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Internalizing Personality Traits and Coping Motivations for Gaming During the COVID-19 Pandemic: A Cross-Lagged Panel Mediation Analysis

Rebecca E. Lewinson[1], *Jeffrey D. Wardell*[1, 2, 3], *Joel Katz*[1], *& Matthew T. Keough*[1]

[1] York University, Faculty of Health, Department of Psychology, Toronto, Canada
[2] Institute for Mental Health Policy Research, Centre for Addition and Mental Health, Toronto, Canada
[3] Department of Psychiatry, University of Toronto, Toronto, Canada

Abstract

Anxiety sensitivity and hopelessness are two traits that have been previously linked to increased gaming problems. Research in the early stages of the COVID-19 pandemic showed that emotionally vulnerable individuals were turning to video games as a means of coping with their distress. However, more research is needed on the long-term and enduring pathways from internalizing traits to time spent gaming during COVID-19, after the lockdowns and preventative measures had been lifted. As such, the current study employs a multi-wave longitudinal study that predicted that those participants who experience high levels of anxiety sensitivity or hopelessness would use gaming as a means to cope with their emotional discomfort, resulting in increased gaming behaviours. A sample of 1,001 American gamers (M_{age} = 38.43, SD = 12.11, 53.2% female) completed three surveys through Mechanical Turk, with the first occurring in July 2021, and subsequent surveys spaced three months apart. This study measured participants' baseline anxiety sensitivity and hopelessness using the Substance Use Risk Profile. At each time point, participants were asked to recall their average time spent gaming over the past month using a Timeline Follow-Back method, and answer questions related to their coping motivations for gaming using the Motives for Online Gaming Questionnaire. Coping motives consistently predicted time spent gaming at the next timepoint. Furthermore, we found evidence that high levels of anxiety sensitivity at baseline predicted greater future time spent gaming at Time 3, through greater coping motives at Time 2. Hopelessness was correlated with coping motives and time spent gaming at baseline, but did not relate to these variables across time. Anxious individuals who were gaming to cope during the COVID-19 pandemic may be at higher risk for excessive gaming. This may be particularly true for individuals who are higher in anxiety sensitivity. Future research should aim to understand how the relationships between anxiety sensitivity, coping motivations, and time spend gaming exist in the context of symptoms of gaming disorder and functional impairments that exist due to excessive gaming.

Keywords: anxiety sensitivity; coping; COVID-19 gaming; hopelessness; negative thinking; pandemic; problematic gaming

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Introduction

The COVID-19 pandemic has been shown to have continued negative impacts on symptoms of depression, anxiety, and overall feelings of loneliness worldwide (Kotwal et al., 2022; Rosenberg et al., 2021; Shattuck et al., 2022; Sommerlad et al., 2021). As a result of the changes imposed by the COVID-19 pandemic and ongoing stressors that persisted well beyond the initial lockdown, many sought new ways to cope with their isolation and negative emotions. One such method is the use of video games. A recent systematic review looked at articles published since December 2019 (Pallavicini et al., 2022). The researchers found that many people turned to video gaming during the pandemic to mitigate their stress, anxiety, depression, and loneliness; however, for those individuals who were at-risk for addictive behaviour, particularly male youths or those with maladaptive or avoidant coping styles, excessive gaming was found to have long-term increases in symptoms of anxiety, depression, and overall stress, but short-term relaxing effects to the player (Pallavicini et al., 2022). This may indicate that these at-risk populations experience greater distress or risk for developing gaming problems as a means of coping with their distress (Pallavicini et al., 2022). This discovery is reinforced by earlier research conducted by Melodia and colleagues (2022) prior to the pandemic. In their systematic review, they examined 26 articles published between 2010 and 2020 that explored avoidance and escape coping strategies for gaming. Their analysis revealed a significant connection between escape or avoidance coping motives and the prevalence of excessive gaming behaviours (Melodia et al., 2022). However, while these studies give information regarding gaming activity and its potential negative effects both prior to and during the pandemic, much still remains unknown regarding the longitudinal pathways of risk for gaming problems in this context, and the mechanisms that would explain that risk.

Gaming Activity During COVID-19

The USA has seen significant growth in the number of self-reported video gamers since the beginning of the COVID-19 pandemic, from 164 million in 2019 to 215 million in 2022. (Entertainment Software Association, 2019, 2022). Not only are more Americans playing video games, but the amount of time spent gaming is steadily rising, from an average of 8.3 hours per week in 2019, to 13 hours per week in 2022, representing a nearly 57% increase in time spent gaming. (Entertainment Software Association, 2019, 2022). Moreover, Verizon reported a 75% increase in online gaming activity, corresponding with stay-at-home directives (Shanley, 2020).

Gaming, in itself, is not inherently problematic; in fact, previous research has shown that gaming can be associated with numerous benefits with regard to social (Wiederhold, 2021), emotional, and physical development (Merino-Campos & del Castillo Fernndez, 2016), particularly with moderate game play (Granic et al., 2014). However, it is important to note that there are passionate gamers who do not encounter gaming-related problems or functional impairment. The specific genre or nature of the video games that are played may influence the positive outcomes associated with gaming. For example, cooperative or team-based video games (e.g., World of Warcraft) have been linked to increased prosocial behaviours and social skills in some studies (Gentile et al., 2009; Lenhart et al., 2008). On the other hand, casual or puzzle video games (e.g., Bejeweled, Angry Birds) have found to have mood-boosting and relaxing effects (Russoniello et al., 2009).

