

Blaszczynski, A., & Nower, L. (2002). A pathways model of problem and pathological gambling. *Addiction, 97*(5), 487-499. doi:10.1046/j.1360-0443.2002.00015.x

Bonnaire, C., & Baptista, D. (2019). Internet gaming disorder in male and female young adults: The role of alexithymia, depression, anxiety and gaming type. *Psychiatry Research, 272,* 521-530. doi:10.1016/j.psychres.2018.12.158

Brezing, C., Derevensky, J. L., & Potenza, M. N. (2010). Non-substance-addictive behaviors in youth: Pathological gambling and problematic Internet use. *Child and Adolescent Psychiatric Clinics of North America, 19*(3), 625-641. doi:10.1016/j.chc.2010.03.012

Brunelle, N., Leclerc, D., Cousineau, M. M., Dufour, M., & Gendron, A. (2012a). Relationship between virtual games of chance and money and certain deviant behaviors among Quebec youth. *Criminologie, 45*(2), 107-132. https://www.jstor.org/stable/42745760

Brunelle, N., Leclerc, D., Cousineau, M.-M., Dufour, M., Gendron, A., & Martin, I. (2012b). Internet gambling, substance use, and delinquent behavior: An adolescent deviant

behavior involvement pattern. *Psychology of Addictive Behaviors, 26*(2), 364-370. doi:10.1037/a0027079

Burleigh, T. L., Griffiths, M. D., Sumich, A., Stavropoulos, V., & Kuss, D. J. (2019). A systematic review of the co-occurrence of gaming disorder and other potentially addictive behaviors. *Current Addiction Reports, 6*(4), 383-401. doi:10.1007/s40429-019-00279-7

Buss, A. H., & Perry, M. (1992). The aggression questionnaire. *Journal of Personality and Social Psychology, 63*, 452-459.

Calado, F., Alexandre, J., & Griffiths, M. D. (2017). Prevalence of adolescent problem gambling: A systematic review of recent research. *Journal of Gambling Studies, 33*(2), 397-424. doi:10.1007/s10899-016-9627-5

Cheng, C., Cheung, M. W., & Wang, H.-Y. (2018). Multinational comparison of Internet gaming disorder and psychosocial problems versus well-being: Meta-analysis of 20 countries. *Computers in Human Behavior, 88*, 153-167. doi:10.1016/j.chb.2018.06.033

Cheung, N. W. (2014). Low self-control and co-occurrence of gambling with substance use and delinquency among Chinese adolescents. *Journal of Gambling Studies, 30*(1), 105-124. doi:10.1007/s10899-012-9351-8

Chinneck, A., Mackinnon, S. P., & Stewart, S. H. (2016). Investigating possible reciprocal relations between depressive and problem gambling symptoms in emerging adults. *The Canadian Journal of Psychiatry / La Revue canadienne de psychiatrie, 61*(2), 93-101. doi:10.1177/0706743715625934

Cook, S., Turner, N. E., Ballon, B., Paglia-Boak, A., Murray, R., Adlaf, E. M., Ilie, G., den Dunnen, W., & Mann, R. E. (2015). Problem gambling among Ontario students: Associations with substance abuse, mental health problems, suicide attempts, and

delinquent behaviours. *Journal of Gambling Studies, 31*(4), 1121-1134. doi:10.1007/s10899-014-9483-0

Cosenza, M., Ciccarelli, M., & Nigro, G. (2019). Decision-making styles, negative affectivity, and cognitive distortions in adolescent gambling. *Journal of Gambling Studies, 35*(2), 517-531. doi:10.1007/s10899-018-9790-y

Crick, N. R. (1997). Engagement in gender normative versus nonnormative forms of aggression: Links to social–psychological adjustment. *Developmental Psychology, 33*(4), 610–617. https://doi.org/10.1037/0012-1649.33.4.610

Dang, D. L., Zhang, M. X., Leong, K. K.-H., & Wu, A. M. S. (2019). The predictive value of emotional intelligence for internet gaming disorder: A 1-year longitudinal study. *International Journal of Environmental Research and Public Health, 16*(15), 2762. doi:10.3390/ijerph16152762

Dean, J., & Keshavan, M. (2017). The neurobiology of depression: An integrated view. *Asian Journal of Psychiatry, 27*, 101-111. doi:10.1016/j.ajp.2017.01.025

Delfabbro, P., Lahn, J., & Grabosky, P. (2006). Psychosocial correlates of problem gambling in Australian students. *Australian & New Zealand Journal of Psychiatry, 40*(6), 587-595. doi:10.1080/j.1440-1614.2006.01843.x

Derevensky, J. (2019). Behavioral addictions: Some developmental considerations. *Current Addiction Reports*. doi:10.1007/s40429-019-00257-z

Desai, R. A., Krishnan-Sarin, S., Cavallo, D., & Potenza, M. N. (2010). Video-gaming among high school students: Health correlates, gender differences, and problematic gaming. *Pediatrics, 126*(6), e1414-1424. doi:10.1542/peds.2009-2706

Diamond, P. M., & Magaletta, P. R. (2006). The short-form Buss-Perry Aggression Questionnaire (BPAQ-SF): A validation study with federal offenders. *Assessment, 13*, 227–240. doi: 10.1177/1073191106287666

Dowd, D. A., Keough, M. T., Jakobson, L. S., Bolton, J. M., & Edgerton, J. D. (2018). A latent class analysis of young adult gamblers from the Manitoba Longitudinal Survey of Young Adults. *International Gambling Studies, 19,* 148-166. doi:10.1080/14459795.2018.1520909

Dowling, N. A., Merkouris, S. S., Greenwood, C. J., Oldenhof, E., Toumbourou, J. W., & Youssef, G. J. (2017). Early risk and protective factors for problem gambling: A systematic review and meta-analysis of longitudinal studies. *Clinical Psychology Reviews, 51*, 109-124. doi:10.1016/j.cpr.2016.10.008

Dussault, F., Brendgen, M., Vitaro, F., Carbonneau, R., Boivin, M., & Tremblay, R. E. (2016). Co-morbidity between gambling problems and depressive symptoms: A longitudinal perspective of risk and protective factors. *Journal of Gambling Studies, 32*(2), 547-565. doi:10.1007/s10899-015-9546-x

Edgerton, J. D., Keough, M. T., & Roberts, L. W. (2018). Co-development of problem gambling and depression symptoms in emerging adults: A parallel-process latent class growth model. *Journal of Gambling Studies, 34*(3), 949-968. doi:10.1007/s10899-018-9760-4

Edgerton, J. D., Melnyk, T. S., & Roberts, L. W. (2015). Problem gambling and the youth-to-adulthood transition: Assessing problem gambling severity trajectories in a sample of young adults. *Journal of Gambling Studies, 31*(4), 1463-1485. doi:10.1007/s10899-014-9501-2

Ellenbogen, S., Derevensky, J., & Gupta, R. (2007). Gender differences among adolescents with gambling-related problems. *Journal of Gambling Studies, 23*(2), 133-143. doi:10.1007/s10899-006-9048-y

Englund, M. M., & Siebenbruner, J. (2012). Developmental pathways linking externalizing symptoms, internalizing symptoms, and academic competence to adolescent substance use. *Journal of Adolescence, 35*(5), 1123-1140. doi:10.1016/j.adolescence.2012.03.004

Fam, J. Y. (2018). Prevalence of internet gaming disorder in adolescents: A meta-analysis across three decades. *Scandinavian Journal of Psychology.* doi:10.1111/sjop.12459

Ferris J. & Wynne, H. (2001). *The Canadian Problem Gambling Index: User manual.* Ottawa (ON): Canadian Centre of Substance Abuse.

Fisher, S. (2000). Developing the DSM-IV criteria to identify adolescent problem gambling in non-clinical populations. *Journal of Gambling Studies, 16,* 253–273.

Fonagy, P., & Luyten, P. (2018). Conduct problems in youth and the RDoC approach: A developmental, evolutionary-based view. *Clinical Psychology Review, 64,* 57-76. doi:10.1016/j.cpr.2017.08.010

Giralt, S., Müller, K. W., Beutel, M. E., Dreier, M., Duven, E., & Wölfling, K. (2018). Prevalence, risk factors, and psychosocial adjustment of problematic gambling in adolescents: Results from two representative German samples. *Journal of Behavioral Addictions, 7*(2), 339-347. doi:10.1556/2006.7.2018.37

Givron, H., Berrewaerts, J., Houbeau, G., & Desseilles, M. (2018). Problematic use of internet and video games in students in medicine. *Sante Mentale Au Quebec, 43*(1), 101-121. doi:10.7202/1048897ar

González-Bueso, V., Santamaría, J., Fernández, D., Merino, L., Montero, E., & Ribas, J. (2018). Association between Internet gaming disorder or pathological video-game use and comorbid psychopathology: A comprehensive review. *International Journal of Environmental Research and Public Health, 15*(4), 668. doi:10.3390/ijerph15040668

Grant, J. E., Potenza, M. N., Weinstein, A., & Gorelick, D. A. (2010). Introduction to behavioral addictions. *The American Journal of Drug and Alcohol Abuse, 36*(5), 233-241. doi:10.3109/00952990.2010.491884

Griffiths, M. (2005). Relationship between gambling and video-game playing: A response to Johansson and Götestam. *Psychological Reports, 96,* 644–646. doi:10.2466/pr0.96.3.644-646

Griffiths, M. D. (2008). Digital impact, crossover technologies and gambling practices. *Casino & Gaming International, 4*, 37–42. http://irep.ntu.ac.uk/id/eprint/883

Griffiths, M. D. (2018). Is the buying of loot boxes in video games a form of gambling or gaming? *Gaming Law Review: Regulation, Compliance, and Policy, 22*(1), 52-54.

Griffiths, M. D., Kuss, D. J., & King, D. L. (2012). Video game addiction: Past, present and future. *Current Psychiatry Reviews, 8,* 308–318.

Griffiths, M. D., Kuss, D. J., Lopez-Fernandez, O., & Pontes, H. M. (2017). Problematic gaming exists and is an example of disordered gaming. *Journal of Behavioral Addictions, 6*(3), 296-301. doi:10.1556/2006.6.2017.037

Guillot, C. R., Bello, M. S., Tsai, J. Y., Huh, J., Leventhal, A. M., & Sussman, S. (2016). Longitudinal associations between anhedonia and internet-related addictive behaviors in emerging adults. *Computers in Human Behavior, 62,* 475-479. doi:10.1016/j.chb.2016.04.019.

Gupta, R., Nower, L., Derevensky, J. L., Blaszczynski, A., Faregh, N., & Temcheff, C. (2013). Problem gambling in adolescents: An examination of the Pathways Model. *Journal of Gambling Studies, 29*(3), 575-588. doi:10.1007/s10899-012-9322-0

Hardoon, K. K., Gupta, R., & Derevensky, J. L. (2004). Psychosocial variables associated with adolescent gambling. *Psychology of Addictive Behaviors, 18*(2), 170-179. doi:10.1037/0893-164X.18.2.170

Hawkins, J. D., Smith, B. H., & Catalano, R. F. (2002). Delinquent behavior. *Pediatrics in Review, 23*(11), 387-392. doi:10.1542/pir.23-11-387

Hayatbakhsh, M. R., Clavarino, A., Williams, G. M., Bor, W., & Najman, J. M. (2013). Young adults' gambling and its association with mental health and substance use problems. *Australian and New Zealand Journal of Public Health, 36*(2), 160-166. doi:10.1111/j.1753-6405.2011.00815.x.

Hilgard, J., Engelhardt, C. R., & Bartholow, B. D. (2013). Individual differences in motives, preferences, and pathology in video games: The gaming attitudes, motives, and experiences scales (GAMES). *Frontiers in Psychology, 4*, 1–13. doi:10.3389/fpsyg.2013.00608

Hussong, A. M., Jones, D. J., Stein, G. L., Baucom, D. H., & Boeding, S. (2011). An internalizing pathway to alcohol use and disorder. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 25*(3), 390–404. doi:10.1037/a0024519

James, R. J. E., & Tunney, R. J. (2017). The need for a behavioural analysis of behavioural addictions. *Clinical Psychology Review, 52,* 69-76. doi:https://doi.org/10.1016/j.cpr.2016.11.010

Jessor, R. & Jessor, S. L. (1977). *Problem Behavior and Psychosocial Development: A Longitudinal Study of Youth.* New York: Academic Press.

Johansson, A., Grant, J. E., Kim, S. W., Odlaug, B. L., & Gotestam, K. G. (2009). Risk factors for problematic gambling: a critical literature review. *Journal of Gambling Studies, 25*(1), 67-92. doi:10.1007/s10899-008-9088-6

Kaminer, Y., Burleson, J. A., & Jadamec, A. (2002). Gambling behavior in adolescent substance abuse. *Substance Abuse, 23*(3), 191-198. doi:10.1080/08897070209511489

Kessler, R. C., Andrews, G., Mroczek, D., Ustun, B., & Wittchen, H. U. (1998). The World Health Organization composite international diagnostic interview short-form (CIDI-SF). *International Journal of Methods in Psychiatric Research, 7*(4), 171-185.

Khoddam, R., Jackson, N. J., & Leventhal, A. M. (2016). Internalizing symptoms and conduct problems: Redundant, incremental, or interactive risk factors for adolescent substance use during the first year of high school?. *Drug and Alcohol Dependence, 169,* 48–55. doi:10.1016/j.drugalcdep.2016.10.007

Kim, E., Yim, H. W., Jeong, H., Jo, S. J., Lee, H. K., Son, H. J., & Han, H. H. (2018). The association between aggression and risk of Internet gaming disorder in Korean adolescents: The mediation effect of father-adolescent communication style. *Epidemiology and Health, 40,* e2018039. doi:10.4178/epih.e2018039

King, D., Delfabbro, P., & Griffiths, M. (2010). The convergence of gambling and digital media: Implications for gambling in young people. *Journal of Gambling Studies, 26,* 175–187. doi:10.1007/s10899-009-9153-9.

King, D. L., Gainsbury, S. M., Delfabbro, P. H., Hing, N., & Arabanel, B. (2015). Distinguishing between gaming and gambling activities in addiction research. *Journal of Behavioral Addictions, 4*, 215–220. doi:10.1556/2006.4.2015.045

Kircaburun, K., Griffiths, M. D., & Billieux, J. (2019). Trait emotional intelligence and problematic online behaviors among adolescents: The mediating role of mindfulness, rumination, and depression. *Personality and Individual Differences, 139*, 208-213. doi:10.1016/j.paid.2018.11.024

Kong, G., Tsai, J., Krishnan-Sarin, S., Cavallo, D. A., Hoff, R. A., Steinberg, M. A., Rugle, L. & Potenza, M. N. (2014). A latent class analysis of pathological-gambling criteria among high school students: Associations with gambling, risk and health/functioning characteristics. *Journal of Addiction Medicine, 8*(6), 421-430. doi:10.1097/ADM.0000000000000074.

Krossbakken, E., Pallesen, S., Mentzoni, R. A., King, D. L., Molde, H., Finseras, T. R., & Torsheim, T. (2018). A cross-lagged study of developmental trajectories of video game engagement, addiction, and mental health. *Frontiers in Psychology*, *9.* doi: 10.3389/fpsyg.2018.02239

Kuss, D. J., & Griffiths, M. D. (2012). Online gaming addiction in children and adolescents: A review of empirical research. *Journal of Behavioral Addictions, 1*(1), 3-22. doi:10.1556/jba.1.2012.1.1

Langhinrichsen-Rohling, J., Rohde, P., Seeley, J. R., & Rohling, M. L. (2004). Individual, family, and peer correlates of adolescent gambling. *Journal of Gambling Studies, 20*(1), 23-46. doi:10.1023/B:JOGS.0000016702.69068.53

Lemmens, J.S., Valkenburg, P.M., & Peter, J. (2009). Development and validation of a game addiction scale for adolescents. *Journal of Media Psychology, 12*, 77–95. https://doi.org/10.1080/15213260802669458.

Lemmens, J. S., Valkenburg, P. M., & Gentile, D. A. (2015) The internet gaming disorder scale. *Psychological Assessment 27*, 567–582.

Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of pathological gamblers. *American Journal of Psychiatry, 144*(9), 1184–1188.

Li, D., Liau, A., & Khoo, A. (2011). Examining the influence of actual-ideal self-discrepancies, depression, and escapism, on pathological gaming among massively multiplayer online adolescent gamers. *Cyberpsychology, Behavior and Social Networking, 14*(9), 535-539. doi:10.1089/cyber.2010.0463

Li, W., Mills, D., & Nower, L. (2019). The relationship of loot box purchases to problem video gaming and problem gambling. *Addictive Behaviors, 97*, 27–34. https://doi.org/10.1016/j.addbeh.2019.05.016

Liu, L., Yao, Y. W., Li, C. S. R., Zhang, J. T., Xia, C. C., Lan, J., Ma, S. S., Zhou, N., & Fang, X. Y. (2018). The comorbidity between internet gaming disorder and depression: Interrelationship and neural mechanisms. *Frontiers in Psychiatry, 9.* doi:10.3389/fpsyt.2018.00154

Lorains, F. K., Cowlishaw, S., & Thomas, S. A. (2011). Prevalence of comorbid disorders in problem and pathological gambling: systematic review and meta-analysis of population surveys. *Addiction, 106*(3), 490-498. doi:10.1111/j.1360-0443.2010.03300.x

Lovibond, S. H., & Lovibond, P. F. (1996). *Manual for the Depression Anxiety Stress Scales*. Psychology Foundation of Australia: Sydney, Australia.

Mader, J., Christensen, D. R., & Williams, R. J. (2019). An evaluation of the pathways model using the Quinte Longitudinal dataset. *International Gambling Studies, 19*(3), 417-431. doi:10.1080/14459795.2019.1602158

Mannikko, N., Billieux, J., & Kaariainen, M. (2015). Problematic digital gaming behavior and its relation to the psychological, social and physical health of Finnish adolescents and young adults. *Journal of Behavioral Addictions, 4*(4), 281-288. doi:10.1556/2006.4.2015.040

Martin, R. J., Usdan, S., Cremeens, J., & Vail-Smith, K. (2014). Disordered gambling and co-morbidity of psychiatric disorders among college students: An examination of problem drinking, anxiety and depression. *Journal of Gambling Studies, 30*(2), 321-333. doi:10.1007/s10899-013-9367-8

Martins, S. S., Lee, G. P., Santaella, J., Liu, W. W., Ialongo, N. S., & Storr, C. L. (2014). Age of first arrest varies by gambling status in a cohort of young adults. *American Journal on Addictions, 23*(4), 386-392. doi:10.1111/j.1521-0391.2014.12121.x.

Martins, S. S., Liu, W. W., Hedden, S. L., Goldweber, A., Storr, C. L., Derevensky, J. L., Stinchfield, R., Ialongo, N. S., & Petras, H. (2013). Youth aggressive/disruptive behavior trajectories and subsequent gambling among urban male youth. *Journal of Clinical Child and Adolescent Psychology, 42*(5), 657-668. doi:10.1080/15374416.2013.764827.

Marchica, L. A., Mills, D. J., Derevensky, J. L., & Montreuil, T. C. (2019). The role of emotion regulation in video gaming and gambling disorder: A systematic review. *Canadian Journal of Addiction, 10*(4), 19-29. doi:10.1097/cxa.0000000000000070

Maslowsky, J., Schulenberg, J. E., & Zucker, R. A. (2014). Influence of conduct problems and depressive symptomatology on adolescent substance use: Developmentally proximal versus distal effects. *Developmental Psychology, 50*(4), 1179–1189. doi:10.1037/a0035085

Mihara, S., & Higuchi, S. (2017). Cross-sectional and longitudinal epidemiological studies of Internet gaming disorder: A systematic review of the literature. *Psychiatry and Clinical Neuroscience, 71*(7), 425-444. doi:10.1111/pcn.12532

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Medicine, 6*(7), e1000097. doi:10.1371/journal.pmed.1000097

Molde, H., Pallesen, S., Bartone, P., Hystad, S., & Johnsen, B. H. (2009). Prevalence and correlates of gambling among 16 to 19-year-old adolescents in Norway: Personality and Social Sciences. *Scandinavian Journal of Psychology, 50*(1), 55-64. doi:10.1111/j.1467-9450.2008.00667.x

Moon, M., Lister, J. J., Milosevic, A., & Ledgerwood, D. M. (2017). Subtyping non-treatment-seeking problem gamblers using the pathways model. *Journal of Gambling Studies, 33*, 841–853. https://doi.org/10.1007/s10899-016-9658-y

Müller, K. W., Janikian, M., Dreier, M., Wölfling, K., Beutel, M. E., Tzavara, C., Richardson, C., & Tsitsika, A. (2015). Regular gaming behavior and internet gaming disorder in European adolescents: Results from a cross-national representative survey of prevalence, predictors, and psychopathological correlates. *European Child and Adolescent Psychiatry, 24*(5), 565-574. doi:10.1007/s00787-014-0611-2

Myrseth, H., & Notelaers, G. (2018). A latent class approach for classifying the problem and disordered gamers in a group of adolescence. *Frontiers in Psychology, 9*(2273). doi:10.3389/fpsyg.2018.02273

National Research Council. (1999). *Pathological gambling: A critical review*. Washington, DC: The National Academies Press. https://doi.org/10.17226/6329

Nigro, G., Cosenza, M., & Ciccarelli, M. (2017). The blurred future of adolescent gamblers: Impulsivity, time horizon, and emotional distress. *Frontiers in Psychology, 8*. doi:10.3389/fpsyg.2017.00486

Nower, L., Gupta, R., Blaszczynski, A., & Derevensky, J. (2004). Suicidality and depression among youth gamblers: A preliminary examination of three studies. *International Gambling Studies, 4*(1), 69-80. doi:10.1080/1445979042000224412

Nower, L., Martins, S. S., Lin, K.-H., & Blanco, C. (2013). Subtypes of disordered gamblers: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Addiction, 108*(4), 789-798. doi:10.1111/add.12012

Olson, S. L., Schilling, E. M. & Bates, J. E. (1999). Measurement of impulsivity: Construct coherence, longitudinal stability, and relationship with externalizing problems in middle childhood and adolescence. *Journal of Abnormal Child Psychology, 27,* 151–165. https://doi.org/10.1023/A:1021915615677

Ong, R. H. S., Peh, C. X., & Guo, S. (2016). Differential risk factors associated with adolescent addictive disorders: A comparison between substance use disorders and internet/gaming addiction. *International Journal of Mental Health and Addiction, 14*(6), 993-1002. doi:10.1007/s11469-016-9676-0

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan: A web and mobile app for systematic reviews. *Systematic Reviews, 5*: 210. doi:10.1186/s13643-016-0384-4

Pace, U., Schimmenti, A., Zappulla, C., & Di Maggio, R. (2013). Psychological variables characterizing different types of adolescent gamblers: A discriminant function analysis. *Clinical Neuropsychiatry: Journal of Treatment Evaluation, 10*(6), 253-259. doi:10.1037/t03938-000

Pascual-Leone, A., Gomes, K., Orr, E. S., Kaploun, K. A., & Abeare, C. A. (2011). Affective and cognitive correlates of gambling behavior in university students. *Journal of Gambling Studies, 27*(3), 401-408. doi:10.1007/s10899-010-9226-9

Paulus, F. W., Ohmann, S., von Gontard, A., & Popow, C. (2018). Internet gaming disorder in children and adolescents: A systematic review. *Developmental Medicine & Child Neurology,* 60(7), 645-659. doi:10.1111/dmcn.13754

Petry, N. M., & Tawfik, Z. (2001). Comparison of problem-gambling and non-problem-gambling youths seeking treatment for marijuana abuse. *Journal of the American Academy of Child & Adolescent Psychiatry, 40*(11), 1324-1331. doi:10.1097/00004583-200111000-00013

Petry, N. M., Zajac, K., & Ginley, M. K. (2018). Behavioral addictions as mental disorders: To be or not to be? *Annual Review of Clinical Psychology, 14*(1), 399-423. doi:10.1146/annurev-clinpsy-032816-045120

Potenza, M. N. (2014). Non-substance addictive behaviors in the context of DSM-5. *Addictive Behaviors, 39*(1), 1-2. doi:https://doi.org/10.1016/j.addbeh.2013.09.004

Potenza, M. N., Wareham, J. D., Steinberg, M. A., Rugle, L., Cavallo, D. A., Krishnan-Sarin, S., & Desai, R. A. (2011). Correlates of at-risk/problem internet gambling in adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry, 50*(2), 150-159.e153. doi:10.1016/j.jaac.2010.11.006.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1,* 385–401. 10.1177/014662167700100306

Rapee, R. M., Oar, E. L., Johnco, C. J., Forbes, M. K., Fardouly, J., Magson, N. R., & Richardson, C. E. (2019). Adolescent development and risk for the onset of social-emotional disorders: A review and conceptual model. *Behaviour Research and Therapy, 123*, 103501. doi:10.1016/j.brat.2019.103501

Reynolds, W. M. (1987). *Reynolds Adolescent Depression Scale.* Champaign, IL: Psychological Assessment Resources, Inc.

Reynolds, W. M. (2001). *Reynolds Adolescent Adjustment Screening Inventory™ (RAASI™): Professional Manual.* Lutz, FL: Psychological Assessment Resources.

Richard, J. (2018). From play-to-win to pay-to-win: The trap of 'loot boxes' in video games. *Youth Gambling International Newsletter, 18*(1), 3-6.

Richard, J. & Derevensky, J. (2017). Identifying the relationship between mental health symptoms, problem behaviors and gambling among adolescents. *Annals of Behavioural Science, 3*(2), 1-9. doi:10.21767/2471-7975.100030

Sanders, J., & Williams, R. (2019). The relationship between video gaming, gambling, and problematic levels of video gaming and gambling. *Journal of Gambling Studies, 35*(2), 559-569. doi:10.1007/s10899-018-9798-3

Sagoe, D., Pallesen, S., Hanss, D., Leino, T., Molde, H., Mentzoni, R. A., & Torsheim, T. (2017). The relationships between mental health symptoms and gambling behavior in the transition from adolescence to emerging adulthood. *Frontiers in Psychology, 8(478).* doi:10.3389/fpsyg.2017.00478

Sanscartier, M. D., Edgerton, J. D., & Roberts, L. W. (2018). A latent class analysis of gambling activity patterns in a canadian university sample of emerging adults: socio-demographic, motivational, and mental health correlates. *Journal of Gambling Studies, 34*(3), 863-880. doi:10.1007/s10899-017-9734-y

Secades-Villa, R., Martínez-Loredo, V., Grande-Gosende, A., & Fernández-Hermida, J. R. (2016). The Relationship between impulsivity and problem gambling in adolescence. *Frontiers in Psychology, 7*, 1931. https://doi.org/10.3389/fpsyg.2016.01931

Shaffer, D., Fisher, P., Lucas, C., Dulcan, M., & Schwab-Stone, M. (2000). NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): Description, differences from previous versions, and reliability of some common diagnoses. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*, 28–38.

Shaffer, H. J., & Korn, D. A. (2002). Gambling and related mental disorders: A public health analysis. *Annual Review of Public Health, 23*, 171-212. doi:10.1146/annurev.publhealth.23.100901.140532

Shaffer, H. J., LaBrie, R., Scanlan, K. M. & Cummings, T. H. (1994). Pathological gambling among adolescents: Massachusetts gambling screen (MAGS). *Journal of Gambling Studies, 10*, 339–362.

Shead, N. W., Derevensky, J. L., & Gupta, R. (2010). Risk and protective factors associated with youth problem gambling. *International Journal of Adolescent Medicine and Health, 22*(1), 39-58.

Stockdale, L., & Coyne, S. M. (2018). Video game addiction in emerging adulthood: Cross-sectional evidence of pathology in video game addicts as compared to matched healthy controls. *Journal of Affective Disorders, 225,* 265-272. doi:10.1016/j.jad.2017.08.045

Strittmatter, E., Kaess, M., Parzer, P., Fischer, G., Carli, V., Hoven, C. W., Wasserman, C., Sarchiapone, M., Durkee, T., Apter, A., Bobes, J., Brunner, R., Cosman, D., Sisask, M., Varnik, P. & Wasserman, D. (2015). Pathological Internet use among adolescents: Comparing garners and non-garners. *Psychiatry Research, 228*(1), 128-135. doi:10.1016/j.psychres.2015.04.029

Stuhldreher, W. L., Stuhldreher, T. J., & Forrest, K. Y. Z. (2007). Gambling as an emerging health problem on campus. *Journal of American College Health, 56*(1), 75-83. doi:10.3200/JACH.56.1.75-88

Sugaya, N., Shirasaka, T., Takahashi, K., & Kanda, H. (2019). Bio-psychosocial factors of children and adolescents with internet gaming disorder: A systematic review. *BioPsychoSocial Medicine, 13*(1), 3. doi:10.1186/s13030-019-0144-5

Tackett, J. L., Krieger, H., Neighbors, C., Rinker, D., Rodriguez, L., & Edward, G. (2017). Comorbidity of alcohol and gambling problems in emerging adults: A bifactor model conceptualization. *Journal of Gambling Studies, 33*(1), 131-147. doi:10.1007/s10899-016-9618-6.

Tejeiro, R. A., Gomez-Vallecillo, J. L., Pelegrina, M., Wallace, A., & Emberley, E. (2012). Risk factors associated with the abuse of video games in adolescents. *Psychology, 3*(4), 310-314. doi:10.4236/psych.2012.34044

Terrone, G., Musetti, A., Raschielli, S., Marino, A., Costrini, P., Mossi, P., Salvatore, S., & Caretti, V.(2018). Attachment relationships and internalization and externalization problems in a group of adolescents with pathological gambling disorder. *Clinical Neuropsychiatry, 15*(1), 66-74. doi:2018-11717-009

Tian, M., Tao, R., Zheng, Y., Zhang, H., Yang, G., Li, Q., & Liu, X. (2018). Internet gaming disorder in adolescents is linked to delay discounting but not probability discounting. *Computers in Human Behavior, 80,* 59-66. doi:https://doi.org/10.1016/j.chb.2017.10.018

Trucco, E. M., Villafuerte, S., Hussong, A., Burmeister, M., & Zucker, R. A. (2018). Biological underpinnings of an internalizing pathway to alcohol, cigarette, and marijuana use. *Journal of Abnormal Psychology, 127*(1), 79-91. doi:10.1037/abn0000310

Torres-Rodriguez, A., Griffiths, M. D., Carbonell, X., & Oberst, U. (2018). Internet gaming disorder in adolescence: Psychological characteristics of a clinical sample. *Journal of Behavioral Addictions, 7*(3), 707-718. doi:10.1556/2006.7.2018.75

Turner, N. E., Paglia-Boak, A., Ballon, B., Cheung, J. T. W., Adlaf, E. M., Henderson, J., Chan, V., Rehm, J., Hamilton, H., & Mann, R. E. (2012). Prevalence of problematic video gaming among Ontario adolescents. *International Journal of Mental Health and Addiction, 10*(6), 877-889. doi: 10.1007/s11469-012-9382-5

Vadlin, S., Aslund, C., Hellstrom, C., & Nilsson, K. W. (2016). Associations between problematic gaming and psychiatric symptoms among adolescents in two samples. *Addictive Behaviors, 61,* 8-15. doi:10.1016/j.addbeh.2016.05.001

Valleur, M., Codina, I., Vénisse, J.-L., Romo, L., Magalon, D., Fatséas, M., . . . Groupe, J. E. U. (2016). Towards a validation of the three pathways model of pathological gambling. *Journal of Gambling Studies, 32*(2), 757-771. doi:10.1007/s10899-015-9545-y

Van Rooij, A. J., Kuss, D. J., Griffiths, M. D., Shorter, G. W., Schoenmakers, T. M., & Van De Mheen, D. (2014). The (co-)occurrence of problematic video gaming, substance use, and psychosocial problems in adolescents. *Journal of Behavioral Addictions, 3*(3), 157-165. doi:10.1556/JBA.3.2014.013

Vitaro, F., Brendgen, M., Ladouceur, R., & Tremblay, R. E. (2001). Gambling, delinquency, and drug use during adolescence: Mutual influences and common risk factors. *Journal of Gambling Studies, 17*(3), 171-190. doi:10.1023/A:1012201221601

Walther, B., Morgenstern, M., & Hanewinkel, R. (2012). Co-occurrence of addictive behaviours: Personality factors related to substance use, gambling and computer gaming. *European Addiction Research, 18*(4), 167-174. doi:10.1159/000335662

Wanner, B., Vitaro, F., Carbonneau, R., & Tremblay, R. E. (2009). Cross-lagged links among gambling, substance use, and delinquency from midadolescence to young adulthood: Additive and moderating effects of common risk factors. *Psychology of Addictive Behaviors, 23*(1), 91-104. doi:10.1037/a0013182

Wartberg, L., Kriston, L., Kramer, M., Schwedler, A., Lincoln, T. M., & Kammerl, R. (2017). Internet gaming disorder in early adolescence: Associations with parental and adolescent mental health. *European Psychiatry, 43*, 14-18. doi:10.1016/j.eurpsy.2016.12.013

Wartberg, L., Kriston, L., Zieglmeier, M., Lincoln, T., & Kammerl, R. (2019). A longitudinal study on psychosocial causes and consequences of Internet gaming disorder in adolescence. *Psychological Medicine, 49*(2), 287-294.doi:10.1017/S003329171800082X

Welte, J. W., Barnes, G. M., Tidwell, M.-C. O., & Hoffman, J. H. (2009). Association between problem gambling and conduct disorder in a national survey of adolescents and young adults in the United States. *Journal of Adolescent Health, 45*(4), 396-401. doi:10.1016/j.jadohealth.2009.02.002.

Widinghoff, C., Berge, J., Wallinius, M., Billstedt, E., Hofv, er, B., & Hakansson, A. (2019). Gambling disorder in male violent offenders in the prison system: psychiatric and substance-related comorbidity. *Journal of Gambling Studies, 35*(2), 485-500. doi:10.1007/s10899-018-9785-8

Wiesner, M., Kim, H. K., & Capaldi, D. M. (2005). Developmental trajectories of offending: Validation and prediction to young adult alcohol use, drug use, and depressive symptoms. *Development and Psychopathology, 17*, 251–270. doi:10.1017/s0954579405050133

Willoughby, T., Chalmers, H., & Busseri, M. A. (2004). Where is the syndrome? Examining co-occurrence among multiple problem behaviors in adolescence. *Journal of Consulting and Clinical Psychology, 72*(6), 1022-1037. doi:10.1037/0022-006X.72.6.1022

Winters, K. C., Stinchfield, R. D., & Fulkerson, J. (1993). Toward the development of an adolescent gambling problem severity scale. *Journal of Gambling Studies, 9*(1), 63–84. doi:10.1007/BF01019925

Wohl, M. J. A., Matheson, K., Young, M. M., & Anisman, H. (2008). Cortisol rise following awakening among problem gamblers: Dissociation from comorbid symptoms of depression and impulsivity. *Journal of Gambling Studies, 24*(1), 79-90. doi:10.1007/s10899-007-9080-6

World Health Organization. (2019). *International statistical classification of diseases and related health problems (11th Revision)*. Retrieved from: https://icd.who.int/browse11/l-m/en

Yakovenko, I., & Hodgins, D. C. (2018). A scoping review of co-morbidity in individuals with disordered gambling. *International Gambling Studies, 18*(1), 143–172. doi:10.1080/14459795.2017.1364400

Yip, S. W., Desai, R. A., Steinberg, M. A., Rugle, L., Cavallo, D. A., Krishnan-Sarin, S., & Potenza, M. N. (2011). Health/functioning characteristics, gambling behaviors, and gambling-related motivations in adolescents stratified by gambling problem severity: Findings from a high school survey. *American Journal on Addictions, 20*(6), 495-508. doi:10.1111/j.1521-0391.2011.00180.x.

Yu, H., & Cho, J. (2016). Prevalence of internet gaming disorder among Korean adolescents and associations with non-psychotic psychological symptoms, and physical aggression. *American Journal of Health Behavior, 40*(6), 705-716. doi:10.5993/AJHB.40.6.3

Yücel, M., Whittle, S., Youssef, G. J., Kashyap, H., Simmons, J. G., Schwartz, O., Lubman, D. I., & Allen, N. B. (2015). The influence of sex, temperament, risk-taking and mental health on the emergence of gambling: A longitudinal study of young people. *International Gambling Studies, 15*(1), 108-123. doi:10.1080/14459795.2014.1000356

Zendle, D., Meyer, R., & Over, H. (2019). Adolescents and loot boxes: Links with problem gambling and motivations for purchase. *Royal Society Open Science, 6*(6), 190049. https://doi.org/10.1098/rsos.190049

Zigmond, A. B. & Snaith, R. P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica, 67*, 361–370.

Zucker, R. A. (1994). Pathways to alcohol problems and alcoholism: A developmental account of the evidence for multiple alcoholism and for contextual contributions to risk. In: R. A. Zucker, G. Boyd, & J. Howard (Eds.), *The development of alcohol problems: Exploring the biopsychosocial matrix of risk* (pp. 255-289). National Institute on Alcohol Abuse and Alcoholism Research Monograph No. 26. National Institute on Alcohol Abuse and Alcoholism, Rockville, MD.

Zucker, R. A., Heitzeg, M. M., & Nigg, J. T. (2011). Parsing the undercontrol/disinhibition pathway to substance use disorders: A multilevel developmental problem. *Child Development Perspectives, 5*(4), 248–255. doi:10.1111/j.1750-8606.2011.00172.x

Bridging Document 1

Study 1 reviewed peer-reviewed journal articles on the association between conduct problem, depressive symptoms, and problem gambling (PG) and video gaming (PVG) among adolescents and emerging adults. The results of this review including 71 articles indicated that conduct problems (included within the externalizing problems spectrum) are more closely associated with PG, whereas depressive symptoms (included within the internalizing problems spectrum) are more closely associated with PVG. The difference in associations was pronounced in longitudinal research, with more similar effects for conduct problems and depressive symptoms being noted within the cross-sectional research (Richard et al., 2020a). This review concluded that there appears to be greater evidence for a combined (i.e., externalizing and internalizing problem) pathway (Englund & Siebenbruner, 2012; Maslowsky et al., 2014) for the development of PG and PVG, an externalizing pathway (Zucker, 1994; Zucker et al., 2011) for the development of PG, and an internalizing pathway (Hussong et al., 2011; Trucco et al., 2018) for the development of PVG. Moreover, various explanations for these associations were explored, including the presence of shared etiological factors (e.g., impulsivity, behavioral disinhibition, emotion dysregulation) and symptomatology (e.g., loss of interest in previous hobbies/activities [symptom of PG and PVG] and anhedonia [symptom of depression]).

Considering the synthesis of findings provided in Study 1, there is substantive empirical evidence identifying externalizing and internalizing problems as risk factors for the development of PG and PVG during adolescence and emerging adulthood. Although available research has investigated the presence of these associations, it remains unclear where these behaviors (i.e., PG and PVG) fit within broader frameworks of psychopathology, including the two-dimensional hierarchical structure of psychopathology featuring overarching externalizing and internalizing

problems spectra (Krueger, 1999; Krueger & Markon, 2006; Lahey et al., 2012). Based on the results of two studies featuring adult samples, PG appears to be best classified under the umbrella of externalizing problems (King et al., 2020; Oleski et al., 2011), with some potential overlap with internalizing problems amongst women (Oleski et al., 2011). For gaming disorder, although classified as a behavioral addiction with potential overlapping etiology with other addictive behaviors (Brezing et al., 2010; Potenza, 2014; Yakovenko & Hodgins, 2018), it has not been empirically tested where gaming disorder fits within the spectra of externalizing and internalizing problems. Given these findings and knowledge gaps, the aim of Study 2 is to empirically investigate the fit of both PG and PVG within the hierarchical structure of psychopathology among adolescents. The review of the literature provided in Study 1 will inform the hypotheses for this study considering both the fit of these problems within the hierarchical structure and the role of sex in these associations.

Study 2

Adolescent Problem Gambling and Gaming in the Hierarchical Structure of Psychopathology

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Abstract

Objective: Research suggests that certain mental health disorders are likely to co-occur, with higher order dimensions of psychopathology being discernable. Specifically, mental health disorders tend to be organized into two general dimensions: internalizing and externalizing disorders. Despite substantial evidence supporting this hierarchical structure, no studies have integrated both recognized forms of behavioral addictions, gambling and gaming disorders, into this model utilizing a sample of adolescents. The objective of this study is to examine how risk for problem gambling (PG) and problem video gaming (PVG) load onto the higher order structure of psychopathology. **Method:** Survey responses were collected from 6,413 adolescents (50.4% male, M_{age} = 14.74 years, 80.2% White) from Wood County, Ohio. Measures included frequency of gambling, PG symptoms, frequency of video gaming, PVG symptoms, symptoms of depression and anxiety, aggressive problems, and delinquency. **Results:** Confirmatory factor analyses were conducted and data were fit to a two-factor structure. PG symptoms loaded most highly on the externalizing factor (β = .18, *SE* = .02), and PVG symptoms loaded similarly on the externalizing (β = .32, *SE* = .02) and internalizing (β = .24, *SE* = .02) factors. Model fit indices indicated that the model in which PG and PVG were loaded on the externalizing factor provided the best fit. Exploratory analyses were suggestive of an alternative three-factor models which improved model fit. **Conclusions:** Findings suggest that youth prevention and intervention approaches need to address behavioral addictions early while considering the impact of other commonly associated problems.

Introduction

Gambling and video gaming behaviors are generally described as being on a continuum ranging from non-engagement through to excessive, problematic, or disordered engagement (Shaffer & Korn, 2002; Griffiths et al., 2017). In the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013), gambling disorder was reclassified as a non-substance-related addictive disorder and Internet gaming disorder was included in Section III as a condition requiring further research (APA, 2013). As of May 2019, the World Health Organization (WHO) officially included gaming disorder in the International Classification of Diseases – Eleventh Edition (ICD-11) alongside gambling disorder as the two formally recognized behavioral addictions (WHO, 2019). According to the DSM-5 (APA, 2013), both disorders are defined as the persistent and recurrent engagement in the behavior (gambling or video gaming), leading to clinically significant impairment or distress. Recent literature reviews have shown that rates of problematic participation in both gambling and gaming are higher among adolescents than adults, with 0.2 to 12.3% reporting problem gambling (PG; Calado et al., 2016) and 5 to 10% reporting problem video gaming (PVG; Fam, 2018; Paulus et al., 2018).

Gambling and gaming share a number of similarities at the structural (e.g., variable reinforcement schedules), aesthetic (e.g., stimulating sounds and visual effects) and motivational (e.g., escapism, socializing) levels (Griffiths, 2008; Hilgard et al., 2013; King et al., 2010; King et al., 2015). Moreover, with regard to the diagnostic criteria, both disorders share features including salience, mood modification, tolerance, withdrawal, relapse, increased interpersonal conflict, negative consequences, and relapse. However, some differences are also present. For one, whereas all gambling activities are legally restricted to adults in most jurisdictions, age

ratings are applied to video games by the Entertainment Software Association (ESA), which restricts the purchase of certain video games based on age appropriateness (e.g., everyone, teen [13+], mature [17+]). Additionally, video games are most often played for points and/or status, with skill determining one's performance, whereas gambling can be engaged in for money with the outcome being predominantly random (Griffiths, 2005). Lastly, although variable reinforcement schedules are present for both, some video games delay rewards for extended periods of strategic and goal-directed engagement (James & Tunney, 2017).

Common predisposing risk factors have been associated with PG and PVG, with substantial empirical evidence for both externalizing and internalizing problems (DeLisi et al., 2013; Dowling et al., 2017; Kryszaijtys et al ., 2018; Myrseth & Notelaers, 2018; Jahic et al., 2021; Richard et al., 2020a, 2020b, 2021; Sugaya et al., 2019). The constructs of externalizing and internalizing problems were initially derived from factor analyses of psychopathology phenotypes indicating that prevalent mental disorders can be organized into two higher-order factors representing different manifestations of intercorrelated core psychopathological processes and forming a hierarchical structure of psychopathology (Gibbons & Hedeker, 1992; Krueger, 1999; Krueger & Markon, 2006; Lahey et al., 2012). The overarching externalizing factor includes conduct problems such as rule-breaking, aggressive behaviors, antisocial behaviors, and violent or delinquent acts (APA, 2013; Fonagy & Luyten, 2018; Lahey et al., 2012). The overarching internalizing factor includes symptoms of depression (e.g., worthlessness, low mood, anhedonia) and anxiety (e.g., excessive worries, fears) (APA, 2013; Kruger, 1999; Krueger & Markon, 2006; Lahey et al., 2012; Rapee et al., 2019). Although the two-factor externalizing/internalizing structure has been widely validated, alternative models that separate internalizing and externalizing problems into two additional sub-factors have also been proposed.

Within these models, there appears to be consistency in sub-factors specific to internalizing problems (i.e., anxious-misery and fear; Krueger, 1999). However, there seems to be a greater number of competing theoretical models specific to externalizing problems including oppositional behaviors and social norm violations (Farmer et al., 2009) antisocial deviance/oppositional behavior and substance disorder (Forbes et al., 2016; Tully & Iacono, 2014) and disruptive behaviors and substance disorder (Farmer et al., 2009; Farmer et al., 2015). Overall, these findings indicate that research in the hierarchical structure of psychopathology is ongoing, with differing factor structures emerging as a result of the sampled populations and the breadth of mental disorders assessed.

Although both externalizing and internalizing problems have been associated with PG and PVG, only two studies have investigated where PG fits within the hierarchical structure of psychopathology (King et al., 2020; Oleski et al., 2011), and no studies have investigated this for PVG. Proper classification has significant implications with regard to formulating a clinical understanding of these disorders, informing both treatment and prevention. Based on available research, PG appears to be best understood under the umbrella of externalizing problems although the standardized factor loading for PG under the externalizing factor tends to be smaller than those for other disorders within this domain (e.g., antisocial and oppositional behaviors) (King et al., 2020; Oleski et al., 2011). These results are consistent with the findings of other confirmatory factor analyses which have found that PG had the worst fit on an overarching latent factor compared to all other problem behaviors including delinquency and aggression (Willoughby et al., 2014). Additionally, mixed findings have been noted regarding sex differences for these factor loadings, with one study noting some overlap with internalizing

problems among adult women (Oleski et al., 2011), and one study finding no sex differences among emerging adults (King et al., 2020).

For PVG, although classified as a behavioral addiction sharing etiological factors with gambling (Brezing et al., 2010; Potenza, 2014; Yakovenko & Hodgins, 2018), it has not been empirically tested where PVG fits within the hierarchical structure of psychopathology. In a study investigating Internet gaming disorder (IGD) among Korean middle school students, it was noted that both externalizing and internalizing disorders showed an increasing trend as the severity of IGD increased (Lee et al., 2017). Lee and colleagues (2017) noted that both externalizing and internalizing disorders may be associated with IGD, with externalizing disorders increasing the odds of reporting a lower severity of IGD, and internalizing problems increasing the odds of reporting a greater severity of IGD. Moreover, in a systematic review investigating the association between conduct problems and depressive symptoms with PVG, both were found to be associated with PVG, with larger effects being reported for depressive symptoms (Richard et al., 2020a). Based on these limited findings, it is unclear whether PVG is more likely to be classified under the externalizing or internalizing problems factor, with the possibility of PVG being more closely associated with internalizing problems.

Due to the paucity of research specifically evaluating the classification of behavioral addictions in relation to broader psychopathological dimensions and the implications for classification within both the DSM and ICD, it is critical to empirically investigate models testing the classification of both PG and PVG within the hierarchical structure of psychopathology. Findings from research investigating these phenomena have the potential to expand our current clinical understanding of both PG and PVG symptomatology and their association with other mental health problems. Empirical research on behavioral addictions has

implications relevant not only to diagnostic classification, but also in guiding future research identifying the underlying causal mechanisms and common liabilities for traits associated with these disorders. Moreover, as no studies have investigated these relationships among adolescents, it is unknown whether these associations are present at a developmental period earlier than emerging adulthood. It is essential to identify possible early manifestations of psychopathology as this can inform prevention and treatment initiatives in addition to elucidating risk factors relevant to the later development of behavioral addictions. Lastly, with mixed findings being noted for these associations based on sex (King et al., 2020; Oleski et al., 2011), there is a need for further research investigating potential differences between males and females during adolescence as these may be informative of differential underlying risk factors or motivations for engagement in gambling or gaming.

Current Investigation and Study Hypotheses

The present research aims to address these gaps in existing knowledge regarding the fit of PG and PVG within the hierarchical structure of psychopathology. More specifically, the following research questions were addressed: (1) What is the fit of PG and PVG within the externalizing and internalizing hierarchical factors? (2) Are there sex differences in the fit of PG and PVG within this structure? Based on previous research, it is hypothesized that PG will be optimally identified under the umbrella of externalizing problems (King et al., 2020; Oleski et al., 2011; Richard et al., 2020a), while PVG will be optimally identified under the umbrella of internalizing problems (Richard et al., 2020a). Moreover, it is hypothesized that no sex differences will be present in the classification of these disorders among adolescents (King et al., 2020; Oleski et al., 2011). Beyond the two aforementioned research questions, as an exploratory aim, this study also sought to investigate an alternative model to the two-factor structure of

psychopathology when gambling and gaming behaviors are included, which will be informed primarily through comparisons of model fit indices and standardized factor loadings.

Method

Participants and Procedures

The current study utilized data from the biannual Alcohol, Drug Addiction and Mental Health Services (ADAMHS) Board/Wood County Educational Service Centre survey on alcohol and other drug use. School principals provided parents with an informed consent form to ensure parental agreement for participation. Information regarding the survey was provided to all parents by letter and was available on each school district website for viewing. Parents could elect for their children to opt out of participating by informing their school principals. Students were also informed about the confidential nature of the survey and that they could withdraw from participation at any time without consequence. Participating students from 10 public schools in Wood County, Ohio, completed an anonymous paper-pencil survey administered by their classroom teacher between October 2019 and December 2019. The survey included questions assessing gambling, video gaming, and mental health symptoms. In each school, trained addiction counsellors coordinated the survey distribution and assisted teachers with administration. Ethical approval was granted by the ADAMHS ethics committee.

Out of the 7,573 students who completed the survey, 763 responses were excluded due to suspected insincere or inconsistent responding (e.g., reporting the use of fake drugs or use of all drugs at all times, reporting having participated in all gambling activities daily). Moreover, 397 participants were excluded if they had missing data for sex and/or age as these were variables of interest for the present study. A total of 6,413 students (M_{age} = 14.74 years, SD = 1.77, 50.4% male) from grade 7 to 12 were included for analysis.

Measures

Demographic Characteristics. All participants indicated their sex (i.e., male or female), age, grade-level, and ethnicity (e.g., White, Black, Hispanic) at the beginning of the survey.

Gambling Frequency. Participants were asked about their frequency of engagement in eight different gambling activities over the past year. The gambling activities included: playing cards for money, betting on games of personal skill (e.g., pool, golf), betting on sports teams, betting on seasonal fantasy sports, betting on daily fantasy sports, betting on esports, buying lottery tickets, and buying scratch-offs. Frequency of participation was assessed on a 5-point Likert scale (0 = "Not at all"; 1 = "Less than once a month"; 2 = "About once a month"; 3 = "About once a week"; 4 = "Daily"). For the present analysis, an additional variable was calculated indicating the frequency of participation in any of the aforementioned gambling activities over the past year, with the highest value for frequency being retained.

Problem Gambling. Problem gambling was assessed using the National Opinion Research Centre (NORC) DSM-IV Screening for Gambling Problems (NODS-CLiP; Toce-Gerstein, Gerstein, & Volberg, 2009). Adapted from the original 17-item NODS questionnaire (Gerstein et al., 1999), and based on the DSM-IV criteria for pathological gambling (APA, 1994), the NODS-CLiP is a screening measure containing three dichotomous (yes/no) questions assessing loss of control, lying and preoccupation. Participants responding affirmatively to one or more items are identified as being at-risk for problem gambling. The NODS-CLiP has demonstrated excellent sensitivity, capturing 94% of problem gamblers identified by the NODS, while having a specificity of 96% (Toce-Gerstein et al., 2009).

Gaming Frequency. Participants were asked about their frequency of engagement in online and offline video gaming (on computer/laptop, tablet, gaming console, or smart phone)

over the past year. They were asked how often they spent at least two hours or more playing video games on the same day. Frequency of participation was assessed on a 5-point Likert scale (0 = "Not at all"; 1 = "Less than once a month"; 2 = "About once a month"; 3 = "About once a week"; 4 = "Daily").

Problem Video Gaming. Problem video gaming was assessed using the Internet Gaming Disorder Scale–Short Form 9 (IGDS-SF9; Pontes & Griffiths, 2015). The IGDS-SF9 includes nine items that assess the degree of Internet gaming disorder symptoms over the past 12 months. The IGDS-SF9 is based on the nine criteria outlined in the DSM-5 (APA, 2013). Participants were asked to respond on a 5-point Likert scale (1 = "Never"; 2 = "Rarely"; 3 = "Sometimes"; 4 = "Often"; 5 = "Very often"), with derived scores ranging from 9 to 45 (greater scores indicating a greater severity of problems). Within the present sample, the internal consistency for the IGDS-SF9 was excellent (Cronbach $\alpha = 0.92$).

Mental Health Symptoms and Problem Behaviors. Mental health symptoms and problem behaviors were assessed using the Problem Severity Scale (PSS) of the Ohio Youth Scales (Ogles et al., 2001). The PSS was developed based on four sources of information: (1) problem behaviors identified in the DSM-IV (APA, 1994), (2) common presenting problems for youth with emotional disturbances, (3) consultations with childcare service providers, and (4) items from other commonly used instruments to assess youth psychopathology. The PSS includes 20-items based on common mental health symptoms (e.g., feeling worthless or useless) and problem behaviors (e.g., yelling, swearing, or screaming at others) rated on a 6-point Likert scale (0 = "Not at all"; 1 = "Once or twice"; 2 = "Several times"; 3 = "Often"; 4 = "Most of the time"; and 5 = "All of the time"), for a possible total score ranging from 0 to 100. Qualitative descriptors have been assigned to the overall score, with scores ranging from 0 to 9 indicating *no*

problems, 10 to 19 *low problems*, 20 to 36 *moderate problems*, 37 to 52 *severe problems*, and 53 to 100 *intense problems* (Ogles et al., 2001). Through confirmatory factor analyses, Bonadio and Tompsett (2017) identified a four-factor model for the PSS. Each factor is associated with a unique number of items (Aggression = 8 items; Anxiety = 3 items; Depression = 6 items; Delinquency = 3 items), with higher scores indicating greater problem severity in each domain. Within the present sample, the internal consistency for the PSS was excellent (Cronbach α = 0.93).

Data Analysis

IBM SPSS version 27 was utilized to calculate descriptive statistics (e.g., means, frequencies, percentages) for demographic characteristics, frequency and severity of gambling and gaming behaviors and severity of mental health symptoms. Sex differences in the aforementioned variables were also examined through chi-square tests and independent samples *t*-tests. Effect size estimates are provided as phi (φ) coefficients for chi-square tests and Cohen's *d* for *t*-tests.

M*plus* version 8.4 was used in order to conduct confirmatory factor analyses (CFAs) and to examine the underlying factor structure of psychopathology within the present sample. First, a baseline model representing the two-factor model of psychopathology was established based on existing research, whereby problem behaviors (i.e., aggressive and delinquent behaviors) were loaded on a latent externalizing factor and mental health symptoms (i.e., depressive and anxiety symptoms) were loaded on a latent internalizing factor.

Second, a comparison of the model fit indices (i.e., chi-square, Comparative Fit Index [CFI], Tucker Lewis Index [TLI], Root Mean Square Error of Approximation [RMSEA], and Standardized Room Mean Square Residual [SRMR]) for the four following models were

explored: (1) loading PG and PVG on the externalizing factor; (2) loading PG and PVG on the internalizing factor; (3) loading PG on the externalizing factor and PVG on the internalizing factor; and (4) loading PG on the internalizing factor and PVG on the externalizing factor. While a non-significant chi-square remains the gold standard for model fit, with very large samples, chi-squares are likely to be inflated and therefore incremental fit indices are more useful (Cheung & Rensvold, 2002). Rules of thumb for adequate model fit using incremental fit indices include a cut-off of below .06 for RMSEA, below 0.08 for SRMR, and above .95 for the TLI and CFI (Hu & Bentler, 1999).

Third, for the best-fitting model, differences in the factor structure based on sex were investigated based on tests for measurement invariance by conducting hierarchical tests for invariance of measurement parameters based on published guidelines (Byrne, 2013; Muthén & Muthén, 2012; Wang & Wang, 2012). To conduct hierarchical tests, it is necessary to first examine the configural invariance model which imposes no equality restrictions of model parameters (including sex). Once this is established, the weak invariance model or metric invariance is examined where factor loadings are treated as invariant across sex. Third, the strong invariance model or scalar invariance is examined which imposes invariance on both factor loadings and item intercepts across sex. Once measurement invariance is established, invariance of structural parameters is investigated by comparing the least restrictive model (i.e., configural invariance model) to the more restrictive models (i.e., metric and scalar). A value of the change in CFI smaller than or equal to 0.01 indicates that the hypothesis of invariance should not be rejected. For change in TLI and RMSEA, critical values of 0.01 and 0.015 have been respectively established.

For the exploratory purposes an additional CFA was conducted while loading poor fitting variables based on their standardized coefficients within the two-factor model onto alternative factors. A standardized factor loading greater than or equal to 0.3 has been proposed as an indicator of good fit for the latent factor (Byrne, 2013). Comparisons of model fit indices between analyses were explored and a final model was determined based on optimal model fit indices, elevated standardized coefficients within each factor and parsimony based on empirical research and theory.

Results

Descriptive Results

Tables 1 provides an overview of the demographic characteristics of the sample, frequency of gambling and gaming, and self-reported mental health symptoms and problem behaviors. Investigating sex differences, based on continuous scores for PG and PVG, males (M = 0.12, SD = 0.41) compared to females (M = 0.05, SD = 0.25) endorsed greater PG symptoms ($t(6160) = 7.73$ $p < .001$, $d = 0.21$). As for PVG, males (M = 14.58, SD = 7.22) compared to females (M = 11.59, SD = 6.00) also endorsed higher symptomatology scores ($t(6134) = 17.62$, $p < .001$, $d = 0.45$).

Regarding frequency of engagement in the behaviors assessed, males reported more frequent engagement in both gambling ($t(6351) = 13.53$, $p < .001$, $d = 0.35$) and video gaming ($t(6313) = 20.41$ $p < .001$, $d = 0.51$) compared to females. Finally, for mental health symptoms and problem behaviors, overall scores on the PSS indicated that females (M = 17.40, SD = 17.52) had greater scores than males (M = 11.84, SD = 14.20) ($t(5875) = 13.36$, $p < .001$, d = 0.35). Investigating sex differences within the four-factor model of the PSS, females had greater scores on aggression ($t(6013) = 4.33$, $p < .001$, $d = 0.11$), depression ($t(6078) = 17.17$, $p < .001$,

d = 0.44) and anxiety (t(6105) = 18.77, p < .001, d = 0.48) when compared to males. No significant differences were noted for delinquency (p = .20).

Table 1

Participant characteristics, frequency of gambling and gaming, and mental health symptoms.

	n	%
Sociodemographic data		
Sex		
Male	3230	50.4
Female	3183	49.6
Ethnicity		
White	5141	80.2
Black	149	2.3
Hispanic	311	4.8
Asian	140	2.2
Multicultural	252	3.9
Other/Missing	420	6.6
Grade in school		
7-8	2103	32.7
9-10	2115	33.0
11-12	2001	31.2
Gambling involvement		
Not at all	4717	73.6
Less than monthly	930	14.5
Monthly	359	5.6
Weekly	193	3.0
Daily	154	2.4
Gaming more than 2 hours daily		
Not at all	2539	39.6
Less than monthly	444	6.9
Monthly	438	6.8
Weekly	1062	16.6
Daily	1832	28.6
Mental health symptoms/problem behaviors		
No problems	3033	47.3
Low problems	1215	18.9
Moderate problems	984	15.3
Severe problems	400	6.2
Intense problems	245	3.8

Note. Percentages may not add up to 100% due to missing data.

Structure of Psychopathology Including Gambling and Gaming

Externalizing and Internalizing Factors

Four CFAs were conducted in order to explore model fit indices based on the placement of PG and PVG under the externalizing and/or internalizing factors. Model fit indices are presented in Table 2. Overall, model fit indices suggest that although similar, Model 1, loading PG, gambling frequency, PVG, and gaming frequency on the externalizing factor indicated the best fit. RMSEA and SRMR values indicated adequate model fit, yet the CFI and TLI were below identified thresholds. Figure 1 presents the standardized beta values for all variable loadings onto the latent externalizing and internalizing factors. Comparing the standardized values, PVG (β = .32, *SE* = .02) and gambling frequency (β = .28, *SE* = .02) had the highest values, followed by PG (β = .18, *SE* = .02) and gaming frequency (β = .17, *SE* = .01). Although the loadings for these four variables were smaller than for other measured variables and the latter two were below the 0.3 threshold, they remained statistically different from zero (all $p < .01$).

This model can be compared to the second-best fitting model, which was in line with our initial hypothesis, Model 3, loading PG and gambling frequency on the externalizing factor, and PVG and gaming frequency on the internalizing factor. For this model, both the RMSEA and SRMR represented adequate fit, with the CFI and TLI being below threshold. Consistent with Model 1, gambling frequency (β = .28, *SE* = .02) and PG (β = .18, *SE* = .02) loaded significantly on the externalizing factor (both $p < .01$). As for the variables loaded on the internalizing factor, both PVG (β = .24, *SE* = .02) and gaming frequency (β = .10, *SE* = .01) were significant (both $p < .01$), although their values were lower compared to Model 1.

Model 4, loading PG and gambling frequency on the internalizing factor, and PVG and gaming frequency on the externalizing factor, was the third-best fitting model. Both gambling

frequency (β = .08, *SE* = .02) and PG (β = .09, *SE* = .02) indicated substantially lower standardized beta values when loaded onto the internalizing factor despite being statistically significant (both $p < .01$), whereas the results for PVG (β = .31, *SE* = .02) and gaming frequency (β = .17, *SE* = .01) loaded onto the externalizing factor were similar to those established in Model 1. Finally, Model 2, loading PG, gambling frequency, PVG, and gaming frequency on the internalizing factor represented the worst fitting model. Despite being statistically significant (all $p < .01$), gambling frequency (β = .09, *SE* = .02), PG (β = .08, *SE* = .02), PVG (β = .24, *SE* = .02) and gaming frequency (β = .10, *SE* = .01) represented poor loadings that were all below the 0.3 threshold. Overall, considering model fit indices and standardized beta values as indicated in each of the four models, Model 1 provides the best fit for the data.

Table 2

Comparison of model fit indices depending on the placement of problem gambling and problem video gaming on the externalizing and/or internalizing factor.

Model	Chi-square	RMSEA	CFI	TLI	SRMR
1. PG and PVG on EXT	5290.27*	0.056 [0.055, 0.058]	0.87	0.85	0.06
2. PG and PVG on INT	5692.33*	0.058 [0.057, 0.060]	0.85	0.84	0.07
3. PG on EXT/PVG on INT	5452.19*	0.057 [0.056, 0.058]	0.86	0.85	0.06
4. PG on INT/PVG on EXT	5544.63*	0.058 [0.056, 0.059]	0.86	0.84	0.07

Note. EXT = externalizing problems; INT = internalizing problems; * $p < .001$; 90% confidence interval for RMSEA reported in square brackets.

Sex Differences in the Model

In order to investigate sex differences in the best fitting model, a configural invariance model fit test was conducted. This analysis of model fit indices for the configural model indicated similar values compared to Model 1 (CFI = 0.866, TLI = 0.853, RMSEA = 0.055). This configural model was then compared against more restrictive measurement invariance including both metric and scalar invariance models. For the metric or weak invariance model,

changes of CFI, TLI and RMSEA were within acceptable values (ΔCFI = 0.005, ΔTLI = 0.001, ΔRMSEA = 0), indicating that the metric of factor scores was invariant across sex and that items used to estimate the factor loadings have the same meaning for females and males. For the scalar or strong invariance model, changes in model fit represented acceptable values for most model fit indices (ΔCFI = 0.02, ΔTLI = 0.01, ΔRMSEA = 0.002). These results suggest that both factor loadings and item intercepts appear to be invariant across sex and that the model results do not differ significantly between males and females.

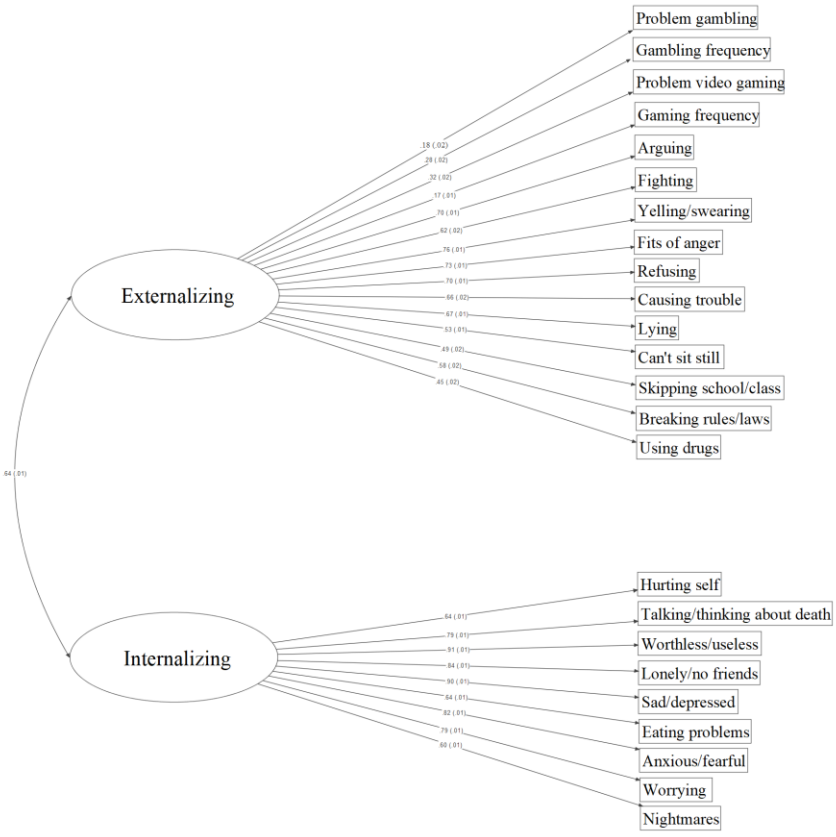

Figure 1. Two-factor model loading problem gambling and problem video gaming on the externalizing factor.

Exploratory Analysis: Three Factor Model

An exploratory analysis involving a three-factor model was conducted in order to

explore potential improvements in model fit while investigating changes in factor loadings for the included variables. A three-factor model was established by moving all variables with factor loadings below or close to 0.30 in the optimal two-factor model onto a separate latent variable. This included: PG, gambling frequency, PVG, and gaming frequency. Model fit indices indicated a minor improvement of model fit compared to the previously established two-factor model (chi-square test of model fit = 4983.23, $p < .001$; RMSEA = 0.055; CFI = 0.87; TLI = 0.86; SRMR = 0.056). Loadings on this third factor, labeled as *behavioral addiction*, were elevated and statistically significant ($p < .001$) and are presented in Figure 2. Within this three-factor model, the gambling and gaming variables indicated an improvement of factor loadings with no variables being below the 0.30 threshold.

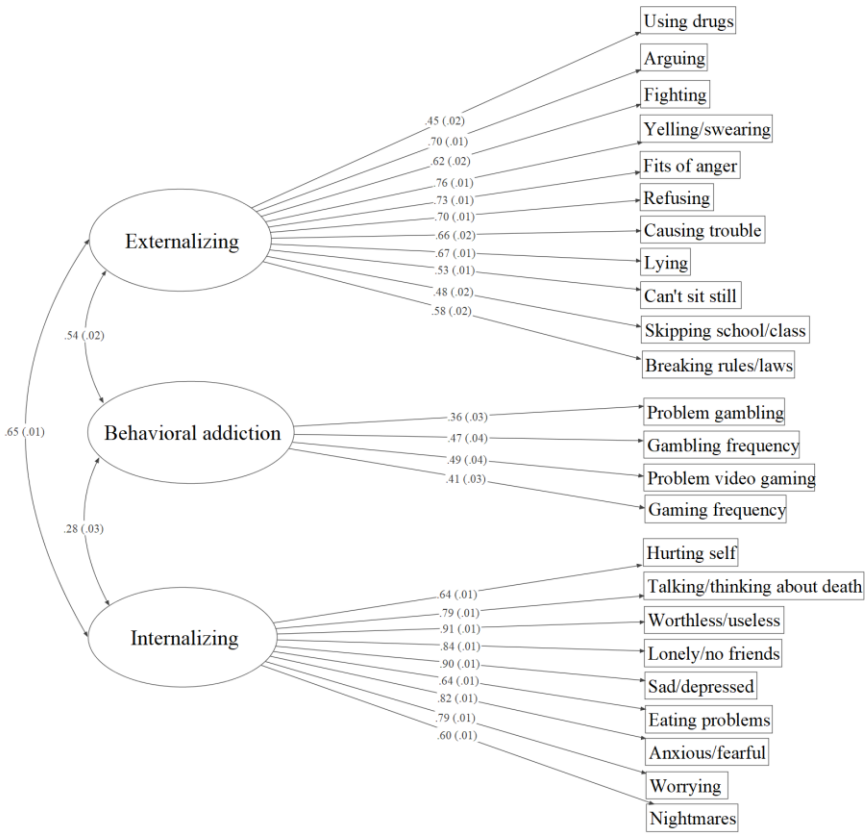

Figure 2. Three-factor model loading gambling and gaming variables on a separate latent factor.

Discussion

The present study investigated the fit of PG and PVG within the two-factor structure of psychopathology including externalizing and internalizing problem factors in a sample of adolescents. Consistent with our hypothesis and previous findings among adults (King et al., 2020; Oleski et al., 2011) PG was found to load optimally under the externalizing problem factor along with various aggressive, delinquent and substance use behaviors. However, contrary to our hypothesis, PVG did not load optimally under the internalizing problem factor, indicating a more optimal fit when also loaded under the externalizing factor. To the author's knowledge, this is the first study to integrate PVG into the hierarchical structure of psychopathology with preliminary findings suggesting that both PG and PVG may be best conceptualized and classified within the externalizing domain of psychopathology. Nevertheless, it is relevant to note that the associations with gambling and gaming were not as strong compared to most problem behaviors included within the externalizing problem factor, a finding that has been previously established for PG (King et al., 2020; Oleski et al., 2011).

The more optimal fit of PG and PVG within the externalizing factor when compared to the internalizing factor could be the result of shared etiological, neurobiological, clinical, and phenomenological features across disorders and problems included within this factor (Brezing et al., 2010; Potenza, 2014; Yakovenko & Hodgins, 2018). Of note, underlying psychological vulnerabilities and risk factors including impulsivity, behavioral disinhibition, and high sensation seeking could partially explain the associations between these problems (Yakovenko & Hodgins, 2018). Although there appears to be greater evidence supporting the fit of PG within the externalizing factor, both externalizing and internalizing problems have been previously associated with PVG (Lee et al., 2017; Richard et al., 2020a). This includes associations between

PVG and symptoms of both depression and anxiety in cross-sectional and longitudinal studies (Kuss et al., 2020; Richard et al., 2020a, 2020b). However, based on available evidence, there appear to be greater support for the relationship between externalizing problems and PVG, at least when measured cross-sectionally among community adolescents (Richard et al., 2020a, 2020b). Within the present study, comparing the results of Model 1 (PG and PVG loaded onto the externalizing factor) to Model 3 (PG loaded onto the externalizing factor, PVG loaded onto the internalizing factor), significant loadings were present between PVG and gaming frequency across both factors, yet the relationship was slightly stronger for the externalizing factor. Given the minor differences in fit and the moderate correlation between the externalizing and internalizing latent factors within the two-factor model, there is a need for additional research to support these findings relevant to the fit of PVG under the externalizing problems hierarchical factor.

As previously stated, when both PG and PVG were loaded onto the internalizing problem factor, model fit indices worsened, and standardized beta coefficients decreased. Nevertheless, these associations remained statistically significant and warrant some discussion. To explain these associations, it is possible that shared underlying psychological vulnerabilities for internalizing problems, PVG, and PG, may be present including trait neuroticism, inhibited temperament, emotional dysregulation, and difficulties with emotional coping (Lahey et al., 2012; Richard et al., 2020a). Comparing PVG and PG, these associations appear to be stronger among adolescents endorsing PVG, with the possibility that the association between internalizing problems and gambling behaviors becomes stronger in adulthood (Richard et al., 2022). Overall, these findings indicate that although significant, internalizing problems do not represent as

considerable an association with PG and PVG when compared to the externalizing problems among adolescents.

Based on the invariance analyses, there were no sex differences in model fit indicating that the model where PG and PVG was loaded on externalizing factors provided the best fit for both males and females. This finding suggests that the underlying associations for frequent or problematic engagement in gambling and gaming are similar by sex within this adolescent sample. These results are consistent with our hypothesis and findings established by King and colleagues (2020) for PG among emerging adults. However, this finding is in contrast to the findings by Oleski and colleagues (2011). In their study of adults, Oleski et al. (2011) indicated that for women, the best fit for PG was found when it was loaded onto both the higher-order externalizing problem factor and the lower-order anxious-misery factor of internalizing problems. The difference in findings could be indicative of sex differences only developing in later developmental periods, with youth having lower rates of engagement and problems related to gambling. Moreover, it is possible that these differences were due to variations in the methodology to assess sex differences, with Oleski and colleagues (2001) not directly testing whether factor loadings differed by sex, but instead modifying paths between variables in order to improve indices of model fit. As for the absence of sex differences relevant to PVG, since problems related to gaming tend to emerge earlier in life when compared to gambling (King et al., 2015), these findings suggest that similar associations with externalizing and internalizing problems are present for males and females.

Considering the results from the exploratory analysis, minor improvements in model fit were noted once gambling and gaming behaviors were separated from the externalizing factor and loaded on a separate factor. Compared to other studies investigating competing theoretical

models to the externalizing problems factor, the present study is unique in that PG and PVG were also included. Considering the addition of PG and PVG, it is noteworthy that the gambling and gaming behaviors fit best on a separate latent factor that had a greater correlation with the externalizing factor ($r = 0.54$) compared to the internalizing factor ($r = 0.28$). These exploratory analyses highlight the need for additional research on behavioral addictions to further elucidate these hierarchical interrelationships and the optimal classifications of these behaviors.

Strengths and Limitations

A number of strengths should be noted relevant to the present study including its large sample of public-school students, the adequate representation of both male and female respondents, and the number of variables assessed relevant to substance use, gambling, gaming, problem behaviors and youth mental health. Nevertheless, several limitations should be noted. First, the present study only utilized self-report data, which allows for the possibility of biased responding. Given the sensitive nature of some of the survey questions (e.g., mental health symptoms, gambling among minors), it is possible that some individuals did not respond truthfully. To account for this, a series of checks and filters were employed to confirm validity and sincerity of the responses; however, it is impossible to validate each respondent's true engagement. Second, a short screening tool was utilized to assess for PG which does not include all symptoms of disordered gambling that could have been experienced. Third, although a validated screening tool for youth externalizing and internalizing problems was utilized, not all problems related to these constructs were measured and future studies including more comprehensive methodological tools should be conducted. Fourth, although RMSEA and SRMR values were good within the excluded models, both the CFI and TLI values fell below the suggested threshold. This may be indicative of limitations at the levels of the included measures

which may be indicative of the difficulties in measuring behavioral addictions among youth. It is recommended that future studies further develop and utilize youth-specific measures of problem gambling and gaming. Finally, although a large sample size was used, the data was collected from one county in the United States (Wood County, Ohio). As such, it may not be representative of adolescents more broadly and additional studies should examine these relationships across different regions for the purpose of generalizability.

Clinical Implications

Given that both PG and PVG appear to fit best under the externalizing factor of the hierarchical structure of psychopathology, interventions related to other externalizing problems may also be effective in treating youth PG and PVG. For instance, CBT is a transdiagnostic treatment approach that addresses common features across externalizing disorders including poor behavioral control, response inhibition and difficulties in perspective taking. In a meta-analysis investigating effectiveness of cognitive-behavioral therapy (CBT) for externalizing disorders, CBT was found to be moderately effective in treating a range of externalizing problems including oppositional defiant disorder, attention deficit hyperactivity disorder and aggressive behaviors (Battagliese et al., 2015). Although not considered in the meta-analysis, CBT has also been identified as being effective in the treatment of gambling disorder (Gooding & Tarrier, 2009) and gaming disorder (Stevens et al., 2019). Moreover, as prevention programs for youth externalizing problems are more commonly available than prevention programs of youth gambling or gaming, the addition of problem gambling and gaming within these psychosocial programs has the potential to be effective in reducing or minimizing the development of these problems over time.

Conclusions

Overall, the results from the present study indicate that both PG and PVG fit best onto the externalizing factor, with the possibility of separating gambling and gaming behaviors on a behavioral addictions factor. These results provide additional evidence for the classification of PG within the externalizing factor among a sample of youth, and initial evidence for the classification of PVG within the externalizing factor. As problematic patterns of engagement in gambling and video games are becoming issues of increasing importance, it is essential that these behaviors be more formally recognized as being a part of the behaviors considered when studying youth psychopathology in order to inform emerging prevention and treatment initiatives.

References

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders: DSM-IV* (4th ed.). Washington, DC: American Psychiatric Association.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed.). Washington, DC: American Psychiatric Association.

Battagliese, G., Caccetta, M., Luppino, O. I., Baglioni, C., Cardi, V., Mancini, F., & Buonanno, C. (2015). Cognitive-behavioral therapy for externalizing disorders: A meta-analysis of treatment effectiveness. *Behaviour Research and Therapy, 75*, 60–71. https://doi.org/10.1016/j.brat.2015.10.008

Bonadio, F. T., & Tompsett, C. (2017). The factor structure of the Ohio Scales: A practical measure of psychological symptoms in youth. *Journal of Child and Family Studies, 26*(1), 101-117. doi:10.1007/s10826-016-0544-0.

Brezing, C., Derevensky, J. L., & Potenza, M. N. (2010). Non-substance-addictive behaviors in youth: Pathological gambling and problematic Internet use. *Child and Adolescent Psychiatric Clinics of North America, 19*(3), 625-641. doi:10.1016/j.chc.2010.03.012

Byrne, B. M. (2013). *Structural Equation Modeling with Mplus: Basic Concepts, Applications, and Programming.* New York, NY: Routledge, Taylor & Francis Group.

Calado, F., Alexandre, J., & Griffiths, M. D. (2017). Prevalence of adolescent problem gambling: A systematic review of recent research. *Journal of Gambling Studies, 33*(2), 397-424. doi:10.1007/s10899-016-9627-5

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*(2), 233–255.

DeLisi, M., Vaughn, M. G., Gentile, D. A., Anderson, C. A., & Shook, J. J. (2013). Violent video games, delinquency, and youth violence: New evidence. *Youth Violence and Juvenile Justice, 11*(2), 132-142.

Dowling, N. A., Merkouris, S. S., Greenwood, C. J., Oldenhof, E., Toumbourou, J. W., & Youssef, G. J. (2017). Early risk and protective factors for problem gambling: A systematic review and meta-analysis of longitudinal studies. *Clinical Psychology Reviews, 51*, 109-124. doi:10.1016/j.cpr.2016.10.008

Fam, J. Y. (2018). Prevalence of internet gaming disorder in adolescents: A meta-analysis across three decades. *Scandinavian Journal of Psychology.* doi:10.1111/sjop.12459

Farmer, R. F., Seeley, J. R., Kosty, D. B., Gau, J. M., Duncan, S. C., Lynskey, M. T., & Lewinsohn, P. M. (2015). Internalizing and externalizing psychopathology as predictors of cannabis use disorder onset during adolescence and early adulthood. *Psychology of Addictive Behaviors, 29*(3), 541–551. https://doi.org/10.1037/adb0000059

Farmer, R. F., Seeley, J. R., Kosty, D. B., & Lewinsohn, P. M. (2009). Refinements in the hierarchical structure of externalizing psychiatric disorders: Patterns of lifetime liability from mid-adolescence through early adulthood. *Journal of Abnormal Psychology*, *118*(4), 699–710. https://doi.org/10.1037/a0017205

Fonagy, P., & Luyten, P. (2018). Conduct problems in youth and the RDoC approach: A developmental, evolutionary-based view. *Clinical Psychology Review, 64*, 57-76.

Forbes, M. K., Tackett, J. L., Markon, K. E., & Krueger, R. F. (2016). Beyond comorbidity: Toward a dimensional and hierarchical approach to understanding psychopathology across the life span. *Development and Psychopathology, 28*(4), 971–986.

Gerstein, D., Volberg, R. A., Toce, M. T., Harwood, H., Johnson, R. A., Buie, T., . . . Engelman, L. (1999). *Gambling impact and behavior study: Report to the national gambling impact study commission.* Chicago: National Opinion Research Center.

Gibbons, R. D., & Hedeker, D. R. (1992). Full-information item bifactor analysis. *Psychometrika, 57*(3), 423–436.

Gooding, P. & Tarrier, N. (2009). A systematic review and meta-analysis of cognitive-behavioural interventions to reduce problem gambling: Hedging our bets? *Behaviour Research and Therapy, 47*(7), 592–607. doi:10.1016/j.brat.2009.04.002

Griffiths, M. D. (2005). Relationship between gambling and video-game playing: A response to Johansson and Götestam. *Psychological Reports, 96*, 644–646. doi:10.2466/pr0.96.3.644-646

Griffiths, M. D. (2008). Digital impact, crossover technologies and gambling practices. *Casino & Gaming International, 4*, 37–42. http://irep.ntu.ac.uk/id/eprint/883

Griffiths, M. D., Kuss, D. J., Lopez-Fernandez, O., & Pontes, H. M. (2017). Problematic gaming exists and is an example of disordered gaming. *Journal of Behavioral Addictions, 6*(3), 296-301. doi:10.1556/2006.6.2017.037

Hilgard, J., Engelhardt, C. R., & Bartholow, B. D. (2013). Individual differences in motives, preferences, and pathology in video games: The gaming attitudes, motives, and experiences scales (GAMES). *Frontiers in Psychology, 4*, 1–13. doi:10.3389/fpsyg.2013.00608

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*(1), 1-55. doi:10.1080/10705519909540118

James, R. J. E., & Tunney, R. J. (2017). The need for a behavioural analysis of behavioural addictions. *Clinical Psychology Review, 52*, 69-76. doi:10.1016/j.cpr.2016.11.010

Jahic, I., DeLisi, M., & Vaughn, M. G. (2021). Psychopathy and violent video game playing: Multiple associations in a juvenile justice system involved sample. *Aggressive Behavior, 47*(4), 385-393;

King, D., Delfabbro, P., & Griffiths, M. (2010). The convergence of gambling and digital media: Implications for gambling in young people. *Journal of Gambling Studies, 26*, 175–187. doi:10.1007/s10899-009-9153-9.

King, D. L., Gainsbury, S. M., Delfabbro, P. H., Hing, N., & Arabanel, B. (2015). Distinguishing between gaming and gambling activities in addiction research. *Journal of Behavioral Addictions, 4*, 215–220. doi:10.1556/2006.4.2015.045

King, S. M., Saunders, G. R. B., Elkins, I. J., Winters, K. C., Iacono, W. G., & McGue, M. (2020). Where do gambling problems fit in the structure of psychopathology during emerging adulthood? *International Gambling Studies, 20*(1), 1-13. doi:10.1080/14459795.2019.1643901

Krueger, R. F. (1999). The structure of common mental disorders. *Archives of General Psychiatry, 56*, 921–26.

Krueger, R. F., & Markon, K. E. (2006). Reinterpreting comorbidity: A model-based approach to understanding and classifying psychopathology. *Annual Review of Clinical Psychology, 2*, 111–133.

Kryszajtys, D. T., Hahmann, T. E., Schuler, A., Hamilton-Wright, S., Ziegler, C. P., & Matheson, F. I. (2018). Problem gambling and delinquent behaviours among

adolescents: A scoping review. *Journal of Gambling Studies, 34*(3), 893-914. doi:10.1007/s10899-018-9754-2

Lahey, B. B., Applegate, B., Hakes, J. K., Zald, D. H., Hariri, A. R., & Rathouz, P. J. (2012). Is there a general factor of prevalent psychopathology during adulthood? *Journal of Abnormal Psychology, 121*(4), 971–977. https://doi.org/10.1037/a0028355

Lee, S. Y., Lee, H. K., Jeong, H., Yim, H. W., Bhang, S. Y., Jo, S. J., . . . Kweon, Y. S. (2017). The hierarchical implications of internet gaming disorder criteria: Which indicate more severe pathology? *Psychiatry Investigation, 14*(3), 249-259.

Muthén, L. K., & Muthén, B. O. (2012). *Mplus user's guide, 7th edition*. Los Angeles, CA: Muthén & Muthén.

Myrseth, H., & Notelaers, G. (2018). A latent class approach for classifying the problem and disordered gamers in a group of adolescence. *Frontiers in Psychology, 9*(2273). doi:10.3389/fpsyg.2018.02273

Ogles, B. M., Melendez G., Davis D. C., Lunnen, K. M. (2001) The Ohio Scales: Practical outcome assessment. *Journal of Child and Family Studies, 10*, 199-212.

Oleski, J., Cox, B. J., Clara, I., & Hills, A. (2011). Pathological gambling and the structure of common mental disorders. *Journal of Nervous and Mental Disease, 199*(12), 956–960.

Paulus, F. W., Ohmann, S., von Gontard, A., & Popow, C. (2018). Internet gaming disorder in children and adolescents: A systematic review. *Developmental Medicine & Child Neurology*, 60(7), 645-659. doi:10.1111/dmcn.13754

Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 Internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior, 45*, 137-143. doi:10.1016/j.chb.2014.12.006

Potenza, M. N. (2014). Non-substance addictive behaviors in the context of DSM-5. *Addictive Behaviors, 39*(1), 1-2. doi:10.1016/j.addbeh.2013.09.004

Rapee, R. M., Oar, E. L., Johnco, C. J., Forbes, M. K., Fardouly, J., Magson, N. R., & Richardson, C. E. (2019). Adolescent development and risk for the onset of social-emotional disorders: A review and conceptual model. *Behaviour Research and Therapy, 123*, 103501. doi:10.1016/j.brat.2019.103501

Richard, J., Fletcher, E., Boutin, S., Derevensky, J., & Temcheff, C. (2020a). Conduct problems, depressive symptoms and behavioral addictions in adolescents and young adults: A systematic review. *Journal of Behavioral Addictions, 9*(3), 497-533.

Richard, J., Temcheff, C., & Derevensky, J. (2020b). Gaming disorder across the lifespan: A scoping review of longitudinal studies. *Current Addiction Reports 7*(4), 561-587.

Richard, J., Temcheff, C., Fletcher, E., Lemieux, A., Derevensky, J., & Dery, M. (2021). An empirical investigation of the externalizing and internalizing pathways to problem video gaming: A longitudinal study across childhood and adolescence. *Computers in Human Behavior*, 1-8. https://doi.org/10.1016/j.chb.2021.107096

Richard, J., Temcheff, C., Fletcher, E., Lemieux, A., Derevensky, J., & Dery, M. (2022). Externalizing and internalizing trajectories to adolescent gambling: A longitudinal study. International Gambling Studies, 1-19. https://doi.org/10.1080/14459795.2022.2154378

Shaffer, H. J., & Korn, D. A. (2002). Gambling and related mental disorders: A public health analysis. *Annual Review of Public Health, 23*, 171-212. doi:10.1146/annurev.publhealth.23.100901.140532

Stevens, M., King, D. L., Dorstyn, D., & Delfabbro, P. H. (2019). Cognitive-behavioral therapy for Internet gaming disorder: A systematic review and meta-analysis. *Clinical Psychology & Psychotherapy, 26*(2), 191–203.