Despite these benefits, there are also times when gaming can lead to functional impairment, distress, or other problems. Though there are some differences throughout the literature in the constructs used to measure problematic gaming (King et al., 2013; Kuss, 2013), most literature agrees that the term “excessive gaming” encompasses problematic gaming habits that also cause gaming-related problems or functional issues (King et al., 2013). As such, excessive gaming is essentially a term used to conceptualize addiction to gaming, without a formal diagnosis being attached to the definition (Sanders et al., 2017). Excessive gaming has been associated with a number of mental health concerns including anxiety (Wang et al., 2017), depression (Liu et al., 2018), and substance use (Na et al., 2017). A systematic review of 24 articles conducted by González-Bueso et al. (2018) examined the relations between gaming problems, anxiety, and depression. The authors concluded that there were significant positive correlations between gaming problems and emotional disorders, namely anxiety and depression. However, the authors note that the lack of longitudinal studies that examine the directional relations between gaming problems, anxiety, and depression is a significant limitation (González-Bueso et al., 2018).

A further meta-analysis included data collected from 210, 557 participants, aiming to determine risk and protective factors to the development of Gaming Disorder (Ropovik et al., 2023). The researchers included studies published

from 2013 onwards. Relevant to the current study, they found that anxiety, stress, gaming time, and escape motives all were risk factors for the development of Gaming Disorder (Ropovik et al., 2023). Collectively, these studies demonstrate an established relationship between anxiety and depression with excessive gaming; however, in the context of the global pandemic where emotional issues have peaked, there is a need for research that is focused on how vulnerable individuals are coping, and if they are gaming more in order to cope.

Anxiety Sensitivity and Hopelessness

Internalizing personality traits, such as anxiety sensitivity and hopelessness, are risk factors that can help us to better understand gaming risk by providing insights into how individuals with these traits may use gaming as a coping mechanism for anxiety or hopelessness. Anxiety sensitivity is defined as the fear that physiological or emotional symptoms of anxiety will have harmful consequences (Mantar et al., 2011). For example, an individual high in anxiety sensitivity may fear an impending heart attack if they notice an increase in their heart rate. The literature identifies anxiety sensitivity as an enduring personality trait that contributes to higher risk for virtually all anxiety disorders (Mantar et al., 2011; Olatunji & Wolitzky-Taylor, 2009; Schmidt et al., 2010; Taylor et al., 1992). Hopelessness is conceptualized as a stable trait of depression-proneness. Individuals who are high in hopelessness tend to have frequent negative thoughts about themselves, others, and about the future. Consequently, high levels of trait hopelessness have been associated with increased risk for recurrent major depressive episodes (Mac Giollabhui et al., 2018; Soloff et al., 2000; Szanto et al., 1998). Overall, the literature on personality indicates that both anxiety sensitivity and hopelessness are more than simply experiencing situational or state-level negative emotions. They are enduring traits that give risk to emotional vulnerability.

Within the context of the COVID-19 pandemic, previous research has shown that higher anxiety sensitivity can contribute experiencing high levels of fear related to COVID-19 (Warren et al., 2021), elevated symptoms of anxiety and depression (Rogers et al., 2021; Warren et al., 2021), or post-traumatic stress disorder (Li et al., 2020; Zhao et al., 2022) and significant functional impairment in their daily life (Manning et al., 2021). Studies have also found that individuals who experience higher levels of anxiety sensitivity are also more likely to experience problematic gaming behaviours during the pandemic (Kahraman & Yertutanol, 2021), and are also more likely to report coping motivations for gaming (Biolcati et al., 2021). This is consistent with pre-pandemic literature that found associations between anxiety sensitivity, problematic and excessive internet use (Taş, 2019), gambling and risk-taking behaviours (Broman-Fulks et al., 2014), and video game use (Kahraman & Yertutanol, 2021). Moreover, anxiety symptoms more generally have been positively associated with problematic or excessive gaming behaviours both before (Mannikko et al., 2015; Wang et al., 2017) and during the COVID-19 pandemic (Fazeli et al., 2020; Teng et al., 2021). Given that individuals higher in anxiety sensitivity seem to have experienced an exacerbated level of emotional distress caused by the COVID-19 pandemic, those same individuals may have gamed excessively in order to manage these symptoms.

Comparatively, there is significantly less research surrounding the association between hopelessness and excessive gaming during the COVID-19 pandemic. Despite this, the available research does suggest a positive association between hopelessness and COVID-19 related depression and loneliness (Akova et al., 2022; Padmanabhanunni & Pretorius, 2021). Teng et al. (2021) conducted a two timepoint study (October/November 2019 and April/May 2020) with 1,178 children and adolescents to characterize changes before- and during- the COVID-19 pandemic with regards to excessive video game use, and symptoms of gaming problems, depression, and anxiety. The researchers found that higher symptoms of anxiety and depression at Time 1 each independently positively predicted symptoms of gaming problems and excessive video game use at Time 2 (Teng et al., 2021). It is important to note that this study did not measure trait hopelessness; however, as mentioned, there is a strong association between trait hopelessness and symptoms of depression (Akova et al., 2022; Padmanabhanunni & Pretorius, 2021).

Given that the rates of depression in North America skyrocketed during the COVID-19 pandemic, with moderate to severe depression rates in the USA increasing from 8.5% in 2018 to 27.8% in the first few months of the pandemic (March and April 2020; Ettman et al., 2020), it stands to reason that these increases in depressive symptoms during the pandemic may be a contributing factor to increased time spent gaming. Other studies conducted during the pandemic have also found a positive association between levels of depression or hopelessness and gaming problems (Chen et al., 2021; Cudo et al., 2022). Biolcati et al. (2021) recruited 627 self-reported video game players and asked them to complete the Substance Use Risk Profile Scale along with the Internet Gaming Disorder Scale—Short Form and the Motives for Online Gaming Questionnaire during the COVID-

19 pandemic. The researchers found that hopelessness was a distinguishing trait between those who met criteria for Gaming Disorder and those who did not, where higher levels of hopelessness were associated with more symptoms of Gaming Disorder. However, while the relationship between anxiety sensitivity or hopelessness and excessive gaming has been previously defined, the motivations for gaming in this relationship are not yet well understood. Biolcati et al. (2021) did find that there was a positive association between anxiety sensitivity and coping motives for gaming; however, more research is needed to better understand this association.