Sugaya, N., Shirasaka, T., Takahashi, K., & Kanda, H. (2019). Bio-psychosocial factors of children and adolescents with internet gaming disorder: A systematic review. *BioPsychoSocial Medicine, 13*(1), 3. doi:10.1186/s13030-019-0144-5

Toce-Gerstein, M., Gerstein, D. R., & Volberg, R. A. (2009). The NODS–CLiP: A rapid screen for adult pathological and problem gambling. *Journal of Gambling Studies, 25*(4), 541.

Tully, E., & Iacono, W. G. (2014). An integrative common liabilities model for the comorbidity of substance use disorders with externalizing and internalizing disorders. *Psychology Faculty Publications.* Paper 145.

Wang, J., & Wang, X. (2012). *Structural Equation Modeling Applications Using Mplus.* Chichester: John Wiley & Sons Ltd. doi: 10.1002/9781118356258

Willoughby, T., Chalmers, H., & Busseri, M. A. (2004). Where is the syndrome? Examining co-occurrence among multiple problem behaviors in adolescence. *Journal of Consulting and Clinical Psychology, 72*(6), 1022-1037. doi:10.1037/0022-006X.72.6.1022

World Health Organization. (2019). *International statistical classification of diseases and related health problems (11th Revision).* Retrieved from: https://icd.who.int/browse11/l-m/en

Yakovenko, I., & Hodgins, D. C. (2018). A scoping review of co-morbidity in individuals with disordered gambling. *International Gambling Studies, 18*(1), 143–172. doi:10.1080/14459795.2017.1364400

Bridging Document 2

Study 2 empirically investigated the fit of problem gambling (PG) and problem video gaming (PVG) within the two-factor hierarchical structure of psychopathology including externalizing and internalizing problem factors in a sample of adolescents. Findings from this cross-sectional study indicated that both PG and PVG loaded optimally under the externalizing problem factor with no sex differences being present in these associations (Richard et al., 2023). Although similar associations were identified when PVG was loaded on the internalizing problem factor, the model did not fit the data as optimally compared to PVG being loaded onto the externalizing problem factor. Moreover, exploratory analyses identifying alternative models further optimized the indices of model fit by separating both substance use behaviors and other addictive behaviors (i.e., PG and PVG) into separate yet correlated factors. The final exploratory model yielded a four-factor model featuring antisocial/oppositional behaviors, substance use behaviors, behavioral addictions, and internalizing problems. Overall, as reported in the conclusions of this study, the results indicate that both PG and PVG fit best onto the externalizing factor, with the possibility of separating externalizing problems into antisocial/oppositional behaviors, substance use, and behavioral addictions lower-order factors.

Consistent with results from Study 1, PG appears to be more closely associated with problems included within the externalizing spectra such as conduct problems (i.e., antisocial and oppositional behaviors) and substance use behaviors (Richard et al., 2020a). Comparatively, although PVG was found to be more closely associated with problems included within the internalizing spectra such as depressive symptoms, in Study 2, PVG was best identified within the externalizing problem factor. These contrasting findings may be suggestive of the nuance necessary to understanding the association between externalizing problems, internalizing

problems, and PVG among adolescent samples and the differences that can be underscored when investigating these problems concurrently versus sequentially. Specifically, Study 1 indicated how conduct problems and depressive symptoms may be more similarly associated with PVG in cross-sectional research when compared to prospective studies (Richard et al., 2020a). The findings of Study 2 would support these conclusions in that PVG appears to be more closely associated with externalizing problems when these variables are measured concurrently, although a significant association with internalizing problems remains.

Based on the results of review conducted for Study 1 and the cross-sectional evidence from Study 2, the aim of Study 3 is to empirically investigate the effect of externalizing and/or internalizing problem trajectories in predicting PVG among adolescents. Utilizing longitudinal data from a cohort of children and adolescents, this study aims to investigate these variables sequentially in order to elucidate evidence for the externalizing, internalizing or combined pathways to PVG. A similar empirical investigation will be conducted for Study 4, with these problem trajectories predicting gambling behaviors among adolescents. The hypotheses for Study 3 and Study 4 are informed by the review of the literature provided in Study 1.

Study 3

An Empirical Investigation of the Externalizing and Internalizing Pathways to Disordered Gaming Behavior: A Longitudinal Study Across Childhood and Adolescence

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Abstract

Background: Problematic engagement in video gaming is a prevalent concern among youth with an increasing number of adolescents reporting symptoms of gaming disorder. There is a need for longitudinal research evaluating factors in childhood that increase the risk of endorsing symptoms of gaming disorder in adolescence. Method: Children (N = 744, 53.2% boys, Mage = 8.3, SD = 0.93 years old), were followed over five years, with questionnaires for internalizing and externalizing problems being completed yearly (Time 1 to Time 5), and disordered gaming being measured at Time 6. Results: Parallel process growth models were utilized to establish trajectories for externalizing and internalizing problems over time. Findings from regression analyses indicated that initial levels of both internalizing and externalizing problems significantly predicted disordered gaming symptoms five years later. Additionally, the development of internalizing problems over time was significant in predicting disordered gaming symptoms. The interaction effects for intercept and slope of internalizing and externalizing problems were non-significant and no differences based on sex were identified. Conclusions: Children with internalizing and/or externalizing problems appear to be at a greater risk of developing symptoms of disordered gaming in adolescence. A pattern of increasing internalizing problems from childhood to adolescence seems to further exacerbate this risk.

Introduction

Over the past decade, concerns have been raised about the potential for problematic engagement in Internet technologies (Fumero et al., 2018; Ho et al., 2014; Zhang et al., 2017), with special attention being placed on video games (Pan et al., 2020; Saunders et al., 2017). In 2013, the American Psychiatric Association (APA) outlined the proposed criteria for Internet gaming disorder in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) as a condition warranting further research. As of 2019, the World Health Organization (WHO) recognized gaming disorder (GD) as a mental disorder in the International Classification of Diseases 11th Revision (ICD-11), where it is defined as persistent engagement in gaming over a period of at least 12 months characterized by impaired control over gaming, increased priority given to gaming over other activities and life interests, and an escalation and continuation of gaming despite negative consequences. Literature reviews have identified that the prevalence rate of GD ranges from 0.7% to 27.5% globally, with noteworthy differences being identified based on the demographic characteristics of the sampled population (higher rates among males and youth) and the measurement tool used (Fam, 2018; Feng et al., 2017; Mihara & Higuchi, 2017; Richard et al., 2020a; Stevens et al., 2020).

A majority of the research investigating GD, or more broadly, problem video gaming (which includes GD as well as subclinical levels of GD) has been cross-sectional, with the purpose of identifying factors associated with problematic or disordered gaming (Richard et al., 2020a). Although this research was essential to initially identify associations between certain variables and GD, it remains restricted in its ability to clearly identify the effect of these variables across time in predicting GD. Moreover, the developmental period (e.g., childhood or adolescence) in which an individual begins developing symptoms of GD appears to be related to

the presence of certain, potentially interconnected and distinctive, biological, psychological, and social vulnerabilities (Richard et al., 2020a). Of note, longitudinal risk factors for GD in children and adolescents (e.g., attention difficulties, loneliness, aggression, poor parental and peer relationships; Ferguson & Ceranoglu, 2014; Gentile et al., 2011; Krossbakken et al., 2018; Lemmens et al., 2011a; Peeters et al., 2019) are different from some risk factors for GD in adulthood (e.g., perfectionism, escapism and achievement motives, decreased purpose in life; Chang & Lin, 2019; Forrest et al., 2017; Zhang et al., 2019). Overall, developmental considerations appear to be of significant importance when attempting to understand the development of problem or disordered gaming across the lifespan.

To date, a number of theoretical and conceptual models have been proposed to explain the development of GD (Benarous et al., 2019; Brand et al., 2016, 2019; Lee et al., 2017a; Paulus et al., 2018; Richard et al., 2020a). Taken together, these models propose various pathways towards the development of GD that are influenced by specific predisposing vulnerabilities which can interact with affective, cognitive, and executive process to maintain disordered gaming behaviors. Across these models, there are two general categories of predisposing factors that appear to be associated with the development of GD from childhood onwards: (i) internalizing vulnerabilities (consisting of emotional vulnerabilities, depressive and/or anxious symptoms, and emotion dysregulation) and (ii) externalizing vulnerabilities (constituting of conduct problems, aggressive, antisocial and/or oppositional behaviors, and behavioral disinhibition) (Richard et al., 2020a, 2020b). These vulnerabilities have also been identified as being risk factors for other addictive behaviors including gambling (Dussault et al., 2016; Martins et al., 2013, 2014) and substance use (Englund & Siebenbruner, 2012; Hussong et al., 2011; Maslowsky et al., 2014; Trucco et al., 2018; Zucker, 1994; Zucker et al., 2011).

Although internalizing and externalizing vulnerabilities have been identified as risk factors for GD within theoretical and conceptual models, the extant literature has produced mixed findings in the predictive roles of these problems. In terms of internalizing problems, while some longitudinal studies have reported significant predictive effects of internalizing problems on problem or disordered gaming among children and adolescents (Gentile et al., 2011; Liu et al., 2018; Teng et al., 2021), others have reported non-significant effects (Mößle & Rehbein, 2013; Wichstrom et al., 2019). For externalizing problems, only one study identified a significant predictive effect of externalizing problems among adolescents and emerging adults (Krossbakken et al., 2018), with studies among children and adolescents reporting non-significant effects (Lemmens et al., 2011b; Wartberg et al., 2019; Wichstrom et al., 2019). Overall, these inconsistent findings appear to be a result of differences in the instruments used to measure internalizing or externalizing problems across studies, age differences between the samples, and differences in study duration (ranging from six months to two years).

With regards to the developmental trajectories of internalizing and externalizing problems, no studies to date have investigated the developmental change of these variables across time and how this change can be predictive of GD. These developmental processes are crucial to investigate as both internalizing and externalizing problems have been found to vary over time. For instance, children and adolescents have generally been found to show decreasing frequencies of externalizing problems as a function of age (Bongers et al., 2004; Campbell et al., 2000; López-Romero et al., 2015) and a relative stability of internalizing problems (Galambos et al., 2003; Keiley et al., 2000), despite some children manifesting clinically elevated levels of these problems in the transition from childhood to adolescence (Nagin & Tremblay, 2001; Reynolds et al., 2010; Riina et al., 2014). Notably, females were found to be more likely than

males to maintain higher levels of internalizing problems in the transition from childhood to adolescence (Bongers et al., 2004; Costello et al., 2008), although these differences appear to be small or limited to children with particular vulnerabilities (Shanahan et al., 2015). Taken together, it is important to consider the trajectories of these problems since both the initial levels of these vulnerabilities and their rate of change over time may have critical differential effects when examining the development of GD.

Moreover, the interaction between internalizing and externalizing problems has been investigated in the broader addiction literature, but not specific to disordered gaming. It is critical to investigate the potential interaction of these problems as youth reporting greater externalizing problems have been found to more vulnerable to co-occurring internalizing problems when compared to their peers (Martin-Storey et al., 2018; Wolff & Ollendick, 2006). While some evidence suggests that these two problems increase the risk of substance use when they are in the low to moderate range (Maslowsky & Schulenberg, 2013; McCarty et al., 2013), other research indicates that internalizing problems might buffer against the risk of substance use in youth with elevated levels of externalizing problems (Mason et al., 2008; Scalco et al., 2014). As such, there have been mixed findings on the effect of these two problems in the prediction of substance use behaviors, with an interaction effect being potentially relevant for the development of disordered gaming.

Lastly, none of the studies investigating the predictive role of internalizing problems on GD have examined the influence of sex on these relationships. For externalizing problems, Wartberg and colleagues (2019) conducted their analyses separately by sex, with no differences being reported between males and females. Based on current research, males tend to report greater GD symptoms compared to females, even without endorsing comorbid psychopathology

(Fam, 2018; Lee et al., 2017b; Mihara & Higuchi, 2017; Richard et al., 2020a). Taken together, although these preliminary results would suggest that no sex differences are present regarding the predictive role of internalizing and externalizing problems on disordered gaming, additional research is necessary to elucidate these findings.

Current Investigation and Study Hypotheses

The current study aimed to empirically investigate trajectories of externalizing and internalizing problems from late childhood to early adolescence in predicting disordered gaming in mid-adolescence. As mixed findings have been reported in the role of internalizing and externalizing problems as predictors of GD, there is a need for longitudinal research integrating temporally distal predictors and their change over time in order to draw clearer conclusions regarding the predictive role of both externalizing and internalizing problems. Specifically, this study aimed to investigate how baseline scores of externalizing and internalizing problems in childhood and their temporal trajectories over time predict disordered gaming in mid-adolescence. In line with several previous studies (Gentile et al., 2011; Liu et al., 2018; Teng et al., 2021), it was hypothesized that both greater baseline scores and a trajectory of increasing internalizing problems would be predictive of disordered gaming. As for externalizing problems, in line with the majority of previous research on the subject (Lemmens et al., 2011b; Wartberg et al., 2019; Wichstrom et al., 2019), it was hypothesized that baseline scores and a trajectory of elevated externalizing problems would not be predictive of disordered gaming. Moreover, there is a need to investigate the potential interaction of externalizing and internalizing problems across time in predicting GD. As no studies have been conducted specific to GD, this aim was exploratory in nature and no hypotheses were specified. Lastly, with regards to the limited research investigating sex differences in the literature among youth, it was hypothesized that

there would be no sex differences in the predictive role of internalizing and externalizing problems on disordered gaming.

Materials and Methods

Participants and Procedures

The present study utilized data from an ongoing longitudinal research project. Recruitment at study inception took place from 2008 to 2010 from eight French-speaking schoolboards in Québec (Eastern Townships, Montréal, Montérégie, and Québec City). A total of 744 children and adolescents participated in completing a battery of questionnaires on a yearly basis. Most participants were born in Québec (93.5%), with 29.5% of them living in a single-parent-headed family at study inception. Participants had an average age of 8.3 years at baseline (range of 6.3 to 9.9 years of age at Time 1 [T1]). The sample is evenly distributed by sex (53.2% male), with half of the students presenting with significant externalizing behaviors and the other half presenting without significant externalizing behaviors (comparison group) at study inception.

In order to recruit a relatively large number of children with significant externalizing behaviors before age 10, the majority of this half of the sample was recruited based on the fact that they were receiving psychosocial services for their externalizing behaviors in public schools. Since children who were referred for these services were mainly boys, all girls and one in four boys (randomly selected) from 155 elementary public schools were invited to participate in order to obtain a sample containing a roughly equal proportion of girls and boys. A total of 75.1% of those invited agreed to participate (n = 370), with no significant differences being noted for participation in terms of gender, grade, or school socioeconomic status. Of these 370 children,

91.6% (*n* = 339) were in the borderline or clinical range (above the 93rd percentile) of the conduct problem and oppositional defiant problem DSM-oriented scales of the Achenbach System of Empirically Based Assessment (ASEBA) and were included in the study. The remaining children with significant externalizing behaviors were selected from a random sample of 881 students from schools in low-income neighborhoods whose parents and teachers completed the aforementioned scales of the ASEBA. Of the 881 students, 10.8% (*n* = 95) scored above the threshold of elevated risk (above the 93rd percentile) on the above-mentioned ASEBA scales and were included in the study. For the comparison group, 35.5% (*n* = 279) of the 786 boys and girls who did not meet the risk threshold on the ASEBA scales were recruited randomly based on their match based on age, school, and sex to the children with significant externalizing behaviors.

Data for the longitudinal study were collected annually via in-home interviews by trained research assistants. Parents were provided with a full description of the study, a consent form for the interview, and the authorization to contact the child's classroom teacher. Interviews were performed by graduate-level research assistants with three days of formal training on the interview procedures.

Measures

Externalizing and Internalizing Problems. Measures of externalizing and internalizing problems were measured yearly utilizing the French versions of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) and the Teacher Report Form (TRF; Achenbach & Rescorla, 2001) of the ASEBA. The CBCL is a 118-item measure of internalizing (e.g., depression, anxiety, social withdrawal) and externalizing problems (e.g., conflict with others, violation of social norms, aggressive behaviors) designed for the evaluation of youth aged six to

18. Externalizing and internalizing problems were measured yearly from T1 to Time 5 (T5) based on parent and teacher ratings. Normed T-scores derived from raw scores were utilized to facilitate comparisons of results over time and between groups. T-scores greater than or equal to 65 on the Internalizing or Externalizing scales are considered in the at-risk range, indicative of significant behavioral or emotional problems in the range of children referred for professional mental health evaluation (Achenbach & Rescorla, 2001). The CBCL and the TRF have demonstrated satisfactory reliability (e.g., test-retest, internal consistency) and validity (e.g., construct validity) in both clinical and non-clinical populations (Achenbach, 1991; Crijnen et al., 1997, 1999; Macmann et al., 1992). In the present study, the internalizing problems scale (CBCL: $\alpha = 0.87\text{-}0.90$; TRF: $\alpha = 0.87\text{-}0.90$) and externalizing problems scale (CBCL: $\alpha = 0.92\text{-}0.93$; TRF: $\alpha = 0.95\text{-}0.96$) demonstrated good internal consistency.

Internet Gaming Disorder. At Time 6 (T6), disordered gaming behavior was measured utilizing a French translation of the Internet gaming disorder (IGD) criteria outlined in Section III of the DSM-5 (APA, 2013). Nine items were included to assess for the presence of each IGD criteria over the past 12 months and participants were asked to self-report a dichotomous (yes or no) answer to each of these items. Based on the DSM-5, five of the nine diagnostic criteria (preoccupation or obsession, withdrawal, tolerance, loss of control, loss of interest, continued overuse, deceiving others, escape of negative feelings, functional impairment) must be met within a year to be categorized as meeting the diagnostic criteria for IGD. For the present study, the outcome was measured continuously to capture differing severity of disordered gaming symptomatology. The internal consistency of the IGD scale based on Cronbach's alpha was 0.65. In order to improve the normality of the IGD score distribution, a total of 10 cases were

truncated at the 98th percentile (i.e., maximum score of six), significantly improving the skewness and kurtosis values of this variable.

Sociodemographic Characteristics. The sociodemographic variables assessed at baseline (T1) that were included as covariates in the model include the child's sex (female = 0; male = 1), age (in years and months), and annual family income (a 20-point scale ranging from 1 [$0 to $999] to 20 [greater than $160,000] CAD). This information was reported by the child's parent.

Data Analysis

IBM SPSS version 25 was used to calculate descriptive statistics and correlation coefficients. First, descriptive statistics regarding demographic variables at baseline and other assessed variables were provided for participants with valid responses at all measurement points (Table 1). Pearson correlation coefficients were conducted for externalizing and internalizing problems across all measurement points. Independent samples *t*-tests were conducted to explore sex and baseline externalizing behavior differences in rates of externalizing problems, internalizing problems, and gaming disorder symptom severity. Moreover, Chi-square tests and independent samples *t*-tests were conducted to identify any baseline differences between individuals with complete and incomplete data.

Second, parallel process growth modeling was utilized to empirically identify the mean developmental trajectories of externalizing and internalizing problems throughout childhood and early adolescence (from T1 to T5) with M*plus* version 8.4 (Muthén & Muthén, 2017). This analytic approach allowed for the identification of mean trajectories for each of the two problems while determining how well the statistical model reflects the data through a combination of

Table 1

Participant characteristics

	n	%
Sex (male)	396	53.2
Significant externalizing behaviors at baseline (yes)	434	58.3
Age at baseline [1]	744	8.39 (0.93)
Socioeconomic status		
$1,000-$11,999	52	6.9
$12,000-$19,999	49	6.6
$20,000-$29,999	86	11.5
$30,000-$49,999	155	20.9
$50,000-$69,999	124	16.7
$70,000-$79,000	171	23.0
$80,000 or more	99	13.4
Internalizing problems (T1) [1]	744	63.48 (8.60)
Internalizing problems (T2) [1]	714	62.57 (9.40)
Internalizing problems (T3) [1]	706	62.96 (9.06)
Internalizing problems (T4) [1]	692	61.31 (9.45)
Internalizing problems (T5) [1]	687	61.27 (9.85)
Externalizing problems (T1) [1]	744	66.17 (10.34)
Externalizing problems (T2) [1]	714	64.14 (10.38)
Externalizing problems (T3) [1]	706	63.73 (10.07)
Externalizing problems (T4) [1]	692	61.57 (10.80)
Externalizing problems (T5) [1]	687	60.75 (10.37)
Disordered gaming symptoms (T6) [1]	596	1.57 (1.70)

Note. [1] = Mean (Standard Deviation).

model fit indices. Optimal goodness-of-fit was assessed across several indices including the root mean square error of approximation (RMSEA; ≤ .06), comparative fit index (CFI; ≥ .95), Tucker-Lewis Index (TLI; ≥ .95), and standardized root mean squared residual (SRMR; ≤ .06) (Shi et al., 2019). Trajectories were built utilizing scores based on both parent and teacher report whereby the highest T-scores on externalizing and internalizing problems were retained at each time-point. Parent and teacher scores for externalizing and internalizing problems at each time-point were significantly correlated, with Pearson correlation coefficients ranging between 0.34 and 0.40 ($p < .001$) for internalizing problems and between 0.54 and 0.61 ($p < .001$) for

externalizing problems. Little's MCAR test was non-significant (χ^2 [170] = 184.70, p = 0.21, indicating that data was missing completely at random. Moreover, only 4.86% of the data was missing across all variables included in the multilevel analyses indicating that FIML estimation could be used. Thus, missing data on externalizing and internalizing scores were handled with full information maximum likelihood (FIML) estimation available in M*plus* version 8.4 (Muthén & Muthén, 2017). FIML estimation assumes that data are missing at random (Arbuckle, 1996; Schafer & Graham, 2002) and is a widely accepted form of estimation for longitudinal data with attrition, producing unbiased and efficient estimates (Muthén & Shedden, 1999; Schafer & Graham, 2002). Measurement invariance was tested in the present sample to observe potential differences between males and females, and between the participants endorsing high levels of externalizing problems and the comparison group. Longitudinal invariance for externalizing and internalizing problems was also conducted using ΔCFI (i.e., equal loadings across time versus free estimated loadings across time) because the Chi-Square test is known to be sensitive in large samples (n > 200). Cheung and Rensvold (2002) suggest that a CFI difference < 0.01 indicates a non-significant difference across measurement points.

Third, linear regression analyses were conducted to examine whether externalizing, internalizing or an interaction of these problem trajectories were predictive of disordered gaming at Time 6, while controlling for sex, age, and socioeconomic status. Pearson correlation coefficients were calculated to investigate the association between the variables included in the model. Specifically, the regression coefficients from the latent intercept and latent slope to the distal outcome variable were estimated in order to examine whether one's initial status (latent intercept) or growth rate (latent slope) on externalizing, internalizing or an interaction of these problems predicted disordered gaming.

Results

Descriptive, Correlational and Longitudinal Measurement Invariance Analyses

Overall, 92.34% of participants completed the questionnaires from T1 to T6. No significant differences based on sex were identified with regards to externalizing problems from T1 to T5. Boys consistently reported greater levels of internalizing problems from T1 to T5 (mean T-score differences ranging from 1.59 to 2.70, $p < 0.001$ to $p = 0.03$). Moreover, boys reported a greater number of symptoms of disordered gaming compared to girls ($M = 2.01$, $SD = 1.83$ vs. $M = 0.98$, $SD = 1.30$, $t[734] = 2.36$, $p < .001$). As for baseline externalizing behaviors, greater internalizing and externalizing problems at all time-points were noted in the significant externalizing behaviors group in contrast to the comparison group (mean T-score differences ranging from 6.23 to 6.95 for internalizing problems; 12.97 to 16.92 for externalizing problems, all $p < 0.001$). Lastly, youth with significant baseline externalizing behaviors reported greater disordered gaming symptoms compared to those without significant baseline externalizing behaviors ($M = 1.91$, $SD = 1.86$ vs. $M = 1.10$, $SD = 1.32$, $t[594] = 5.94$, $p < .001$).

Correlation coefficients for externalizing problems and for internalizing problems from T1 to T5 are reported in Table 2. These correlation coefficients indicate a positive significant correlation between these problems across all measurement periods suggesting a relative stability of these problems across time. Longitudinal invariance analyses for parents and teachers, both for externalizing and internalizing problems indicated a non-significant difference across measurement periods between all but one of the CFIs (ΔCFI ranging from 0.001 to 0.006). The one significant difference was for internalizing problems from T1 to T3, representing a ΔCFI of

Table 2

Pearson correlation coefficients between variables measured longitudinally

Variable	1	2	3	4	5	Variable	1	2	3	4	5
1. EXT T1	-					1. INT T1	-				
2. EXT T2	0.77***	-				2. INT T2	0.59***	-			
3. EXT T3	0.76***	0.77***	-			3. INT T3	0.56***	0.59***	-		
4. EXT T4	0.73***	0.73***	0.76***	-		4. INT T4	0.49***	0.51***	0.57***	-	
5. EXT T5	0.69***	0.70***	0.72***	0.77***	-	5. INT T5	0.50***	0.52***	0.57***	0.63***	-

Note. $*p < 0.05$, $**p \leq 0.01$, $***p \leq 0.001$. EXT = externalizing problems; INT = internalizing problems.

0.024, with the factor loadings of items at T1 being smaller statistically when compared to T3. Although the Cronbach alpha value for T1 internalizing problems for teachers is good ($\alpha = 0.88$), it is possible that the slight longitudinal variance in the results is explained by the fact that this value was lower than the values at other time periods (ranging from 0.89 to 0.90). However, given the relatively high Cronbach alpha values across both parent and teacher reports at all time points and the fact that the mean trajectories were constructed utilizing the highest T-score provided by parents or teachers, this difference would be unlikely to undermine the invariance of the longitudinally measured constructs.

Parallel Process Growth Models for Externalizing and Internalizing Problems

The mean trajectories for externalizing and internalizing problems were established independently in order to test the fit of each model. The mean trajectory for internalizing problems showed good fit, χ^2 (10, N = 744) = 19.76, p = 0.032, RMSEA = 0.04, CFI = 0.99 TLI = 0.99, SRMR = 0.04, and the mean trajectory for externalizing problems also showed adequate fit, χ^2 (10, N = 744) = 31.61, $p < 0.001$, RMSEA = 0.05, CFI = 0.99, TLI = 0.90, SRMR = 0.07.

Following these preliminary analyses, the mean trajectories for externalizing and internalizing problems were included within the same model. The model fit indices indicated a poor overall fit for the model, $\chi^2 = (41, N = 744) = 547.90$, $p < 0.001$, RMSEA = 0.13, CFI = 0.89, TLI = 0.88, SRMR = 0.06. In order to improve the model fit, model modification indices were explored and correlations between the error terms for externalizing and internalizing problems at each time point (i.e., T1 through T5) were included and significantly improved the model. These modification indices were selected as they maintained a high level of parsimony within the model, with the correlated error terms being derived from responses by the same participant, at the same time-point, utilizing the same measurement tool (i.e., externalizing and internalizing problems being measured by the CBCL and TRF).

The final model indicated excellent fit, χ^2 (36, $N = 744$) = 55.52, $p = 0.02$, RMSEA = 0.03, CFI = 0.99, TLI = 0.99, SRMR = 0.05. For externalizing problems, the means for the intercept ($B = 66.05$, $p < 0.001$) and slope ($B = -1.33$, $p < 0.001$) were significant, indicating an average decrease in externalizing problems over time. The variance around the intercept ($B = 85.20$, $p < 0.001$) and slope ($B = 1.30$, $p < 0.001$) were also significant, suggesting variability in the initial levels of externalizing problems, as well as in their change over time. As for internalizing problems, the means for the intercept ($B = 63.51$, $p < 0.001$) and slope (B = -0.06, $p < 0.001$) were significant, indicating an average decrease in internalizing problems over time. The variance around the intercept ($B = 48.11$, $p < 0.001$) and slope ($B = 1.80$, $p < 0.001$) were also significant, suggesting variability in the initial levels of internalizing problems, as well as in their change over time.

Invariance by Sex and Baseline Externalizing Behaviors. Invariance analyses by sex and whether or not children reported significant externalizing behaviors at baseline were

conducted to compare the result of the model with equality constraints against the model where no equality constraints were imposed. Results indicated that the chi-square difference between the two models for sex (χ^2 (6, N = 744) = 9.92, p = 0.13) and for baseline externalizing behaviors (χ^2 (7, N = 744) = 7.41, p = 0.39) were not statistically significant. These results indicate that the model does not vary by sex or by baseline externalizing behaviors.

Linear Regression Analysis for Disordered Gaming

Correlation analyses between all of the variables included in the linear regression model were conducted. Pearson correlation coefficients (outside of the interaction effects) ranged from r = 0.00 to r = 0.60, indicating the absence of multicollinearity as no coefficients exceeded 0.90 (Hair et al., 2007). As expected, both the intercepts and slopes for externalizing and internalizing problems intercepts were positively correlated (r = 0.60 and 0.54, respectively).

For the linear regression, the slope and intercept of both internalizing problems and externalizing problems were regressed on disordered gaming while controlling for age, SES, and sex (Table 3). Both the intercept of internalizing problems (B = 0.03, p = 0.02) and the intercept of externalizing problems (B = 0.03, p = 0.01) significantly predicted disordered gaming at T6. Moreover, the slope of the trajectory of internalizing problems (B = 0.24, p = 0.04) was significant in predicting disordered gaming at T6. Lastly, sex was the only significant control in the model with boys reporting greater disordered gaming symptoms compared to girls (B = 0.86, p < 0.001). These results indicate that higher levels of internalizing and externalizing problems in late childhood predicted greater disordered gaming symptoms in adolescence. Moreover, these results suggest that children with a smaller decrease in internalizing problems over time had a higher likelihood of endorsing greater disordered gaming symptoms.

Table 3

Prediction of disordered gaming at T6 by the initial status (intercept) and change over time (slope) of internalizing and externalizing problems

	Predictors	*B* (*SE*)	β (*SE*)
Main model			
	Internalizing problem – Intercept	0.03 (0.01)*	0.14 (0.06)*
	Internalizing problem – Slope	0.24 (0.12)*	0.18 (0.09)*
	Externalizing problem – Intercept	0.03 (0.01)**	0.16 (0.06)**
	Externalizing problem – Slope	-0.03 (0.13)	-0.02 (0.09)
	Age	0.02 (0.07)	0.01 (0.04)
	Socioeconomic status	0.03 (0.02)	0.06 (0.04)
	Sex	0.86 (0.13)***	0.26 (0.04)***
Interaction of slopes			
	Internalizing problem – Intercept	0.03 (0.01)*	0.14 (0.06)*
	Internalizing problem – Slope	0.13 (0.16)	0.10 (0.13)
	Externalizing problem – Intercept	0.03 (0.01)**	0.16 (0.06)**
	Externalizing problem – Slope	-0.10 (0.16)	-0.07 (0.11)
	Interaction of slope of internalizing and externalizing problems	-0.08 (0.09)	0.07 (0.08)
	Age	0.02 (0.07)	0.01 (0.04)
	Socioeconomic status	0.03 (0.02)	0.06 (0.04)
	Sex	0.86 (0.13)***	0.26 (0.04)***
Interaction of intercepts			
	Internalizing problem – Intercept	0.02 (0.08)	0.09 (0.33)
	Internalizing problem – Slope	0.23 (0.12)*	0.18 (0.09)*
	Externalizing problem – Intercept	0.02 (0.08)	0.10 (0.44)
	Externalizing problem – Slope	-0.03 (0.13)	-0.02 (0.09)
	Interaction of intercept of internalizing and externalizing problems	0.000 (0.00)	0.01 (0.05)
	Age	0.02 (0.07)	0.01 (0.04)
	Socioeconomic status	0.03 (0.02)	0.06 (0.04)
	Sex	0.86 (0.13)***	0.26 (0.04)***

Note. *$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$

Interaction Effects for Internalizing and Externalizing Problems. When the interaction effects for the intercept or slope of internalizing and/or externalizing problems were added to the linear regression model, results indicated that these variables were non-significant predictors of disordered gaming at T6 (Table 3). Specifically, in the model investigating the

interaction of the intercepts for internalizing and externalizing problems, the independent effects of the internalizing and externalizing intercepts were reduced to non-significance. Likewise, in the model investigating the interaction of the slopes for internalizing and externalizing problems, the independent effect of the slope of internalizing problems was reduced to non-significance. These results suggest that there is no interaction between initial externalizing and internalizing problems, nor between their rate of change over time when predicting disordered gaming.

Discussion

The current study examined the predictive role of the trajectories of internalizing and externalizing problems from childhood to adolescence in predicting disordered gaming. Results indicated that baseline scores of externalizing and internalizing problems predicted disordered gaming symptoms severity five years later. Moreover, the change over time of internalizing problems was also significant in predicting disordered gaming symptoms. The interactions of baseline scores and slopes of externalizing and internalizing problems were non-significant, and the results did not differ based on sex or baseline externalizing behaviors. These findings provide additional evidence for the predictive role of internalizing vulnerabilities (Gentile et al., 2011; Krossbakken et al., 2018; Liu et al., 2018; Teng et al., 2021) and their increasing severity over time as being a predisposing risk factor for disordered gaming, while providing some preliminary evidence for the temporally distal role of externalizing vulnerabilities.

Internalizing and Externalizing Pathways to Disordered Gaming

Based on case reports, Benarous and colleagues (2019) proposed an internalized and an externalized pathway towards the development of GD with internalizing and externalizing symptoms being present from childhood onwards. Moreover, other conceptual models have

proposed that internalizing and externalizing vulnerabilities predict the development and maintenance of GD (Brand et al., 2016, 2019; Lee et al., 2017a; Richard et al., 2020a). Empirical evidence for these relationships has been mixed, with some studies reporting significant predictive effects for internalizing (Gentile et al., 2011; Liu et al., 2018; Teng et al., 2021) and externalizing problems (Krossbakken et al., 2018), and others reporting non-significant effects (Lemmens et al., 2011b; Mößle & Rehbein, 2013; Wartberg et al., 2019; Wichstrom et al., 2019). An important limitation of the previous literature was that few studies measured internalizing or externalizing problems in children under the age of 12, while the duration of these longitudinal studies did not exceed two years.

In the present study, internalizing and externalizing problems were measured beginning in childhood (mean age of 8.3 years at baseline) and every following year for four years. For the entire sample, mean baseline scores for externalizing problems were considered within the at-risk range, whereas internalizing scores were slightly below the threshold (T-score $\geq$ 65). Results from the present study indicate that these clinical or near-clinical scores for externalizing and internalizing problems were significantly predictive of disordered gaming symptoms five years later. These results are consistent with previous literature (Gentile et al., 2011; Krossbakken et al., 2018; Liu et al., 2018; Teng et al., 2021), yet extend the predictive value of externalizing and internalizing problems for later GD across a longer period of time. These results may also be indicative of predisposing vulnerabilities in childhood that remain constant over time through to adolescence. An unexpected finding given the previous literature was the predictive role of baseline externalizing problems in predicting disordered gaming as this finding was not previously identified in children and adolescents (Wartberg et al., 2019; Wichstrom et al., 2019). It is possible that the present analyses detected such an effect due to the sample including a

proportion of children with clinically elevated levels of externalizing behaviors, which may be indicative of other underlying vulnerabilities including greater impulsivity, behavioral disinhibition, and/or emotional dysregulation (Richard et al., 2020a).

As for the rate of change in externalizing and internalizing problems, both were found to decrease significantly over time, although externalizing problems were decreasing at a greater rate than internalizing problems. The present study indicated that increases in internalizing problems, but not externalizing problems were related to disordered gaming symptoms at T6. Taken together, although mean T-scores for internalizing problems decreased over time, a greater risk for disordered gaming at T6 was present for those that experienced a less decrease of internalizing problems over time. This is a novel result in studying the development of GD as no previous studies have looked at the change over time of psychopathological symptoms and how this relates to GD. As disordered gaming was only measured at T6 in the present study, it is possible that the relationship between disordered gaming and internalizing problems is reciprocal, with both disorders having comorbid and mutually reinforcing effects (Krossbakken et al., 2018; Liu et al., 2018). Additional longitudinal research is necessary to investigate the effect of the dynamic interplay between disordered gaming and internalizing problems across childhood and adolescence. Overall, these results provide evidence for the first hypothesis regarding the predictive role of both baseline scores of internalizing problems and their rate of change over time in being predictive of disordered gaming. In addition, a significant effect was found for the intercept of externalizing problems, but not the slope, meaning that this hypothesis was only partially supported. Specifically, this suggest that levels of externalizing problems may in childhood affect disordered gaming in adolescence, but their development over time does not.

Interaction of Internalizing and Externalizing Problems

For the second aim of the study, the predictive value of the interaction of baseline scores and temporal trajectories of internalizing and externalizing problems for later disordered gaming symptoms was investigated. Due to this not having been investigated in the behavioral addiction literature, no firm hypotheses were presented. Results from the present study indicate that these interaction effects were non-significant in predicting disordered gaming symptoms. Given these findings, it appears as though internalizing and externalizing problems have independent effects on the development of disordered gaming. These results would be consistent with the externalized and internalized pathways proposed by Benarous and colleagues (2019), with these specific problems functioning independently, yet potentially in association with other psychosocial risk factors (e.g., social withdrawal, isolation, and avoidance-based coping for internalizing problems; emotional dysregulation, impulsivity, hyperactivity, and substance use for externalizing problems) to predict GD severity. Future studies are required to investigate the reciprocal relationships between these psychosocial risk factors and whether interaction effects are present when levels of severity (i.e., low, moderate, high) of internalizing and externalizing problems are considered.

Sex Differences and Disordered Gaming

For the third aim of the study, differences between males and females were investigated. Males were identified as having greater internalizing problems, and children with significant baseline externalizing behaviors were found to have greater internalizing and externalizing problems. Consistent with the study hypothesis, no significant differences based on sex were identified in the predictive value of the baseline and change scores for externalizing and internalizing problem for later disordered gaming. It is relevant to note that in the regression

model, sex was the only significant covariate, whereby males were at an increased risk of disordered gaming symptoms. These results are consistent with previous studies indicating that young males report greater levels of problem or disordered gaming (Fam, 2018; Feng et al., 2017; Mihara & Higuchi, 2017; Stevens et al., 2020). Moreover, these results are consistent with the results by Wartberg and colleagues (2019) who identified no sex differences in the predictive value of externalizing problems on GD, although the present study did find a significant effect of baseline externalizing problems on later disordered gaming.

Strengths and Limitations

To the knowledge of the authors, this is one of the longest longitudinal studies investigating predictors of disordered gaming from childhood to adolescence with noteworthy methodological strengths. The retention rate across the measurement points was very high (92.34%), with detailed assessments of internalizing and externalizing problems utilizing both the CBCL and TRF of the ASEBA (Achenbach & Rescorla, 2001). Moreover, with approximately half of the sample having significant externalizing behaviors at study inception, a wide variance of externalizing behaviours was reflected in the sample which strengthens the present assessment of the contribution of externalizing problems in predicting disordered gaming. In spite of these strengths, some limitations should also be noted. First, it is important to note that the sample did not over-select for children with significant internalizing problems at baseline and as a result, the mean variance in baseline internalizing problems was not as high as it was for externalizing problems. Given that internalizing problems and the change in these symptoms over time may be particularly important for disordered gaming, it would be important for future studies to sample children with significant internalizing problems. Second, GD severity was not measured from T1 to T5, and neither was frequency of video game playing.

Although problem or disordered gaming is more commonly reported in older children and adolescents when compared to young children (Paulus et al., 2018), this is a noteworthy limitation as GD has been found to be cross-sectionally associated with certain externalizing and internalizing problems among children below the age of 13 years (Lau et al., 2018; Wartberg et al., 2017). Due to this lack of adjustment, it is possible that the present study overestimates that predictive effect of internalizing and externalizing problems on disordered gaming symptoms. Future studies should include a measure of disordered gaming and video game playing earlier in development in order to control for this early exposure.

Conclusions

The findings of present study provide empirical support for the role of early internalizing and externalizing problems and their value in predicting disordered gaming severity in adolescence. Specifically, the results demonstrate the presence of an internalizing pathway from childhood to adolescence whereby early internalizing problems and their change over time increases the risk for disordered gaming. These results are indicative of the importance of investigating temporally distal psychopathological factors when attempting to understand the development of GD and the potential for early prevention and intervention. As problematic engagement in video games is an issue of increasing importance with implications on a personal and societal level (Saunders et al., 2017), it is crucial that future research considers the temporal trajectories towards GD over periods of time spanning across developmental periods.

References

Achenbach, T. M. (1991). *Manual for Child Behavior Checklist/ 4–18 and 1991 Profile.* Burlington: University of Vermont Department of Psychiatry.

Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for the Achenbach system of empirically based assessment (ASEBA) school-age forms and profiles.* University of Vermont, Research Center for Children, Youth and Families, Burlington.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5 (5th ed.).* Washington, DC: American Psychiatric Association.

Arbuckle, J. L. (1996). Full information estimation in the presence of incomplete data. In: G. A. Marcoulides & R. E. Schumacker (Eds.), *Advanced Structural Equation Modeling* (pp. 243-277). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Benarous, X., Morales, P., Mayer, H., Iancu, C., Edel, Y., & Cohen, D. (2019). Internet gaming disorder in adolescents with psychiatric disorder: Two case reports using a developmental framework. *Frontiers in Psychiatry, 10*(336). doi:10.3389/fpsyt.2019.00336

Brand, M., Wegmann, E., Stark, R., Müller, A., Wölfling, K., Robbins, T. W., & Potenza, M. N. (2019). The Interaction of Person-Affect-Cognition-Execution (I-PACE) model for addictive behaviors: Update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. *Neuroscience & Biobehavioral Reviews, 104*, 1-10. doi:10.1016/j.neubiorev.2019.06.032

Brand, M., Young, K. S., Laier, C., Wolfling, K., & Potenza, M. N. (2016). Integrating psychological and neurobiological considerations regarding the development and

maintenance of specific Internet-use disorders: An Interaction of Person-Affect-Cognition-Execution (I-PACE) model. *Neuroscience and Biobehavioral Reviews, 71,* 252-266. doi:10.1016/j.neubiorev.2016.08.033

Bongers, I. L., Koot, H. M., Van Der Ende, J., & Verhulst, F. C.. (2004). Developmental trajectories of externalizing behaviors in childhood and adolescence. *Child Development, 75*(5), 1523–1537. https://doi.org/10.1111/j.1467-8624.2004.00755.x

Campbell, S. B., Shaw, D. S., Gilliom, M. (2000). Early externalizing behavior problems: Toddlers and preschoolers at risk for later maladjustment. *Development and Psychopathology, 12*, 467–488.

Chang, S.-M., & Lin, S. S. J. (2019). Online gaming motive profiles in late adolescence and the related longitudinal development of stress, depression, and problematic internet use. *Computers & Education, 135*, 123-137. doi:10.1016/j.compedu.2019.02.003

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. S*tructural Equation Modeling*, 9(2), 233–255. https://doi.org/10.1207/s15328007sem0902_5

Costello, D. M., Swendsen, J., Rose, J. S. & Dierker, L. C. (2008). Risk and protective factors associated with trajectories of depressed mood from adolescence to early adulthood. *Journal of Consulting and Clinical Psychology, 76*(2), 173-183.