Coping Motives

Motivational theory identifies reasons for engaging in addictive behaviours as proximal factors related to risk for problem alcohol and other substance use (Cooper et al., 1995; Cox & Klinger, 1988; Miller et al., 2000), as well as for behavioural addictions, such as gambling (Chantal & Vallerand, 1996; Rodriguez et al., 2015) and gaming (Przybylski & Weinstein, 2019; Weinstein et al., 2017). Coping motives in particular have been found in various forms of addiction. For example, Cooper (1994) introduced a four-factor model of motivations for alcohol use, consisting of social motives, coping motives, enhancement motives, and conformity motives, while Myrseth et al. (2017) suggested a four-dimensional model of motivation for online gaming consisting of social motives, coping motives, enhancement motives, and self-gratification motives. Coping motives have also been found in other addictive behaviours including gambling (Schlagintweit et al., 2017; Stewart & Zack, 2008) and substance use (Hogarth et al., 2019; Votaw & Witkiewitz, 2021). According to these motivational models of addiction, people who are emotionally vulnerable are at risk for excessive gaming and related harms due to their strong coping motives for playing (Balhara et al., 2018). These people may have been the ones who increased their gaming in efforts to cope with the enduring pandemic situation.

Myrseth et al. (2017) identified four key motives for gaming, namely: enhancement motives (internal, positive reinforcement; gaming for the pleasurable experience of gaming itself), coping motives (internal, negative reinforcement; reduction of negative emotions), social motives (external, positive reinforcement motives; increasing social interaction), and self-gratification motives (gaming to satisfy one's own personal desires). Coping motives seem to be the most central to problematic gaming, particularly among those with emotional vulnerabilities, as they have been found to predict increased risk for gaming harms (Myrseth et al., 2017). Furthermore, coping motives independently predict a loss of control of gaming behaviours as well as the development of gaming problems (Myrseth et al., 2017).

A longitudinal study conducted by Lewinson et al. (2022) examined the relations between emotional vulnerability (i.e., state depression and anxiety symptoms) and video game usage in the first six months of the COVID-19 pandemic. A sample of 332 Canadian gamers were recruited through Prolific to participate in a longitudinal study with three time points spaced three months apart beginning in April 2020 (approximately six weeks after the declared state-of-emergency in several parts of the United States). At each time point, participants were asked to complete surveys assessing their levels of anxiety and depression (collectively called "emotional vulnerability"), time spent gaming, gaming problems, and motivations for gaming. The researchers found that higher initial levels of emotional vulnerability predicted future excessive time spent gaming and gaming problems six months into the pandemic. Moreover, the researchers found that individuals who were higher in emotional vulnerability at the outset of the pandemic were more likely to use video gaming as a coping method, which in turn related to increased gaming harms. However, it is important to note that the measures of emotional vulnerability in this study were state-like emotions, and captured initial reactions to the pandemic situation; as such, the relationship between video game usage and coping is currently unclear in individuals who are higher in trait hopelessness or trait anxiety sensitivity. Furthermore, the aforementioned study occurred during the first year of the pandemic; since that time, much has changed societally with the alleviation of lockdown procedures and mandatory masking, and increased availability of vaccines. As such, it is important to understand this association over time, during a different period of the COVID-19 pandemic.

While previous research acknowledges that gaming has increased during the pandemic, the longitudinal pathways and mechanisms that underlie the relationship between excessive gaming and internalizing traits such as anxiety sensitivity and hopelessness remain unclear. This study will provide insights into how individuals with these internalizing traits may use gaming as a coping mechanism, and how this may be attributed to more time spent gaming.

It is important to note that while the present study was conducted during a specific period of the COVID-19 pandemic, the identified psychological pathways and coping strategies extend beyond the immediate context of

the study. By elucidating the relationships between internalizing traits, coping motives, and excessive gaming, this research contributes to a broader understanding of the enduring impact of psychological distress on gaming behaviors. As we explore these pathways, we acknowledge the necessity of considering the study's timeframe and contextualizing the findings within the evolving landscape of the COVID-19 pandemic and its aftermath.

Aims and Hypothesis

Psychological distress during the COVID-19 pandemic has been proposed to lead to longer-term or enduring impacts on maladaptive substance use for coping purposes (Rehm et al., 2020). With regards to gaming behaviours, it is possible that we might see similar enduring distress-related pathways. We examined these pathways later in the pandemic, focusing on trait-level internalizing factors and longer-term excessive gaming. Using a three-timepoint longitudinal survey design beginning in July 2021 (with subsequent timepoints spaced three months apart), we examined how anxiety sensitivity and hopelessness were prospectively positively related to time spent gaming across time. We expect that individuals that are high in hopelessness and anxiety sensitivity will game more frequently due to their coping motivations for gaming. In addition, we tested the mediational role of coping motives as a secondary aim. Invariance tests were also conducted for biological sex (male versus female). Prior research has found variations between sexes in their gaming behaviours, including their gaming preferences and confidence levels in gaming; however, as this information has not been found during the COVID-19 pandemic, this invariance analysis was exploratory in nature (Lange & Schwab, 2018; Lucas & Sherry, 2004; Terlecki et al., 2011). Furthermore, gaming disorders are more prevalent in males (Marraudino et al., 2022), and previous research has shown that male youths in particular are more at-risk for experiencing detrimental effects such as increased anxiety, depression, and loneliness, due to excessive gaming (Pallavicini et al., 2022). As such, it is imperative to assess whether the proposed pathways remain consistent across sex to ensure the validity of our results' interpretation within our sample.