Crijnen, A. A., Achenbach, T. M., & Verhulst, F. C. (1997). Comparisons of problems reported by parents of children in 12 cultures: total problems, externalizing, and internalizing. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*(9), 1269–1277. https://doi.org/10.1097/00004583-199709000-00020

Crijnen, A. A., Achenbach, T. M., & Verhulst, F. C. (1999). Problems reported by parents of children in multiple cultures: The Child Behavior Checklist syndrome constructs. *The American Journal of Psychiatry, 156*(4), 569–574. https://doi.org/10.1176/ajp.156.4.569

Dussault, F., Brendgen, M., Vitaro, F., Carbonneau, R., Boivin, M., & Tremblay, R. E. (2016). Co-morbidity between gambling problems and depressive symptoms: A longitudinal perspective of risk and protective factors. *Journal of Gambling Studies, 32*(2), 547-565. doi:10.1007/s10899-015-9546-x

Englund, M. M., & Siebenbruner, J. (2012). Developmental pathways linking externalizing symptoms, internalizing symptoms, and academic competence to adolescent substance use. *Journal of Adolescence, 35*(5), 1123-1140. doi:10.1016/j.adolescence.2012.03.004

Fam, J. Y. (2018). Prevalence of internet gaming disorder in adolescents: A meta-analysis across three decades. *Scandinavian Journal of Psychology.* doi:10.1111/sjop.12459

Feng, W., Ramo, D. E., Chan, S. R., & Bourgeois, J. A. (2017). Internet gaming disorder: Trends in prevalence 1998-2016. *Addictive Behaviors, 75*, 17–24. https://doi.org/10.1016/j.addbeh.2017.06.010

Ferguson, C. J., & Ceranoglu, T. A. (2014). Attention problems and pathological gaming: resolving the 'chicken and egg' in a prospective analysis. *Psychiatric Quarterly, 85*(1), 103–110. https://doi.org/10.1007/s11126-013-9276-0

Forrest, C. J., King, D. L., & Delfabbro, P. H. (2017). Maladaptive cognitions predict changes in problematic gaming in highly-engaged adults: A 12-month longitudinal study. *Addictive Behaviors, 65*, 125-130. doi:10.1016/j.addbeh.2016.10.013

Fumero, A., Marrero, R. J., Voltes, D., & Peñate, W. (2018). Personal and social factors involved in internet addiction among adolescents: A meta-analysis. *Computers in Human Behavior, 86,* 387–400. https://doi.org/10.1016/j.chb.2018.05.005

Galambos, N. L., Barker, E. T., & Almeida, D. M. (2003). Parents do matter: Trajectories of change in externalizing and internalizing problems in early adolescence. *Child Development, 74*, 578–594.

Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D., Fung, D., & Khoo, A. (2011). Pathological video game use among youths: A two-year longitudinal study. *Pediatrics, 127*(2), e319-e329. doi:10.1542/peds.2010-1353

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2007). *Multivariate data analysis, 6th edition.* New Jersey: Pearson Prentice Hall.

Ho, R. C., Zhang, M. W., Tsang, T. Y., Toh, A. H., Pan, F., Lu, Y., Cheng, C., Yip, P. S., Lam, L. T., Lai, C.-M., Watanabe, H., & Mak, K.-K. (2014). The association between internet addiction and psychiatric co-morbidity: A meta-analysis. *BMC Psychiatry, 14*(1), 183. https://doi.org/10.1186/1471-244x-14-183

Hussong, A. M., Jones, D. J., Stein, G. L., Baucom, D. H., & Boeding, S. (2011). An internalizing pathway to alcohol use and disorder. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 25*(3), 390–404. doi:10.1037/a0024519

Keiley, M. K., Bates, J. E., Dodge, K. A., & Pettit, G. S. (2000). A cross-domain growth analysis: Externalizing and internalizing behaviors during 8 years of childhood. *Journal of Abnormal Child Psychology, 28,* 161–179

Krossbakken, E., Pallesen, S., Mentzoni, R. A., King, D. L., Molde, H., Finseras, T. R., & Torsheim, T. (2018). A cross-lagged study of developmental trajectories of video game engagement, addiction, and mental health. *Frontiers in Psychology, 9.* doi:10.3389/fpsyg.2018.02239

Lau, C., Stewart, S., Sarmiento, C., Saklofske, D., & Tremblay, P. (2018). Who is at risk for problematic video gaming? Risk factors in problematic video gaming in clinically referred Canadian children and adolescents. *Multimodal Technologies and Interaction, 2*(2), 19. https://doi.org/10.3390/mti2020019

Lee, S.-Y., Lee, H. K., & Choo, H. (2017a). Typology of Internet gaming disorder and its clinical implications. *Psychiatry and Clinical Neurosciences, 71*(7), 479–491. https://doi.org/10.1111/pcn.12457

Lee, S. Y., Lee, H. K., Jeong, H., Yim, H. W., Bhang, S. Y., Jo, S. J., . . . Kweon, Y. S. (2017b). The hierarchical implications of internet gaming disorder criteria: Which indicate more severe pathology? *Psychiatry Investigation, 14*(3), 249-259.

Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011a). Psychosocial causes and consequences of pathological gaming. *Computers in Human Behavior, 27*(1), 144-152.

Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011b). The effects of pathological gaming on aggressive behavior. *Journal of Youth and Adolescence, 40*(1), 38-47.

López-Romero, L., Romero, E., & Andershed, H. (2015). Conduct problems in childhood and adolescence: Developmental trajectories, predictors and outcomes in a six-year follow up. *Child Psychiatry & Human Development, 46*(5), 762–773. https://doi.org/10.1007/s10578-014-0518-7

Macmann, G. M., Barnett, D. W., Burd, S. A., Jones, T., LeBuffe, P. A., O'Malley, D., Shade, D. B., & Wright, A. (1992). Construct validity of the Child Behavior Checklist: Effects of item overlap on second-order factor structure. *Psychological Assessment, 4*(1), 113–116. https://doi.org/10.1037/1040-3590.4.1.113

Martins, S. S., Lee, G. P., Santaella, J., Liu, W. W., Ialongo, N. S., & Storr, C. L. (2014). Age of first arrest varies by gambling status in a cohort of young adults. *American Journal on Addictions, 23*(4), 386-392. doi:10.1111/j.1521-0391.2014.12121.x.

Martins, S. S., Liu, W. W., Hedden, S. L., Goldweber, A., Storr, C. L., Derevensky, J. L., Stinchfield, R., Ialongo, N. S., & Petras, H. (2013). Youth aggressive/disruptive behavior trajectories and subsequent gambling among urban male youth. *Journal of Clinical Child and Adolescent Psychology, 42*(5), 657-668. doi:10.1080/15374416.2013.764827.

Martin-Storey, A., Temcheff, C., Dery, M., Poirier, M., Verlaan, P., & Lemelin, J.-P. (2018). Trajectories of internalizing problems during the transition to adolescence in children with and without conduct problems. *International Journal of Behavioral Development, 42*(5), 464–473. https://doi.org/10.1177/0165025417730681

Maslowsky, J.M. & Schulenberg, J.E. (2013). Interaction matters: Quantifying conduct problem x depressive symptoms interaction and its association with adolescent alcohol, cigarette, and marijuana use in a national sample. *Development and Psychopathology, 25*(4), 1029-1043.

Maslowsky, J., Schulenberg, J. E., & Zucker, R. A. (2014). Influence of conduct problems and depressive symptomatology on adolescent substance use: Developmentally proximal

versus distal effects. *Developmental Psychology, 50*(4), 1179–1189. doi:10.1037/a0035085

Mason, W.A., Hitchings, J.E., Spoth, R.L. (2008). The interaction of conduct problems and depressed mood in relation to adolescent substance involvement and peer substance use. *Drug and Alcohol Dependence, 96*(3), 233–248.

McCarty, C.A., Wymbs, B.T., Mason, W.A., King, K.M., McCauley, E., Baer, J. & Vander Stoep, A. (2013). Early adolescent growth in depression and conduct problem symptoms as predictors of later substance use impairment. *Journal of Abnormal Child Psychology, 41*(7), 1041-1051.

Mihara, S., & Higuchi, S. (2017). Cross-sectional and longitudinal epidemiological studies of Internet gaming disorder: A systematic review of the literature. *Psychiatry and Clinical Neuroscience, 71*(7), 425-444. doi:10.1111/pcn.12532

Mößle, T., & Rehbein, F. (2013). Predictors of problematic video game usage in childhood and adolescence. *Sucht, 59*(3):153-64. doi:https://doi.org/10.1024/0939-5911.a000247.

Muthén, L. K., & Muthén, B. O. (2017). *Mplus: Statistical Analysis with Latent Variables: User's Guide (Version 8).* Los Angeles, CA: Authors.

Muthén, B., & Shedden, K. (1999). Finite mixture modeling with mixture outcomes using the EM algorithm. *Biometrics, 6*, 463–469.

Nagin, D. S., Tremblay, R. (2001). Analyzing developmental trajectories of distinct but related behaviors: A group-based model. *Psychological Methods, 6,* 18–34.

Pan, Y.-C., Chiu, Y.-C., & Lin, Y.-H. (2020). Systematic review and meta-analysis of epidemiology of internet addiction. *Neuroscience & Biobehavioral Reviews, 118,* 612–622. https://doi.org/10.1016/j.neubiorev.2020.08.013

Paulus, F. W., Ohmann, S., von Gontard, A., & Popow, C. (2018). Internet gaming disorder in children and adolescents: A systematic review. *Developmental Medicine & Child Neurology,* 60(7), 645-659. doi:10.1111/dmcn.13754

Peeters, M., Koning, I., & Van Den Eijnden, R. (2019). Predicting Internet gaming disorder symptoms in young adolescents: A one-year follow-up study. *Computers in Human Behavior, 80,* 255-261. doi:10.1016/j.chb.2017.11.008

Reynolds, M. R., Sander, J. B., & Irvin, M. J. (2010). Latent curve modeling of internalizing behaviors and interpersonal skills through elementary school. *School Psychology Quarterly, 25*, 189–201.

Riina, E. M., Martin, A., & Brooks-Gunn, J. (2014). Parent-to-child physical aggression, neighborhood cohesion, and development of children's internalizing and externalizing. *Journal of Applied Developmental Psychology, 35*, 468–477.

Richard, J., Temcheff, C. E., & Derevensky, J. L. (2020a). Gaming disorder across the lifespan: A scoping review of longitudinal studies. *Current Addiction Reports, 7*(4), 561-587. doi:10.1007/s40429-020-00339-3

Saunders, J. B., Hao, W., Long, J., King, D. L., Mann, K., Fauth-Bühler, M., Rumpf, H.-J., Bowden-Jones, H., Rahimi-Movaghar, A., Chung, T., Chan, E., Bahar, N., Achab, S., Lee, H. K., Potenza, M., Petry, N., Spritzer, D., Ambekar, A., Derevensky, J., … Poznyak, V. (2017). Gaming disorder: Its delineation as an important condition for

diagnosis, management, and prevention. *Journal of Behavioral Addictions, 6*(3), 271–279. https://doi.org/10.1556/2006.6.2017.039

Scalco, M. D., Colder, C. R., Hawk, L. W., Jr., Read, J. P., Wieczorek, W. F., & Lengua, L. J. (2014). Internalizing and externalizing problem behavior and early adolescent substance use: A test of a latent variable interaction and conditional indirect effects. *Psychology of Addictive Behaviors, 28*(3), 828-840. http://dx.doi.org/10.1037/a0035805

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods, 7,* 147–177.

Shanahan, L., Calkins, S. D., Keane, S. P., Kelleher, R., & Suffness, R. (2014). Trajectories of internalizing symptoms across childhood: The roles of biological self-regulation and maternal psychopathology. *Development and Psychopathology, 26*(4), 1353–1368. https://doi.org/10.1017/S0954579414001072

Shi, D., Lee, T., & Maydeu-Olivares, A. (2019). Understanding the model size effect on SEM fit indices. *Educational and Psychological Measurement, 79*(2), 310–334. https://doi.org/10.1177/0013164418783530

Stevens, M. W., Dorstyn, D., Delfabbro, P. H., & King, D. L. (2020). Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian & New Zealand Journal of Psychiatry,* 1-16. doi:10.1177/0004867420962851

Teng, Z., Pontes, H. M., Nie, Q., Griffiths, M. D., & Guo, C. (2021). Depression and anxiety symptoms associated with internet gaming disorder before and during the COVID-19 pandemic: A longitudinal study. *Journal of Behavioral Addictions.* https://doi.org/10.1556/2006.2021.00016

Trucco, E. M., Villafuerte, S., Hussong, A., Burmeister, M., & Zucker, R. A. (2018). Biological underpinnings of an internalizing pathway to alcohol, cigarette, and marijuana use. *Journal of Abnormal Psychology, 127*(1), 79-91. doi:10.1037/abn0000310

Wartberg, L., Kriston, L., Kramer, M., Schwedler, A., Lincoln, T., & Kammerl, R. (2017). Internet gaming disorder in early adolescence: Associations with parental and adolescent mental health. *European Psychiatry, 43*, 14-18. doi:10.1016/j.eurpsy.2016.12.013

Wartberg, L., Kriston, L., Zieglmeier, M., Lincoln, T., & Kammerl, R. (2019). A longitudinal study on psychosocial causes and consequences of Internet gaming disorder in adolescence. *Psychological Medicine, 49*(2), 287-294. doi:10.1017/s003329171800082x

Wichstrom, L., Stenseng, F., Belsky, J., von Soest, T., & Hygen, B. W. (2019). Symptoms of Internet gaming disorder in youth: Predictors and comorbidity. *Journal of Abnormal Child Psychology, 47*(1), 71-83.

Wolff, J. C., & Ollendick, T. H. (2006). The comorbidity of conduct problems and depression in childhood and adolescence. *Clinical Child and Family Psychology Review, 9*, 201–220.

World Health Organization. (2019). *International statistical classification of diseases and related health problems (11th Revision)*. Retrieved from: https://icd.who.int/browse11/l-m/en

Zhang, J.-T., Ma, S.-S., Li, C.-S. R., Liu, L., Xia, C.-C., Lan, J., . . . Fang, X.-Y. (2018). Craving behavioral intervention for Internet gaming disorder: Remediation of functional connectivity of the ventral striatum. *Addiction Biology, 23*(1), 337-346. doi:http://dx.doi.org/10.1111/adb.12474

Zhang, M. W. B., Lim, R. B. C., Lee, C., & Ho, R. C. M. (2018). Prevalence of Internet Addiction in Medical Students: A meta-analysis. *Academic Psychiatry, 42*(1), 88–93. https://doi.org/10.1007/s40596-017-0794-1

Zucker, R. A. (1994). Pathways to alcohol problems and alcoholism: A developmental account of the evidence for multiple alcoholism and for contextual contributions to risk. In: R. A. Zucker, G. Boyd, & J. Howard (Eds.), *The development of alcohol problems: Exploring the biopsychosocial matrix of risk* (pp. 255-289). National Institute on Alcohol Abuse and Alcoholism Research Monograph No. 26. National Institute on Alcohol Abuse and Alcoholism, Rockville, MD.

Zucker, R. A., Heitzeg, M. M., & Nigg, J. T. (2011). Parsing the undercontrol/disinhibition pathway to substance use disorders: A multilevel developmental problem. *Child Development Perspectives, 5*(4), 248–255. doi:10.1111/j.1750-8606.2011.00172.x

Bridging Document 3

Study 3 empirically investigated externalizing and internalizing problems in childhood and their trajectories over five years in predicting PVG among adolescents. Results from this study indicated how greater externalizing and internalizing problems at baseline and a trajectory involving a slower decline of internalizing problems was predictive of PVG (Richard et al., 2022a). These results are consistent with previously identified associations between internalizing problems (including depressive symptoms) and PVG and would be consistent with the internalizing pathway towards PVG (Richard et al., 2020a). With mixed findings being noted specific to the association between externalizing problems and PVG, this study suggest that although levels of externalizing problems may in childhood affect disordered gaming in adolescence, but their development over time does not (Richard et al., 2022a). This would be suggestive of a distal effect as a result of youth externalizing problems. Moreover, Study 3 compliments the results from Study 2 in that these studies provide both cross-sectional and longitudinal evidence for the association between internalizing and externalizing problems and gaming behaviors.

Whereas the aim of Study 3 was to investigate the predictive role of early externalizing and internalizing problems and their change over time in predicting PVG, the purpose of Study 4 is to extend this research by modeling similar predictive analyses relevant to gambling behaviors. Whereas Study 2 investigated the association between externalizing problems, internalizing problems, and gambling behaviors cross-sectionally, Study 4 aimed to do so longitudinally. Utilizing the same longitudinal dataset included in Study 3 yet extending over two additional years, this study investigated the externalizing, internalizing or combined pathways to gambling

engagement from childhood to adolescence. Once again, hypotheses for this study were informed by the empirical findings synthesized in Study 1.

Study 4

Externalizing and Internalizing Trajectories to Adolescent Gambling: A Longitudinal Study

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Abstract

Externalizing (e.g., conduct problems, antisocial behaviors) and internalizing (e.g., depression and anxiety) problems have been associated with gambling-related harms. However, there is a paucity of longitudinal research investigating how these problems and their pattern of change over time (i.e., trajectories) predict gambling engagement among youth. This study aimed to examine the trajectories of externalizing and internalizing problems and their predictive value for later gambling. Data came from a cohort of 744 children (53.2% male, M_{age} 8.3 years at baseline) from Québec, Canada, with 58.3% reporting significant externalizing behaviors at baseline. Participants were followed for seven years. Externalizing and internalizing problems were measured annually and past year gambling was assessed at final measurement. Mean trajectories of externalizing and internalizing problems were identified through parallel process growth modelling and logistic regression was utilized to examine whether these trajectories were predictive of gambling engagement. Thirty-one participants of the 659 remaining at final measurement reported participation in gambling. Greater baseline externalizing problems, lower baseline internalizing problems, and a less significant decrease of externalizing problems over time predicted gambling engagement. These results provide evidence of the externalizing pathway towards youth gambling and the importance of early intervention involving youth and other relevant stakeholders.

Introduction

Youth gambling is a significant public health concern with research substantiating the importance of addressing early manifestations of gambling in order to minimize associated harms (Sideli et al. 2018). Reviews of international epidemiological studies indicate that rates of past year gambling among children and adolescents range from 15% to 80% (Brezing et al., 2010; Molinaro et al., 2018; King et al., 2020), with rates of problem gambling among youth ranging from 0.2% to 12.3% (Calado et al., 2017; Delfabbro et al., 2016). Within the province of Québec, Canada (where the current study takes place), rates of past year gambling among high-school students appear to be lower, being closer to 20-25%, with rates of problem gambling being around 1% (Traoré et al., 2014, 2021). Gambling engagement has been generally described as being on a continuum ranging from no gambling, to occasional or recreational participation, through to problematic and disordered engagement (Shaffer & Korn, 2002). Beyond symptoms of problem gambling, youth who gamble may also be at risk of developing a wide range of difficulties across psychological, social, legal, and economic domains (Blinn-Pike et al., 2010; Dowling et al., 2017).

Although gambling is legally restricted for minors in most jurisdictions, gambling is becoming increasingly accessible and available (Ofori Dei et al., 2020; St-Pierre et al., 2014). Studies have found that youth as young as seven years of age have engaged in some form of gambling (Temcheff et al., 2016), with gambling initiation being most prevalent among youth aged 14 to 15 (Brezing et al., 2010; Livazović & Bojčić, 2019). Interestingly, although rates of participation in gambling increases as an individual ages (i.e., lower rates in childhood, higher rates in adulthood), recent studies have identified that rates of gambling among older adolescents in certain jurisdictions have been decreasing since the early 2000s (Emond & Griffiths, 2020;

Raisamo et al., 2020; Stinchfield, 2020; Winters et al., 2019). Reasons for this may include the *gamblification* of gaming environments whereby youth at risk for gambling in the past may instead be engaging in simulated forms of gambling (e.g., social casino games) or other activities with gambling-like features within video games (e.g., loot boxes) instead of participating in traditional forms of gambling (Delfabbro et al., 2016; Russell et al., 2020). Despite these changes, youth recreational gambling has been associated with numerous negative consequences outside of increasing the risk for later problem gambling, including an increased severity of psychiatric and medical difficulties, financial, familial and social concerns, academic difficulties, and substance use problems (Brezing et al., 2010; Burge et al., 2004, 2006; Foster et al., 2015; Rahman et al., 2012; Winters et al., 2002; Yip et al., 2011). Moreover, early onset gamblers (before the legal age of 18 or 21) have a greater likelihood of developing more severe gambling-related problems compared to those with a later age of onset (Burge et al., 2006; Lynch et al., 2004). As such, there is a need to better understand risk factors of gambling engagement in adolescence.

In understanding the development of youth gambling, longitudinal research is critical in order to tease apart antecedents, consequences, and factors that are reciprocally associated with gambling behaviors. Moreover, models proposing pathways for the development of both substance and non-substance (e.g., gambling) addictive behaviors can provide a rationale to identify risk factors which may be involved in the development of youth gambling. The potential application of substance use developmental models to explain non-substance addictions is based on research demonstrating etiological, neurobiological, clinical, and phenomenological similarities between substance and non-substance addictions (Brezing et al., 2010; Potenza, 2014; Yakovenko & Hodgins, 2018).

Three developmental pathways initially established to explain substance use and disorder have been hypothesized as also applying to behavioral addictions including gambling and gaming (Richard et al., 2020). These models include the externalizing pathway, internalizing pathway, and combined pathways, whereby early externalizing problems (such as conduct problems, aggressive, antisocial/oppositional behaviors, and behavioral disinhibition; Zucker, 1994; Zucker et al., 2011), early internalizing problems (such as emotional vulnerabilities, emotion dysregulation, depressive and/or anxious symptoms; Cox et al., 2021; Hussong et al., 2011; Trucco et al., 2018), or a combination or interaction of these problems (Englund & Siebenbruner, 2012; Maslowsky et al., 2014) predicts later substance use and disorder. Uniting these developmental pathways to what has been established for problem gambling, the internalizing and externalizing pathways appear to parallel the two subgroups of problem gamblers identified within the Pathways Model (Blaszczynski & Nower, 2002), namely, the emotionally vulnerable (Pathway 2) and antisocial impulsivist (Pathway 3) problem gamblers, respectively. In a recent systematic review, Richard and colleagues (2020), established that there appears to be greater evidence for the externalizing and combined pathways towards problem gambling, with little evidence for the internalizing pathway, a finding consistent with other literature reviews integrating longitudinal findings investigating risk factors for problem gambling (Dowling et al., 2017; Johansson et al., 2009; Shead et al., 2010; Yakovenko & Hodgins, 2018). In another paper, the authors identified greater evidence for the internalizing and combined pathways towards problem gaming, with little evidence for the externalizing pathways, a finding that was later supported in a longitudinal study of these pathways (Richard et al., 2021). Taken together, although these models tend to emphasize problematic engagement in substance use, video gaming, or gambling as the final outcome, developmental models focused

on these pathways also emphasize how early engagement in these behaviors is a necessary precursor for the later development of problematic or disordered use (Hussong et al., 2011; Zucker et al., 2011).

To date, few studies have investigated the predictive role of externalizing problems for youth gambling beginning in childhood, with one study identifying that conduct problems in childhood predicted early gambling involvement (Temcheff et al., 2016), and another study reporting that chronically high externalizing problems in childhood and adolescence predict problem gambling in emerging adulthood (Martins et al., 2013). Other longitudinal studies have measured externalizing problems among older adolescents and gambling in emerging adulthood, with these results indicating mixed findings in the predictive role of externalizing problems for later problem gambling (Allami et al., 2017; Martins et al., 2014; Vitaro et al., 2001; Wanner et al., 2009). As for internalizing problems, mixed findings have been reported with these studies focusing primarily on emerging adults, with internalizing problems not being measured prior to the age of 17. Specifically, one study noted a significant predictive effect of internalizing problems for problem gambling (Dussault et al., 2011), and others identifying non-significant associations (Allami et al., 2018; Afifi et al., 2016; Chinneck et al., 2016; Edgerton et al., 2015, 2018). Investigating both externalizing and internalizing problems together, some studies have identified that youth with high levels of both externalizing and internalizing problems have a greater likelihood of endorsing gambling problems (Allami et al., 2017, 2018). However, to the authors' knowledge, no studies have specifically explored the interaction of externalizing and internalizing problems in predicting gambling engagement. This represents an important limitation of the research literature as these frequently comorbid problems may interact to

increase or buffer against the risk of problematic behaviors among youth (Maslowsky et al., 2014; Mason et al., 2008; McCarty et al., 2013; Scalco et al., 2014; Sroufe, 1997).

Overall, a paucity of longitudinal studies have established predictors of gambling engagement beginning in childhood. This marks a significant gap within the research literature as the presence of certain vulnerabilities may predispose youth to early involvement in gambling which is an illegal and potentially problematic behavior associated with various negative outcomes including later gambling problems. Longitudinal research investigating the developmental trajectories of externalizing and internalizing problems would allow for an empirical investigation of the early manifestation of these problems and their change over time in predicting gambling behaviors. With past longitudinal studies on this topic including samples that are predominantly male (Richard et al., 2020), there is also a need for research including samples that capture a greater proportion of females to understand whether these trajectories and their effect on youth gambling are comparable. Moreover, longitudinal studies that include a proportion of youth with significant behavioral issues would allow for the differentiation between sub-groups of youth with differing levels of risk for early engagement in gambling.

Current Investigation and Study Hypotheses

The current study aimed to empirically investigate how externalizing and internalizing problems in childhood and their developmental trajectories predict past year engagement in gambling in mid-adolescence. In order to achieve these aims, trajectories of externalizing and internalizing problems will be modelled. As approximately half of the present sample had clinically significant externalizing problems at baseline, invariance of these models for children with and without clinically significant externalizing behaviors will be investigated. In addition, as the sample includes approximately equal numbers of males and females (53.2% male),

invariance of the trajectories will also be investigated based on sex. With regards to the prediction models, in line with previous research (Martins et al., 2013; Temcheff et al., 2016), it was hypothesized that greater externalizing problems at baseline and a trajectory involving a slower decline of externalizing problems over time would be predictive of past year gambling. Based on the paucity of evidence suggesting that early internalizing problems predict problem gambling/gambling engagement in adolescence (Afifi et al., 2016; Allami et al., 2018; Chinneck et al., 2016; Edgerton et al., 2015, 2018), it was hypothesized that baseline scores and the temporal trajectory of internalizing problems would not be predictive of past year gambling. Lastly, as no studies have investigated the interaction of externalizing and internalizing problems in predicting gambling engagement, exploratory analyses will be conducted for these effects with no hypotheses being specified.

Materials and Methods

Participants and Procedures

From 2008 to 2010, recruitment for the longitudinal research project took place in eight French-speaking schoolboards across Québec (Eastern Townships, Montréal, Montérégie, and Québec City). At study inception, 744 children completed a battery of questionnaires and follow-up was conducted on a yearly basis. Data for the longitudinal study were collected annually via in-home interviews by trained research assistants with three days of formal training in the interview procedures. Parents were provided with a full description of the study, an informed consent form, and the authorization to contact the child's classroom teacher. Participants were primarily born in Québec (93.5%), and 29.5% were living in a single-parent-headed family. The average age of participants at baseline was of 8.3 years, while the sample was evenly distributed by sex (53.2% male). Fifty-eight percent (n = 434) of the recruited participants presented with

significant externalizing behaviors at study inception, with the remaining participants presenting without significant externalizing behaviors (i.e., comparison group). The present study is utilizing data from study inception (range of 6.3 to 9.9 years of age at time of recruitment) through to Time 8 (range of 13.3 to 17.3 years of age). Since study inception, less than 9% of recruited participants have declined continued participation or have become untraceable. Ethical approval for the study was granted by the ethics board of the Université de Sherbrooke.

The majority of the sample of children with significant externalizing behaviors were purposefully recruited among children receiving in-school psychosocial services for their significant externalizing behaviors. For this part of the sample, all females and approximately one out of four males were randomly selected and invited to participate in the study to obtain a roughly equal number of participants by sex (n = 370; participation rate of 75.1%). Among these children, 339 (40.3% females) obtained a score above the 93rd percentile (i.e., the borderline clinical cut-off score) on the DSM-oriented scales for conduct problems and oppositional defiant problems of the Achenbach System of Empirically Based Assessment (ASEBA; Achenbach & Rescorla, 2001) as reported by parents and teachers, and were considered as having significant externalizing behaviors. The remaining children with externalizing behaviors (n = 95; 57.9% females) were identified with the same scales and criteria through a multi-gated screening procedure of 881 students (participation rate of 71.5%). As for the comparison group, children were selected among those who were screened and completed the aforementioned ASEBA scales but did not reach the borderline clinical cut-off score (n = 279; 51.6% females). Roughly one out of three of these participants were randomly selected though in a way that they did not differ significantly from children with externalizing behaviors according to sex and age.

Measures

Externalizing and Internalizing Problems

Externalizing and internalizing problems were measured yearly utilizing the French language versions of the Child Behavior Checklist (CBCL) and the Teacher Report Form (TRF) of the ASEBA (Achenbach & Rescorla, 2001). The CBCL and TRF include 118-items measuring youth externalizing (e.g., aggressive behaviors, conduct problems, interpersonal conflict) and internalizing (e.g., depression, anxiety) problems. Items are measured on a three-point scale ranging from 0 (not true) to 2 (very/often true). Externalizing and internalizing problems were measured yearly based on both parent and teacher ratings from Time 1 (T1) to Time 7 (T7). Normed T-scores derived from raw scores were utilized to facilitate the comparison of results over time and between groups. Based on children referred for professional mental health evaluations, T-scores greater than or equal to 65 on the internalizing or externalizing scales are considered in the at-risk range and are indicative of significant emotional or behavioral problems (Achenbach & Rescorla, 2001). The CBCL and the TRF have demonstrated satisfactory validity and reliability in clinical and non-clinical samples (Achenbach, 1991; Crijnen et al., 1997, 1999; Macmann et al., 1992). In the current study, the externalizing problems scale (CBCL: $\alpha = 0.93\text{-}0.94$; TRF: $\alpha = 0.95\text{-}0.96$) and internalizing problems scale (CBCL: $\alpha = 0.87\text{-}0.90$; TRF: $\alpha = 0.88\text{-}0.90$) demonstrated good internal consistency.

Gambling Engagement

Gambling engagement and severity was assessed at Time 8 (T8) with the Diagnostic and Statistical Manual of Mental Disorders-IV Adapted for Juveniles (DSM-IV-J; Fisher, 1992). This scale includes 12 items that measures nine dimensions of gambling including preoccupation,

tolerance, withdrawal, loss of control, escape, lying, chasing, deception, engagement in illegal behavior, and social/academic impairments. Gambling participation was identified by participants providing a dichotomous response (yes or no) based on whether they had engaged in any gambling behaviors over the past 12 months. Specifically, participants were asked "Over the course of the past 12 months, have you purchased or asked someone to purchase lottery tickets, scratch tickets, or bet (wagered) money or other objects of value on gambling activities?"[1].

Sociodemographic Characteristics

Sociodemographic variables were assessed at baseline and include: the child's sex (female = 0; male = 1)[2], age (in years and months), and annual family income (a 20-point scale ranging from 1 [$0 to $999] to 20 [greater than $160,000] CAD). This information was reported by the child's parent.

Statistical Analysis

First, IBM SPSS version 25 was utilized to calculate descriptive statistics of demographic characteristics at baseline and other included variables across all measurement points. Additionally, independent samples *t*-tests were conducted in order to explore sex and age differences in self-report gambling participation over the past year. Pearson correlation coefficients were calculated for externalizing and internalizing problems across all measurement periods.

[1] The following wording was used to assess gambling participation in the French language survey: "*Au cours des 12 derniers mois, as-tu acheté ou demandé à quelqu'un de t'acheter des billets de loterie ou gratteux ou parié (misé) de l'argent ou d'autres objets de valeur à des jeux de hasard? non / oui".*

[2] The following wording was used to assess this demographic characteristic in the French language survey: "*Sexe de l'enfant: masculin / feminin*".

Second, M*plus* version 8.4 (Muthén & Muthén, 2017) was used to calculate parallel process growth models to establish the mean trajectories of externalizing and internalizing problems from childhood to adolescence (from T1 to T7). A combination of model fit indices were utilized to assess optimal goodness-of-fit, including the root mean square error of approximation (RMSEA; ≤ .06), Tucker-Lewis Index (TLI; ≥ .95), comparative fit index (CFI; ≥ .95), and standardized root mean squared residual (SRMR; ≤ .06) (Shi et al., 2019). Trajectories were constructed utilizing the highest T-scores for externalizing and internalizing problems at each time-point based on both parent and teacher report. The use of the highest T-score between informants (i.e., parents and teachers) has been found to provide the optimal balance between sensitivity and specificity for behavioral problems (Lapalme et al., 2020).

Missing data analyses were conducted in order to verify patterns of missing data. Little's test of missing completely at random (MCAR; Little, 1988) was non-significant (χ^2 [258] = 270.02, p = 0.21), indicating that data was missing completely at random. Additionally, only 6.66% of the data was missing across all variables included in the multilevel analyses. Given the results of Little's MCAR test and the total missing data, all models were handled with full information maximum likelihood (FIML) estimation. FIML is a widely accepted form of estimation for longitudinal data analysis (Muthén & Shedden, 1999; Schafer & Graham, 2002). Moreover, model invariance was tested to observe potential differences in the longitudinal models by sex and externalizing behavior status.

Lastly, logistic regression analyses were conducted to identify whether baseline scores (latent intercept) or the change over time (latent slope) in externalizing problems, internalizing problems, or an interaction of these problems, were predictive of gambling engagement at T8.

Results

Descriptive Statistics

Sample demographic characteristics are presented in Table 1. Out of the initial 744 participants, 659 responded to the gambling questions at Time 8. Among the 659 youth, 31

Table 1

Participant characteristics

	n	%
Sex (male)	396	53.2
Significant externalizing behaviors at baseline (yes)	434	58.3
Age at baseline [1]	744	8.39 (0.93)
Socioeconomic status		
$1,000-$11,999	52	6.9
$12,000-$19,999	49	6.6
$20,000-$29,999	86	11.5
$30,000-$49,999	155	20.9
$50,000-$69,999	124	16.7
$70,000-$79,000	171	23.0
$80,000 or more	99	13.4
Internalizing problems (T1) [1]	744	63.48 (8.60)
Internalizing problems (T2) [1]	714	62.57 (9.40)
Internalizing problems (T3) [1]	706	62.96 (9.06)
Internalizing problems (T4) [1]	692	61.31 (9.45)
Internalizing problems (T5) [1]	687	61.27 (9.85)
Internalizing problems (T6) [1]	664	60.77 (9.30)
Internalizing problems (T7) [1]	647	60.46 (8.95)
Externalizing problems (T1) [1]	744	66.17 (10.34)
Externalizing problems (T2) [1]	714	64.14 (10.38)
Externalizing problems (T3) [1]	706	63.73 (10.07)
Externalizing problems (T4) [1]	692	61.57 (10.80)
Externalizing problems (T5) [1]	687	60.75 (10.37)
Externalizing problems (T6) [1]	664	59.87 (10.51)
Externalizing problems (T7) [1]	647	59.77 (9.97)
Gambling Engagement (T8; yes)	31	4.7

Note. [1] = Mean (Standard Deviation).

(4.7%) reported gambling participation in the past 12 months. No sex differences were present between those that had or had not gambled over the past year (5.6% males; 3.6% females, p = .23). Those who reported gambling over the past year were significantly older than those who did not report gambling (M = 15.76, SD = 0.79 vs. M = 15.35, SD = 0.93), t = 2.40 (df = 657), p = 0.02. As for symptoms of problem gambling, seven participants (0.9%; 4 males, 3 females) reported one or more symptoms based on the DSM-IV-J over the past 12 months. All Pearson correlation coefficients from T1 to T7 for externalizing and internalizing problems were statistically significant (all $p < .001$) and ranged between 0.62 and 0.79 for externalizing problems and between 0.41 and 0.63 for internalizing problems.

Parallel Process Growth Model for Externalizing and Internalizing Problems

Mean trajectories for externalizing and internalizing problems were independently established in order to test the fit of each model. The mean trajectory for externalizing problems showed adequate fit, χ^2 (12, N = 744) = 97.94, $p < 0.001$, RMSEA = 0.07, CFI = 0.98, TLI = 0.98, SRMR = 0.10, while the mean trajectory for internalizing problems showed good fit, χ^2 (12, N = 744) = 70.42, $p < 0.001$, RMSEA = 0.05, CFI = 0.98, TLI = 0.98, SRMR = 0.12. Following these analyses, the mean trajectories for both externalizing and internalizing problems were included within the same model. Model fit indices indicated a poor fit for the model, χ^2 = (91, N = 744) = 1042.34, $p < 0.001$, RMSEA = 0.12, CFI = 0.88, TLI = 0.88, SRMR = 0.09. In order to improve the fit of this model, model modification indices were explored and correlations between externalizing and internalizing problems at each time point (i.e., T1 through T7) were included which significantly improved the model. These model modification indices were selected as they ensured a high level of parsimony within the model.

The final model including the correlation terms provided an excellent fit for the data, χ^2 (84, N = 744) = 196.37, $p < 0.001$, RMSEA = 0.04, CFI = 0.99, TLI = 0.99, SRMR = 0.08. For externalizing problems, the mean scores for the intercept (B = 65.77, $p < 0.001$) and slope (B = -1.13, $p < 0.001$) were significant, indicating elevated levels of externalizing problems at baseline which decreased over time. The variance around the intercept (B = 87.09, $p < 0.001$) and slope (B = 0.96, $p < 0.001$) were significant, suggesting variability in the initial levels and change of externalizing problems over time. Regarding internalizing problems, the mean scores for the intercept (B = 63.48, $p < 0.001$) and slope (B = -0.05, $p < 0.001$) were significant, indicating elevated levels of internalizing problems at baseline which decreased over time. The variance around the intercept (B = 49.16, $p < 0.001$) and slope (B = 0.75, $p < 0.001$) were also significant, suggesting variability in the initial levels and change of internalizing problems over time.

Invariance by Sex and Baseline Externalizing Behaviors

Invariance analyses by sex and baseline externalizing behaviors were conducted to compare the result of the models with and without equality constraints. The chi-square difference between the two models for sex (χ^2 (5, N = 744) = 4.804, p = 0.54) and baseline externalizing behaviors (χ^2 (5, N = 744) = 5.0, p = 0.79) were not statistically significant. These results indicate that the final parallel process growth model of externalizing and internalizing problems does not vary based on sex or baseline externalizing behaviors.

Logistic Regression Analysis for Gambling Engagement

For the logistic regression, the intercept and slope of externalizing and internalizing problems were regressed on gambling engagement while controlling for demographic characteristics that were significantly associated with gambling engagement (Table 2). The

intercept of externalizing problems ($B = 0.10$, $p = 0.003$) and the intercept of internalizing problems ($B = -0.10$, $p = 0.026$) significantly predicted gambling engagement at T8. These results indicate that lower internalizing problems at baseline and greater externalizing problems at baseline were predictive of later gambling engagement. Additionally, the slope of the trajectory of externalizing problems ($B = 0.58$, $p = 0.039$) was significant in predicting gambling engagement at T8, indicating that although there was an overall decrease in externalizing problems over time, those who experienced less of a decrease in these problems were more likely to report past year gambling engagement. The slope of the trajectory for internalizing problems was not a significant predictor of past year gambling engagement ($B = -0.01$, $p = 0.99$). As for the included covariate, age was significant with older individuals reporting greater gambling engagement ($B = 0.63$, $p = 0.01$).

Table 2

Prediction of gambling engagement at T8 by the initial status (intercept) and change over time (slope) of internalizing and externalizing problems

Predictors		*B* (*SE*)	β (*SE*)
Main model			
	Internalizing problem – Intercept	-0.10 (0.05)*	-0.32 (0.14)*
	Internalizing problem – Slope	-0.01 (0.45)	-0.00 (0.18)
	Externalizing problem – Intercept	0.10 (0.03)**	0.42 (0.13)**
	Externalizing problem – Slope	0.58 (0.28)*	0.44 (0.17)**
	Age	0.63 (0.24)**	0.26 (0.09)**

Note. *$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$

Interaction Effects for Internalizing and Externalizing Problems

Additional analyses were conducted to investigate the potential interaction effect of the intercept or slope of internalizing and externalizing problems in predicting past year gambling engagement. Results indicated that neither the interaction of the intercept ($p = 0.89$) nor the

slope (p = .99) for externalizing and internalizing problems were predictive of past year gambling engagement.

Discussion

This longitudinal study investigated externalizing and internalizing problems in childhood and their trajectories over six years in predicting gambling engagement among adolescents. The modelled trajectories indicated that although average externalizing problems at baseline were above the borderline clinical cut-off (T-score ≥ 65), the severity of this problem and internalizing problems decreased significantly over time. Moreover, no differences in these trajectories were identified based on sex and baseline externalizing behaviors. Results from the regression model for externalizing problems were in line with the hypothesis that greater externalizing problems at baseline and a trajectory involving a slower decline of externalizing problems would be predictive of gambling engagement. As for internalizing problems, the established hypothesis was partially supported with results indicating that although no significant predictive effect for the trajectory of internalizing problems was identified, internalizing problems at baseline decreased the risk for later gambling engagement. Finally, regarding the exploratory analyses, the interaction of the baseline scores and trajectory of externalizing and internalizing problems were identified as not being predictive of later gambling.

Externalizing and Internalizing Pathways to Youth Gambling

Based on previous longitudinal evidence investigating the predictive role of externalizing problems for youth problem gambling, results from the present study appear to be in line with research identifying childhood externalizing problem as predictive of gambling engagement (Temcheff et al., 2016) and problem gambling (Martins et al., 2013). Due to the limited number

of participants endorsing problem gambling in the present study, this variable was not utilized as the primary outcome. Previous studies measuring problem gambling did so at a later time (i.e., age 17-20) which increases the likelihood that this outcome would be endorsed based on the higher prevalence rates of gambling among emerging adults (Calado et al., 2017). Moreover, as other longitudinal studies measured externalizing problems among older adolescents and gambling in emerging adulthood (Allami et al., 2017; Martins et al., 2014; Vitaro et al., 2001; Wanner et al., 2009), the present study marks an important attempt at measuring externalizing problems and gambling behaviors in earlier developmental periods while including an evenly distributed sample of males and females. As a whole, results from the current study suggest that externalizing problems in childhood are a significant predictor of youth gambling.

The presence of significant externalizing problems may point to certain etiological and risk factors that have been previously associated with gambling engagement and problem gambling. Consistent with the externalizing pathway to substance use and disorder (Zucker, 1994; Zucker et al., 2011), it is possible that certain etiological factors including greater impulsivity, aggression, anti-social tendencies, behavioral disinhibition, and sensation-seeking increase the risk for involvement in gambling (Dowling et al., 2017; Richard et al., 2020; Shead et al. 2010). Beyond these psychological and cognitive predispositions, it is possible that various social risk factors including negative early childhood experiences, academic difficulties, exposure to gambling through family members, poor family cohesion, and affiliating with delinquent peers or peers who gamble, may play a role in the development of both externalizing problems and early engagement in gambling (Dowling et al., 2017; Shead et al., 2010). Overall, future research elucidating the specific aspects of youth externalizing problems that increase the

risk for gambling is necessary in order to identify developmental mechanisms that can be targeted through early intervention programs.

With regards to the longitudinal evidence investigating the predictive role of internalizing problems for youth gambling engagement and problem gambling, mixed findings have been reported with one study finding a significant predictive effect of internalizing problems (Dussault et al., 2011), and others identifying non-significant associations between internalizing problems and problem gambling (Allami et al., 2018; Afifi et al., 2016; Chinneck et al., 2016; Edgerton et al., 2015, 2018). Compared to the present study, these longitudinal surveys focused primarily on young adults, with internalizing problems and problem gambling being measured from the ages of 17 to 23. Although the non-significant effects that have been established across both longitudinal and some cross-sectional data (Richard et al., 2020) are consistent with the results of the trajectory of internalizing problems in the present study, the significant negative predictive effect of baseline internalizing problems on gambling engagement is a novel finding that requires explanation.