Methods

Participants and Procedure

This research was reviewed and approved by the York University Research Ethics Board (Human Participants Review Committee certificate #e2021-238). Participants residing in the United States were recruited through CloudResearch, a research platform that integrates with Mechanical Turk to allow researchers to more easily conduct longitudinal academic or social research (Litman et al., 2017). Mechanical Turk is a crowdsourcing platform that allows workers to complete "Human Intelligence Tasks" in exchange for money (Buhrmester et al., 2011; Litman et al., 2015). Eligibility to participate was determined using pre-existing screening data available on CloudResearch, with participants being eligible if they were older than 18 years of age, live in the United States of America, and self-report that they regularly play video games (more than one hour per day of gaming). Only n = 2 participants endorsed 0 hours of daily gaming at baseline; these participants were included in the analysis as they are individuals who are self-reported gamers, who therefore have motives for their gaming behaviour, and including them allowed us to avoid bias and allow us the full spectrum of gaming in our sample. The conscientious responders scale (Marjanovic et al., 2014), as well as an additional attention-check item created by the researchers (*when asked what your favorite color is, please respond with "coffee"*), were included to ensure that the participants were attending to the surveys and responding conscientiously (Marjanovic et al., 2014). Participants were excluded from analysis if they failed more than two attention-check items (six participants at each Time 1 and 2, three participants from Time 3). During data collection at Time 3, a technical error caused nine participant's data to be unable to be connected to their previous responses at Time 1 and Time 2. This data was also excluded from analysis. Data collection took place as follows: July 2021 (Time 1), October 2021 (Time 2), and January 2022 (Time 3). Although many lockdown measures were listed, life at these time points had not fully returned to normal, with remote or hybrid work and travel, and other restrictions still being in place in a number of locations across the United States. Participants were compensated $1 USD for their participation in Time 1, $2 USD for their participation in Time 2, and $3 USD for their participation in Time 3.

Measures

Table 1 outlines the timeline of the study as well as which measures were used at each time point. Measures were completed online, and hosted through Qualtrics (Qualtrics, 2014). The order of measure presentation was non-randomized.

Table 1. *Synopsis of Measures Used at Time 1, Time 2, and Time 3.*

	Time 1 (July 2021)	Time 2 (October 2021)	Time 3 (January 2022)
Measures used	SUDS EGMQ TLFB	EMGQ TLFB	EMGQ TLFB

Note. SUDS: Substance Use Disorder Scale; EMGQ: Electronic Gaming Motives Questionnaire; TLFB: Timeline Follow-Back.

Electronic Gaming Motives Questionnaire (EGMQ)

The EGMQ is a self-report measure of video gaming motives (Myrseth et al., 2017). In the current study, only the coping motives subscale was used. The coping motives subscale consists of four items (e.g., *to forget your worries)*, with participants responding to the items on a 1 (*almost never/never*) to 4 (*almost always*) scale. (Myrseth et al., 2017). In previous studies, the EGMQ has been shown to have good criterion validity (based on measures of gaming behaviours including categories of games played, the typical number of hours played per week, feelings of loss of control over gaming, and symptoms of gaming problems measured by the Gaming Addiction Scale), and good internal consistency (Myrseth et al., 2017). The coping motives subscale of the EGMQ in the present study had internal consistencies of Ω = .816, Ω = .810, and Ω = .844 at Time 1, Time 2, and Time 3, respectively.

The Substance Use Risk Profile Scale (SURPS)

The SURPS (Woicik et al., 2009) measures personality risk for substance abuse on four dimensions; however, only the two internalizing subscales were used in this study: hopelessness (e.g., seven items; *I am content*), and anxiety sensitivity (e.g., five items; *It frightens me when I feel my heart beat change*). Each item is rated on a 1 (*strongly disagree*) to 4 (*strongly agree*) Likert-type scale (Woicik et al., 2009). The SURPS was collected only at baseline (Time 1) for the current study. This scale was chosen as it efficiently and reliably assesses hopelessness and anxiety sensitivity, minimizing participant burden by capturing both variables in a single instrument. Additionally, the SURPS is commonly employed in gaming research to deliniate personality variables associated with substance use risk, potentially providing valuable insights for future studies in this field. In previous studies, the SURPS has shown strong discriminant and convergent validity, good concurrent, incremental, and construct validity, and good internal consistency (Woicik et al., 2009). In the current study, the SURPS had an internal consistency of Ω = .789 and Ω = .906 for the anxiety sensitivity and hopelessness subscales, respectively.

Time Spent Gaming

At each time point, participants were asked to indicate how much time on average (in hours) they had spent gaming each day over the past month. This number was multiplied by 30 to determine the participants' total time spent gaming over the previous month at each time point. This procedure was based on the Timeline Follow-Back method which has been used in previous studies to measure gambling-related behaviours (Weinstock et al., 2004), substance use (Agrawal et al., 2008), and video gaming (Peter et al., 2020).

Data Analysis Overview

The data set for this manuscript is available online. We conducted preliminary analyses prior to hypothesis testing with a cross-lagged panel model (CLPM). CLPM is often used in longitudinal research to examine the reciprocal relationships between two or more variables measured at multiple timepoints. Namely, it is designed to explore the direction and strength of relationships between variables over time by analyzing how changes in one variable at an earlier timepoint predicts changes in another variable at a later timepoint (Muthén & Muthén, 2017). It is a widely used framework to test mediation with longitudinal data, such as the data presented in the current study.

In the case of the current study, hopelessness and anxiety sensitivity (Time 1) were treated as predictors of coping motives and time spent gaming (Time 2 and Time 3), while also being considered as concurrent correlates of coping motives and time spent gaming at Time 1. Given the temporal nature of the data, reciprocal pathways were also included to examine the presence of mediation as a secondary aim.

The preliminary analysis involved data screening (i.e., winsorizing extreme values to $\pm$ 3.29 standard deviations from the mean and verifying multiple regression assumptions), and conducting a missing data analysis. For the missing data, we used a series of *t*-tests to examine potential baseline differences between participants with complete data versus those with incomplete data (Enders, 2010). In this analysis, we utilized full information maximum likelihood (FIML) as the specific estimation technique within the CLPM to handle missing data. FIML is commonly used to handle missing data and provides unbiased estimates when data is missing at random. This enhances the robustness of our statistical model.

Next, we used a cross-lagged mediation model in MPlus v8.4 to test the hypothesized pathways from internalizing traits to gaming via coping motives across the three timepoints (Muthén & Muthén, 2017). In this model, anxiety sensitivity and hopelessness were specified as predictors of the mediator (coping motives) and outcome variable (time spent gaming) at Time 2 and Time 3. Anxiety sensitivity and hopelessness were specified as correlates of the mediator and outcome variable at Time 1, as these variables were measured concurrently. The autoregressive effects and cross-lagged effects were specified among coping motives and time spent gaming across the three time points.

Fit of the hypothesized model was evaluated using several indices. For comparative fit index (CFI), $\geq$.95 was considered excellent, while between .90 and .95 is adequate. A root mean square error of approximation (RMSEA) of .06 or below is considered excellent, while a score between .06 and .10 is considered adequate. A score above .10 is considered poor fit. A standardized root mean square residual (SRMR) below .05 is considered excellent, while a score between .05 and .08 represents adequate fit (Fabrigar et al., 1999; Hu & Bentler, 1999; Kyndt & Onghena, 2014). In addition, the presence and magnitude of direct and indirect paths were evaluated using a bootstrapped bias-corrected 95% Confidence Interval (CI) approach (Fritz & MacKinnon, 2007). If the 95% CI for a given direct or indirect path coefficient does not include zero, the effect is considered to be supported (Fritz & Mackinnon, 2007; Hu & Bentler, 1999; Kline, 2013). The fit of our model is based on the comprehensive set of indices described above.

Following the evaluation of the CLPM in the full sample, the invariance of our model was tested across biological sex (i.e., men vs. women) to ensure that the interpretations of our results are consistent across our sample. In order to proceed with the path invariance testing, the proposed model was first tested in each sex group individually to ensure good fit (Cheung & Rensvold, 2002). A configural model was then tested, one that allows the paths to vary freely between groups. Assuming that good model fit was established in these first two steps, a path invariance model was estimated that constrains the direct effects to be equal effects across sex groups. If there were no significant differences in model fit between the configural and invariant models, then it was inferred that the overall model applies equally across sex (i.e., to both males and females) groups (Cheung & Rensvold, 2002). Differences in fit between path invariant and configural models were evaluated using the $\Delta\chi^2$ test and the change in CFI value. A significant difference between models is supported if the *p*-value for the $\Delta\chi^2$ test is below .05 and/or the ΔCFI is ≥.01 (Cheung & Rensvold, 2002).

Results

Preliminary Analyses

1,001 participants (532 females; 469 males) completed the study at Time 1. At Time 2, n = 699 (69.8%) of participants participated in the study. At Time 3, n = 747 (74.6%) of participants participated in the study. "Completers" (N = 435) are those who completed all three time points, while "non completers" (N = 566) completed less than three time points. Our variables did not show any substantial skew or kurtosis, based on Kline (2011) who indicates that a skew of < 3 and kurtosis of < 10 is acceptable for normality. Table 3 outlines the skew and kurtosis of our variables.

There were no significant differences between completers and non-completers with regards to amount of time spent gaming, $t(999) = .965$, $p = .335$, $d = .062$ hopelessness, $t(999) = -.579$, $p = .563$, $d = -.037$, or coping motivations, $t(999) = .525$, $p = .60$, $d = .033$. Effect sizes represent Cohen's d for missingness. There were also no

significant differences between completers and non-completers in their sociodemographic factors (see Table 2). However, there was a significant difference between completers (M = 7.66, SD = 3.039) and non-completers (M = 8.26, SD = 3.063) in anxiety sensitivity, $t(999) = 3.075$, $p = .002$, $d = .196$. This indicates that individuals who were lower in anxiety sensitivity were more likely to complete all three time points of this study.

Sociodemographic Variables

Table 2 shows the sociodemographic variables, comparing completers and non-completers.

Table 2. *Sociodemographic Variables*.

	Completers	Non-Completers	χ(*df*) or *t(df)*	*p*
Age in years (*SD*)	40.17 (12.17)	36.17 (11.67)	−5.254 (999)	.226
Sex *n* (%)				
Male	271 (47.9)	198 (45.5)	0.551 (1)	.458
Female	295 (52.1)	237 (54.5)		
Education *n* (%)				
High school or less	58 (10.2)	52 (11.9)	4.971 (3)	.174
Some post-secondary/trade school	151 (26.7)	120 (27.5)		
Completed post-secondary/trade school	241 (42.6)	197 (45.2)		
Post-graduate work/degree	116 (20.5)	66 (15.1)		
Ethnicity *n* (%)				
BIPOC	140 (24.7)	123 (28.2)	1.592 (1)	.207
White	426 (75.3)	312 (71.6)		

Descriptive Statistics

Table 3 shows the descriptive data for the observed variables. The values for time spent gaming represent the average number of hours that participants spent gaming over the previous month. Our participants therefore spent an average of 3.02 hours per day gaming at Time 1, 2.83 hours per day gaming at Time 2, and 2.79 hours per day gaming at Time 3. In our sample, we observed a wide range of hopelessness, anxiety sensitivity, coping motives, and time spent gaming.

Table 3. *Descriptive Statistics for the Observed Variables*.