First, it is possible that children endorsing greater levels of mood disturbance, anxiety, and social withdrawal (i.e., internalizing problems) are less likely to develop relationships with peers who are aggressive and/or engage in delinquent acts (youth high in externalizing problems), and as such, are less likely to be exposed to the high-risk behaviors (such as underaged gambling) that these youth may also engage in. This would be consistent with evidence indicating that a significant predictor of youth gambling is having friends who gamble (Shead et al., 2010). Alternatively, it is possible that internalizing problems may decrease gambling engagement due to a fear of negative consequences which may be associated with such activities. This effect of internalizing problems in diminishing engagement in addictive behaviors

has been previously established within the substance use literature (Colder et al., 2013; Mason et al., 2008) and may also be applicable for youth gambling behaviors. Indeed, this would be markedly different from what has been established for gaming disorder, with early internalizing problems increasing the risk of disordered gaming (Richard et al., 2021). These contrasting findings may be indicative of the differences in attitudes, beliefs, and motivations for engagement in gambling and gaming among youth. Moreover, although the self-medication hypothesis (Khantzian, 1997) has been proposed to explain the greater likelihood of gambling and substance use behaviors among adults with internalizing problems (i.e., engagement in the addictive behavior to reduce or eliminate elevated negative affect) (Bilevicius et al., 2018; Szerman et al., 2020), some researchers have suggested that this pathway may not emerge until late adolescence/early adulthood (Colder et al., 2010; Hussong et al., 2011). Overall, additional research integrating various hypothesized factors is necessary to elucidate the presence of a pathway from childhood internalizing problems to later gambling engagement.

As for the interaction of externalizing and internalizing problems, although previous studies have identified classes of youth reporting problem gambling and high levels of both externalizing and internalizing problems (Allami et al., 2017, 2018), results from the present study did not identify a significant interaction effect of these problems in predicting gambling behaviors. In other words, the predictive effect of externalizing problems on gambling engagement did not change at differing levels of internalizing problems. Based on the present findings, it appears as though the presence of internalizing problems does not exacerbate or diminish the association between externalizing problems and gambling engagement among youth. Overall, given the significant effects for the baseline scores and change over time of externalizing problems and the mixed effects identified for internalizing problems, the findings

of the present study would be in line with the presence of an externalizing pathway to gambling engagement, but would not be consistent with an internalizing problem or combined problems pathway.

Strengths and Limitations

Strengths of the present study include its longitudinal design, high retention rates across the measurement points (86.96%), and detailed assessments of internalizing and externalizing problems utilizing multiple informants. Moreover, with more than half of the sample having significant externalizing behaviors at study inception, a wide variance of externalizing behaviors is reflected in the sample, strengthening the present assessment of the contribution of externalizing problems in predicting gambling engagement in adolescence. Limitations of the present study include the fact that there was no over-selection of children with significant internalizing problems at baseline. Given that internalizing problems and the change in these symptoms over time may be relevant to gambling engagement and problem gambling, it is important for future studies to address this limitation. Moreover, although the sample was evenly distributed by sex and participants were recruited from four regions in Québec, Canada, given that approximately half of the youth reported significant externalizing behaviors, the sample may not be representative of youth more broadly. Further, there was a low prevalence of youth reporting problem gambling symptoms and as a result, this variable could not be utilized as an outcome. There was also a low sample size of youth reporting engaging in gambling (4.7% of youth aged 13.3 to 17.3 years) compared to other epidemiological studies in the province of Québec (20-25%; Traoré et al., 2014, 2021). Although it is possible that youth within the present sample had lower rates of gambling compared to other studies, another potential explanation is that the use of a single question with a dichotomous (no/yes) response to assess gambling

participation resulted in under-reported rates of gambling engagement compared to measures independently assessing the frequency of engagement in a number of different gambling activities (e.g., bingo, cards, online gambling, sports betting) using a Likert-type scale. As a result, replication studies with greater statistical power are needed to support the reliability and generalizability of the present findings while utilizing well validated, reliable, and comprehensive measures to assess gambling participation, problems, and harm among youth (e.g., Canadian Adolescent Gambling Inventory; Tremblay et al., 2010). Alternatively, larger longitudinal studies including adolescent populations endorsing greater rates of participation in gambling (e.g., through purposive sampling) could be advantageous in replicating results in relation to the externalizing and internalizing pathways towards adolescent gambling engagement and problem gambling.

Clinical and Practical Implications

The results of the present study have important clinical and practical implications relevant to youth externalizing problems and gambling involvement. Specifically, as early externalizing problems and a limited decrease of these problems have been identified as predicting gambling engagement, interventions focusing on further decreasing these behavioral issues could have significant implications in improving youth mental health and decreasing the risk for the development of problematic gambling behaviors later in life. Empirically-validated programs for youth externalizing problems may be beneficial for such purposes. These generally involve both youth and their parents, with treatment objectives involving improvements in goal orientation, emotional awareness, perspective taking, problem solving skills and behaviorally oriented training for parents (Weisz et al., 2004). Beyond reducing youth externalizing problems, early prevention efforts related to youth gambling/problem gambling could potentially be

integrated within available youth psychosocial services for externalizing problems. Since youth as young as the age of six already know about gambling from their families, peers, or digital media (Wardle, 2019), early assessment of youth gambling with age-appropriate prevention or treatment interventions could be integrated within current intervention protocols with potentially positive effects in reducing the risk for problem gambling and other mental health disorders. Moreover, despite the fact that parents, teachers, and mental-health professionals in schools (e.g., child psychologists, psychoeducators, social workers) are aware of the fact that youth gamble, they tend to regard gambling as being one of the least serious adolescent risk behaviors (Campbell et al., 2011; Derevensky et al., 2013; Temcheff et al., 2014). Given these findings, there appears to be a need for continued efforts in increasing awareness of youth gambling among parents, teachers and other professionals, particularly those working with youth with externalizing problems.

Conclusions

The findings of present study provide empirical support for the role of childhood externalizing problems and their change over time in predicting past year gambling involvement among adolescents. These results underscore the importance of investigating temporally distal risk factors when attempting to understand youth gambling involvement. As an earlier age of initiation in gambling behaviors has been identified as a risk factor for the development of problem gambling (Brezing et al., 2010), it is crucial that future research and interventions consider early predictors of gambling involvement and the importance of prevention in reducing gambling-related harms.

References

Achenbach, T. M. (1991). *Manual for Child Behavior Checklist/ 4–18 and 1991 Profile.* Burlington: University of Vermont Department of Psychiatry.

Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for the Achenbach system of empirically based assessment (ASEBA) school-age forms and profiles.* University of Vermont, Research Center for Children, Youth and Families, Burlington.

Afifi, T. O., Nicholson, R., Martins, S. S., & Sareen, J. (2016). A longitudinal study of the temporal relation between problem gambling and mental and substance use disorders among young adults. *Canadian Journal of Psychiatry - Revue Canadienne de Psychiatrie, 61*(2), 102-111. doi:10.1177/0706743715625950

Allami, Y., Vitaro, F., Brendgen, M., Carbonneau, R., Lacourse, E., & Tremblay, R. E. (2017). A longitudinal empirical investigation of the Pathways Model of problem gambling. *Journal of Gambling Studies, 33*(4), 1153–1167. https://doi.org/10.1007/s10899-017-9682-6.

Allami, Y., Vitaro, F., Brendgen, M., Carbonneau, R., & Tremblay, R. E. (2018). Identifying at-risk profiles and protective factors for problem gambling: A longitudinal study across adolescence and early adulthood. *Psychology of Addictive Behaviors, 32*(3), 373-382. doi:10.1037/adb0000356

Bilevicius, E., Single, A., Bristow, L. A., Foot, M., Ellery, M., Keough, M. T., & Johnson, E. A. (2018). Shame mediates the relationship between depression and addictive behaviours. *Addictive Behaviors, 82*, 94–100. https://doi.org/10.1016/j.addbeh.2018.02.023

Blaszczynski, A., & Nower, L. (2002). A pathways model of problem and pathological gambling. *Addiction, 97*(5), 487–499. https://doi.org/10.1046/j.1360-0443.2002.00015.x

Blinn-Pike, L., Worthy, S. L., & Jonkman, J. N. (2010). Adolescent gambling: A review of an emerging field of research. *Journal of Adolescent Health, 47*(3), 223–236. https://doi.org/10.1016/j.jadohealth.2010.05.003

Brezing, C., Derevensky, J. L., & Potenza, M. N.. (2010). Non–substance-addictive behaviors in youth: Pathological gambling and problematic internet use. *Child and Adolescent Psychiatric Clinics of North America, 19*(3), 625–641. https://doi.org/10.1016/j.chc.2010.03.012

Burge, A. N., Pietrzak, R. H., Molina, C. A., & Petry, N. M. (2004). Age of gambling initiation and severity of gambling and health problems among older adult problem gamblers. *Psychiatric Services, 55*(12), 1437–1439. https://doi.org/10.1176/appi.ps.55.12.1437

Burge, A. N., Pietrzak, R. H., & Petry, N. M.. (2006). Pre/early adolescent onset of gambling and psychosocial problems in treatment-seeking pathological gamblers. *Journal of Gambling Studies, 22*(3), 263–274. https://doi.org/10.1007/s10899-006-9015-7

Calado, F., Alexandre, J., & Griffiths, M. D.. (2017). Prevalence of adolescent problem gambling: A systematic review of recent research. *Journal of Gambling Studies, 33*(2), 397–424. https://doi.org/10.1007/s10899-016-9627-5

Campbell, C. A., Derevensky, J. L., Meerkamper, E., & Cutajar, J.. (2012). The influence of cultural background on parental perceptions of adolescent gambling behaviour: A Canadian study. *International Journal of Mental Health and Addiction, 10*(4), 537–550. https://doi.org/10.1007/s11469-011-9337-2

Chinneck, A., Mackinnon, S. P., & Stewart, S. H. (2016). Investigating possible reciprocal relations between depressive and problem gambling symptoms in emerging adults. *The Canadian Journal of Psychiatry / La Revue canadienne de psychiatrie*, *61*(2), 93-101. doi:10.1177/0706743715625934

Colder, C. R., Chassin, L., Lee, M. R., & Villalta, I. K. (2010). Developmental perspectives: Affect and adolescent substance use. In J. D. Kassel (Ed.), *Substance Abuse and Emotion* (pp. 109–135). Washington, DC: American Psychological Association.

Colder, C. R., Scalco, M., Trucco, E. M., Read, J. P., Lengua, L. J., Wieczorek, W. F., & Hawk, L. W. (2013). Prospective associations of internalizing and externalizing problems and their co-occurrence with early adolescent substance use. *Journal of Abnormal Child Psychology*, *41*(4), 667–677. doi:10.1007/s10802-012-9701-0

Cox, S. M. L., Castellanos Ryan, N., Parent, S., Benkelfat, C., Vitaro, F., Pihl, R. O., Boivin, M., Tremblay, R. E., Leyton, M. & Séguin, J. R. (2021). Externalizing risk pathways for adolescent substance use and its developmental onset: A Canadian birth cohort study. *Canadian Journal of Psychiatry*, 1-10. doi:10.1177/0706743720982429

Crijnen, A. A., Achenbach, T. M., & Verhulst, F. C. (1997). Comparisons of problems reported by parents of children in 12 cultures: total problems, externalizing, and internalizing. *Journal of the American Academy of Child and Adolescent Psychiatry*, *36*(9), 1269–1277. https://doi.org/10.1097/00004583-199709000-00020

Crijnen, A. A., Achenbach, T. M., & Verhulst, F. C. (1999). Problems reported by parents of children in multiple cultures: The Child Behavior Checklist syndrome constructs. *The American Journal of Psychiatry*, *156*(4), 569–574. https://doi.org/10.1176/ajp.156.4.569

Delfabbro, P., King, D. L., & Derevensky, J. L. (2016). Adolescent gambling and problem gambling: prevalence, current issues, and concerns. *Current Addiction Reports, 3*(3), 268–274. https://doi.org/10.1007/s40429-016-0105-z

Derevensky, J. L., St-Pierre, R. A., Temcheff, C. E., & Gupta, R. (2014). Teacher awareness and attitudes regarding adolescent risky behaviours: Is adolescent gambling perceived to be a problem? *Journal of Gambling Studies, 30*(2), 435–451. https://doi.org/10.1007/s10899-013-9363-z

Dowling, N. A., Merkouris, S. S., Greenwood, C. J., Oldenhof, E., Toumbourou, J. W., & Youssef, G. J. (2017). Early risk and protective factors for problem gambling: A systematic review and meta-analysis of longitudinal studies. *Clinical Psychology Review, 51*, 109–124. https://doi.org/10.1016/j.cpr.2016.10.008

Dussault, F., Brendgen, M., Vitaro, F., Wanner, B., & Tremblay, R. E.. (2011). Longitudinal links between impulsivity, gambling problems and depressive symptoms: A transactional model from adolescence to early adulthood. *Journal of Child Psychology and Psychiatry, 52*(2), 130–138. https://doi.org/10.1111/j.1469-7610.2010.02313.x

Edgerton, J. D., Keough, M. T., & Roberts, L. W. (2018). Co-development of problem gambling and depression symptoms in emerging adults: A parallel-process latent class growth model. *Journal of Gambling Studies, 34*(3), 949-968. doi:10.1007/s10899-018-9760-4

Edgerton, J. D., Melnyk, T. S., & Roberts, L. W. (2015). Problem gambling and the youth-to-adulthood transition: Assessing problem gambling severity trajectories in a sample of young adults. *Journal of Gambling Studies, 31*(4), 1463-1485. doi:10.1007/s10899-014-9501-2

Emond, A. M., & Griffiths, M. D. (2020). Gambling in children and adolescents. *British Medical Bulletin, 136*(1), 21–29. https://doi.org/10.1093/bmb/ldaa027

Englund, M. M., & Siebenbruner, J. (2012). Developmental pathways linking externalizing symptoms, internalizing symptoms, and academic competence to adolescent substance use. *Journal of Adolescence, 35*(5), 1123-1140. doi:10.1016/j.adolescence.2012.03.004

Fisher, S. (1992). Measuring pathological gambling in children: The case of fruit machines in the U.K. *Journal of Gambling Studies, 8,* 263–285.

Foster, D. W., Hoff, R. A., Pilver, C. E., Yau, Y. H. C., Steinberg, M. A., Wampler, J., Krishnan-Sarin, S., & Potenza, M. N. (2015). Correlates of gambling on high-school grounds. *Addictive Behaviors, 51,* 57–64. https://doi.org/10.1016/j.addbeh.2015.07.006

Hussong, A. M., Jones, D. J., Stein, G. L., Baucom, D. H., & Boeding, S. (2011). An internalizing pathway to alcohol use and disorder. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 25*(3), 390–404. doi:10.1037/a0024519

Johansson, A., Grant, J. E., Kim, S. W., Odlaug, B. L., & Götestam, K. G. (2009). Risk factors for problematic gambling: A critical literature review. *Journal of Gambling Studies, 25*(1), 67–92. https://doi.org/10.1007/s10899-008-9088-6

Khantzian, E. J. (1997) The self-medication hypothesis of substance use disorders: A reconsideration and recent applications. *Harvard Review of Psychiatry, 4*(5), 231-244, doi:10.3109/10673229709030550

King, D. L., Russell, A., & Hing, N. (2020). Adolescent land-based and internet gambling: Australian and international prevalence rates and measurement issues. *Current Addiction Reports, 7*(2), 137–148. https://doi.org/10.1007/s40429-020-00311-1

Lapalme, M., Bégin, V., Le Corff, Y., & Déry, M. (2020). Comparison of discriminant validity indices of parent, teacher, and multi-informant reports of behavioral problems in elementary schoolers. *Journal of Psychopathology and Behavioral Assessment, 42*(1), 58–68. https://doi.org/10.1007/s10862-019-09782-7

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83*(404), 1198–1202. https://doi.org/10.1080/01621459.1988.10478722

Livazović, G., & Bojčić, K. (2019). Problem gambling in adolescents: What are the psychological, social and financial consequences? *BMC Psychiatry, 19*(1). https://doi.org/10.1186/s12888-019-2293-2

Lynch, W. J., Maciejewski, P. K., & Potenza, M. N. (2004). Psychiatric correlates of gambling in adolescents and young adults grouped by ageat gambling onset. *Archives of General Psychiatry, 61,* 1116–1122. http://dx.doi.org/10.1001/archpsyc.61.11.1116

Macmann, G. M., Barnett, D. W., Burd, S. A., Jones, T., LeBuffe, P. A., O'Malley, D., Shade, D. B., & Wright, A. (1992). Construct validity of the Child Behavior Checklist: Effects of item overlap on second-order factor structure. *Psychological Assessment, 4*(1), 113–116. https://doi.org/10.1037/1040-3590.4.1.113

Martins, S. S., Lee, G. P., Santaella, J., Liu, W. W., Ialongo, N. S., & Storr, C. L. (2014). Age of first arrest varies by gambling status in a cohort of young adults. *American Journal on Addictions, 23*(4), 386-392. doi:10.1111/j.1521-0391.2014.12121.x.

Martins, S. S., Liu, W. W., Hedden, S. L., Goldweber, A., Storr, C. L., Derevensky, J. L., Stinchfield, R., Ialongo, N. S., & Petras, H. (2013). Youth aggressive/disruptive behavior trajectories and subsequent gambling among urban male youth. *Journal of Clinical Child and Adolescent Psychology, 42*(5), 657-668. doi:10.1080/15374416.2013.764827.

Maslowsky, J., Schulenberg, J. E., & Zucker, R. A. (2014). Influence of conduct problems and depressive symptomatology on adolescent substance use: Developmentally proximal versus distal effects. *Developmental Psychology, 50*(4), 1179–1189. doi:10.1037/a0035085

Mason, W.A., Hitchings, J.E., & Spoth, R.L. (2008). The interaction of conduct problems and depressed mood in relation to adolescent substance involvement and peer substance use. *Drug and Alcohol Dependence, 96*(3), 233–248.

McCarty, C.A., Wymbs, B.T., Mason, W.A., King, K.M., McCauley, E., Baer, J. & Vander Stoep, A. (2013). Early adolescent growth in depression and conduct problem symptoms as predictors of later substance use impairment. *Journal of Abnormal Child Psychology, 41*(7), 1041-1051.

Molinaro, S., Benedetti, E., Scalese, M., Bastiani, L., Fortunato, L., Cerrai, S., Canale, N., Chomynova, P., Elekes, Z., Feijão, F., Fotiou, A., Kokkevi, A., Kraus, L., Rupšienė, L., Monshouwer, K., Nociar, A., Strizek, J., & Urdih Lazar, T. (2018). Prevalence of youth gambling and potential influence of substance use and other risk factors throughout 33

European countries: first results from the 2015 ESPAD study. *Addiction, 113*(10), 1862–1873. https://doi.org/10.1111/add.14275

Muthén, L. K., & Muthén, B. O. (2017). *Mplus: Statistical Analysis with Latent Variables: User's Guide (Version 8).* Los Angeles, CA: Authors.

Muthén, B., & Shedden, K. (1999). Finite mixture modeling with mixture outcomes using the EM algorithm. *Biometrics, 6*, 463–469.

Ofori Dei, S. M., Christensen, D. R., Awosoga, O. A., Lee, B. K., & Jackson, A. C. (2020). A composite measure of gambling exposure: Availability, accessibility or both? *Journal of Gambling Studies.* https://doi.org/10.1007/s10899-020-09985-8

Potenza, M. N. (2014). Non-substance addictive behaviors in the context of DSM-5. *Addictive Behaviors, 39*(1), 1–2. https://doi.org/10.1016/j.addbeh.2013.09.004.

Raisamo, S., Kinnunen, J. M., Pere, L., Lindfors, P., & Rimpelä, A.. (2020). Adolescent gambling, gambling expenditure and gambling–related harms in Finland, 2011–2017. *Journal of Gambling Studies, 36*(2), 597–610. Doi:10.1007/s10899-019-09892-7

Rahman, A. S., Pilver, C. E., Desai, R. A., Steinberg, M. A., Rugle, L., Krishnan-Sarin, S., & Potenza, M. N.. (2012). The relationship between age of gambling onset and adolescent problematic gambling severity. *Journal of Psychiatric Research, 46*(5), 675–683. https://doi.org/10.1016/j.jpsychires.2012.02.007

Richard, J., Fletcher, E., Boutin, S., Derevensky, J., & Temcheff, C. (2020). Conduct problems, depressive symptoms and behavioral addictions in adolescents and young adults: A systematic review. *Journal of Behavioral Addictions, 9*(3), 497-533. doi:10.1556/2006.2020.00045

Richard, J., Temcheff, C., Fletcher, E., Lemieux, A., Derevensky, J., & Dery, M. (2021). An empirical investigation of the externalizing and internalizing pathways to problem video gaming: A longitudinal study across childhood and adolescence. *Computers in Human Behavior, 1-8.* https://doi.org/10.1016/j.chb.2021.107096

Russell, A., Armstrong, T., Rockloff, M., Greer, N., Hing, N., & Browne, M. (2020). *Exploring the changing landscape of gambling in childhood, adolescence and young adulthood.* Sydney: NSW Responsible Gambling Fund; CQUniversity Australia. doi.org/10.25946/5f2335f6d50d1

Scalco, M. D., Colder, C. R., Hawk, L. W., Jr., Read, J. P., Wieczorek, W. F., & Lengua, L. J. (2014). Internalizing and externalizing problem behavior and early adolescent substance use: A test of a latent variable interaction and conditional indirect effects. *Psychology of Addictive Behaviors*, *28*(3), 828-840. http://dx.doi.org/10.1037/a0035805

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods, 7,* 147–177.

Sideli, L., La Barbera, D., Montana, S., Sartorio, C. R., Seminerio, F., Corso, M., Giunta, S., Mannino, G., Cascia, C. L. (2018). Pathological gambling in adolescence: A narrative review. *Mediterranean Journal of Clinical Psychology, 6*(1), 1–40. https://doi.org/10.6092/2282-1619/2018.6.1738.

Shaffer, H. J., & Korn, D. A. (2002). Gambling and related mental disorders: A public health analysis. *Annual Review of Public Health, 23,* 171–212. https://doi.org/10.1146/annurev.publhealth.23.100901.140532.

Shead, N. W., Derevensky, J. L., & Gupta, R. (2010). Risk and protective factors associated with youth problem gambling. *International Journal of Adolescent Medicine and Health, 22*(1), 39–58.

Shi, D., Lee, T., & Maydeu-Olivares, A. (2019). Understanding the model size effect on SEM fit indices. *Educational and Psychological Measurement, 79*(2), 310–334. https://doi.org/10.1177/0013164418783530

Sroufe, L. A. (1997). Psychopathology as an outcome of development. *Development and Psychopathology, 9*(2), 251–268. https://doi.org/10.1017/s0954579497002046

Stinchfield, R. (2020). Gambling and problem gambling among Minnesota public school students in 2019. *Issues in Mental Health Nursing, 41*(12), 1083–1094. https://doi.org/10.1080/01612840.2020.1806965

St-Pierre, R. A., Walker, D. M., Derevensky, J., & Gupta, R. (2014). How availability and accessibility of gambling venues influence problem gambling: A review of the literature. *Gaming Law Review and Economics, 18*, 150-172.

Szerman, N., Ferre, F., Basurte-Villamor, I., Vega, P., Mesias, B., Marín-Navarrete, R., & Arango, C. (2020). Gambling dual disorder: A dual disorder and clinical neuroscience perspective. *Frontiers in Psychiatry, 11*, 589155. https://doi.org/10.3389/fpsyt.2020.589155

Temcheff, C. E., Derevensky, J. L., St-Pierre, R. A., Gupta, R., & Martin, I. (2014). Beliefs and attitudes of mental health professionals with respect to gambling and other high risk behaviors in schools. *International Journal of Mental Health and Addiction, 12*(6), 716–729. https://doi.org/10.1007/s11469-014-9499-9

Temcheff, C. E., Déry, M., St-Pierre, R. A., Laventure, M., & Lemelin, J.-P. (2016). Precocious initiation into smoking, alcohol use, and gambling among children with conduct problems. *The Canadian Journal of Psychiatry, 61*(1), 50–58. https://doi.org/10.1177/0706743715620402

Traoré, I., Pica, L. A., Camirand, H., Cazale, L., Berthelot, M. & Plante, N. (2014). Jeux de hasard et d'argent. In *Enquête québécoise sur le tabac, l'alcool, la drogue et le jeu chez les élèves du secondaire 2013.* Ste-Foy, QC: Institut de la statistique du Québec.

Traoré, I., Simard, M., Camirand, H., Conus, F., & Contreras, G. (2021). Jeux de hasard et d'argent. In *Enquête québécoise sur le tabac, l'alcool, la drogue et le jeu chez les élèves du secondaire 2019.* Ste-Foy, QC: Institut de la statistique du Québec.

Tremblay, J., Stinchfield, R., Wiebe, J., & Wynne, H. (2010). *Canadian Adolescent Gambling Inventory (CAGI) Phase III Final Report.* Submitted to the Canadian Centre on Substance Abuse and the Interprovincial Consortium on Gambling Research.

Trucco, E. M., Villafuerte, S., Hussong, A., Burmeister, M., & Zucker, R. A. (2018). Biological underpinnings of an internalizing pathway to alcohol, cigarette, and marijuana use. *Journal of Abnormal Psychology*, *127*(1), 79-91. doi:10.1037/abn0000310

Vitaro, F., Brendgen, M., Ladouceur, R., & Tremblay, R. E. (2001). Gambling, delinquency, and drug use during adolescence: Mutual influences and common risk factors. *Journal of Gambling Studies, 17*(3), 171-190. doi:10.1023/A:1012201221601

Wanner, B., Vitaro, F., Carbonneau, R., & Tremblay, R. E. (2009). Cross-lagged links among gambling, substance use, and delinquency from midadolescence to young adulthood:

Additive and moderating effects of common risk factors. *Psychology of Addictive Behaviors, 23*(1), 91-104. doi:10.1037/a0013182

Wardle, H. (2019). Perceptions, people and place: Findings from a rapid review of qualitative research on youth gambling. *Addictive Behaviors, 90*, 99–106. https://doi.org/10.1016/j.addbeh.2018.10.008

Weisz, J. R., Hawley, K. M., & Jensen Doss, A. (2004). Empirically tested psychotherapies for youth internalizing and externalizing problems and disorders. *Child and Adolescent Psychiatric Clinics of North America, 13*(4), 729–815. doi:10.1016/j.chc.2004.05.006

Winters, K. C., & Smith, N. D. L. (2019). Gambling expansion and its association with disordered gambling trends. In H. J. Shaffer, A. Blaszczynski, R. Ladouceur, P. Collins, & D. Fong (Eds.), Responsible gambling: Primary stakeholder perspectives (pp. 85–110). Oxford University Press. https://doi.org/10.1093/med-psych/9780190074562.003.0004

Winters, K. C., Stinchfield, R. D., Botzet, A., & Anderson, N. (2002). A prospective study of youth gambling behaviors. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 16*(1), 3–9. https://doi.org/10.1037//0893-164x.16.1.3

Yakovenko, I., & Hodgins, D. C.. (2018). A scoping review of co-morbidity in individuals with disordered gambling. *International Gambling Studies, 18*(1), 143–172. https://doi.org/10.1080/14459795.2017.1364400

Yip, S. W., Desai, R. A., Steinberg, M. A., Rugle, L., Cavallo, D. A., Krishnan-Sarin, S., & Potenza, M. N. (2011). Health/functioning characteristics, gambling behaviors, and gambling-related motivations in adolescents stratified by gambling problem severity:

findings from a high school survey. *The American Journal on Addictions, 20*(6), 495–508. https://doi.org/10.1111/j.1521-0391.2011.00180.x

Zucker, R. A. (1994). Pathways to alcohol problems and alcoholism: A developmental account of the evidence for multiple alcoholism and for contextual contributions to risk. In: R. A. Zucker, G. Boyd, & J. Howard (Eds.), *The development of alcohol problems: Exploring the biopsychosocial matrix of risk* (pp. 255-289). National Institute on Alcohol Abuse and Alcoholism Research Monograph No. 26. National Institute on Alcohol Abuse and Alcoholism, Rockville, MD.

Zucker, R. A., Heitzeg, M. M., & Nigg, J. T. (2011). Parsing the undercontrol/disinhibition pathway to substance use disorders: A multilevel developmental problem. *Child Development Perspectives, 5*(4), 248–255. doi:10.1111/j.1750-8606.2011.00172.

Comprehensive Scholarly Discussion

The last decade has seen a substantial increase of interest in the study of gambling and gaming behaviors due to technological innovations facilitating the accessibility and availability of these activities. Specifically, concerns have been raised regarding the possibility for problematic patterns of engagement in gambling and gaming (Calado et al., 2017; Gabellini et al., 2022; Kim et al., 2022; Richard et al., 2020b; Stevens et al., 2021). Generally recognized as behavioral addictions (Derevensky, 2019; Grant et al., 2010; Potenza, 2017), gambling and gaming disorder share commonalities in disordered symptomatology and predisposing psychological vulnerabilities (Dowling et al., 2017; Griffiths, 2005; Richard et al., 2020b). However, research comparing gambling and gaming disorder remains in its infancy, with a need for research investigating problem gambling (PG) and problem video gaming (PVG) within extant models of psychopathology while identifying and differentiating risk factors relevant to the development of these behavioral addictions. Moreover, with a greater proportion of males and youth reporting problems related to both gambling or gaming (Calado et al., 2017; Fam, 2018; Paulus et al., 2018), there is a need for research investigating the effects of sex and age on the manifestation of these problems.

Summary and Differences Between Studies

The purpose of this thesis is to address these gaps in the literature by investigating the association between theoretically established risk factors (i.e., externalizing and internalizing problems) for the two presently recognized behavioral addictions (i.e., PG and PVG) from childhood to emerging adulthood. The results from the four studies included within this thesis provide important insights into the associations between these variables and how they are concurrently and sequentially related. As described in the comprehensive literature review, the

study of behavioral addictions is lagging behind the study of substance use disorders (SUDs). Therefore, across four studies, this thesis provides an overview of the empirical literature investigating the concurrent and prospective associations between externalizing problems, internalizing problems, PG and PVG, while utilizing varied yet complimentary methodological and statistical designs to address gaps in the literature. This comprehensive discussion will provide a synthesis of the research findings across the four included studies while identifying the overarching limitations and implications for theory, methodology and clinical intervention.

The organization of the four studies follow a trajectory from providing a detailed summary of the state of empirical evidence (Study 1; Richard et al., 2020a), to the realization of a cross-sectional (Study 2; Richard et al., 2023) and two longitudinal (Study 3 & 4; Richard et al., 2022a, 2022b) studies to provide a comprehensive understanding of the relationships between externalizing problems, internalizing problems, PG and PVG. Whereas Study 2 explored the cross-sectional association between the variables (i.e., externalizing problems, internalizing problems, PG and PVG) within a large sample of high-school students, Study 3 and 4 determined how trajectories of externalizing and internalizing problems from childhood to adolescence predict PVG and gambling behaviors within a sample of youth with and without significant externalizing behaviors. Overall, the results from the empirical studies share conceptual overlap while being complementary in the way that Study 2 provides an overview of the relationship between observed variables and their underlying latent constructs (i.e., externalizing and internalizing factors) concurrently, and Study 3 and 4 identified the relationship between these variables over time.

Despite the conceptual overlap of the studies included in this thesis, it is necessary to acknowledge the differences between them. First, despite the fact that this thesis focuses on the

spectrum of externalizing and internalizing problems in association with PG and PVG, the systematic review in Study 1 focused solely on conduct problems (instead of externalizing problems more broadly) and depressive symptoms (instead of internalizing problems more broadly). These adjustments were made due to the need for greater specificity in the variables specified within the inclusion and exclusion criteria. Due to the breadth of problems and behaviors included within the externalizing and internalizing factors, it was necessary to limit the scope of the review to specific facets of these two factors to allow for a detailed synthesis of the research findings while being compliant with PRISMA guidelines (Moher et al., 2009). Conduct problems and depressive symptoms were selected as the specific variables of interest within the broader spectrum of behaviors due to their consistent inclusion across the identified pathways towards the development of substance use behaviors (i.e., externalizing, internalizing and combined externalizing-internalizing pathways; Englund & Siebenbruner, 2012; Hussong et al., 2011; Maslowsky et al., 2014; Trucco et al., 2018; Zucker, 1994; Zucker et al., 2011), gaming disorder (i.e., externalized and internalized pathways; Benarous et al., 2019) and gambling disorder (i.e., antisocial-impulsivist and emotionally vulnerable pathways; Blaszczynski & Nower, 2002; Nower et al., 2022).

Second, differences in the participants recruited across the empirical studies should be addressed. For the three empirical studies, two different samples were used: 1) 6,413 students (50.4% male, M_{age} = 14.74 years) from Wood County, Ohio, United States (Richard et al., 2023); and 2) 744 students (53.2% male, M_{age} = 8.3 years at baseline) from Québec, Canada (Richard et al., 2022a, 2022b). A first noteworthy difference between the samples are possible cultural, social, and economic differences between youth living in Canada and the United States. Although these differences could be widespread, variables with potential psychosocial effects

include values, attitudes, language, political ideology, religiosity, trust in institutions, uncertainty avoidance, and individualism-collectivism (Dheer et al., 2014). Moreover, whereas the sample from Wood County, Ohio can be considered primarily rural (defined as a population density of under 400 inhabitants per square kilometer; Du Plessis et al., 2001), the sample from Québec can be considered as both rural (some areas of the Eastern Townships and Montérégie) and urban (Montréal, Québec City). Although similar rates of mental disorders are reported in urban and rural areas, reduced availability and accessibility of specialized services are present in rural areas (Ziller et al., 2010). Finally, whereas a representative sample of youth were selected from Wood County, Ohio, the sample from Québec overrepresented children with significant externalizing behaviors (58.3% at baseline) that were referred for school-based services. As such, there may be differences in the level of problem severity and access to care between the two samples.

Third, differences in the measures used across the empirical studies should be noted. Different measurements were used as a result of study methodology (e.g., participant recruitment, limitations on questionnaire length, single versus repeated measures), and reading level considerations. In order to measure internalizing and externalizing problems, Study 2 utilized the Problem Severity Scale (Ogles et al., 2001), a 20-item self-report screen that measures common emotional and behavioral problems among youth. Comparatively, Study 3 and Study 4 utilized the Child Behavior Checklist (CBCL) and the Teacher Report Form (TRF) of the ASEBA (Achenbach & Rescorla, 2001), a 118-item instrument utilizing self, parent, and teacher ratings. To measure PVG, Study 2 utilized the Internet Gaming Disorder Scale–Short Form 9 (IGDS-SF9; Pontes & Griffiths, 2015) which includes nine items assessing the severity of gaming disorder over the past 12 months on a 5-point scale. Study 3 utilized a similar measure of nine questions (APA, 2013), but dichotomous (yes/no) responses were recorded. To measure

PG, Study 2 utilized the National Opinion Research Centre (NORC) DSM-IV Screening for Gambling Problems (NODS-CLiP; Toce-Gerstein et al., 2009), a three-item screening tool for at-risk problem gambling, whereas Study 4 utilized the 12-item Diagnostic and Statistical Manual of Mental Disorders-IV Adapted for Juveniles (DSM-IV-J; Fisher, 1992). Moreover, due to the low number of adolescents endorsing PG symptoms in Study 4, gambling behaviors more broadly were utilized as a proxy for gambling risk. Overall, differences in measurement across studies should be considered as this has implications as to how these results should be interpreted. With these considerations being brought to light, the discussion will shift to a broader review of the research findings and their contribution to the study of addictive behaviors.

Problem Gambling and Problem Video Gaming in Association with Externalizing Problems

Based on the findings of the systematic review (Study 1; Richard et al., 2020a), although conduct problems were significantly associated with both PG and PVG in most cross-sectional studies, there was greater evidence of the predictive role of conduct problems for later PG based on longitudinal findings. Only two studies investigated the role of conduct problems as predictive of PVG, with this association being non-significant among adolescents aged 13 to 14 (Wartberg et al., 2019), and significant among emerging adults aged 17 to 18 (Krossbakken et al., 2018). When both conduct problems and depressive symptoms were measured, greater effect sizes were noted for conduct problems in association with PG, with greater effect sizes being noted for depressive symptoms in association with PVG. Overall, findings were indicative of greater evidence for an externalizing pathway towards PG, followed by a combined externalizing-internalizing pathway for both PG and PVG.

The three empirical studies included within this thesis can be conceived as an extension of research investigating the association between PG, PVG and externalizing problems. Differences in the methodology utilized in these studies are part of the original contribution to the field of behavioral addictions while being grounded in a developmental psychopathology framework (Cicchetti et al., 1996).

Prior to investigating developmental pathways towards PG and PVG, Study 2 aimed to investigate the fit of PG and PVG within the externalizing and internalizing problem hierarchical factors, which represent different manifestations of intercorrelated core psychopathological processes (Krueger, 1999; Krueger & Markon, 2006; Lahey et al., 2012). Three significant gaps were noted within this area of research: 1) a paucity of studies investigating PG within the hierarchical structure of psychopathology, 2) no studies having investigated PVG within this structure, and 3) few studies having investigated this hierarchical structure among adolescents despite evidence that over two-thirds of psychiatric disorders have an onset before the age of 18 (Caspi et al., 2020). Consistent with previous research (King et al., 2020; Oleski et al., 2011), the primary results from Study 2 indicated how PG was optimally classified under the externalizing factor (Richard et al., 2023). Although PVG was hypothesized to be optimally classified under the internalizing factor, similarly to PG, PVG was also found to have the best fit within the externalizing factor. As this study utilized cross-sectional data, this would be consistent with findings between conduct problems, PG and PVG as established within the systematic review (Richard et al., 2020a). Taken together, evidence would point towards interrelated core psychopathological processes among established externalizing problems including conduct problems, antisocial behaviors and both PG and PVG.

As for empirical evidence pertinent to developmental pathways, Study 3 and Study 4 empirically evaluated the externalizing pathway towards PVG (Richard et al., 2022a) and gambling engagement (Richard et al., 2022b), respectively. Beginning with PVG, externalizing problems at baseline (6 to 9 years of age) were predictive of PVG five years later (11 to 15 years of age). The rate of change of externalizing problems across four years was not significant in predicting PVG (Richard et al., 2022a). As for youth gambling, both externalizing problems at baseline (6 to 9 years of age) and a less significant decrease of externalizing problems over time were predictive of gambling engagement seven years later (age 13 to 17 years) (Richard et al., 2022b). These findings point towards externalizing liabilities as a developmental predictor of a pathway towards both PVG and PG, although sustained levels of externalizing problems involving behavioral undercontrol and disinhibition across late childhood and adolescence may be particularly relevant to PG (Zucker et al., 2011). Given that these pathways were initially developed as a way of understanding the development of SUDs, these findings further bolster the concept of multifinality, namely that different outcomes (e.g., SUDs, PG, PVG) can be predicted by the same psychopathological risk factors (Cicchetti & Rogosch, 1996).

Problem Gambling and Problem Video Gaming in Association with Internalizing Problems

The findings of the systematic review (Study 1; Richard et al., 2020a) indicated that among the cross-sectional studies, depressive symptoms were associated with PG and PVG in a majority of studies. Based on longitudinal findings, there was greater evidence for depressive symptoms as being predictive of PVG when compared to PG, with depressive symptoms having received greater attention compared to conduct problems in the research literature. Overall, these findings were indicative of greater evidence for an internalizing pathway towards PVG, with a combined externalizing-internalizing pathway being more prominent for PG.

As described in the previous section, the results from Study 2 (Richard et al., 2023) indicated that both PG and PVG were optimally classified under the externalizing problem factor. When both PG and PVG were loaded onto the internalizing problem factor, model fit indices worsened, and standardized beta coefficients (a measure of effect size) decreased. A similar model fit was noted only when PVG was loaded onto the internalizing factor, despite the standardized beta coefficient remaining below what it was when loaded on the externalizing factor ($\beta = .32$, $SE = .02$ vs. $\beta = .24$, $SE = .02$). Given the small effect size difference when PVG was loaded on the externalizing and internalizing problems factors, no strong conclusions can be drawn based on these findings, with evidence for overlap in interrelated core psychopathological processes between PVG and both internalizing and externalizing problem. This may be indicative of individual differences between youth endorsing symptoms of PVG, a topic that will be further elaborated on in the upcoming section on the typology of PG and PVG.

Lastly, regarding the empirical evidence specific to the internalizing pathway towards PVG (Study 3; Richard et al., 2022a) and gambling behaviors (Study 4; Richard et al., 2022b), there was substantial empirical support for the internalizing pathway towards PVG. Both internalizing problems at baseline (6 to 9 years of age) and a rate of change indicating a less significant decrease of internalizing problems across time were predictive of PVG five years later (11 to 15 years of age) (Richard et al., 2022a). As for gambling behaviors, not only was the rate of change in internalizing problems not predictive of gambling (age 13 to 17 years), but elevated internalizing problems at baseline (6 to 9 years of age) decreased the risk of gambling seven years later (Richard et al., 2022b). These findings point towards internalizing characteristics as a developmental predictor of a pathway towards PVG, with sustained levels of internalizing liabilities involving emotional dysregulation, social withdrawal, and maladaptive

coping motives across late childhood and adolescence (Hussong et al., 2011) being particularly relevant to PVG. It is possible that these specific internalizing symptoms and processes may decrease the risk for engagement in gambling, with comorbid externalizing symptoms being necessary for youth to be at an increased risk of gambling.

Biopsychosocial Risk Factors in the Development of Behavioral Addictions

With the development of addictive behaviors being a multifactorial and complex phenomenon, as established in the comprehensive literature review, the integration of an ecologically-sensitive biopsychosocial model of addiction can provide a framework to further expand the discussion of these research findings (Bronfenbrenner, 1979; Marlatt et al., 1988; Skewes & Gonzalez, 2013). A biopsychosocial framework is often implicit in current theories or conceptual models explaining the development of addictive behaviors (e.g., externalizing and internalizing pathways to SUDs [Hussong et al., 2011; Trucco et al., 2018; Zucker, 1994; Zucker et al., 2011], pathways model to PG [Blaszczynski & Nower, 2002], internalized and externalized pathways to gaming disorder [Benarous et al., 2019], integrated pathways model for gaming disorder [Lee et al., 2017]), although the emphasis on biological, psychological, and socio-cultural factors varies. Moreover, addictive behaviors have been hypothesized as having a number of distinct common components (i.e., salience, mood modification, tolerance, withdrawal, conflict, and relapse), suggesting that both substance and behavioral addictions are the result of an interaction and interplay of biopsychosocial process which involve cognitions, affect, and behavior (Griffiths, 2005). This section of the discussion will provide a detailed exploration of etiology and longitudinal risk factors relevant to the externalizing and internalizing pathways to behavioral addictions, expand on typologies of PG and PVG, explore the role of types/genres of gambling/gaming activities, and comment on the role of sociocultural

factors in the development of PG and PVG based on how they interact with an individual's mental health.

Etiology and Risk Factors for Problem Gambling and Problem Video Gaming

Hierarchical models of psychopathology point to common liabilities within externalizing and internalizing disorders that can explain the comorbidity of mental disorders (Krueger, 1999; Krueger & Markson, 2006). However, comorbidity has also been noted between externalizing and internalizing disorders which has led to some researchers hypothesizing the presence of a single dimension of general psychopathology (i.e., *p* factor) that can explain a person's general liability to mental disorders (Caspi & Moffitt, 2018; Lahey et al., 2012, 2018). As PG and PVG have been found to share overlap with both externalizing and internalizing problems, albeit to differing extents, it is possible that general psychopathological factors beyond the externalizing and internalizing liabilities are of influence in their development. These factors include trait neuroticism (i.e., diffuse unpleasant affective states), emotion dysregulation (i.e., poor impulse control over emotions), intellectual impairments (i.e., cognitive problems) and disordered thinking (i.e., disordered form and content of thought), which can each be partially explained by genetics, differences in brain function/networks, and the experience of childhood trauma (Caspi & Moffitt, 2018). It is relevant to note that each of these factors have been associated with greater rates of PG and PVG among youth and adults (Dowling et al., 2017; Johansson et al., 2009; Richard et al., 2020b; Richard & King, 2022; Yakovenko & Hodgins, 2018). With these broader liabilities in mind, the discussion will now provide detail on both externalizing and internalizing liabilities and potential mechanisms underlying their association with PG and PVG.