Variable	Mean	Median	*SD*	Range	Skewness	Kurtosis
Time Spent Gaming (T1)	90.58	60	79.83	0–450	2.35	6.40
Time Spent Gaming (T2)	84.87	60	70.08	0–378	2.18	5.76
Time Spent Gaming (T3)	83.61	60	67.62	0–335.26	1.81	3.48
SURPS Hopelessness (T1)	14.65	14	4.37	7–28	0.66	0.48
SURPS Anxiety Sensitivity (T1)	12.92	13	3.06	5–20	−0.34	−0.03
Coping Motives (T1)	10.49	11	2.96	4–16	−0.06	−0.70
Coping Motives (T2)	10.23	10	2.98	4–16	0.03	−0.65
Coping Motives (T3)	10.24	10	3.2	4–16	−0.16	−0.61

Note. Time spent gaming is measured by average number of hours gamed over the previous month; SURPS: Substance Use Profile Scale; T1: Time 1; T2: Time 2; T3: Time 3.

Mediation Model

Model Results

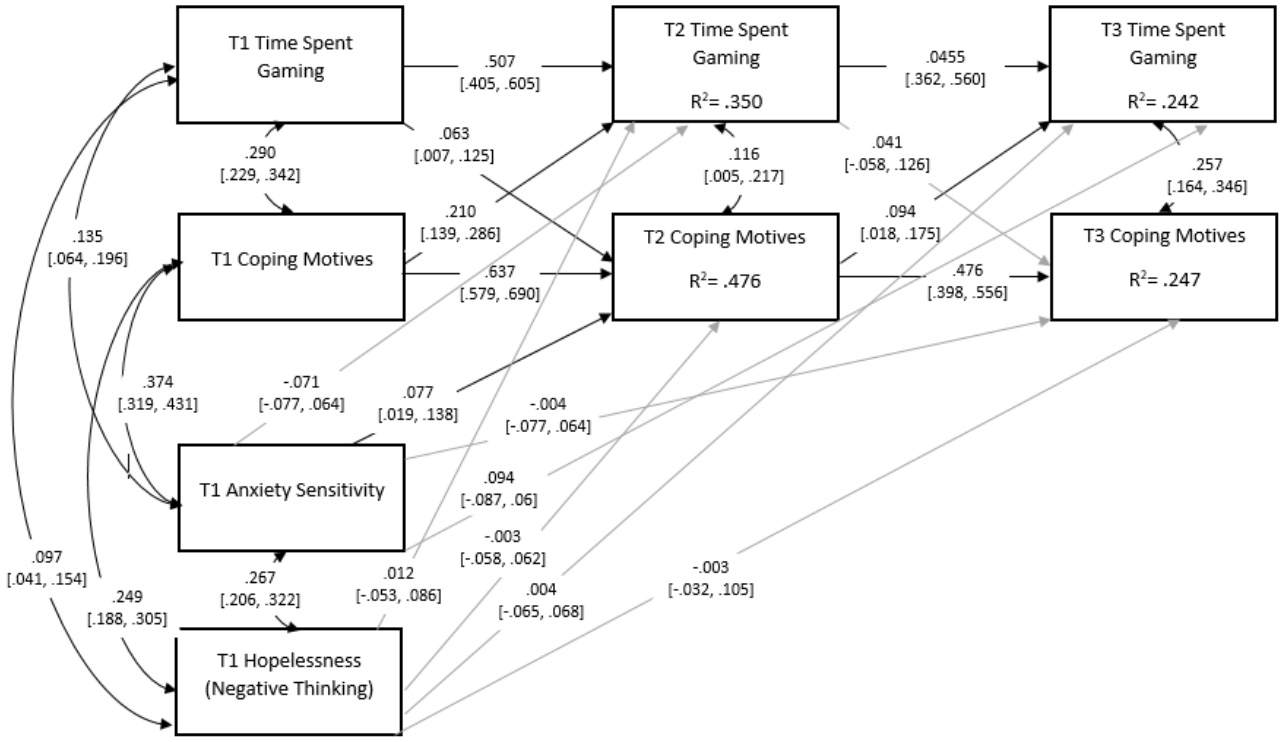
Our model supports an adequate-to-excellent fit based on the fit indices described above: $\chi^2 = 38.807$, $df = 4$, $p = < .001$, $\chi^2/df = 9.70$; CFI = .971, RMSEA = .093, 95% CI [.068, .121], SRMR = .022. It should be noted that although the χ^2/df ratio is high, this ratio is also sensitive to larger sample sizes (Alavi et al., 2020). Furthermore, it is

important to acknowledge that a number of df's in our model are quite low, which is problematic pertaining to RMSEA as low df's will often result in inflated RMSEA (Fabrigar et al., 1999; Hu & Bentler, 1999; Kyndt & Onghena, 2014). Given this, the final model was selected based on the comprehensive results across fit indices, given the detrimental impact of low df on RMSEA estimates. The coefficients and 95% CIs for the cross-lagged panel model are shown in Figure 1.

Cross-Lagged Effects

Results showed that Time 1 time spent gaming predicted Time 2 coping motives, β = .063, 95% CI [.007, .125], but this prospective association was not supported from Time 2 time spent gaming to Time 3 coping motives, β = .041, 95% CI [−.058, .126]. In contrast, we did find consistent cross-lagged effects from coping motives to time spent gaming across Time 1 to Time 2, and across Time 2to Time 3. Overall, this suggests that coping motives were a driver of future excessive gaming.

Figure 1. *Cross-Lagged Panel Model of Hopelessness and Anxiety Sensitivity to Time Spent Gaming and Coping Motives*.



Note. Grey arrows represent non-significant pathways, while black arrows denote significant pathways. Standardized estimates are shown with their corresponding 95% bias-corrected bootstrapped confidence intervals. 95% confidence intervals are reported between squared brackets.

There were no significant direct effects from Time 1 anxiety sensitivity to Time 3 coping motives or Time 3 time spent gaming. As hypothesized, we observed a mediational effect from Time 1 anxiety sensitivity to Time 3 time spent gaming, via Time 2 coping motives, β = .007, 95% CI [.001, .021]. We did not find support that hopelessness was associated with concurrent or future coping motives or time spent gaming.