Externalizing liabilities including behavioral uncontrol and disinhibition, impulsivity, risk taking and antisocial behavior, appear to be associated with specific genetic, neurobiological,

and cognitive markers which are highly heritable (Kruger et al., 2021, 2022; Zucker et al., 2011). Moreover, environmental risks including abuse, neglect, hostile parenting, neighborhood violence and affiliation with deviant peers also appear to contribute to the manifestation of externalizing liabilities (Krueger et al., 2021). Based on the results from both longitudinal studies within this thesis, externalizing problems appear to be a distal risk factor for PVG (Richard et al., 2022a), whereas externalizing problems appear to be both distal and proximal risk factors for gambling behaviors (Richard et al., 2022b). This may be indicative of the externalizing pathway being a developmental cascade of risk-cumulation (Maslowsky et al., 2014; Zucker et al., 2011) involving undercontrolled behavior, impulsive sensation seeking and antisociality which may be predominant in the development of problematic patterns of engagement in gambling. This, in part, may be due to the fact that gambling, as opposed to video gaming, is a socially undesirable or restricted action which individuals with undercontrolled-disinhibited predispositions have greater difficulties inhibiting engagement in. As for PVG, the externalized pathway proposed by Benarous and colleagues (2019) does appear to have some empirical support based on Study 3 (Richard et al., 2022a). Specifically, greater externalizing problems (a developmental risk factor within the pathway) in childhood were predictive of PVG in mid-adolescence. However, given the overlap of both internalizing and externalizing problems (Richard et al., 2020b), although certain youth may present with only one domain of risk factors, it is possible that there is a combined internalizing-externalizing pathway that distinguishes between levels of gaming disorder problem severity.

Internalizing liabilities including inhibited temperament, social withdrawal and difficulties with emotion regulation and coping, similar to externalizing liabilities, appear to have both a genetic and environmental risk markers (Hussong et al., 2011; Trucco et al., 2018). The

internalizing pathway appears to be more closely associated with negative affect, both at the level of experienced emotional intensity and poor emotion regulation skills, which begins in infancy and continues to evolve throughout adolescence and early adulthood (Hussong et al., 2011). Similar to SUDs, it is possible that for gambling behaviors and PG, the internalizing pathway is not the dominant risk trajectory and may only emerge in adulthood once more severe levels of PG manifest themselves (Richard et al., 2020a). However, for PVG, with gaming behaviors and misuse being more prevalent among adolescents, it is possible that the primary factors involved within the internalizing pathway at that age (i.e., positive expectations for mood modification effect of gaming, interpersonal skill deficits leading to social withdrawal, and coping motives for gaming; Hussong et al., 2011) are resulting in more problematic patterns of engagement in gaming. This would be consistent with the proposition by Benarous and colleagues (2019) that gaming can function as a maladaptive coping strategy to avoid unpredictable interpersonal relationships, while favoring the immediate gratification of gaming to the long-term gratification of peer/familial relationships and academic or occupational achievement. Moreover, developmental risk factors including depressive symptoms and anxiety identified in the internalized pathway were empirically supported based on the results of Study 3 (Richard et al., 2022a). With depressive symptoms and loneliness being identified as antecedents and consequences of gaming disorder (Richard et al., 2020b), it is plausible that there are bi-directional risk processes between PVG and internalizing problems resulting in the earlier and more rapid onset of PVG compared to PG.

Typologies of Problem Gambling and Problem Video Gaming

The pathways model of PG (Blaszczynski & Nower, 2002) is a highly influential framework in the field of gambling studies which has had a sustained impact across the broader

field of behavioral addictions (Clark et al., 2022). After having undergone revisions, the revised pathways model of problem gambling (Nower et al., 2022) presented the same three subtypes of problem gamblers (i.e., behaviorally conditioned [BC], emotionally vulnerable [EV] and antisocial impulsivist [AI]), although greater distinction was made between EV and AI subtypes. Specifically, although the AI subtype was hypothesized as having similar psychosocial vulnerabilities (e.g., depression and anxiety) as EV problem gamblers (Blaszczynski & Nower, 2002), it was found that AI problem gamblers had fewer symptoms of depression and anxiety while having heightened levels of impulsivity, antisocial traits and gambling motivated by a search for meaning and purpose (Nower et al., 2022). Given these recent modifications, these two subtypes appear to align even more closely with the externalizing pathway (AI subtype) and internalizing pathway (EV subtype) discussed throughout this thesis.

In the two empirical studies included within this thesis that investigated gambling behaviors (Study 2 and Study 4), a variable-centered methodological approach was utilized to identify associations between variables (Richard et al., 2022b; Richard et al., 2023). A person-centered approach (Bergman & Magnusson, 1997) would have been necessary to identify subgroups of people in a manner similar to the pathways model of PG (Blaszczynski & Nower, 2002). It is relevant to note that in studies that have empirically investigated the pathways model among adolescents and emerging adults, these three subtypes of problem gamblers have been identified, in addition to combined EV/AI subtypes (Allami et al., 2017; Gupta et al., 2013) and a depressive-only subtype (Gupta et al., 2013). Despite the inconsistent findings specific to the predictive role of internalizing problems on later gambling behaviors (Richard et al., 2020a; Richard et al., 2022b), empirical studies investigating the pathways model indicate that the EV subtype tends to make up a significant proportion of problem gamblers (Allami et al., 2017;

Gupta et al., 2013; Nower et al., 2022). Once again, it is possible that there are differences in the types of problem gamblers, and that individuals with externalizing problems are simply at greater risk of developing problems with gambling when compared to individuals with internalizing problems. Moreover, in all of the studies empirically investigating the pathways model, the BC subtype, consists of the highest proportion of individuals within the sample (ranging from 34% to 58%) (Allami et al., 2017; Gupta et al., 2013; Nower et al., 2022). As a whole, although externalizing liabilities, and based on other studies, internalizing liabilities, may increase the risk for the development of PG, a substantial proportion of individuals develop problems with gambling despite reporting with little co-occurring psychopathology.

As previously mentioned, based on the pathways model for PG, Lee and colleagues (2017) developed the integrated pathways model to gaming disorder. They proposed three types of problem gamers based on the salience of biological, psychological, and social vulnerabilities: (1) socially conditioned problem gamers which can be further subdivided into covert and overt types, (2) emotionally vulnerable problem gamers, and (3) impulsive/aggressive problem gamers. These subtypes are similar to those established by Blaszczynski and Nower (2002), with slight modifications being made at the level of conditioning in the first subtype (behaviorally conditioned versus socially conditioned) and greater levels of aggression in the third subtype (as opposed to antisocial traits) (Lee et al., 2017). Despite these modifications, this typology remains consistent with the externalizing and internalizing framework argued within this thesis. Only one study has empirically investigated the pathways model subtypes among adolescent problem gamers with some consistencies with the model being identified (Marchica et al., 2022). However, additional subtypes were identified based on levels of risk, with there being milder and more severe classes of youth endorsing externalizing and/or internalizing problems. Consistent

with evidence of the internalizing pathway towards PVG, the number of youths within the EV subtypes made up a larger proportion of the sample (24%) compared to the AI subtype (15%) (Marchica et al., 2022). Similar to the aforementioned studies on PG, the BC subtype made up the largest proportion of the sample (44%). Taken together, youth endorsing symptoms of PVG appear to be quite heterogeneous. Similar to PG, although internalizing and externalizing problems may increase the risk for the development of PVG, these are neither necessary nor essential factors.

The Interaction of Gambling Activities and Video Game Genres

Following the discussion on typologies of PG and PVG based on externalizing and internalizing problems, the relationship between these symptoms and specific gambling activities and video game genres should be briefly examined. These variables were not accounted for in the context of this thesis yet appear to be important targets for future study. As a whole, all gambling and gaming activities involve reward, gratification, and conditioning processes that influence the individual's cognitions (e.g., outcome expectancies), affect (e.g., mood modification) and behaviors (e.g., repetitive or habitual engagement) which can increase the risk of developing problematic patterns of engagement in the activity (Brand et al., 2019; Brezing et al., 2010; Skewes & Gonzalez, 2013).

The only typology to discuss the fact that certain individuals may be attracted to specific activities or genres is Lee and colleagues (2017) in their integrated pathways model for gaming disorder. First, they indicated that the impulsive/aggressive subtype (consistent with the externalizing pathway) would be more likely to engage in multiplayer online battle arena (MOBA) and multiplayer shooter games as this would be aligned with their motivations to game to release aggressive impulses, for the sake of competition, as a means of sensation seeking or to

alleviate boredom. Second, the emotionally vulnerable subtype (consistent with the internalizing pathway) would be more likely to engage in video games that allow for escapism and mood modification, which would be in line with immersive role-playing games or rapidly accessible mobile games. Third, the socially conditioned subtype, depending on whether they are covert (more consistent with the internalizing pathway) or overt (more consistent with the externalizing pathway), would be drawn to either massive multiplayer online role-playing games (MMORPG) or games that involve ranking systems and team missions (e.g., first person shooter [FPS] games), respectively. Given the potential interaction between internalizing and externalizing problems and games genre, it is possible that for some individuals, their risk of developing problems related to gaming increase as some genres of games have been associated with higher rates of PVG (e.g., MMORPG, MOBA, FPS games; Bonnaire & Baptista, 2019; Lemmens & Hendriks, 2016; Na et al., 2017)

Fewer investigations have been conducted into the types of gambling activities engaged in based on psychological or psychiatric liabilities. A recent meta-analysis investigated risk factors of PG in the general adult population and identified moderate to large effect sizes based on the type of gambling activity, with continuous forms of gambling (i.e., electronic gambling machines [EGMs], internet gambling) being associated with the largest effect sizes (Allami et al., 2021). Only two studies including adult samples were identified investigating the role of internalizing and externalizing problems on gambling activity choice. First, Moragas and colleagues (2015) differentiated between active, passive, strategic and chance-based gambling activities. Their results indicated that those who gambled to avoid negative emotions were more likely to engage in passive (e.g., lottery) and chance-based (e.g., slot machines) activities, whereas those who gambled for excitement were more likely to engage in strategic (e.g., poker,

sports betting) or active (e.g., slot machines, scratch cards) gambling activities. Additionally, strategic gambling was also associated with greater depression, anxiety and hostility compared to non-strategic gambling (Moragas et al., 2015). Second, psychological distress (as represented by feelings of nervousness, worthlessness, hopelessness, and depression) was uniquely associated with higher frequency venue gambling using EGMs and card/table games compared to online gambling (Gainsbury et al., 2019). Taken together, these studies may indicate that gamblers with more externalizing problems may be more likely to gamble on strategic or active gambling activities, whereas those with internalizing problems may be more likely to gamble in venues on chance-based or passive gambling activities. Additional research is necessary to generalize these findings to younger populations who have limited access to gambling activities.

Sociocultural Factors and Individual Mental Health

Sociocultural factors have been identified as having a significant effect on the mental health of adolescents and emerging adults (Alegría et al., 2018; Kim et al., 2020; Rapee et al. 2019). Research has expanded into investigating relevant psychosocial risk factors for PG and PVG, including academic difficulties, peer and parental problems, delinquent peer affiliation, and low life satisfaction (Dowling et al., 2017; Richard et al., 2020b; Shead et al., 2010). It is noteworthy that these social risk factors do not occur in a vacuum, with potential interactions at the level of the individual and associations with internalizing and/or externalizing problems. This would be consistent with Bronfenbrenner's (1979) ecological model which discusses the interaction between individual factors (e.g., physical and mental wellbeing) and the micro/ mesosystem (e.g., family, neighborhood, school, peer groups), exosystem (e.g., parental workplace, community childcare facilities, juvenile justice system, social protections), and macrosystem (e.g., cultural practices, legislation, media).

For children, adolescents and emerging adults, primary interactions between social factors and internalizing and externalizing problems will be manifest in their familial relationships, peer relationships, academic and occupational performance, and level of engagement in extracurricular interests or hobbies. The temporal sequencing of these difficulties are complex to unravel and is outside the scope of the present discussion. Relevant to the risk of problematic engagement in video games or gambling, the role of motivation and psychological wellbeing appears to be central. For instance, motivations including escape, competition, distraction, and coping/affect regulation have been associated with a greater severity of PVG (Laconi et al., 2017; von der Heiden et al., 2019). For gambling, similar motivations have been identified including excitement, financial, escape, socializing, and coping/affect regulation, (Barrada et al., 2019; Yip et al., 2011). What these motivations may indicate is that if a child, adolescent, or emerging adult does not find that their family, peer, academic or occupational endeavors are interesting or gratifying, they may engage in these behaviors as a means to escape, distract, cope, and feel a sense of excitement and fulfillment. This may be exacerbated in youth with externalizing and internalizing problems who tend to endorse high levels of difficulty within the aforementioned domains (Harold & Sellers, 2018; Howard et al., 2010; La Greca & Lai, 2014; Lau et al., 2021; Pagerols et al., 2022).

As a final point of discussion relevant to for engagement in gaming and gambling, an emerging area of concern is the increasing convergence of gambling and gaming activities (Delfabbro & King, 2020; King et al., 2010; Kolandai-Matchett & Abbott, 2022). Specifically, findings are indicating that gambling and gaming activities are converging in multiple overlapping contexts (e.g., gaming elements in gambling activities, games including gambling features, free simulated online gambling) which is driven by technological advancements and

commercial interests. This is a critical element within the macrosystem that may be relevant to future harms related to problematic patterns of engagement in both gaming and gambling. As children may be first exposed to gambling-like activities through engagement in video games (Richard & King, 2022), in addition to the mechanisms of risk involved in the externalizing and internalizing pathways, there could be an increased risk of sequential comorbidity from PVG in adolescence to PG in emerging adulthood. This is an emerging area of concern which should be closely monitored as the first generation of children (Generation Alpha; McCrindle & Wolfinger, 2014) exposed to these gaming technologies age into adulthood.

The Role of Age and Sex

The impact of age on PG and PVG has been previously discussed in the context of the previous section highlighting biopsychosocial predispositions. In addition, there are other changes in physical, cognitive, emotional, and social development from childhood to emerging adulthood that should be highlighted. Specifically, the period of adolescence (12 to 17 years of age) is associated with significant changes in brain development, individuation processes, and novel peer relationships which can result in increases in experimentation, risk-taking and vulnerability to addiction (Casey & Jones, 2010; Dayan et al., 2010). In Study 3 and Study 4, it was noted that whereas there were no differences by age specific to disordered gaming symptomatology (Richard et al., 2022a), older individuals were more likely to report gambling over the past year (Richard et al., 2022b). These findings raise important matters at the level of the availability and accessibility of video games and gambling activities based on age. Age of onset for both video gaming and gambling have been found to be predictive of later risk of problematic engagement (Johansson et al., 2009; Nakayama et al., 2020; Rahman et al., 2012; Sanders et al., 2017). As individuals tend to start playing video games at a younger age than they

begin gambling, this may explain the greater prevalence of PVG symptoms in Study 3 (Richard et al., 2022a) when compared to PG symptoms in Study 4 (Richard et al., 2022b). Moreover, this may speak to the association between PVG and internalizing symptoms in adolescence, as internalizing problems tend to remain more stable (and sometimes increase) across adolescence (Galambos et al., 2003; Keiley et al., 2000; Reynolds et al., 2010; Riina et al., 2014) when compared to externalizing problems which tend to decrease over time (Bongers et al., 2004; Campbell et al., 2000; López-Romero et al., 2015). In previous longitudinal studies investigating PG, it has been noted that it is by emerging adulthood, once gambling activities and venues become more readily accessible, that these patterns of disordered gambling tend to emerge (Richard et al., 2020a). This is consistent with other longitudinal research findings identifying that although conduct problems and antisocial behaviors may reach disordered levels by adolescence, addictive behavior such as SUDs tend to emerge in later adolescence/emerging adulthood (Caspi et al., 2020). The fact that some youth begin engaging in gambling at an earlier age and as a result, are at an increased risk of PG, may be closely related to the externalizing pathway as these gambling behaviors may be another manifestation of the impulsivity, sensation seeking, and rule-breaking tendencies endorsed by youth with externalizing problems.

The studies included within this thesis also investigated sex differences. Although males have been found to endorse higher rates of PG and PVG (Calado et al., 2017; Fam, 2018; Paulus et al., 2018), a finding replicated in the present studies, sex differences in the respective role of internalizing and externalizing problems in association with PG and PVG were investigated. In the confirmatory factor analysis (Study 2; Richard et al., 2023), parallel process growth models and regression analyses (Study 3 and Study 4; Richard et al., 2022a, 2022b), no sex differences were identified in the association between internalizing/externalizing problems and PG/PVG.

These results indicate that there are similarities among both males and females in the levels of risk associated with predispositions to PG and PVG. The results from Study 3 and Study 4 are consistent with findings of the externalizing pathway (Zucker et al., 2011) and internalizing pathway (Hussong et al., 2011) towards SUDs where sex or gender differences are mostly absent or remain inconclusive. Moreover, the results from Study 2 are consistent with the absence of sex differences being noted in the hierarchical structure of psychopathology as represented by Lahey et al. (2018) and King and colleagues (2020) who investigated this model among emerging adults. As a whole, these results suggest that despite the fact that sex differences can be noted during adolescence at the level of puberty (Marshall, 1970), hormones and brain development (Lenroot & Giedd, 2010; Martel, 2013), personality (Kuhn, 2015), behavior (Gur & Gur, 2016), and familial/peer environment (Kuhn, 2015), the associations between externalizing/internalizing liabilities and PG/PVG remains equivocal, potentially due to an actual absence of differences between the sexes or significant heterogeneity within the sexes nullifying these differences.

Implications and Future Directions

Theoretical Importance

The theoretical importance of this thesis is two-fold. First, the systematic review (Study 1) and longitudinal studies (Study 3 and 4) contribute to the theoretical literature on the developmental pathways towards behavioral addictions. Although these pathways have been given various names, this thesis supports the notion that there are two important pathways that increase the risk of developing problematic patterns of engagement in gambling or gaming: the externalizing pathway (otherwise known as the externalized [Benarous et al., 2019], antisocial-impulsivist [Blaszczynski & Nower, 2002; Nower et al., 2022] or impulsive/aggressive [Lee et

al., 2017] pathway), and the internalizing pathway (otherwise known as the internalized [Benarous et al., 2019] or emotionally vulnerable [Blaszczynski & Nower, 2002; Lee et al., 2017; Nower et al., 2022] pathway). Despite not all individuals reporting risk for PG or PVG falling within these pathways (see behaviorally conditioned or socially conditioned subtypes [Blaszczynski & Nower, 2002; Lee et al., 2017; Nower et al., 2022]) and some youth reporting a risk for both (see comorbid externalizing-internalizing subtypes [Allami et al., 2017; Gupta et al., 2013; Marchica et al., 2022]), these two pathways are of significant theoretical importance and should be further researched while investigating the various distal and proximal, genetic and environmental risk factors.

Second, the systematic review (Study 1) and cross-sectional study (Study 2) contribute the theoretical literature investigating the fit of behavioral addictions within the hierarchical structure of psychopathology. Current theories and conceptual models investigating this phenomenon have identified a bifactor model including internalizing and externalizing dimensions (King et al., 2020; Krueger, 1999), with internalizing problems occasionally being separated into two further dimensions, anxious-misery and fear (Krueger & Markon, 2006; Oleski et al., 2011). Moreover, recent studies have investigated the proposed *p* or general factor that accounts for the general risk for psychopathology from the specific internalizing and externalizing factors (Caspi & Moffitt, 2018; Lahey et al., 2018). As behavioral addictions (i.e., PG and PVG) were generally omitted from these models, this thesis aimed to address this gap and noted that these behaviors tend to be more closely associated with the externalizing as opposed to the internalizing factor (Richard et al., 2023). However, the second best-fitting model indicated that PVG could also be closely associated with the internalizing factor. Lastly, in the exploratory analysis included within this study, these behaviors were best represented on a

separate behavioral addictions factor, accounting for all gambling and gaming-related variables (Richard et al., 2023). Given that the fit of PG and PVG within the hierarchical structure of psychopathology was poorer than other disorders (a finding consistent with research incorporating PG; King et al., 2020; Oleski et al., 2011), an important avenue for future research is to investigate whether PG and PVG are better accounted for by the proposed *p* or general factor. This an emerging area of research with support that other disorders including ADHD fit best under the proposed *p* factor when compared to the externalizing or internalizing factors (Lahey et al., 2018). As PG, PVG and ADHD are closely associated disorders (González-Bueso et al., 2018; Richard et al., 2020b; Theule et al., 2016), this may be a promising avenue for future research. Furthermore, with the inclusion of gambling disorder in the "Substance-Related and Addictive Disorders" section of the DSM-5 (APA, 2013) and consideration to include (Internet) gaming disorder in the upcoming revision of the DSM (APA, 2013), there continues to be a need for research utilizing the hierarchical structure of psychopathology framework to further elucidate similarities and differences between recognized behavioral addictions and SUDs.

Methodological Importance

The analyses conducted in the four studies included within this thesis are of significant methodological importance while presenting avenues for future research. Beginning with Study 2, although the included confirmatory factor analysis was the first to integrate both PG and PVG within the bifactor model of psychopathology (Richard et al., 2023), additional research is required to empirically investigate the associations between the general factor and PG/PVG. Moreover, as the externalizing and internalizing dimensions have been previously subdivided into facets (i.e., disinhibition and antagonism for externalizing [Krueger et al., 2021]; anxious-misery and fear for internalizing [Krueger & Markon, 2006]), additional analyses could be

conducted based on these more specific domains. These studies would need to be conducted on large sample sizes given the necessary statistical power for such analyses while also utilizing validated and reliable measures for the included disorders.

As for Study 3 and 4, these longitudinal studies were among the few to begin measuring externalizing and internalizing problems in childhood and representing the trajectories of these problems over time in predicting PVG (Richard et al., 2022a) and gambling behaviors (Richard et al., 2022b), respectively. Alternative methodological approaches to analyzing longitudinal data including cross-lagged designs represent potential avenues for future research in order to identify any reinforcing effects and possible across-symptom interactions between the externalizing and internalizing pathways and PG/PVG. Moreover, person-centered approaches that allow for the identification of subgroups of youth based on the presence or absence of internalizing and externalizing problems (e.g., latent growth class trajectory analyses) could add further nuance in understanding these developmental trajectories while potentially mapping the subgroups included within the pathways model (Blaszczynski & Nower, 2002; Lee et al., 2017; Nower et al., 2022). Finally, regarding the measurements used and age of participants, as there were a low number of participants endorsing symptoms of PG at final measurement in Study 4 (Richard et al., 2022b), continued measurements of PG into emerging adulthood could allow for an extension of the findings of this study from past year gambling behaviors to PG symptoms. Additionally, controlling for baseline or age of onset of video gaming and gambling behaviors will be an important integration in future research projects to further compliment findings related to the predictive value of childhood externalizing and internalizing problems.

Beyond the analytic methods and measurements utilized in the included studies, two additional suggestions for future research should be noted. First, given the importance of video

game genre and gambling activity on the risk for PVG or PG, respectively, future studies should include detailed questions on the types of gaming or gambling activities engaged in while accounting for the frequency of engagement in each of these different genres. As there could be potential interactions of game genre or gambling activities with the externalizing and internalizing pathways, this is an important future research direction that would foster a more nuanced understanding of these phenomena. Second, all of the studies included within this thesis utilized quantitative methodologies and survey-based research. Qualitative research in the field of behavioral addictions is slowly emerging (Manohar et al., 2021) and can yield important insights into the experiences of youth with problematic patterns of engagement in gambling or gaming while providing further empirical evidence for the internalizing and externalizing pathways. Qualitative research techniques including themed interviews, focus groups and narrative research could be beneficial to better understand research questions related to the experience, meaning and perspective of those struggling with behavioral addictions (Hammarberg et al., 2016; Neale et al., 2005).

Clinical Significance

The findings from the studies included within this thesis can be used to inform the development of targeted prevention and treatment efforts for youth who are at an increased risk of PG and PVG. Prevention is considered the first line intervention for youth, with age-appropriate prevention programs for both behavioral addictions sharing important similarities, including the importance of harm-minimization strategies, increasing awareness of symptoms indicative of problematic engagement, and information dissemination through workshops for youths, parents, and educators (Derevensky, 2020; Király et al., 2018). Moreover, prevention programs for internalizing and externalizing problems can begin even earlier than programs for

PG and PVG and can address potential deficits in emotion regulation relevant to both problem domains. For example, emotion regulation programs directed towards children and adolescents could be promoted within schools as these prevention programs are universal, can benefit all children, and provide population-level benefits (Greenberg & Abenavoli, 2017).

For treatment, cognitive-behavioral therapy has been identified as the most widely utilized and effective treatment approach for youth PG and PVG (Derevensky, 2020; King et al, 2017; Wölfling et al., 2019). These therapy protocols typically incorporate information about gambling or video gaming, and change techniques including cognitive restructuring, behavioral modification/substitution, problem-solving, goal setting, social skills training, motivational enhancement, and relapse prevention (Derevensky et al., 2022; Richard & Derevensky, 2021 Rodda et al., 2018). As cognitive-behavioral therapy is also effective in treating comorbid externalizing and internalizing problems (Derevensky et al., 2022; Hofmann et al., 2013), it is possible that common factors are being addressed within the therapeutic process that are relevant to overarching individual vulnerabilities. This would be consistent with research emphasizing the importance of addressing transdiagnostic vulnerability factors within psychological treatment protocols (Caspi & Moffitt, 2018; Cuthbert & Insel, 2013), in addition to emerging research on transdiagnostic treatment models of addiction such as the component model of addiction treatment (Kim & Hodgins, 2018).

Overarching Limitations

Herein, the overarching limitations of this thesis will be discussed, rather than those specifically pertaining to each study. First, although the concept of behavioral addictions is receiving increasing attention and empirical support, its inclusion in the ICD-11 (WHO, 2019) and potential future inclusion in the DSM is not without debate (see Aarseth et al., 2017 and

scholars' open debate in volume 6, issue 3 of the *Journal of Behavioral Addictions*). Despite this broader debate, issues in operationalizing problem/disordered gambling and gaming remain. This is particularly true when attempting to measure these problem behaviors among youth, with specific concerns at the level of the language, reading-level, and having sufficient self-awareness and understanding of symptomatology when answering interview questions or completing questionnaires. Notwithstanding these obstacles, the history of the study of pathological/ disordered gambling has shown that many central developments in the field have happened following its inclusion in the DSM-III in 1980 (Rosenthal, 2020), up to the most recent revision of the DSM-5 (APA, 2013). In the current thesis, contemporary instruments measuring both PG and PVG were utilized at the time the studies were conducted. Although measurement tools will most likely change and improve across time, this marks a necessary step in the understanding these evolving phenomena.

This leads into a second limitation, which was first identified in the systematic review, namely, the heterogeneity in the measurements and scales used across studies within this field of research. Not only are there aforementioned difficulties at the level of operationalizing PG and PVG, but there is also significant variation in the operationalizing of externalizing and internalizing problems. For instance, whereas some studies operationalized the specific internalizing or externalizing problems they were measuring (e.g., depressive symptoms, conduct problems), others utilized the broader internalizing or externalizing domain labels despite only measuring specific facets of these problems. Moreover, there is still debate regarding certain problems (e.g., inattention/hyperactivity) and their categorization within the hierarchical model of psychopathology. The labels researchers use to identify syndromes, problems and behaviors matter and is an area deserving of clarification and application on the part of researchers. Once

greater consistency is established between studies, this will allow for the implementation of metanalytic calculations that will provide further clarity on the effect sizes of these associations.

Third, despite the use of both cross-sectional and longitudinal designs utilizing extensive survey or interview questionnaires, a number of factors relevant to the internalizing and externalizing pathways were not measured. Although this comprehensive discussion allowed for some theorizing about potential relationships within an ecologically-informed biopsychosocial framework, the measurement of these variables their integration (as predictors or controls) within the statistical models would have improved the overall quality of the statistical analyses. Moreover, as longitudinal research into epigenetic correlates of externalizing and internalizing disorders are emerging (Milaniak, 2020), integrating epigenetic theory, methodology and technology to understanding psychological phenotypes could result in further insights into the mechanisms underlying these pathways and their association with PG and PVG.

Conclusion

With the contributions offered by this thesis to the study of psychopathology and behavioral addictions, the hope is to have provided a contribution to our understanding of the hierarchical structure of psychopathology and developmental pathways towards PG and PVG. Through the completion of four correspondent studies, the objectives of this thesis have been met and the findings provide novel contributions with significant theoretical, methodological, and clinical implications. Nevertheless, important challenges remain, with additional epidemiological and clinical research utilizing mixed methodologies being necessary to continue developing approaches for identifying at-risk youth and establishing effective prevention and treatment interventions.

In closing, human beings are particularly complex and despite our best efforts, it is incredibly difficult to explain and predict human behavior through measurable parameters. This is especially true in a new and emerging field such as the study of behavioral addictions. Despite this daunting task, it is necessary for research to continue and through collaborative efforts, reach a more comprehensive understanding of what addiction means while being cautious to not overpathologize normal developmental processes and daily life activities.

References

Aarseth, E., Bean, A. M., Boonen, H., Colder Carras, M., Coulson, M., Das, D., Deleuze, J., Dunkels, E., Edman, J., Ferguson, C. J., Haagsma, M. C., Helmersson Bergmark, K., Hussain, Z., Jansz, J., Kardefelt-Winther, D., Kutner, L., Markey, P., Nielsen, R. K. L., Prause, N., … Van Rooij, A. J. (2017). Scholars' open debate paper on the World Health Organization ICD-11 Gaming Disorder proposal. *Journal of Behavioral Addictions, 6*(3), 267–270. https://doi.org/10.1556/2006.5.2016.088

Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for the Achenbach system of empirically based assessment (ASEBA) school-age forms and profiles.* University of Vermont, Research Center for Children, Youth and Families, Burlington.

Alavi, S. S., Ferdosi, M., Jannatifard, F., Eslami, M., Alaghemandan, H., & Setare, M. (2012). Behavioral addiction versus substance addiction: Correspondence of psychiatric and psychological views. *International Journal of Preventive Medicine, 3*(4), 290–294.

Alegría, M., Nemoyer, A., Falgàs Bagué, I., Wang, Y., & Alvarez, K. (2018). Social determinants of mental health: Where we are and where we need to go. *Current Psychiatry Reports, 20*(11). https://doi.org/10.1007/s11920-018-0969-9

Allami, Y., Hodgins, D. C., Young, M., Brunelle, N., Currie, S., Dufour, M., Flores-Pajot, M., & Nadeau, L. (2021). A meta-analysis of problem gambling risk factors in the general adult population. *Addiction, 116*(11), 2968–2977. https://doi.org/10.1111/add.15449

Allami, Y., Vitaro, F., Brendgen, M., Carbonneau, R., Lacourse, É., & Tremblay, R. E. (2017). A longitudinal empirical investigation of the Pathways Model of problem gambling. *Journal of Gambling Studies, 33*(4), 1153-1167. doi:10.1007/s10899-017-9682-6

American Psychological Association. (2012). Definitions related to sexual orientation and gender diversity in APA documents. Retrieved from: https://www.apa.org/pi/lgbt/resources/sexuality-definitions.pdf

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5 (5th ed.)*. Washington, DC: American Psychiatric Association.

Angold, A., Costello, E. J., & Erkanli, A. (1999). Comorbidity. *Journal of Child Psychology & Psychiatry & Allied Disciplines, 40*(1), 57-87.

Barrada, J. R., Navas, J. F., Ruiz De Lara, C. M., Billieux, J., Devos, G., & Perales, J. C. (2019). Reconsidering the roots, structure, and implications of gambling motives: An integrative approach. *PLOS ONE, 14*(2), e0212695. https://doi.org/10.1371/journal.pone.0212695

Benarous, X., Morales, P., Mayer, H., Iancu, C., Edel, Y., & Cohen, D. (2019). Internet gaming disorder in adolescents with psychiatric disorder: Two case reports using a developmental framework. *Frontiers in Psychiatry, 10*(336). doi:10.3389/fpsyt.2019.00336

Bergman, L. R. & Magnusson, D. (1997). A person-centered approach in research on developmental psychopathology. *Development and Psychopathology, 9*, 291–319.

Billieux, J., Schimmenti, A., Khazaal, Y., Maurage, P., & Heeren, A. (2015). Are we overpathologizing everyday life? A tenable blueprint for behavioral addiction research, *Journal of Behavioral Addictions, 4*(3), 119-123. doi:10.1556/2006.4.2015.009

Blaszczynski, A., & Nower, L. (2002). A pathways model of problem and pathological gambling. *Addiction, 97*(5), 487-499. doi:10.1046/j.1360-0443.2002.00015.x

Bongers, I. L., Koot, H. M., Van Der Ende, J., & Verhulst, F. C. (2004). Developmental trajectories of externalizing behaviors in childhood and adolescence. *Child Development, 75*(5), 1523–1537. https://doi.org/10.1111/j.1467-8624.2004.00755.x

Bonnaire, C., & Baptista, D. (2019). Internet gaming disorder in male and female young adults: The role of alexithymia, depression, anxiety and gaming type. *Psychiatry Research, 272,* 521–530. https://doi.org/10.1016/j.psychres.2018.12.158

Brand, M., Wegmann, E., Stark, R., Müller, A., Wölfling, K., Robbins, T. W., & Potenza, M. N. (2019). The Interaction of Person-Affect-Cognition-Execution (I-PACE) model for addictive behaviors: Update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. *Neuroscience & Biobehavioral Reviews, 104,* 1-10.

Brezing, C., Derevensky, J. L., & Potenza, M. N. (2010). Non–substance-addictive behaviors in youth: Pathological gambling and problematic internet use. *Child and Adolescent Psychiatric Clinics of North America, 19*(3), 625–641. https://doi.org/10.1016/j.chc.2010.03.012

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Harvard University Press.

Calado, F., Alexandre, J., & Griffiths, M. D. (2017). Prevalence of adolescent problem gambling: A systematic review of recent research. *Journal of Gambling Studies, 33*(2), 397–424. https://doi.org/10.1007/s10899-016-9627-5

Calado, F., & Griffiths, M. D. (2016). Problem gambling worldwide: An update and systematic review of empirical research (2000–2015). *Journal of Behavioral Addictions, 5*(4), 592–613.

Campbell, S. B., Shaw, D. S., Gilliom, M. (2000). Early externalizing behavior problems: Toddlers and preschoolers at risk for later maladjustment. *Development and Psychopathology, 12*, 467–488.

Casey, B. J., & Jones, R. M. (2010). Neurobiology of the adolescent brain and behavior: Implications for substance use disorders. *Journal of the American Academy of Child and Adolescent Psychiatry, 49*(12),1189–1201. doi:10.1016/j.jaac.2010.08.017.

Caspi, A., Houts, R. M., Ambler, A., Danese, A., Elliott, M. L., Hariri, A., Harrington, H., Hogan, S., Poulton, R., Ramrakha, S., Rasmussen, L. J. H., Reuben, A., Richmond-Rakerd, L., Sugden, K., Wertz, J., Williams, B. S., & Moffitt, T. E. (2020). Longitudinal assessment of mental health disorders and comorbidities across 4 decades among participants in the Dunedin birth cohort study. *JAMA Network Open, 3*(4), e203221. https://doi.org/10.1001/jamanetworkopen.2020.3221

Caspi, A., & Moffitt, T. E. (2018). All for one and one for all: Mental disorders in one dimension. *The American Journal of Psychiatry, 175*(9), 831–844. https://doi.org/10.1176/appi.ajp.2018.17121383

Cicchetti, D. (1996). Developmental theory: Lessons from the study of risk and psychopathology: The evolving science of mental disorder. In *Psychopathology: The evolving science of mental disorder* (pp. 253-254). Cambridge University Press.

Cicchetti, D., & Rogosch, F. A. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology, 8*(4), 597-600.

Cicchetti, D., & Rogosch, F. A. (1999). Psychopathology as risk for adolescent substance use disorders: A developmental psychopathology perspective. *Journal of Clinical Child Psychology, 28*(3), 355-365.

Cicchetti, D., & Rogosch, F. A. (2002). A developmental psychopathology perspective on adolescence. *Journal of Consulting & Clinical Psychology, 70*(1), 6-20.

Clark, L., Billieux, J., & Ledgerwood, D. M. (2022). Introduction to the Special Issue "20 years of the Pathways Model: understanding disordered gambling and other behavioural addictions". *International Gambling Studies, 22*(2), 183–187. https://doi.org/10.1080/14459795.2022.2108484

Cox, B. J., Yu, N., Afifi, T. O., & Ladouceur, R. (2005). A National Survey of Gambling Problems in Canada. *The Canadian Journal of Psychiatry, 50*(4), 213–217. https://doi.org/10.1177/070674370505000404

Cummings, E. M., Davies, P. T., & Campbell, S. B. (2020). *Developmental psychopathology and family process: Theory, research, and clinical implications*. Guilford Publications.

Cuthbert, B. N., & Insel, T. R. (2013). Toward the future of psychiatric diagnosis: The seven pillars of RDoC. *BMC Medicine, 11*, 126. doi:10.1186/1741-7015-11-126

Dayan, J., Bernard, A., Olliac, B., Mailhes, A. S., & Kermarrec, S. (2010). Adolescent brain development, risk-taking and vulnerability to addiction. *Journal of Physiology, Paris, 104*(5), 279–286. https://doi.org/10.1016/j.jphysparis.2010.08.007

Dean, J., & Keshavan, M. (2017). The neurobiology of depression: An integrated view. *Asian Journal of Psychiatry, 27*, 101-111. doi:10.1016/j.ajp.2017.01.025

Delfabbro, P., & King, D. L. (2020). Gaming-gambling convergence: Evaluating evidence for the 'gateway' hypothesis. *International Gambling Studies, 20*, 380–392.

Derevensky, J. (2012). *Teen gambling: Understanding a growing epidemic.* New York: Rowman & Littlefield Publishing.

Derevensky, J. (2019). Behavioral addictions: Some developmental considerations. *Current Addiction Reports, 6*, 313-322. doi:10.1007/s40429-019-00257-z

Derevensky, J. (2020). The prevention and treatment of gambling disorders: Some art, some science. In S. Sussman (Ed.). *Cambridge Handbook of Substance and Behavioral Addictions.* New York: Cambridge University Press.

Derevensky, J. L., Hayman, V., & Gilbeau, L. (2019). Behavioral Addictions. *Pediatric Clinics of North America, 66*(6), 1163–1182. https://doi.org/10.1016/j.pcl.2019.08.008

Derevensky, J., Marchica, L., Gilbeau, L. & Richard, J. (2022). Behavioral addictions in children: A focus on gambling, gaming, internet addiction and excessive smartphone use. In Patel V.B. & Preedy, V. R. (Eds.) *Handbook of Substance Misuse and Addictions.* Springer, Cham. https://doi.org/10.1007/978-3-030-67928-6_161-1

Dheer, R., Lenartowicz, T., Peterson, M. F., & Petrescu, M. (2014). Cultural regions of Canada and United States. *International Journal of Cross Cultural Management, 14*, 343–384. doi:10.1177/1470595814543706

Dodge, K. A., Malone, P. S., Lansford, J. E., Miller, S., Pettit, G. S., & Bates, J. E. (2009). A dynamic cascade model of the development of substance-use onset. *Monographs of the Society for Research in Child Development, 74*(3), vii–119. doi:10.1111/j.1540-5834.2009.00528.x

Dosman, C. F., Andrews, D., & Goulden, K. J. (2012). Evidence-based milestone ages as a framework for developmental surveillance. *Paediatrics & Child Health, 17*(10), 561–568. doi:10.1093/pch/17.10.561

Dowd, D. A., Keough, M. T., Jakobson, L. S., Bolton, J. M., & Edgerton, J. D. (2018). A latent class analysis of young adult gamblers from the Manitoba Longitudinal Survey of Young Adults. *International Gambling Studies, 19,* 148-166. doi:10.1080/14459795.2018.1520909

Dowling, N. A., Merkouris, S. S., Greenwood, C. J., Oldenhof, E., Toumbourou, J. W., & Youssef, G. J. (2017). Early risk and protective factors for problem gambling: A systematic review and meta-analysis of longitudinal studies. *Clinical Psychology Review, 51,* 109–124. https://doi.org/10.1016/j.cpr.2016.10.008

Du Plessis, V., Beshiri, R., Bollman, R. D., & Clemenson, H. (2001). *Rural and Small-Town Canada Analysis Bulletin, Vol. 3, No. 3*. Statistics Canada: Canada. Retrieved from: https://www150.statcan.gc.ca/n1/en/pub/21-006-x/21-006-x2001003-eng.pdf?st=BhbJXQtz

Elton-Marshall, T., Leatherdale, S. T., & Turner, N. E. (2016). An examination of internet and land-based gambling among adolescents in three Canadian provinces: Results from the youth gambling survey (YGS). *BMC Public Health, 16*(1), 1-10.

Englund, M. M., & Siebenbruner, J. (2012). Developmental pathways linking externalizing symptoms, internalizing symptoms, and academic competence to adolescent substance use. *Journal of Adolescence, 35*(5), 1123-1140. doi:10.1016/j.adolescence.2012.03.004

Fam, J. Y. (2018). Prevalence of internet gaming disorder in adolescents: A meta-analysis across three decades. *Scandinavian Journal of Psychology.* doi:10.1111/sjop.12459

Feng, W., Ramo, D. E., Chan, S. R., & Bourgeois, J. A. (2017). Internet gaming disorder: Trends in prevalence 1998-2016. *Addictive Behaviors, 75*, 17–24. doi:10.1016/j.addbeh.2017.06.010

Fisher, S. (1992). Measuring pathological gambling in children: The case of fruit machines in the U.K. *Journal of Gambling Studies, 8*, 263–285.

Fonagy, P., & Luyten, P. (2018). Conduct problems in youth and the RDoC approach: A developmental, evolutionary-based view. *Clinical Psychology Review, 64*, 57-76. doi:10.1016/j.cpr.2017.08.010

Gabellini, E., Lucchini, F., & Gattoni, M. E. (2022). Prevalence of problem gambling: A meta-analysis of recent empirical research (2016-2022). *Journal of Gambling Studies,* 10.1007/s10899-022-10180-0.

Gainsbury, S. M., Angus, D. J., & Blaszczynski, A. (2019). Isolating the impact of specific gambling activities and modes on problem gambling and psychological distress in internet gamblers. *BMC Public Health, 19*(1), 1-16.

Galambos, N. L., Barker, E. T., & Almeida, D. M. (2003). Parents do matter: Trajectories of change in externalizing and internalizing problems in early adolescence. *Child Development, 74*, 578–594.

Gentile, D. (2009). Pathological video-game use among youth ages 8 to 18: A national study. *Psychological Science, 20*(5), 594-602. doi:10.1111/j.1467-9280.2009.02340.x

Gibbons, R. D., & Hedeker, D. R. (1992). Full-information item bifactor analysis. *Psychometrika, 57*(3), 423–436.

Giralt, S., Müller, K. W., Beutel, M. E., Dreier, M., Duven, E., & Wölfling, K. (2018). Prevalence, risk factors, and psychosocial adjustment of problematic gambling in adolescents: Results from two representative German samples. *Journal of Behavioral Addictions, 7*(2), 339-347. doi:10.1556/2006.7.2018.37

González-Bueso, V., Santamaría, J. J., Fernández, D., Merino, L., Montero, E., & Ribas, J. (2018). Association between internet gaming disorder or pathological video-game use and comorbid psychopathology: A comprehensive review. *International Journal of Environmental Research And Public Health, 15*(4), 668.

González-Roz, A., Fernández-Hermida, J. R., Weidberg, S., Martínez-Loredo, V., & Secades-Villa, R. (2017). Prevalence of problem gambling among adolescents: A comparison across modes of access, gambling activities, and levels of severity. *Journal of Gambling Studies, 33*(2), 371–382. doi:10.1007/s10899-016-9652-4

Grant, J. E., Potenza, M. N., Weinstein, A., & Gorelick, D. A. (2010). Introduction to behavioral addictions. *The American Journal of Drug and Alcohol Abuse, 36*(5), 233–241. doi:10.3109/00952990.2010.491884

Greenberg, M. T., & Abenavoli, R. (2017). Universal interventions: Fully exploring their impacts and potential to produce population-level impacts. *Journal of Research on Educational Effectiveness, 10*(1), 40–67. doi:10.1080/19345747.2016.1246632.

Griffiths, M. D. (2005). A 'components' model of addiction within a biopsychosocial framework. *Journal of Substance Use, 10*(4), 191-197.

Griffiths, M. D., Kuss, D. J., Lopez-Fernandez, O., & Pontes, H. M. (2017). Problematic gaming exists and is an example of disordered gaming. *Journal of Behavioral Addictions, 6*(3), 296-301. doi:10.1556/2006.6.2017.037

Gupta, R., Nower, L., Derevensky, J. L., Blaszczynski, A., Faregh, N., & Temcheff, C. (2013). Problem gambling in adolescents: An examination of the Pathways Model. *Journal of Gambling Studies, 29*(3), 575-588. doi:10.1007/s10899-012-9322-0

Gur, R. E., & Gur, R. C. (2016). Sex differences in brain and behavior in adolescence: Findings from the Philadelphia Neurodevelopmental Cohort. *Neuroscience & Biobehavioral Reviews, 70,* 159-170.

Hammarberg, K., Kirkman, M., & de Lacey, S. (2016). Qualitative research methods: When to use them and how to judge them. *Human Reproduction, 31*(3), 498-501.

Harold, G. T., & Sellers, R. (2018). Annual Research Review: Interparental conflict and youth psychopathology: An evidence review and practice focused update. *Journal of Child Psychology and Psychiatry, 59*(4), 374–402. doi:10.1111/jcpp.12893

Hawkins, J. D., Smith, B. H., & Catalano, R. F. (2002). Delinquent behavior. *Pediatrics in Review, 23*(11), 387-392. doi:10.1542/pir.23-11-387

Hilbrecht, M., Baxter, D., Abbott, M., Binde, P., Clark, L., Hodgins, D. C., Manitowabi, D., Quilty, L., Spångberg, J., Volberg, R., Walker, D., & Williams, R. (2020). The conceptual framework of harmful gambling: A revised framework for understanding gambling harm. *Journal of Behavioral Addictions, 9*, 190-205. doi:10.1556/2006.2020.00024

Hilgard, J., Engelhardt, C. R., & Bartholow, B. D. (2013). Individual differences in motives, preferences, and pathology in video games: The gaming attitudes, motives, and experiences scales (GAMES). *Frontiers in Psychology, 4*, 1–13. doi:10.3389/fpsyg.2013.00608

Hing, N., Russell, A. M., Black, A., Rockloff, M., Browne, M., Rawat, V., ... & Woo, L. (2022). Gambling prevalence and gambling problems amongst land-based-only, online-only and mixed-mode gamblers in Australia: A national study. *Computers in Human Behavior, 132*, 107269.

Hofmann, S. G., Asnaani, A., Vonk, I. J., Sawyer, A. T., & Fang, A. (2012). The efficacy of cognitive behavioral therapy: A review of meta-analyses. *Cognitive Therapy and Research, 36*(5), 427–440. doi:10.1007/s10608-012-9476-1

Howard, A. L., Galambos, N. L., & Krahn, H. J. (2010). Paths to success in young adulthood from mental health and life transitions in emerging adulthood. *International Journal of Behavioral Development, 34*(6), 538–546. doi:10.1177/0165025410365803

Hussong, A. M., Jones, D. J., Stein, G. L., Baucom, D. H., & Boeding, S. (2011). An internalizing pathway to alcohol use and disorder. *Psychology of Addictive Behaviors:*

Journal of the Society of Psychologists in Addictive Behaviors, 25(3), 390–404. doi:10.1037/a0024519

Jensen, C. X. J. (2021). Evolution of Play. In T. K. Shackelford & V. W. Weekes-Shackelford (Eds.). *Encyclopedia of evolutionary psychological science* (pp. 2586–2602). Springer Cham. doi:10.1007/978-3-319-19650-3_1062

Jessor, R. & Jessor, S. L. (1977). *Problem behavior and psychosocial development: A longitudinal study of youth.* New York: Academic Press.

Johansson, A., Grant, J. E., Kim, S. W., Odlaug, B. L., & Götestam, K. G. (2009). Risk factors for problematic gambling: A critical literature review. *Journal of Gambling Studies, 25*(1), 67–92. doi:10.1007/s10899-008-9088-6

Keiley, M. K., Bates, J. E., Dodge, K. A., & Pettit, G. S. (2000). A cross-domain growth analysis: Externalizing and internalizing behaviors during 8 years of childhood. *Journal of Abnormal Child Psychology, 28,* 161–179

Khoddam, R., Jackson, N. J., & Leventhal, A. M. (2016). Internalizing symptoms and conduct problems: Redundant, incremental, or interactive risk factors for adolescent substance use during the first year of high school? *Drug and Alcohol Dependence, 169*, 48–55. doi:10.1016/j.drugalcdep.2016.10.007

Kim, H. S. & Hodgins, D. C. (2018). Component model of addiction treatment: A pragmatic transdiagnostic treatment model of behavioral and substance addictions. *Frontiers in Psychiatry, 9*, 406. doi:10.3389/fpsyt.2018.00406

Kim, H. S., & Hodgins, D. C. (2019). A review of the evidence for considering gambling disorder (and other behavioural addictions) a disorder due to addictive behaviours in the ICD-11: A focus on case-control studies. *Current Addictive Reports, 6,* 274-295. doi:10.1007/s40429-019-00256-0.

Kim, H. S., Hodgins, D. C., Kim, B. T., & Wild, T. C. (2020). Transdiagnostic or disorder specific? Indicators of substance and behavioral addictions nominated by people with lived experience. *Journal of Clinical Medicine, 9,* 334-349. doi:10.3390/jcm9020334

Kim, H. S., Son, G., Roh, E. B., Ahn, W. Y., Kim, J., Shin, S. H., ... & Choi, K. H. (2022a). Prevalence of gaming disorder: A meta-analysis. *Addictive Behaviors, 126,* 107183.

Kim, H. S., Vieira, J. L., Parmar, P. K. Hodgins, D. C., Shead, N. W., & Keough, M. T. (2022b). Emotion dysregulation mediates the relationship between adverse childhood experiences and problematic gaming. *Addictive Behaviors, 136.* 107473.

Kim, K. M., Kim, D., & Chung, U. S. (2020). Investigation of the trend in adolescent mental health and its related social factors: A multi-year cross-sectional study for 13 years. *International Journal of Environmental Research and Public Health, 17*(15), 5405. https://doi.org/10.3390/ijerph17155405

King, D. L. (2018). *Online gaming and gambling in children and adolescents – Normalising gambling in cyber places*. Victorian Responsible Gambling Foundation. Retrieved from: https://apo.org.au/sites/default/files/resource-files/2018-09/apo-nid195546.pdf

King, D. L., Delfabbro, P. H., & Griffiths, M. (2010). The convergence of gambling and digital media: Implications for gambling in young people. *Journal of Gambling Studies, 26,* 175–187. doi:10.1007/s10899-009-9153-9.

King, D. L., Delfabbro, P. H., Wu, A. M. S., Doh, Y. Y., Kuss, D. J., Pallesen, S., . . . Sakuma, H. (2017). Treatment of Internet gaming disorder: An international systematic review and CONSORT evaluation. *Clinical Psychology Review, 54,* 123-133. doi:10.1016/j.cpr.2017.04.002

King, D. L., Gainsbury, S. M., Delfabbro, P. H., Hing, N., & Arabanel, B. (2015). Distinguishing between gaming and gambling activities in addiction research. *Journal of Behavioral Addictions, 4,* 215–220. doi:10.1556/2006.4.2015.045

King, S. M., Saunders, G. R. B., Elkins, I. J., Winters, K. C., Iacono, W. G., & McGue, M. (2020). Where do gambling problems fit in the structure of psychopathology during emerging adulthood? *International Gambling Studies, 20*(1), 1-13. doi:10.1080/14459795.2019.1643901

Király, O., Griffiths, M. D., Urbán, R., Farkas, J., Kökönyei, G., Elekes, Z., Tamás, D., & Demetrovics, Z. (2014). Problematic Internet use and problematic online gaming are not the same: Findings from a large nationally representative adolescent sample. *Cyberpsychology, Behavior, and Social Networking, 17,* 749–754. doi:10.1089/cyber.2014.0475

Kolandai-Matchett, K., & Abbott, M. W. (2022). Gaming-gambling convergence: Trends, emerging risks, and legislative responses. *International Journal of Mental Health and Addiction, 20*(4), 2024-2056.

Krossbakken, E., Pallesen, S., Mentzoni, R. A., King, D. L., Molde, H., Finseras, T. R., & Torsheim, T. (2018). A cross-lagged study of developmental trajectories of video game

engagement, addiction, and mental health. *Frontiers in Psychology, 9.* doi:10.3389/fpsyg.2018.02239

Krossbakken, E., Pallesen, S., Molde, H., Mentzoni, R. A., & Finseras, T. R. (2017). Not good enough? Further comments to the wording, meaning, and the conceptualization of Internet gaming disorder. *Journal of Behavioral Addictions, 6*(2), 114-117. doi:10.1556/2006.6.2017.013

Krueger, R. F. (1999). The structure of common mental disorders. *Archives of General Psychiatry, 56,* 921–26.

Krueger, R. F., Hobbs, K. A., Conway, C. C., Dick, D. M., Dretsch, M. N., Eaton, N. R., ... & HiTOP Utility Workgroup. (2021). Validity and utility of hierarchical taxonomy of psychopathology (HiTOP): II. Externalizing superspectrum. *World Psychiatry, 20*(2), 171-193.

Krueger, R. F., & Markon, K. E. (2006). Reinterpreting comorbidity: A model-based approach to understanding and classifying psychopathology. *Annual Review of Clinical Psychology, 2,* 111–133.

Krueger, R. F., Hicks, B. M., Patrick, C. J., Carlson, S. R., Iacono, W. G., & McGue, M. (2002). Etiologic connections among substance dependence, antisocial behavior, and personality: Modeling the externalizing spectrum. *Journal of Abnormal Psychology, 111*(3), 411-424. doi:10.1037//0021-843X.111.3.411

Kryszajtys, D. T., Hahmann, T. E., Schuler, A., Hamilton-Wright, S., Ziegler, C. P., & Matheson, F. I. (2018). Problem gambling and delinquent behaviours among

adolescents: A scoping review. *Journal of Gambling Studies, 34*(3), 893-914. doi:10.1007/s10899-018-9754-2

Kuhn, C. (2015). Emergence of sex differences in the development of substance use and abuse during adolescence. *Pharmacology & Therapeutics, 153*, 55-78.

Kuss, D. J., & Griffiths, M. D. (2012a). Internet gaming addiction: A systematic review of empirical research. *International Journal of Mental Health and Addiction, 10*(2), 278-296. doi:http://dx.doi.org/10.1007/s11469-011-9318-5

Kuss, D. J., & Griffiths, M.D. (2012b). Online gaming addiction in children and adolescents: A review of empirical research. *Journal of Behavioral Addictions, 1*(1), 3-22.

Kuss, D. J., Griffiths, M. D., & Binder, J. (2013). Internet addiction in students: Prevalence and risk factors. *Computers in Human Behavior, 29*(3):959–66.

Laconi, S., Pirès, S., & Chabrol, H. (2017). Internet gaming disorder, motives, game genres and psychopathology. *Computers in Human Behavior, 75*, 652-659.

La Greca, A. M., & Lai, B. S. (2014). The role of peer relationships in youth psychopathology. In J. Ehrenreich-May & B. C. Chu (Eds.), *Transdiagnostic treatments for children and adolescents: Principles and practice* (pp. 111–137). New York: Guilford Press.

Lahey, B. B., Applegate, B., Hakes, J. K., Zald, D. H., Hariri, A. R., & Rathouz, P. J. (2012). Is there a general factor of prevalent psychopathology during adulthood? *Journal of Abnormal Psychology, 121*(4), 971–977. doi:10.1037/a0028355

Lahey, B. B., Zald, D. H., Perkins, S. F., Villalta-Gil, V., Werts, K. B., Van Hulle, C. A., ... & Waldman, I. D. (2018). Measuring the hierarchical general factor model of

psychopathology in young adults. *International Journal of Methods in Psychiatric Research, 27*(1), e1593.

Lau, M. A., Temcheff, C. E., Poirier, M., Bégin, V., Commisso, M., & Déry, M. (2021). School dropout: The role of childhood conduct problems and depressive symptoms. *Psychology in the Schools, 58*(12), 2313–2327. doi:10.1002/pits.22594

Lee, S. Y., Lee, H. K., & Choo, H. (2017). Typology of Internet gaming disorder and its clinical implications. *Psychiatry and Clinical Neurosciences, 71*(7), 479-491.

Lemmens, J. S., & Hendriks, S. J. (2016). Addictive online games: Examining the relationship between game genres and Internet gaming disorder. *Cyberpsychology, Behavior, and Social Networking, 19*(4), 270-276.

Lemmens, J. S., Valkenburg, P. M., & Gentile, D. A. (2015) The internet gaming disorder scale. *Psychological Assessment 27,* 567–582.

Lenroot, R. K., & Giedd, J. N. (2010). Sex differences in the adolescent brain. *Brain and Cognition, 72*(1), 46-55.

Livazović, G., & Bojčić, K. (2019). Problem gambling in adolescents: What are the psychological, social and financial consequences? *BMC Psychiatry, 19*(1), 1-15.

Liu, L., Yao, Y. W., Li, C. S. R., Zhang, J. T., Xia, C. C., Lan, J., Ma, S. S., Zhou, N., & Fang, X. Y. (2018). The comorbidity between internet gaming disorder and depression: Interrelationship and neural mechanisms. *Frontiers in Psychiatry, 9.* doi:10.3389/fpsyt.2018.00154

Loeber, R., Farrington, D., Stouthamer-Loeber, M., & van Kammen, W. (1998). Multiple risk factors for multi-problem boys: Co-occurrence of delinquency, substance use, attention deficit, conduct problems, physical aggression, covert behavior, depressed mood, and shy/withdrawn behavior. In: R. Jessor (Ed.), *New perspectives on adolescent risk behavior* (pp. 90-149). New York, NY, US: Cambridge University Press.

López-Romero, L., Romero, E., & Andershed, H. (2015). Conduct problems in childhood and adolescence: Developmental trajectories, predictors and outcomes in a six-year follow up. *Child Psychiatry & Human Development, 46*(5), 762–773. doi:10.1007/s10578-014-0518-7

Mader, J., Christensen, D. R., & Williams, R. J. (2019). An evaluation of the pathways model using the Quinte Longitudinal dataset. *International Gambling Studies, 19*(3), 417-431. doi:10.1080/14459795.2019.1602158

Maj, M. (2005). "Psychiatric comorbidity": An artefact of current diagnostic systems? *British Journal of Psychiatry, 186*, 182-184. doi:10.1192/bjp.186.3.182

Manohar, H., Thomas, T. L., Asokan, K., Mukherjee, N., & Sharma, E. (2021). Behavioral addiction among children and adolescents–A review of qualitative studies. *Indian Journal of Social Psychiatry, 37*(3), 248.

Marchica, L. A., Richard, J., Nower, L., Ivoska, W., & Derevensky, J. L. (2022). Problem video gaming in adolescents: An examination of the Pathways Model. *International Gambling Studies 22*(2), 1-18. doi:10.1080/14459795.2022.2055110

Marlatt, G. A., Baer, J. S., Donovan, D. M., & Kivlahan, D. R. (1988). Addictive behaviors: Etiology and treatment. *Annual Review of Psychology, 39,* 223–252.

Marshall, W. A. (1970). Sex differences at puberty. *Journal of Biosocial Science, 2*(S2), 31-41.

Martel, M. M. (2013). Sexual selection and sex differences in the prevalence of childhood externalizing and adolescent internalizing disorders. *Psychological Bulletin, 139*(6), 1221–1259. doi:10.1037/a0032247

Maslowsky, J., Schulenberg, J. E., & Zucker, R. A. (2014). Influence of conduct problems and depressive symptomatology on adolescent substance use: Developmentally proximal versus distal effects. *Developmental Psychology, 50*(4), 1179–1189. doi:10.1037/a0035085

Masten, A. S., Faden, V. B., Zucker, R. A., & Spear, L. P. (2009). A developmental perspective on underage alcohol use. *Alcohol Research & Health: The Journal of the National Institute on Alcohol Abuse and Alcoholism, 32*(1), 3–15.

McBride, J., & Derevensky, J. (2016). Gambling and video game playing among youth. *Journal of Gambling Issues, 34,* 156-178. doi:10.4309/jgi.2016.34.9

McCrindle, M., & Wolfinger, E. (2014). *The ABC of XYZ: Understanding the Global Generations.* Sydney: UNSW Press.

Milaniak, I. (2020). *Longitudinal Analyses of Epigenetic Correlates of Externalizing and Internalizing Disorders* (Order No. 28026160). Available from ProQuest Dissertations & Theses Global. (2445926910).

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Medicine, 6*(7), e1000097. doi:10.1371/journal.pmed.1000097

Moon, M., Lister, J. J., Milosevic, A., & Ledgerwood, D. M. (2017). Subtyping non-treatment-seeking problem gamblers using the pathways model. *Journal of Gambling Studies, 33*, 841–853. https://doi.org/10.1007/s10899-016-9658-y

Moragas, L., Granero, R., Stinchfield, R., Fernández-Aranda, F., Fröberg, F., Aymamí, N., ... & Jiménez-Murcia, S. (2015). Comparative analysis of distinct phenotypes in gambling disorder based on gambling preferences. *BMC Psychiatry, 15*(1), 1-11.

Mueser, K. T., Drake, R. E., & Wallach, M. A. (1998). Dual diagnosis: A review of etiological theories. *Addictive Behaviors, 23*(6), 717-734.

Müller, K. W., Janikian, M., Dreier, M., Wölfling, K., Beutel, M. E., Tzavara, C., Richardson, C., & Tsitsika, A. (2015). Regular gaming behavior and internet gaming disorder in European adolescents: Results from a cross-national representative survey of prevalence, predictors, and psychopathological correlates. *European Child and Adolescent Psychiatry, 24*(5), 565-574. doi:10.1007/s00787-014-0611-2

Myrseth, H., & Notelaers, G. (2018). A latent class approach for classifying the problem and disordered gamers in a group of adolescence. *Frontiers in Psychology, 9*(2273). doi:10.3389/fpsyg.2018.02273

Na, E., Choi, I., Lee, T.-H., Lee, H., Rho, M. J., Cho, H., Jung, D. J., & Kim, D.-J. (2017). The influence of game genre on Internet gaming disorder. *Journal of Behavioral Addictions, 6*(2), 248–255. doi:10.1556/2006.6.2017.033

Nakayama, H., Matsuzaki, T., Mihara, S., Kitayuguchi, T., & Higuchi, S. (2020). Relationship between problematic gaming and age at the onset of habitual gaming. *Pediatrics International, 62*(11), 1275-1281.

Neale, J., Allen, D., & Coombes, L. (2005). Qualitative research methods within the addictions. *Addiction, 100*(11), 1584-1593.

Neal, P., Delfabbro, P. H., & O'Neil, M. (2005). *Problem gambling: Towards a national definition.* Melbourne: Gambling Research Australia.

Nower, L., Blaszczynski, A., & Anthony, W. L. (2022). Clarifying gambling subtypes: The revised pathways model of problem gambling. *Addiction, 117*(7), 2000–2008. doi:10.1111/add.15745

Nower, L., Martins, S. S., Lin, K.-H., & Blanco, C. (2013). Subtypes of disordered gamblers: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Addiction, 108*(4), 789-798. doi:10.1111/add.12012

Ogles, B. M., Melendez G., Davis D. C., Lunnen, K. M. (2001) The Ohio Scales: Practical outcome assessment. *Journal of Child and Family Studies, 10,* 199-212.

Oleski, J., Cox, B. J., Clara, I., & Hills, A. (2011). Pathological gambling and the structure of common mental disorders. *Journal of Nervous and Mental Disease, 199*(12), 956–960.

Oshri, A., Rogosch, F. A., Burnette, M. L., & Cicchetti, D. (2011). Developmental pathways to adolescent cannabis abuse and dependence: child maltreatment, emerging personality, and internalizing versus externalizing psychopathology. *Psychology of Addictive Behaviors, 25*(4), 634-644. doi:10.1037/a0023151

Pagerols, M., Prat, R., Rivas, C., Español-Martín, G., Puigbó, J., Pagespetit, È., Haro, J. M., Ramos-Quiroga, J. A., Casas, M., & Bosch, R. (2022). The impact of psychopathology on academic performance in school-age children and adolescents. *Scientific Reports, 12*(1). https://doi.org/10.1038/s41598-022-08242-9

Paulus, F. W., Ohmann, S., von Gontard, A., & Popow, C. (2018). Internet gaming disorder in children and adolescents: A systematic review. *Developmental Medicine & Child Neurology,* 60(7), 645-659. doi:10.1111/dmcn.13754

Petry, N. M., Zajac, K., & Ginley, M. K. (2018). Behavioral addictions as mental disorders: To be or not to be? *Annual Review of Clinical Psychology, 14*, 399–423. https://doi.org/10.1146/annurev-clinpsy-032816-045120

Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 Internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior, 45*, 137-143. doi:10.1016/j.chb.2014.12.006

Potenza, M. N. (2014). Non-substance addictive behaviors in the context of DSM-5. *Addictive Behaviors, 39*(1), 1–2. doi:10.1016/j.addbeh.2013.09.004.

Potenza, M. N. (2017). Clinical neuropsychiatric considerations regarding nonsubstance or behavioral addictions. *Dialogues in Clinical Neuroscience, 19*(3), 281–291. doi:0.31887/dcns.2017.19.3/mpotenza

Rahman, A. S., Pilver, C. E., Desai, R. A., Steinberg, M. A., Rugle, L., Krishnan-Sarin, S., & Potenza, M. N. (2012). The relationship between age of gambling onset and adolescent problematic gambling severity. *Journal of Psychiatric Research, 46*(5), 675-683.

Rapee, R. M., Oar, E. L., Johnco, C. J., Forbes, M. K., Fardouly, J., Magson, N. R., & Richardson, C. E. (2019). Adolescent development and risk for the onset of social-emotional disorders: A review and conceptual model. *Behaviour Research and Therapy, 123*, 103501.

Reith, G., & Dobbie, F. (2013). Gambling careers: A longitudinal, qualitative study of gambling behaviour. *Addiction Research & Theory, 21*(5), 376-390. doi:10.3109/16066359.2012.731116

Reynolds, M. R., Sander, J. B., & Irvin, M. J. (2010). Latent curve modeling of internalizing behaviors and interpersonal skills through elementary school. *School Psychology Quarterly, 25*, 189–201.

Richard, J. & Derevensky, J. (2017). Identifying the relationship between mental health symptoms, problem behaviors and gambling among adolescents. *Annals of Behavioural Science, 3*(2), 1-9. doi:10.21767/2471-7975.100030

Richard, J. & Derevensky, J. (2021). Counselling interventions for youth problem gambling. In M. Zangeneh, J. Landon, & S. Rodda (Eds.) *Counselling Approaches for Gambling Disorder: An Empirical Review*. Concurrent Disorders Society Press.

Richard, J., Fletcher, E., Boutin, S., Derevensky, J., & Temcheff, C. (2020a). Conduct problems and depressive symptoms in association with problem gambling and gaming: A systematic review. *Journal of Behavioral Addictions, 9*(3), 497-533. doi:10.1556/2006.2020.00045

Richard, J., & King, S. (2022). Annual Research Review: Emergence of problem gambling from childhood to emerging adulthood: A systematic review. *Journal of Child Psychology and Psychiatry, 1-44*. doi:10.1111/jcpp.13713

Richard, J., Temcheff, C. E., & Derevensky, J. L. (2020b). Gaming disorder across the lifespan: A scoping review of longitudinal studies. *Current Addiction Reports, 7*(4), 561-587. doi:10.1007/s40429-020-00339-3

Richard, J., Temcheff, C., Fletcher, E., Lemieux, A., Derevensky, J., & Dery, M. (2022a). An empirical investigation of the externalizing and internalizing pathways to disordered gaming behavior: A longitudinal study across childhood and adolescence. *Computers in Human Behavior, 128*, 107096. doi:10.1016/j.chb.2021.107096

Richard, J., Temcheff, C., Fletcher, E., Lemieux, A., Derevensky, J., & Dery, M. (2022b). Externalizing and internalizing trajectories to adolescent gambling: A longitudinal study. *International Gambling Studies,* 1-19. doi:10.1080/14459795.2022.2154378

Richard, J., Temcheff, C., Ivoska, W., & Derevensky, J. (2023). Adolescent problem gambling and gaming in the hierarchical structure of psychopathology. *International Journal of Mental Health and Addiction.* doi:10.1007/s11469-023-01032-y

Riina, E. M., Martin, A., & Brooks-Gunn, J. (2014). Parent-to-child physical aggression, neighborhood cohesion, and development of children's internalizing and externalizing. *Journal of Applied Developmental Psychology, 35,* 468–477.

Rodda, S., Merkouris, S., Abraham, C., Hodgins, D. C., Cowlishaw, S., & Dowling, N. (2018). Therapist-delivered and self-help interventions for gambling problems: A review of contents. *Journal of Behavioural Addictions, 7*(2), 211-226. doi:10.1556/2006.7.2018.44

Ropovik, I., Martončik, M., Babinčák, P., Baník, G., Vargová, L., & Adamkovič, M. (2022). Risk and protective factors for (internet) gaming disorder: A meta-analysis of pre-COVID studies. *Addictive Behaviors,* 107590. doi:10.1016/j.addbeh.2022.107590

Rosenthal, R. J. (2020). Inclusion of pathological gambling in DSM-III, its classification as a disorder of impulse control, and the role of Robert Custer. *International Gambling Studies, 20*(1), 151–170. doi:10.1080/14459795.2019.1638432

Rumpf, H.-J., Brandt, D., Demetrovics, Z., Billieux, J., Carragher, N., Brand, M., Bowden-Jones, H., Rahimi-Movaghar, A., Assanangkornchai, S., Glavak-Tkalic, R., Borges, G., Lee, H.-K., Rehbein, F., Fineberg, N. A., Mann, K., Potenza, M. N., Stein, D. J., Higuchi, S., King, D., … Poznyak, V. (2019). Epidemiological challenges in the study of behavioral addictions: a call for high standard methodologies. *Current Addiction Reports, 6*(3), 331–337. doi:10.1007/s40429-019-00262-2

Sagoe, D., Pallesen, S., Hanss, D., Leino, T., Molde, H., Mentzoni, R. A., & Torsheim, T. (2017). The relationships between mental health symptoms and gambling behavior in the transition from adolescence to emerging adulthood. *Frontiers in Psychology, 8(478).* doi:10.3389/fpsyg.2017.00478

Sanders, J. L., & Williams, R. J. (2019). The relationship between video gaming, gambling, and problematic levels of video gaming and gambling. *Journal of Gambling Studies, 35*(2), 559-569. doi:10.1007/s10899-018-9798-3

Sanders, J. L., Williams, R. J., & Damgaard, M. (2017). Video game play and Internet Gaming Disorder among Canadian adults: A national survey. *Canadian Journal of Addiction, 8*(2), 6-12.

Schulter, M., Kim, H. S., Poole, J. C., Hodgins, D. C., McGrath, D., Dobson, K., & Tavares, H. (2019). Gambling-related cognitive distortions mediate the relationship between depression and disordered gambling severity. *Addictive Behaviors, 90*, 318-323. doi:10.1016/j.addbeh.2018.11.038.

Shaffer, H. J., & Korn, D. A. (2002). Gambling and related mental disorders: A public health analysis. *Annual Review of Public Health, 23*, 171-212. doi:10.1146/annurev.publhealth.23.100901.140532

Shead, N. W., Derevensky, J. L., & Gupta, R. (2010). Risk and protective factors associated with youth problem gambling. *International Journal of Adolescent Medicine and Health, 22*(1), 39.

Slack, J. D., Delfabbro, P., & King, D. L. (2022). Toward a delineation of the differences between high engagement and problem gaming. *Addictive Behaviors Reports, 16*, 100462.

Skewes, M. C., & Gonzalez, V. M. (2013). The biopsychosocial model of addiction. In P. M. Miller (Ed.). *Principles of addiction: Comprehensive addictive behaviors and disorders, Volume 1* (pp. 61-70). Amsterdam: Elsevier.

Steinberg, L., & Morris, A. S. (2001). Adolescent development. *Annual Review of Psychology, 52*(1), 83-110. doi:10.1146/annurev.psych.52.1.83

Stevens, M. W., Dorstyn, D., Delfabbro, P. H., & King, D. L. (2021). Global prevalence of gaming disorder: A systematic review and meta-analysis. *Australian & New Zealand Journal of Psychiatry, 55*(6), 553–568. https://doi.org/10.1177/0004867420962851

Strittmatter, E., Kaess, M., Parzer, P., Fischer, G., Carli, V., Hoven, C. W., Wasserman, C., Sarchiapone, M., Durkee, T., Apter, A., Bobes, J., Brunner, R., Cosman, D., Sisask, M., Varnik, P. & Wasserman, D. (2015). Pathological Internet use among adolescents: Comparing garners and non-garners. *Psychiatry Research, 228*(1), 128-135. doi:10.1016/j.psychres.2015.04.029

Sugaya, N., Shirasaka, T., Takahashi, K., & Kanda, H. (2019). Bio-psychosocial factors of children and adolescents with internet gaming disorder: A systematic review. *BioPsychoSocial Medicine, 13*(1), 3. doi:10.1186/s13030-019-0144-5

Tang, K. T. Y., Hodgins, D. C., & Schluter, M. G. (2022). Attachment, emotion dysregulation, and video game play: Testing the mediating role of emotion dysregulation in gaming disorder. *International Journal of Mental Health and Addiction.* doi:10.1007/s11469-022-00913-y

Temcheff, C. E., Déry, M., St-Pierre, R. A., Laventure, M., & Lemelin, J. P. (2016). Precocious initiation into smoking, alcohol use, and gambling among children with conduct problems. *The Canadian Journal of Psychiatry, 61*(1), 50-58.

Theule, J., Hurl, K. E., Cheung, K., Ward, M., & Henrikson, B. (2019). Exploring the relationships between problem gambling and ADHD: A meta-analysis. *Journal of Attention Disorders, 23*(12), 1427-1437.

Toce-Gerstein, M., Gerstein, D. R., & Volberg, R. A. (2009). The NODS–CLiP: A rapid screen for adult pathological and problem gambling. *Journal of Gambling Studies, 25*(4), 541.

Trucco, E. M., Villafuerte, S., Hussong, A., Burmeister, M., & Zucker, R. A. (2018). Biological underpinnings of an internalizing pathway to alcohol, cigarette, and marijuana use. *Journal of Abnormal Psychology*, *127*(1), 79-91. doi:10.1037/abn0000310

Tyrer, P. (2014). A comparison of DSM and ICD classifications of mental disorder. *Advances in Psychiatric Treatment, 20*(4), 280–285. doi:10.1192/apt.bp.113.011296

Valleur, M., Codina, I., Vénisse, J.-L., Romo, L., Magalon, D., Fatséas, M., . . . Groupe, J. E. U. (2016). Towards a validation of the three pathways model of pathological gambling. *Journal of Gambling Studies, 32*(2), 757-771. doi:10.1007/s10899-015-9545-y

Von der Heiden, J. M., Braun, B., Müller, K. W., & Egloff, B. (2019). The association between video gaming and psychological functioning. *Frontiers in Psychology, 10,* 1731.

Wartberg, L., Kriston, L., Zieglmeier, M., Lincoln, T., & Kammerl, R. (2019). A longitudinal study on psychosocial causes and consequences of Internet gaming disorder in adolescence. *Psychological Medicine, 49*(2), 287-294. doi:10.1017/S003329171800082X

Wiesner, M., Kim, H. K., & Capaldi, D. M. (2005). Developmental trajectories of offending: Validation and prediction to young adult alcohol use, drug use, and depressive symptoms. *Development and Psychopathology, 17,* 251–270. doi:10.1017/s0954579405050133

Williams, R. J., Leonard, C. A., Belanger, Y. D., Christensen, D. R., El-Guebaly, N., Hodgins, D. C., ... & Stevens, R. M. (2021). Gambling and problem gambling in Canada in 2018: Prevalence and changes since 2002. *The Canadian Journal of Psychiatry, 66*(5), 485-494.

Williams, R. J., Leonard, C. A., Belanger, Y. D., Christensen, D. R., el-Guebaly, N., Hodgins, D. C., McGrath, D. S., Nicoll, F., Smith, G. J., & Stevens, R. M. G. (2021). Predictors of gambling and problem gambling in Canada. *Canadian Journal of Public Health, 112,* 521-529. doi:10.17269/s41997-020-00443-x

Williams, R. J., Shaw, C. A., Belanger, Y. D., Christensen, D. R., el-Guebaly, N., Hodgins, D. C., McGrath, D. S., & Stevens, R. M. G. (2022). Etiology of problem gambling in Canada. *Psychology of Addictive Behaviors*. Advance online publication. doi:10.1037/adb0000843

Williams, R. J., West, B. L., & Simpson, R. I. (2012). *Prevention of problem gambling: A comprehensive review of the evidence and identified best practices.* Report prepared for the Ontario Problem Gambling Research Centre and the Ontario Ministry of Health and Long Term Care.

Wölfling, K., Müller, K. W., Dreier, M., Ruckes, C., Deuster, O., Batra, A., . . . Beutel, M. E. (2019). Efficacy of short-term treatment of internet and computer game addiction: A randomized clinical trial. *JAMA Psychiatry, 76*(10), 1018-1025. doi:10.1001/jamapsychiatry.2019.1676

World Health Organization. (2019). *International statistical classification of diseases and related health problems (11th Revision).* Retrieved from: https://icd.who.int/browse11/l-m/en

Yakovenko, I., & Hodgins, D. C. (2018). A scoping review of co-morbidity in individuals with disordered gambling. *International Gambling Studies, 18*(1), 143–172. doi:10.1080/14459795.2017.1364400

Yip, S. W., Desai, R. A., Steinberg, M. A., Rugle, L., Cavallo, D. A., Krishnan-Sarin, S., & Potenza, M. N. (2011). Health/functioning characteristics, gambling behaviors, and gambling-related motivations in adolescents stratified by gambling problem severity: Findings from a high school survey. *The American Journal on Addictions, 20*(6), 495–508. doi:10.1111/j.1521-0391.2011.00180.x

Yu, H., & Cho, J. (2016). Prevalence of internet gaming disorder among Korean adolescents and associations with non-psychotic psychological symptoms, and physical aggression. *American Journal of Health Behavior, 40*(6), 705-716. doi:10.5993/AJHB.40.6.3

Ziller, E. C., Anderson, N. J., & Coburn, A. F. (2010). Access to rural mental health services: Service use and out-of-pocket costs. *The Journal of Rural Health, 26,* 214–224. doi:10.1111/j.1748-0361.2010.00291.x

Zucker, R. A. (1994). Pathways to alcohol problems and alcoholism: A developmental account of the evidence for multiple alcoholism and for contextual contributions to risk. In: R. A. Zucker, G. Boyd, & J. Howard (Eds.), *The development of alcohol problems: Exploring the biopsychosocial matrix of risk* (pp. 255-289). National Institute on Alcohol Abuse and Alcoholism Research Monograph No. 26. National Institute on Alcohol Abuse and Alcoholism, Rockville, MD.

Zucker, R. A., Heitzeg, M. M., & Nigg, J. T. (2011). Parsing the undercontrol/disinhibition pathway to substance use disorders: A multilevel developmental problem. *Child Development Perspectives, 5*(4), 248–255. doi:10.1111/j.1750-8606.2011.00172.x

Appendix A

Appendix A

Summary of research articles investigating the association between conduct problems and behavioral addictions

Authors	Country	Design and sampling method	Sample population	Sample characteristics	PG and PVG measure	CP measure	Findings
				Problem Gambling			
Barnes, Welte, Hoffman, & Tidwell (2011)	United States	Cross-sectional survey Randomly selected telephone sample from a sampling frame of all working telephone blocks in the United States	Representative household sample of adolescents and young adults	*N* = 2274 Gender NR M_{age} = NR, range 14-21	SOGS-RA	DISC-C	PG was correlated with CP (r = .31, p < .001). Youth who endorsed 3 or more symptoms of conduct disorder (CD) were 4 times more likely to report PG compared to those not meeting the criteria for CD (31% vs. 8%). Logistic regression results controlling for gender, age, socioeconomic status, and race/ethnicity indicated that CD increased the odds of being a problem gambler by 4.4 times (p < .001). When alcohol, tobacco and marijuana problems were added to the model, CD remained significant, increasing the odds of being a problem gambler by 2.9 times (p < .001).
Brunelle et al. (2012a)	Canada (Quebec)	Cross-sectional survey Convenience sampling	High-school students	*N* = 1870 54.1% female M_{age} = 15.43 (*SD* = 0.97, range 14-18)	DSM-IV-MR-J (French version)	MASPAQ	Male and female problem gamblers had higher average scores in all domains of CP including severe delinquency, fraud and theft, and vandalism and interpersonal violence compared to non-gamblers and non-problem gamblers (all significant at p < .001).

Brunelle et al. (2012b)	Canada (Quebec)	Cross-sectional survey Convenience sampling	High-school students	*N* = 1870 54.1% female M_{age} = 15.43 (*SD* = 0.97, range 14-18)	DSM-IV-MR-J (French version)	MASPAQ	In both Internet and non-Internet gamblers, CP is associated with a greater severity of PG (β = .29, *p* < .05; β = .15, *p* < .001, respectively).
Cheung (2014)	China	Cross-sectional survey Stratified random sampling	High-school students	*N* = 4734 50.7% male M_{age} = 16.39 (*SD* = 1.73, range 12-23)	DSM-IV-MR-J	Delinquency scale	Correlations between delinquency and gambling variables (problems, frequency, permissiveness) ranged from *r* = .22 to *r* = .28 (*p* < .001). Logistic regression predicting PG indicated that delinquency predicted PG (AOR = 1.20 95% CI [1.17, 1.23]) while controlling for age, gender, SES, familial status. Delinquency remained significant in the model that also included tobacco and alcohol use (AOR = 1.11 95% CI [1.08, 1.15]).
Cook et al. (2015)	Canada (Ontario)	Cross-sectional survey Stratified (region and school type), two-stage (school, class) cluster sampling	High-school students	*N* = 4851 53% female M_{age} = 14.6 (*SD* = NR, range NR)	SOGS-RA	Delinquency scale (violent and non-violent acts)	Correlation between PG and delinquency was significant (*r* = .24, *p* < .001). Violent and non-violent delinquent behaviors were more common in PG than non-PG, with ORs ranging from 3.4 to 19.6 depending on the delinquent act. Overall delinquency scores indicated 11.35 times (*p* < .001) higher likelihood of PG. A multivariate logistic regression indicated that higher overall delinquency resulted in youth being 5.9 times (*p* < .001) more likely to

							meet the criteria for PG compared to less delinquent youth when controlling for hazardous drinking, cannabis dependency, suicide attempt and psychological distress.
Hayatbakhsh, Clavarino, Williams, Bor & Najman (2013)	Australia	Cross-sectional study Convenience sampling	Young adults	*N* = 3512 47% male M_{age} = 20.6 (*SD* = 0.8), range 18-23)	PGSI	CBCL Young Adult Self-Report	Individuals in the top 10% of externalizing problems had a greater likelihood of being categorized as at-risk for problem gambling compared to non-gamblers (OR = 5.4, 95% CI [3.1, 9.4]).
Martins et al., 2013	United States	14-year longitudinal study Convenience sampling	Urban males from predominantly low SES neighbourhoods	*N* = 310 100% male M_{age} = NR (range 6-20)	Age 17, 19, & 20: SOGS-RA	Grade 1-3: Childhood aggressive behaviors (Teacher Observation of Classroom Adaptation-Revised) Grade 6-10: Adolescent aggressive behaviors (Teacher Report of Classroom Behavior-Checklist Form)	General growth mixture modeling based on the longitudinal development of CP indicate that those who had chronically high CP throughout childhood were 2.6 times more likely (95% CI [1.06, 6.38]) to meet the criteria for at-risk or PG. Those with the chronically high CP throughout adolescence were 3.19 times more likely (95% CI [1.18, 8.64]) to meet the criteria for at-risk or PG.
Martins et al. (2014)	United States	17-year longitudinal study Convenience sampling	Urban youth from predominantly low SES neighborhood	*N* = 617 53% male M_{age} = NR (range 6-23)	Age 17, 19, & 20: SOGS-RA	Age 13-17: DISC-C Age 17-23: Arrest history	A greater proportion of PG (65%) were arrested before the age of 23 compared to social (38%) and non-gamblers (24%). PG was significantly associated with the hazard of first arrest by age 23 in both

							the unadjusted (HR = 3.6, p < .001) and adjusted (covarying for gambling status, race, household structure, lunch status, intervention status, theft/property damage, illegal drug use; AHR = 1.6, p = .05) models
Pace, Schimmenti, Zappulla, & Maggio (2013)	Italy	Cross-sectional study Convenience sampling	High-school students	N = 268 100% male M_{age} = 16.23 (SD = 0.39, range 15-17)	SOGS	CBCL Youth Self-Report	The group of at-risk and pathological gamblers compared to non-gamblers did not endorse higher levels of CP (p > .05). They identified in the discriminant function analysis, higher CP was one of the variables that best differentiated at-risk gamblers from pathological gamblers (pathological gamblers having slightly more) but did not differentiate between non-gamblers and at-risk gamblers.
Terrone et al. (2018)	Italy	Cross-sectional study Convenience sampling	High-school students	N = 94 65.96% male M_{age} = 17.51 (SD = 0.82, range 16-20)	SOGS	CBCL Youth Self-Report	Utilizing attachment style as a moderator, there was a significant positive association between CP and PG only among the dismissing-detached group (p = .04), but not among the fearful-avoidant group
Vitaro, Brendgen, Ladouceur, & Tremblay (2001)	Canada (Quebec)	5-year longitudinal study (2 year period reporting CP and PG) Convenience sampling	Adolescent boys from disadvantaged neighborhoods	N = 717 100% male M_{age} = NR (range 13-17)	Age 16-17: SOGS-RA	Age 16-17: Self-Reported Delinquency Scale	PG at age 16 was positively correlated with delinquency at age 16 (r = .29, p < .001) and this association remained significant at age 17 (r = .31, p < .001). The path model accounting for gambling frequency, PG and drug/ alcohol use at age 16 and 17,

							indicated that delinquency at age 16 did not significantly predict PG one year later.
Wanner, Vitaro, Carbonneau, & Tremblay (2009)	Canada (Quebec)	7-year longitudinal study Convenience sampling	Sample 1: Low SES youth Sample 2: Community youth	Sample 1: *N* = 502 100% male Time 1: M_{age} = 16.2 (*SD* = 0.6, range NR) Time 2: M_{age} = 22.8 (*SD* = 0.6, range NR) Sample 2: *N* = 663 100% male Time 1: M_{age} = 16.2 (*SD* = 0.5, range NR) Time 2: M_{age} = 22.5 (*SD* = 0.5, range NR)	SOGS-RA	Sample 1: Self-Report Delinquency Questionnaire Sample 2: DISC-C (delinquency)	In both samples, there were significant correlations (p < .05) between CP and PG at age 16 (r = .22-.25), age 23 (r = .21-.31), age 16 and 23 (r = .07(ns)-.13). Investigating the cross-lagged models, CP (age 16) was not prospectively linked to PG (age 23), when accounting for gambling participation, PG, and substance use at age 16.
Welte, Barnes, Tidwell, & Hoffman (2009)	United States	Cross-sectional study Stratified sample by county and telephone block within county across the United States	United States residents	*N* = 2258 Gender NR M_{age} = NR (range 14-21)	SOGS-RA	DISC-C	Those who had current CP had a 6.1% rate of current PG (vs 1.7% in non-CP) and a 22.9% rate of current at-risk/PG (vs 5.2% in non-CP). In the logistic regression, with each additional CP symptoms, odds of being a current at-risk/PG increased (OR = 1.4 (95% CI [1.3, 1.6]). This effect was more striking for those aged 14-15, with an odds ratio of 1.8 (95% CI [1.3, 2.2]). By age 20-21, this

							relationship was no longer significant ($p > .05$). In the multinomial logistic regression predicting at-risk/PG age of onset, each additional symptom of CP increased the odds that one would have a gambling problem before age 14 (OR = 1.6, 95% CI [1.4, 1.8]) and age 15 and later (OR = 1.2, 95% CI [1.0, 1.4]).
Widinghoff et al. (2019)	Sweden	Cross-sectional study Convenience sampling	Violent offenders in prison	N = 264 100% male M_{age} = 22.3 (SD = NR, range 18-25)	SCID DSM-IV	SCID Conduct Disorder	Rates of gambling disorder were not higher among those with conduct disorder (p = .15).
Willoughby, Chalmers, & Busseri (2004)	Canada (Ontario)	Cross-sectional study Convenience sampling	High-school students	N = 7290 47.7% male M_{age} = 15.58 (SD = 1.33, range 13-18)	SOGS-RA	Delinquency (minor and major) and aggression (direct and indirect)	Correlations between PG and CP were significant ranging from r = .16-.18 ($p < .001$). Results from the confirmatory factor analyses indicated a three-factor model with a delinquency factor including major delinquency (β = .50, $p < .001$), minor delinquency (β = .57, $p < .001$), and gambling (β = .30, $p < .001$). This factor was significantly correlated with the aggression factor (r = .63). Lastly, there was a consistent co-occurrence of CP and PG across levels of severity (risk ratios ranging between 1.01 and 3.45, all $p <$ .001.
Problem Video Gaming							

Kim et al. (2018)	South Korea	Cross-sectional study Convenience sampling	First year middle-school students	*N* = 402 55.5% male M_{age} = 13.0 (*SD* = 0.40, range NR)	IGUESS	BPAQ	Correlation analyses indicated a positive correlation between CP and PVG (r = .32, p < .001). A mediation model was created with father-adolescent communication as a mediating variable between CP and PVG. CP was directly related to PVG (β = .29, p < .001), with a significant partial indirect effect through poorer father-adolescent communication (β = .19, p < .001). Total effect of the model (β = .42, p < .001).
Ong, Peh & Guo (2016)	Singapore	Cross-sectional study Convenience sampling	Adolescents presenting at an addiction treatment center (for substance or behavioral addictions)	*N* = 260 81.2% male M_{age} = 15.48 (*SD* = 1.93, range NR-19)	Pathological gaming based on DSM-IV-R-PG; PIUQ; GAS	Delinquent behavior based on violent and non-violent crimes	Adolescents with a history of delinquency were less likely to report PVG compared to adolescents without a history of delinquency (p = .001).
Tejeiro, Gómez-Vallecillo, Pelegrina, Wallace, & Emberley (2012)	Spain	Cross-sectional study Convenience sampling	High-school students	*N* = 737 52% male M_{age} = 14 (*SD* = 1.12, range 12-17)	PVP	Anti-Social Illegal Behaviors Questionnaire	Cluster analysis indicate three clusters in the data; 1) comorbid-PVG, 2) social-PVG and 3) non-PVG. The comorbid-PVG cluster, had significantly higher levels of CP compared to the non-PVG group (p < .001). These results indicate that not all adolescents who endorse PVG experience similar symptoms.
Wartberg et al. (2017)	Germany	Cross-sectional study Convenience sampling	Family dyads (adolescent and related caregiver). 98.8% of caregivers were biological	*N* = 1095 50.8% male M_{age} = 12.99 (*SD* = 0.82, range 12-14)	IGDS	RAASI subscale for antisocial behavior	Two regression models were conducted (linear and logistic) controlling for gender, anger control problems, self-esteem problems, hyperactivity/ inattention, parental depression and anxiety.

			parents (85% mothers)				In the linear regression, CP predicted PVG (β = .14, p < .001), and CP also predicted PVG in the logistic regression model (OR = 1.11, 95% CI [1.00, 1.22], p < .05).
Wartberg, Kriston, Zieglmeier, Lincoln, & Kammerl (2019)	Germany	1-year longitudinal study Convenience sampling	Family dyads (adolescent and related caregiver). 98.8% of caregivers were biological parents (85% mothers)	N = 985 50.7% male Time 1: M_{age} = 12.99 (SD = 0.82, range 12-14) Time 2: M_{age} = 13.89 (SD = 0.89, range NR)	IGDS	RAASI subscale for antisocial behavior	Correlations indicate that CP and PVG were correlated at Time 1 (r = .44, p < .01), Time 2 (r = .46, p < .01) and between Time 1 and Time 2 (r = .28-.30, p < .01). In the cross-lagged panel design (controlling for anger control problems, emotional distress, self-esteem, hyperactivity/inattention, parental depression and anxiety), CP at Time 1 did not predict PVG at Time 2 (p > .05).