Invariance Testing

The invariance of the proposed model was tested across sex (male vs. female; see Table 4). The model fit the data well for males and for females.

Table 4. *Invariance Testing by Sex: Model Fit Information*.

Model Type	Chi-square	*df*	*p* value	CFI	RMSEA	SRMR	Chi-square difference	*df*	*p* value	CFI difference
Sex										
Overall	38.807	4	< .001	.971	.093	.022				
Males	32.497	5	< .001	.954	.090	.023				
Females	20.701	5	< .001	.971	.078	.023				
Configural	44.38	8	< .001	.969	.097	.024				
Path Invariance	53.198	20	< .001	.971	.059	.029	8.818	12	0.718	.002

Discussion

This study is the first to longitudinally examine how anxiety sensitivity and hopelessness are prospectively related to time spent gaming during the COVID-19 pandemic, and the coping motivations that underlie that relationship. Overall, we found evidence for the hypothesis that coping motivations for gaming were a predictor of future excessive gaming for those with relatively higher anxiety sensitivity in our sample. Hopelessness was correlated with time spent gaming and coping motivations at baseline, but no longitudinal associations were supported in the data.

These findings are consistent with previous research, showing that those who report higher levels of anxiety sensitivity also tend to demonstrate elevated gaming behaviours (Kahraman & Yertutanol, 2021; Taş, 2019). Furthermore, these findings are consistent with previous literature showing that individuals who are higher in anxiety sensitivity are more likely to report coping motivations for gaming (Biolcati et al., 2021). Previous research has shown that individuals who experience higher levels of anxiety sensitivity are particularly at-risk for experiencing symptoms of anxiety and were disproportionately affected by the COVID-19 pandemic (Panteli et al., 2022). The current study's findings help to explain this association by providing a directional aspect to the relationship, showing that that higher levels of anxiety sensitivity seem to prompt gamers to use video games as a coping mechanism for their emotional discomfort during the COVID-19 pandemic.

While coping motives were identified as a predictor of future excessive gaming in individuals with elevated anxiety sensitivity, this relationship did not hold longitudinally for the personality trait of hopelessness. Hopelessness has been shown in previous studies to be associated with gaming-related problems (Biolcati et al., 2021; Chen et al., 2021; Yu et al., 2023); however, in the current study, gaming was measured only through time spent gaming. It is possible that this measurement of time spent gaming was not specific enough to capture this relationship. In contrast, those with higher anxiety sensitivity were likely excessively anxious, and therefore may have engaged in more time gaming during the pandemic, whereas those higher in hopelessness may have engaged in gaming more episodically. Unfortunately, as gaming problems were not specifically measured, it is not possible to disentangle this possibility; however, this is an area for future research.

It is also possible that for those higher in hopelessness, gaming was used as a means of escape, rather than a means of coping. A study by Biolcati et al. (2021) examined personality traits, including anxiety sensitivity and hopelessness, in relation to gaming motives and Gaming Disorder. The research included 627 Italian gamers and employed some similar questionnaires (SUDS, IGDS-SF9), along with a different gaming motives questionnaire, the Motives for Online Gaming Questionnaire (MOGQ). The results revealed that hopelessness predicted escape, recreation, and fantasy motives but not coping motives, whereas anxiety sensitivity predicted coping, escape, and fantasy motives. These results parallel the findings of the current study, where only anxiety sensitivity was linked to coping motives.

It is worth noting that Biolcati et al. (2021) employed the MOGQ, which distinguishes coping and escape motives as separate categories, potentially providing more detailed insights into gaming motives. The lack of significance in predicting coping motives related to hopelessness could be related to the possibility that individuals higher in hopelessness may use gaming as an avoidant coping strategy (escape), rather than actively addressing their negative emotions (coping). It may be that the gaming motive questionnaire used in the current study was not able to capture this important differentiation. Furthermore, given that there was an initial relationship found between hopelessness and time spent gaming at baseline, it may be that individuals higher in hopelessness turned to gaming as a means to cope with their emotional distress in the short term, but may have been motivated to

game for other reasons, such as escape, fantasy, or recreation in the long term that our questionnaire was unable to capture (Fazeli et al., 2020; Liu et al., 2018) Future research should delve into this relationship, particularly in the context of escape versus coping motives in individuals with elevated hopelessness.

The results of the present study can be understood through the self-medication hypothesis in which individuals who are higher in anxiety sensitivity may game excessively as a way to cope with those negative emotions and sensations (Balhara et al., 2018; González-Bueso et al., 2018; Hallauer et al., 2021; King & Delfabbro, 2016; Liu et al., 2018; Vadlin et al., 2016; Wartberg et al., 2017). Within the context of the COVID-19 pandemic, studies have found support for this self-medication hypothesis with regards to a number of addictive behaviours including video game and smart phone use (Menendez-Garcia et al., 2022), alcohol use (Wardell et al., 2020), substance use (Schimmenti et al., 2022), and gambling (Cardwell et al., 2022). This study therefore adds to the wealth of literature supporting the self-medication hypothesis, while also adding to the literature surrounding the COVID-19 pandemic which has previously found that those who experience heightened anxiety are more likely to engage in excessive gaming behaviours (Rozgonjuk et al., 2022; Sallie et al., 2021; Xu et al., 2021). The current study's results are unique in describing the directional nature of this established relationship and the role of coping motivations in this relationship Moreover, the mediating relationship was supported in a fully longitudinal test, overcoming the limits of many past studies that have relied on cross-sectional data.