Note. BPAQ = Buss-Perry Aggression Questionnaire, CBCL = Child Behavior Checklist, DISC-C = Diagnostic Interview Schedule for Children for Conduct Disorder, DSM-IV-R-PG = Diagnostic and Statistical Manual-IV-Revised-Pathological Gambling, CP = conduct problems, GAS = Game Addiction Scale, IGDS = Internet Gaming Disorder Scale, IGUESS = Internet Game Use-Elicited Symptom Screen, MASPAQ = Mesure de l'adaptation sociale et personnelle pour adolescents Quebecois, PIUQ = Problematic Internet Use Questionnaire, PG = problem gambling, PGSI = Problem Gambling Severity Index, PVG = problem video gaming, PVP = Problem Video Game Playing, RAASI = Reynolds Adolescent Adjustment Screening Inventory, SCID = Structured Clinical Interview for DSM-IV, SOGS = South Oaks Gambling Screen, SOGS-RA = South Oaks Gambling Screen – Revised Adolescent.

Appendix B

Appendix B

Summary of research articles investigating the association between depressive symptoms and behavioral addictions

Authors	Country	Design and sampling method	Sample population	Sample characteristics	PG and PVG measure	DS measure	Findings
				Problem Gambling			
Afifi, Nicholson, Martins, & Sareen (2016)	Canada (Manitoba)	5-year longitudinal survey Random sampling, snowball recruitment, and convenience sampling	Representative sample of young adults	Time 1: *N* = 679 51.8% female M_{age} = 18.9 (*SD* = NR, range 18-20) Time 4: *N* = 517	PGSI	CIDI-SF	Cross-sectional analyses indicate that at-risk or PG was associated with an increased risk of major depressive disorder (AOR = 2.33, 95% CI [1.47, 3.68]) Longitudinal findings indicate that at-risk or PG at T1 was associated with increased odds of major depressive disorder at Time 2 through 4 (AOR = 1.98, 95% CI [1.14, 3.44]). Major depressive disorder at T1 was not significantly associated with increased odds of at-risk or PG at Time 2 through 4 (*p* = .56).
Bilevicius et al. (2018)	Canada (Manitoba)	1-month longitudinal survey Convenience sampling through an online participant pool of psychology students	University students	Time 1: *N* = 497 Gender NR M_{age} = NR Time 2: *N* = 210 76% female M_{age} = 19.71 (*SD* = 3.83, range NR)	PGSI	DASS depression subscale	DS were correlated with PG symptoms at both T1 (*r* = .14, *p* < .05) and T2 (*r* = .21, *p* < .01). Mediation analyses indicate that after controlling for baseline PG, there was a significant positive indirect relationship between DS and PG which was partially mediated by high levels of shame (β = .021, 95% CI [0.006, 0.046]).
Chinneck, Mackinnon, & Stewart (2016)	Canada (Manitoba)	4-year longitudinal survey	Representative sample of young adults	Time 1: *N* = 679 51.8% female	PGSI	CIDI-SF	At T1, DS and PG were positively correlated at T1 (*r* = NR). However, DS at T1 were

		Random sampling, snowball recruitment, and convenience sampling		M_{age} = 18.92 (*SD* = 0.79, range 18-20) Time 4: *N* = 530 M_{age} = 22.23 (*SD* = NR, range 22-24)			unrelated to changes in PG over time. Further, PG at T1 was unrelated to changes in DS over time.
Cosenza, Ciccarelli, & Nigro (2019)	Italy	Cross-sectional survey Convenience sampling	High-school students	*N* = 425 45.5% male M_{age} = 17.12 (*SD* = 1.42, range 14-19)	SOGS-RA	DASS depression subscale	PG was correlated with DS (*r* = .23, *p* < .001). Those with PG had higher levels of DS compared to the non-PG group. In the regression model, DS predicted PG (β = .015, *p* < .001).
Delfabbro & Grabosky (2006)	Australia	Cross-sectional survey Convenience sampling	High-school students	*N* = 926 51% male M_{age} = 14.5 (*SD* = 1.64, range 11-19)	DSM-IV-MR-J	Negative Mood Checklist	Those reporting PG had more negative mood (*d* = 0.49; moderate effect, *p* < .01) compared to those who did not report PG. In the regression model, DS was non-significant when accounting for other psychosocial predictors including self-esteem, health, social alienation, and relative deprivation. Only social alienation was significant.
Dowd et al. (2018)	Canada (Manitoba)	Cross-sectional survey Random sampling, snowball recruitment, and convenience sampling	Representative sample of young adults	*N* = 566 47.8% male M_{age} = 19.97 (*SD* = 0.82, range 18-22)	PGSI	CIDI-SF	Results from the latent class analysis indicate that 27.4% of sample were the emotionally vulnerable type of PG, with high levels of DS. This was compared to a larger class of non-problem gamblers (59.90%) and impulsive PG (12.72%).

Dussault et al. (2011)	Canada (Quebec)	9-year longitudinal survey (PG and DS measured over a 6-year period) Convenience sampling	Boys living in economically disadvantaged areas	N = 1004 100% male Time 1: M_{age} = NR, (range 14-17)	Age 17: SOGS-RA Age 23: SOGS	Age 17: CDI Age 23: DISC-D	Correlations between PG and DS at age 17 and 23 was of r = .14 (p < .01). PG and DS at age 23 were correlated at r = .15 (p < .01). Longitudinal associations indicate that PG at age 17 predicted increases in DS at age 23 (β = .151, p < .001). DS at age 17 predicted PG at age 23 (β = .131, p < .001). PG and DS at age 17 (p < .38) and age 23 (p < .66) were not concurrently associated.
Edgerton, Melnky, & Roberts (2015)	Canada (Manitoba)	4-year longitudinal survey Random sampling, snowball recruitment, and convenience sampling	Representative sample of young adults	Time 1: N = 679 51.8% female M_{age} = NR (range 18-20)	PGSI	CIDI-SF	The increased probability of DS was associated with increased initial PG severity scores at Time 1 (β = .134, p < .05). However, this had no effect on the rate of change in PG severity.
Edgerton, Keough, & Roberts (2018)	Canada (Manitoba)	4-year longitudinal survey Random sampling, snowball recruitment, and convenience sampling	Representative sample of young adults	Time 1: N = 679 51.8% female M_{age} = NR (range 18-20)	PGSI	CIDI-SF	Correlations between PG and DS from Time 1 to 4 ranged from r = .001 (p > .05) to r = .09 (p < .05), the latter being between DS at Time 1 and PG at Time 4. Five classes were identified, with only one class indicating PG: moderate and stable PG with no DS (2.06%). Overall, there was no evidence of reciprocal growth in PG and DS in any of the classes.
Ellenbogen, Derevensky, & Gupta (2007)	Canada (Ontario & Quebec)	Cross-sectional survey Convenience sampling	High-school or junior college students	N = 5313 51.8% male	DSM-IV-MR-J	RADS	In non-PG, females were more likely to report DS. However, among those with PG, both males and females report higher rates of DS. Rates of

				M_{age} = 14.77 (*SD* = NR, range 12-18)			DS among PG were approximately 2 to 4 times higher than for social gamblers.
Martin, Usdan, Cremeens, & Vail-Smith (2014)	United States	Cross-sectional study Convenience sampling	University students	*N* = 1430 64.4% female M_{age} = NR (first- or second-year university students)	DSM-IV-MR-J	PHQ-9	Correlations for DS and PG were significant (r = .105, p < .01). When compared to non-PG, PG had higher rates of DS (40.0%, OR = 3.3, 95% CI [1.9, 5.6])
Molde, Pallesen, Bartone, Hystad, & Johnsen (2009)	Western Norway	Cross-sectional study Random sampling from total population of high-school students	High-school students (11th-13th grade)	*N* = 2055 52.9% male M_{age} = 17.3 (*SD* = 0.8, range 16-19)	MAGS	HADS depression subscale	In the univariate logistic regression, DS predicted PG (OR = 14.4, p < .001). In the multivariate logistic regression, significant predictors of PG were gender, depression (OR = 9.23, p < .001), alcohol abuse and self-forgetting when gambling. DS had the largest odds ratio.
Nigro, Cosenza & Ciccarelli (2017)	Italy	Cross-sectional study Convenience sampling	Middle- and high-school students	*N* = 1010 47.5% male M_{age} = 15.37 (*SD* = 2.05, range 12-19)	SOGS-RA	DASS depression subscale	Correlations are noted between DS and PG (r = .279, p < .01). PG also endorsed a greater mean score of DS compared to non-gamblers, non-problem gamblers, and at-risk gamblers (p = NR). In the linear regression, DS predicted severity of PG while controlling for gender, age, impulsivity, anxiety, and future/immediate implications of behavior (β = .129, p < .001).
Nower, Gupta, Blaszczynski, & Derevensky (2004)	Canada (Quebec & Ontario)	Cross-sectional study	Three combined samples of high-school	N = 3941 49.15% male M_{age} = NR	Sample 1 & 2: DSM-IV-MR-J	RADS	In all three samples, those with PG report significantly higher DS compared to non-gamblers and social gamblers

		Convenience sampling	students (two in Quebec, one in Ontario)	(range 12-18)	Sample 3: DSM-IV-MR-J &		($p < .01$; S1 = 23.1%; S2 = 24.5%; S3 = 20.4% clinically depressed).
Pascual-Leone, Gomes, Orr, Kaploun, & Abeare (2011)	Canada (Ontario)	Cross-sectional study Convenience sampling	University students	N = 200 88.5% female M_{age} = 21.41 (SD = 3.53, range NR)	SOGS	BDI-II	Descriptive statistics indicate that 7.5% (n = 15) of the sample were at-risk or PG. Correlations indicate that PG scores were not significantly correlated with DS (r = .117, p > .05). DS were not included in the regression analysis.
Sanscartier, Edgerton & Roberts (2018)	Canada (Manitoba)	Cross-sectional study Convenience sampling	University students	N = 496 43.1% male M_{age} = 20.22 (SD = 1.77, range 18-25)	PGSI	CES-D	Latent class analysis results yielded a four-class solution: 1) casual gamblers; 2) skill-interactive gamblers; 3) chance-passive gamblers; 4) extensive gamblers. Extensive gamblers and chance-passive classes had higher rates of PG compared to the casual and skill-based gamblers. Chance-passive gamblers had greater DS compared to casual gamblers ($p < .05$, $\eta^2 = .14$). Chance-passive gamblers and extensive gamblers did not differ in DS.
Stuhldreher, Stuhldreher, & Forrest (2007)	United States	Cross-sectional study Convenience sampling	University students	N = 1079 58% female M_{age} = 19.9 (SD = 1.6, range NR)	Four questions for PG: gambling-related harms and help-seeking behaviors	BDI	Comparisons for DS were conducted for each of the four criteria for PG. Results indicate that for all four questions, there was a greater proportion of individuals with a positive score for DS. This included item 1 (p = .04); 2 (p = .03); 3 ($p < .001$); and 4 (p = .002).
Wohl, Matheson, Young, &	Canada	Cross-sectional study	First-year university students	N = 125 58.4% male	DSM-IV-MR-J	BDI	DS scores varied between gamblers, where pathological gamblers endorsed

Anisman (2008)		Convenience sampling	reporting gambling in the past year	M_{age} = 20 (*SD* = 0.75, range NR)			significantly more DS (*M* = 14.87, *SD* = 5.70) than problem (*M* = 8.40, *SD* = 7.80) or recreational (*M* = 6.60, *SD* = 5.71) gamblers. This was the case for both males and females.
Problem Video Gaming							
Bonnaire & Baptista (2019)	France	Cross-sectional study Convenience sampling	Online forums	*N* = 429 71.3% male M_{age} = 20.7 (*SD* = 2.6, range 18-25)	GAS Short Version	HADS depression subscale	Compared to non-PVG, PVG had higher DS (*M* = 15.4 vs *M* = 12.2, *p* < .001). This was significant for both males and females. In the logistic regression analysis, DS significantly predicted PVG (OR = 1.2, 95% CI [1.1-1.3], *p* < .001) while controlling for sex, anxiety and alexithymia.
Dang, Zhang, Leong, & Wu (2019)	China	1-year longitudinal study Convenience sampling	University students with gaming experience	N = 282 39.4% male Time 1: M_{age} = 20.47 (SD = 1.15, range NR)	DSM-5 criteria for IGD	DASS depression subscale	PVG and DS were significantly correlated at both time points (*r* = .26-.42, *p* < .001). In the path analysis, DS was identified as a mediator in the relationship between trait emotional intelligence (TEI) and PVG. In the cross-sectional model, DS mediated the relationship between TEI and PVG, while also mediating the relationship between coping flexibility and PVG. Consistent findings are reported noted in the prospective model. The models indicated that DS was a significant concurrent mediator at both Time 1 and Time 2 (direct effects; Time 1:

							(β = .37, p < .001; Time 2: β = .29, p < .001).
Givron, Berrewaerts, Houbeau, & Desseilles (2018)	Belgium	Cross-sectional study Convenience sampling	First-year university medical students	N = 210 29.5% male M_{age} = 18.5 (SD = 1.0, range 17-25)	PVP	MADRS-S	As the severity of DS increases (none, minor, moderate), the average PVG score increases from M = 1.9, M = 2.4, to M = 3.9, respectively. This change is significant (p = .001).
Guillot et al. (2016)	United States	1-year longitudinal study (9 to 18-month range) Convenience sampling	Emerging adults, former attendees of alternative high-schools, and prior participants in a school-based substance abuse prevention program	N = 503 47.7% male M_{age} = NR (range 19-24)	Video Game Addiction (1 item)	Snaith-Hamilton Pleasure Scale	Anhedonia predicted greater levels of PVG one year later (OR = 1.33, 95% CI [1.11, 1.60], p = .003), while controlling for gender and high-school graduation.
Kircaburun, Griffiths, & Billieux (2019)	Turkey	Cross-sectional study Convenience sampling	High-school students	N = 470 40.4% male M_{age} = 16.29 (SD = 1.17, range 14-18)	IGDT-10	SDHS	DS were positively correlated with PVG (r = .13, p < .001). A multiple mediation model was tested to examine the mediating role of DS (in addition to mindfulness and rumination) on the relationship between emotional intelligence (EI) and PVG. Results indicate that although the other mediators were significant, DS did not mediate the relationship between EI and PVG.
Li, Liau, & Khoo (2011)	Singapore	Cross-sectional study Convenience sampling	Adolescents with massively multiplayer online gaming experience	N = 161 49.1% male M_{age} = 14.04 (SD = 0.73, range 13-15)	Pathological gaming based on DSM-IV-R-PG	Asian adolescent depression scale	DS and PVG were positively correlated (r = .31, p < .01). Results of the path model, indicate that escapism mediated the relationship between DS and PVG

							(indirect effect [β = .09, p < .05]; direct effect from DS to escapism [β = .45, p < .01]), while DS mediated the relationship between actual-ideal self-discrepancies (AISD) and escapism (indirect effect [β = .09, p < .05]; direct effect from AISD to DS [β = .20, p < .01]), with escapism being directly related to PVG (β = .34, p < .01). The direct relationship between DS and PVG was non-significant (β = .13, p > .05).
Liu et al. (2018)	China	Study 1: 4-year longitudinal study Convenience sampling	Study 1: University students with experience playing online games, spending on average 20% of their daily time gaming	Study 1: N = 563 78% male Time 1: M_{age} = 18.31 (SD = 0.89, range 16-21)	Chinese Internet Addiction Scale	SCL-90 depressive symptoms	Across the four time points, higher DS at Time 1 were associated with greater PVG severity from Time 2 to 4 (r = .25-.30, p < .01). Higher PVG at Time 1 was associated with greater DS at Time 2 to 4 (r = .19-.27, p < .01). Results from the cross-lagged path models indicate that although there is a temporal interrelationship between DS and PVG, the impact of DS on PVG (β = .118, .126, .127; p < .001) is greater than the impact of PVG on DS (β = .070, .066, .070; p < .05).
Männikkö, Billieux, & Kääriäinen (2015)	Finland	Cross-sectional study Random sampling stratified for age and gender	Adolescents and young adults	N = 293 51% male M_{age} = 18.7 (SD = 3.4, range 13-24)	GAS	Depression (frequency of feeling depressed)	PVG and DS were positively correlated (r = .17, p < .01). Further, those with PVG endorsed greater DS than those with no-PVG (22.6% vs 6.5%, p < .001). In the linear regression model, DS was a significant predictor of PVG

							(β = .18, $p < .01$) when controlling for occupation, education level, age, gaming frequency, health, exercise, life satisfaction, and preference for online interaction.
Vadlin Åslund, Hellström, & Nilsson (2016)	Sweden	Cross-sectional study Sample 1: Total population sampling Sample 2: Consecutive sampling at child and adolescent psychiatric clinics	Sample 1: Community sample of adolescents Sample 2: Clinical sample of adolescents in psychiatric clinics	Sample 1: N = 1868 55.4% female M_{age} = 13.9 (SD = NR, range 12-16) Sample 2: N = 242 69.8% female M_{age} = 15.39 (SD = NR, range 12-18)	GAIT	DSRS-A	In the multivariable logistic regression analysis adjusting for sex, age, school bullying, and family maltreatment, attention problems, and anxiety, adolescents with DS were 2.47 times more likely to be PVG (95% CI [1.44, 4.25], $p < .001$).
Van Rooij et al. (2014)	Netherlands	Cross-sectional study Stratified sampling of schools based on region, urbanization and education level	High-school students	N = 8478 49% male M_{age} = 14.2 (SD = 1.1, range NR)	VAT	Depressive Mood List (Dutch translation)	Analyses were conducted separately by gender. In males, PVG was associated with an increase in DS (d = 0.91, $p < .001$). In females, PVG associated with an increase in DS (d = 1.23, $p < .001$).

Note. BDI = Beck Depression Inventory, CDI = Child Depression Inventory, CES-D = Center for Epidemiologic Studies Depression Scale, CIDI-SF = Composite International Diagnostic Interview-Short Form, DASS = Depression Anxiety Stress Scale, DISC-D = Diagnostic Interview Schedule for Children for Depressive Symptoms, DS = depressive symptoms, DSM-IV-R-PG = Diagnostic and Statistical Manual - IV - Revised - Pathological Gambling, DSRS-A = Depression Self-Rating Scale Adolescent Version, GAIT = Gaming Addiction Identification Test, GAS = Game Addiction Scale, HADS = Hospital Anxiety and Depression Scale, IGD = Internet Gaming Disorder, IGDT-10 = Internet Gaming Disorder Test, MADRS-S = Montgomery and Asberg Depression Rating Scale, MAGS = Massachusetts Gambling Screen DSM-IV subscale, PG = problem gambling, PGSI = Problem Gambling Severity Index, PHQ-9 = Patient Health Questionnaire-9, PVG = problem video gaming, PVP = Problem Video Game Playing, RADS = Reynolds Adolescent Depression Scale, SCL-90 = Symptom Checklist, SDHS = Short Depression Happiness Scale, SOGS = South Oaks Gambling Screen, SOGS-RA = South Oaks Gambling Screen – Revised Adolescent, VAT = Video Game Addiction Test.

Appendix C

Appendix C

Summary of research articles investigating the association between both conduct problems, depressive symptoms and behavioral addictions

Authors	Country	Design and sampling method	Sample population	Sample characteristics	PG and PVG measure	CP and DS measure	Findings
				Problem Gambling			
Allami et al. (2017)	Canada (Quebec)	11-year longitudinal survey Sample 1: Convenience sampling (high-risk) Sample 2: Convenience sampling (partly probabilistic)	Sample 1: Low SES francophone adolescents Sample 2: Representative francophone school students	Sample 1: Time 1: *N* = 1033 Time 4: *N* = 899 100% male M_{age} = NR, range 12-23 Sample 2: Time 1: *N* = 6397 Time 4: *N* = 3017 58% male M_{age} = NR, range 12-23	Age 16: SOGS-RA Age 23: SOGS	CP: Age 12: Teacher report (antisocial & aggressive behavior) DS: Age 12: Teacher report (DS)	Latent profile analysis results indicate 4 classes, with two classes having higher CP and DS respectively: a biologically vulnerable (BV) class and an emotionally vulnerable (EV) class Longitudinal findings indicate that being in both the BV and EV subgroup at age 12 was a risk for PG at age 23, but not age 16. This relationship was strongest for the BV class, reporting 0.48 (p = .045) more PG than behaviorally conditioned gamblers and 0.66 (p = .053) more PG than EV gamblers. By age 23, the proportion of BV gamblers increased from what it was at age 16. For EV gamblers, class proportions were stable.
Allami et al. (2018)	Canada (Quebec)	11-year longitudinal survey Sample 1: Convenience	Sample 1: Low SES francophone adolescents Sample 2: Representative	Sample 1: Time 1: *N* = 1033 Time 4: *N* = 939 100% male	Age 16: SOGS-RA Age 23: SOGS	CP: Age 12: Teacher report (antisocial & aggressive behavior) DS: Age 12: Teacher report (DS)	Correlation analyses indicate significant correlations between PG and CP (r = .08-.16, p < .01) and PG and DS at 16 and 23 years (r = .07-.09, p < .01).

		sampling (high-risk group) Sample 2: Convenience sampling (partly probabilistic)	francophone school students	M_{age} = NR, range 12-23 Sample 2: Time 1: *N* = 6397 Time 4: *N* = 3142 58% male M_{age} = NR, range 12-23			Latent profile analysis results identified an externalizing (high CP), an internalizing (high DS) and a comorbid class (high CP and DS). At age 16 and 23, both externalizing and comorbid classes had greater PG symptoms compared to the well-adjusted class. The internalizing class did not report greater PG compared to the well-adjusted class.
Giralt et al. (2018)	Germany	Cross-sectional study Two samples based on random probability sampling with a stratification by school type and regional population density	Adolescents	*N* = 9309 49.4% male M_{age} = 15.3 (*SD* = 1.71, range 12-18)	DSM-IV-MR-J	CP & DS: Strengths and Difficulties Questionnaire	When covarying for age, DS (boys $p < .001$, $\eta^2 = .037$; girls; $p < .001$, $\eta^2 = .012$) and CP (boys $p < .001$, $\eta^2 = .111$; girls $p < .001$, $\eta^2 = .043$) were greater in those with at-risk/PG compared to those with no PG.
Gupta et al. (2013)	Canada (Quebec & Ontario)	Cross-sectional study Convenience sampling	High-school students reporting problem gambling	*N* = 109 72% male M_{age} = 15.6 (*SD* = 1.10, range 14-18)	DSM-IV-MR-J	CP & DS: Millon Adolescent Clinical Inventory	Results from the latent class analyses identified 5 classes. These classes support the groups identified within the *Pathways Model*, in addition to a depression only class (27%) and a comorbid (DS/CP) (10%) class.
Hardoon, Gupta, &	Canada (Ontario)	Cross-sectional study	High-school students	N = 2336 42% male	DSM-IV-MR-J	CP & DS: Conners-Wells Adolescent Self-Report Scale	CP were the largest clinical problem for probable PG, with 55% of the latter

Derevensky (2004)		Convenience sampling		M_{age} = 14.76 (SD = 1.91, range 12-19)			reporting clinical levels of CP which was greater than non-gamblers and social gamblers ($p < .001$). Similar findings were reported for DS, with 27.4% of probable PG reporting such problems and this being greater than non-gamblers and social gamblers ($p < .001$). In the regression model controlling for family problems, anger control problems, hyperactivity, and inattention, CP was significant in predicting at-risk/probable PG (β = .083, Exp(β) = 1.087, $p < .001$), however, DS was non-significant.
Kaminer, Burleson, & Jadamec (2002)	United States	Cross-sectional study Convenience sampling	Adolescents diagnosed with psychoactive substance use disorders (DSM-III-R)	N = 97 66% male M_{age} = NR (range 13-18)	MAGS	CP & DS: DISC-C & SCID	In the sample, 34% never gambled, 57% were social/non-problem gamblers, 8% (n = 8) were at-risk and 1% (n = 1) met the criteria for pathological gambling. Bivariate analyses indicate that there was no correlation between DS and PG (r = -.09, $p < .05$) and between CP and PG (r = .09-.18, $p < .05$).
Kong et al. (2014)	United States	Cross-sectional study Non-random, yet all schools in Connecticut	High-school students	N = 3901 48.5% male M_{age} = NR (range 14-21)	MAGS	CP: Aggression (2 items; weapon carrying or serious fights)	Latent class analysis results indicate that compared to the low-risk gambling class, all three other classes (including the at-risk chasing gambling, at-risk

		were invited to participate.				DS: Depression (1 item; feeling sad or hopeless almost every day for 2 or more weeks)	negative consequences gambling, and problem gambling) were more likely to experience CP ($p <$ 0.001). For DS, only the at-risk negative consequences and problem gambling classes were more likely to experience DS compared to than the low-risk gambling group ($p < .001$).
Langhinrichsen-Rohling, Rohde, Seeley & Rohling (2004)	United States	Cross-sectional study Convenience sample	High-school students	N = 1735 Gender NR M_{age} = NR (range 14-19)	SOGS-RA	CP: 2 items (getting in trouble more than others your age; more trouble in school than others your age) DS: CES-D	Five groups were identified from the discriminant function analyses: 1) non-gambler; 2) non-problem gambler; 3) at-risk gambler; 4) problem gambler and; 5) pathological gamblers. CP was a significant predictor in the linear progression from least to most PG, DS were not a significant predictor. Pathological gamblers reported significantly more CP (M = 1.36) and more DS (M = 0.88) than did individuals in the other four groups. At-risk gamblers reported more CP (M = 0.67) but not more DS (M = 0.21) compared to non-gambles and non-problem gamblers.
Petry & Tawfik (2001)	United States	Cross-sectional study Convenience sampling	Adolescents entering treatment for marijuana abuse	N = 255 83.92% male	GAIN & DSM-IV-MR-J	CP & DS: GAIN	In the multivariate model examining differences between PG and non-PG (controlling for race, age and gender), PG were more

				M_{age} = 15.8 (SD = 1.2, range 12-18)			likely (p < .05) to endorse CP (i.e., be involved in illegal activities, in a gang, use a weapon or force to get money, hurt someone so badly they need medical attention, and more likely to be arrested). There was no difference in DS between the PG and non-PG groups (p > .05).
Potenza et al. (2011)	United States	Cross-sectional study Convenience sampling	High-school students	N = 2006 59.92% male M_{age} = NR (range 14-18)	MAGS	CP: Aggression (2 items; weapon carrying or serious fights) DS: Depression (1 item; feeling sad or hopeless almost every day for 2 or more weeks)	Comparing at-risk and PG to low risk gamblers, at-risk PG were more likely to report DS among both Internet (29% vs 20%, p = .05) and non-Internet (28% vs 22%, p = .01) gamblers. Similar findings for Internet and non-Internet gamblers are noted for those reporting CP (p < .001) including serious fights (13.55-30% vs 5.94-13.75%) and carrying a weapon (38.8-53% vs 20.15-33%).
Sagoe et al. (2017)	Norway	2-year longitudinal study Random sampling based on national population registry.	Late adolescents/ young adults	N = 1277 67.1% female M_{age} = NR (range 17-19)	PGSI	CP: BPAQ-SF DS: HADS depression subscale	Latent class analyses indicated a three-class solution provided the best fit for patterns of gambling from age 17 to 19. 1) consistent non-gambling (71%); 2) consistent non-risk gambling (23.8%); 3) risk-and-problem gambling (5.1%). Correlates of the risk-and-problem gambling class at age 17 include higher CP

							(physical aggression, OR = 1.58, p = .01; verbal aggression, OR = 1.54, p = .03) and more DS (OR = 1.14, p = .03). At age 19, the third class had the highest levels of DS (d = 0.53) and CP (physical, d = 0.91; verbal, d = 0.57).
Tackett et al. (2017)	United States	Cross-sectional study Convenience sampling	University students	N = 4751 55.1% male M_{age} = 20.34 (SD = 3.31, range NR)	SOGS	CP: Zuckerberg-Kuhlman Personality Questionnaire: Aggression/Hostility & BSI DS: BSI	After accounting for the shared variance with alcohol problems, personality correlates of PG for men include CP (aggression/hostility; r = .31, p = .001), this was non-significant in women. For the mental health correlates, for men, DS was non-significant yet CP (hostility; r = .23, p < .001) was significant. For women, both DS (r = .27, p < .01) and CP (hostility; r = .46, p < .001) were significant.
Yip et al. (2011)	United States	Cross-sectional study Convenience sampling	High-school students	N = 2484 55.84% male M_{age} = NR (range 13-19)	MAGS	CP: Aggression (2 items; weapon carrying or serious fights) DS: Depression (1 item; feeling sad or hopeless almost every day for 2 or more weeks)	Individuals with PG were more likely to report past year DS in comparison to low- (OR = 4.15, p < .001) and at-risk gamblers (OR = 3.95, p < .001). Individuals with PG were also more likely to report serious fights (OR = 6.48, p < .001; OR = 6.45, p < .001) and carrying a weapon to school (OR = 3.40, p < .001; OR = 2.89, p < .001) compared to low- and at-risk gamblers.

Yücel et al. (2015)	Australia	6-year longitudinal study Convenience sampling	Adolescents	*N* = 156 51.3% male Time 1: M_{age} = 12.5 (*SD* = 0.4, range NR) Time 2: M_{age} = 16.7 (*SD* = 0.4, range NR) Time 3: M_{age} = 18.8 (*SD* = 0.5, range NR)	SOGS-RA	CP: CBCL Parent Report DS: CES-D	There were no significant overall differences across gambling risk categories with regards to DS (*p* = .62-.96) and CP (*p* = .41-.59) across time points. However, females with risky gambling showed higher CP scores than no-risk gamblers at Time 1 (*p* = .03). This difference was no longer significant at Time 2 (*p* =.18). Longitudinal change scores in DS and CP did not predict at-risk gambling in the entire sample or in the sample separated by sex. In the model investigating interaction effects by sex, higher aggression predicted PG in females and lower aggression predicted PG in males (β = .36, *p* = .018, OR = 1.43, 95% CI [1.06, 1.92]).
				Problem Video Gaming			
Desai, Krishnan-Sarin, Cavallo, & Potenza (2010)	United States	Cross-sectional study Convenience sampling	High-school students	*N* = 4028 45.8% male M_{age} = NR (range 14-18)	Problem video gaming (3 items: unsuccessful attempts to cut back; irresistible urges to play; tension only relieved by gaming.	CP: Aggression (2 items; weapon carrying or getting into serious fights) DS: Depression (1 item; feeling sad or hopeless almost every day for 2 or more weeks)	Among boys, PVG was associated with DS (11.37% vs. 4.3%, *p* < .001), and CP (serious fights, 13.95% vs. 4.69%, *p* < .001; carrying a weapon, 7.66% vs. 4.55%, *p* = .02). Among girls, PVG was also associated with DS (7.48% vs. 1.01%, *p* < .001) and CP (serious fights, 9.76% vs. 2.67%, *p* = .01), but not carrying a weapon (*p* =

							.37). In the logistic regression, PVG was associated with DS (OR = 3.62, $p < .001$) and CP (OR = 2.97, $p < .001$), controlling for grades, extracurriculars, smoking, marijuana, alcohol, drug, and caffeine use.
Krossbakken et al. (2018)	Norway	3-year longitudinal study Random sampling	Adolescents and young adults	N = 1277 61.7% female Time 1: M_{age} = 17.5 (SD = NR, range NR) Time 2: M_{age} = 18.5 (SD = NR, range NR) Time 3: M_{age} = 19.5 (SD = NR, range NR)	GAS	CP: BPAQ-SF DS: HADS depression subscale	In the unrestricted path model, DS were reciprocally related to PVG (as both an antecedent [β = .11-.12, $p < .01$]; and a consequence [β = .12-.13, $p < .01$]). However, physical aggression was only an antecedent to PVG (β = .08, $p < .05$). Based on a typology of gamers (engaged, problem, addicted), physical (OR = 1.10-1.19, $p < .01$) and verbal (OR = 1.11, $p < .01$) aggression and DS (OR = 1.11, $p < .01$) were antecedents of PVG over a 1-year, but not a 2-year interval.
Müller et al. (2015)	Europe (7 countries)	Cross-sectional study Random probability clustered sample	High-school students	N = 12938 52.9% male M_{age} = NR (range 14-17)	Assessment of Internet and Computer Game Addiction-Gaming Module	CP: CBCL Youth Self-Report DS: CBCL Youth Self-Report	Correlations indicate a positive relationship between PVG and CP (r = .30, $p < .01$). Adolescents in the PVG group had significantly higher scores in CP (males, M = 24.5; females, M = 25.9) compared to non-problematic and non-gamers (M scores for males

							and females range between 10.9 and 11.5; $\eta^2 = .033$, $p < .001$). Large effect sizes were identified within the specific domains of rule-breaking behavior ($M = 10.47$ vs. $M = 4.43$, $\eta^2 = .06$, $p < .001$) and aggressive behavior ($M = 14.29$ vs. $M = 6.71$, $\eta^2 = .05$, $p < .001$) when comparing the PVG group to the non-PVG group. For DS, a significant albeit smaller effect was noted ($M = 5.95$ vs. $M = 2.90$, $\eta^2 = .03$, $p < .001$).
Myrseth & Notelaers (2018)	Norway	Cross-sectional study Random sampling	Adolescents and young adults	$N = 2055$ 52.9% male $M_{age} = 17.5$ (SD = NR, range NR)	GAS-A	CP: BPAQ-SF DS: HADS depression subscale	Latent class analyses identified 5 classes: 1) never symptoms of PVG (46%); 2) rare symptoms of PVG (22%); 3) occasional symptoms of PVG (23%); 4) often symptoms of PVG (7%); 5) very often symptoms of PVG (1.2%). Differences in DS are reported between the classes ($\eta^2 = .04$, $p < .001$), where class 5 endorsed a greater number of DS compared to all other classes. Similar findings are noted for physical ($\eta^2 = .05$, $p < .001$) and verbal aggression ($\eta^2 = .024$, $p < .001$).
Stockdale & Coyne (2018)	United States	Cross-sectional study	University students (87	$N = 174$ 48.85% male	IGDS	CP: BPAQ-SF	Comparing the group with PVG to the non-PVG

		Convenience sampling	game addicts and 87 matched healthy controls)	M_{age} = 20.23 (*SD* = 4.17, range NR)		DS: PROMIS Emotional Distress-Depression-Short Form 8a.	group, the PVG group reported greater DS (*M* = 17.58, *SD* = 7.0 vs. *M* = 12.76, *SD* = 5.26; η^2 = .15, *p* < .001) and greater CP (*M* = 3.22, *SD* = 0.82 vs. *M* = 2.7, *SD* = 0.82; η^2 = .08, *p* < .001).
Strittmatter et al. (2015)	European (5 countries)	Cross-sectional study Random sampling stratified by school	High-school students	N = 8807 45.5% male M_{age} = 15 (SD = 1.3, range NR)	Young Internet Addiction Test	CP: DISC-C DS: BDI-II	The PVG group reported greater CP (*M* = 1.40, *SD* = 1.60 vs. *M* = 0.63, *SD* = 1.06; *d* = 0.71, *p* < .001) and DS (*M* = 11.27, *SD* = 9.96 vs. *M* = 6.90, *SD* = 7.37; *d* = 0.58, *p* < .001) than the non-PVG group. In a multinomial logistic regression predicting PVG, DS (RR = 1.25, 95% CI [1.10, 1.43], *p* = .001) and CP (RR = 1.24, 95% CI [1.14, 1.36], *p* < .001) were significant when controlling for gender, emotional symptoms, hyperactivity, peer problems, well-being, suicidal behavior and self-injurious behavior.
Torres-Rodrígez, Griffiths, Carbonell, & Oberst (2018)	Spain	Cross-sectional study Convenience sampling	Adolescents with a diagnosis of Internet Gaming Disorder seeking mental health treatment	*N* = 31 100% male M_{age} = 14.97 (*SD* = 1.74, range 12-18)	DSM-5 criteria for IGD & IGD-20	CP: CBCL Youth Self-Report DS: SCL-90 depressive symptoms & CBCL Youth Self-Report	Within the sample of PVG, 64.5% were in the clinical range for DS and 6.4% were in the borderline range (SCL-90). Based on the CBCL, there were correlations between DS and PVG (*r* = .522, *p* < .001), and CP and PVG (*r* = .665-.692, *p* < .001). Those with PVG had an average

							score denoting a clinical status in externalizing problems (M = 61.77, SD = 8.32).
Yu & Cho (2016)	South Korea	Cross-sectional study Multiple-stage cluster sampling with stratification by region, grade level and sex. Three or more schools from each of the 15 districts were randomly selected, then, one 8th and one 9th grade from each selected middle school was randomly selected.	Middle-school students	N = 2024 50.6% male M_{age} = 14.5 (SD = 0.50, range 13-15)	IGDS (Modified Korean adaptation)	CP: BPAQ DS: Short Version of Online Psychological Tests	Analyses indicated that the PVG group report a significantly higher mean score of DS (M = 14.21) compared to the non-gamer (NG; M = 12.0), at-risk gamers (M = 11.76), and regular gamer (RG; M = 11.06) groups. Based on the cut-off score for DS, 15.1% of PVG had DS, compared to 5.1% of NG, 2.5% of at-risk gamers and 2.8% of RG. Further, analyses indicated that the PVG group reported the highest mean score in CP (M = 16.18), followed by the at-risk gamers (M = 14.02), NG (M = 13.59), and RG (M = 12.53) groups. Correlations indicate the presence of correlations between DS and PVG (r = .21, p < .01) and CP and PVG (r = .26, p < .01).
Problem gambling and gaming							
Walther, Morgenstern, & Hanewinkel (2012)	Germany	Cross-sectional survey Random sample of 15 public schools	Secondary and vocational school students	N = 2553 50.7% male M_{age} = 16.7 (SD = 3.04, range = 12-25)	PG: SOGS-RA PVG: Video Game Dependency Scale	CP: Rating Scale of Oppositional Defiant/Conduct Disorders DS: Depression scale adapted from Kandel & Davies (1982)	Univariate analyses indicate that both PG (p < .01) and PVG (p < .001) report more CP, but not more DS compared to non-problem gamblers (p = .71) and non-problem gamers (p = .10). Multivariate analyses indicate that PVG report

				more CP (OR = 1.65, 95% CI [1.01-2.69]) but not more DS than non-problem gamers. PG reported no significant differences in either CP or DS.

Note. BPAQ-SF = Buss-Perry Aggression Questionnaire - Short Form, BSI = Brief Symptoms Inventory, CBCL = Child Behavior Checklist, CES-D = Center for Epidemiologic Studies Depression Scale, CP = conduct problems, DS = depressive symptoms, HADS = Hospital Anxiety and Depression Scale, IGDS = Internet Gaming Disorder Scale, IGD = Internet Gaming Disorder, IGD-20 = Internet Gaming Disorder Test, GAIN = Global Assessment of Individual Needs, GAS-A = Gaming Addiction Scale-Adolescents, MAGS = Massachusetts Gambling Screen DSM-IV subscale, PG = problem gambling, PGSI = Problem Gambling Severity Index, PVG = problem video gaming, SCID = Structured Clinical Interview for DSM-IV, SCL-90 = Symptom Checklist, SOGS = South Oaks Gambling Screen, SOGS-RA = South Oaks Gambling Screen – Revised Adolescent