The study's results can also be understood through the I-PACE (Interaction of Person-Affect-Cognition-Execution) model, which posits that addictive behaviours develop through the interaction of predisposing individual factors, along with specific situational triggers (Brand et al., 2016, 2019). The I-PACE model helps to inform the interpretation of our results; in line with the model's principles, the current study found the coping motivations, particularly in individuals with higher levels of anxiety sensitivity, predict future time spent gaming. This aligns with the I-PACE model's focus on the relationship between affective responses, decision making, and the development of habitual behaviours in addictive contexts. The current study also echos the model's perspective on the use of changing coping styles based on prior experiences of gratification along with relief from negative emotionality (Brand et al., 2019). While hopelessness was not found to be associated with coping motives longitudinally, as mentioned above, hopelessness has been previously associated with escape, recreation, and fantasy motives—this may also help to reinforce the I-PACE notion that specific behaviours have the poosibility to lead to diverse emotional outcomes.

The results of this study aids in our understanding of gaming during the COVID-19 pandemic, and how anxiety sensitivity as a stable personality trait may impact gaming behaviours. This understanding could help guide strategies aimed at identifying individuals at risk for problematic excessive gaming, considering those with elevated anxiety sensitivity. Moreover, given this study's findings that excessive gaming seems to be fueled by coping motivations, future research may wish to explore positive coping methods that could help to mitigate the impact of coping motivations on excessive gaming behaviours.

This study had some limitations. Firstly, given that the data came from only one country, the results may not be generalizable to other countries, particularly countries outside of North America. Secondly, although there was a measure of time spent gaming at each time point, this is not necessarily a measure of problematic gaming in and of itself. Many individuals game on a regular basis, or even on an excessive basis, without accompanying symptoms that would make gaming problematic (e.g., distress, disruptions to functioning, etc.). Future studies measuring symptoms of gaming disorder may provide additional information as to how the participants' time spent gaming is impacting their daily functioning and interpersonal relationships. Given that the current study examined only trait-like factors, it would also be worthwhile to track participants' emotional distress over time with measures that have been shown to be sensitive to capturing short-term changes in mood and anxiety. Other studies may wish to examine factors beyond personality that might affect gaming, such as the social or contextual variables associated with the pandemic (e.g., employment status, remote working, living situation). It is also a limitation that for the current study, inferences surrounding the COVID-19 pandemic were made based on the context and timing of the study. As such, we are unable to draw firm conclusions about any COVID-19 specific factors, as they were not included in our model. Finally, the reliance on self-reported data in measuring time spent gaming is a noteworthy limitation of the study. Self-report is susceptible to a number of biases and inaccuracies including memory recall issues, social desirability bias, or the possibility of misrepresenting actual gaming time. As such, the results of this study may be influenced by the inherent limitations of self-reported data, and future research may wish to replicate the study using objective measures of time spent gaming (e.g., tracking software).

Conclusion

The current study examined a specific time period during the pandemic in which lockdown and other measures were being lifted. During this time, many changes were still in effect due to the COVID-19 pandemic, and stress levels remained high for many people (Kastalskiy et al., 2021; Manchia et al., 2022).

These findings aid in our understanding of gaming behaviours and gaming motivations during the COVID-19 pandemic. This longitudinal study not only provides information regarding how anxiety sensitivity relates to time spent gaming during the pandemic, but also how these individuals used gaming as a means to cope with their emotional distress. Understanding these patterns may be valuable for mental health professionals or policy makers in order to better address the emotional needs of individuals during challenging situations, such as pandemics or other difficult events. This study underscores the need for continued research in this area, particularly in determining how gaming habits and motivations evolve over time, especially in response to external stressors. Furthermore, future research should aim to understand how the relationships between anxiety sensitivity, coping motivations, and time spend gaming exist in the context of symptoms of gaming disorder and functional impairments that exist due to excessive gaming.

Conflict of Interest

The authors have no conflicts of interest to declare.

Authors' Contribution

Rebecca E. Lewinson: writing—original draft; writing—review & editing; methodology; data curation; conceptualization; formal analysis. **Jeffrey D. Wardell:** conceptualization; methodology; writing—review & editing. **Joel Katz:** supervision; writing—review & editing. **Matthew T. Keough:** supervision; writing—review & editing; formal analysis; conceptualization; methodology.

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About Authors

Rebecca E. Lewinson is a PhD candidate in Clinical Psychology at York University. Her research interests focus on health psychology, including pain inferences, numerical anchoring, and problematic gaming.

https://orcid.org/0000-0001-7157-2784

Jeffrey D. Wardell is an Assistant Professor of Psychology at York University and a registered Clinical Psychologist with expertise in the assessment and treatment of addictive behaviour. His research seeks to elucidate causes of addictive behaviour, with a particular focus on young adults, people living with HIV, and people who use cannabis for therapeutic purposes.

https://orcid.org/0000-0001-9792-280X

Joel Katz is a Distinguished Research Professor of Psychology and Tier 1 Canada Research Chair in Health Psychology at York University. He is the Research Director of the Pain Research Unit and Lead Researcher of the Transitional Pain Service both in the Department of Anesthesia and Pain Management at the Toronto General Hospital in addition to serving as a Professor in the Department of Anesthesiology & Pain Medicine at the University of Toronto. Dr. Katz's research is aimed, broadly, at understanding the psychological, emotional, and biomedical factors involved in acute and chronic pain.

https://orcid.org/0000-0002-8686-447X

Matthew T. Keough is an Associate Professor in the Department of Psychology. He is a registered clinical psychologist and former Chair of the Addiction Psychology section of the Canadian Psychological Association. He was previously an Assistant Professor in the Department of Psychology at the University of Manitoba (2017 – 2019). Dr. Keough's research focuses on improving understanding of the etiology and treatment of addictive behaviour, including both substance use and behavioural addictions (e.g., problem gambling). Dr. Keough's work is mechanism-focused and is rooted in motivational models of personality and cognitive theory.

https://orcid.org/0000-0001-8567-2874

✉ **Correspondence to**
Rebecca Lewinson, York University, Department of Psychology, Faculty of Health, 4700 Keele St, Toronto, ON, M3J 1P3, lewinsonyork@gmail.com