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Online Gaming Habits and Social Anxiety: Analyzing Playtime, Playstyle, and Symptom Associations

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ABSTRACT: Prior research has observed associations between social anxiety and online gaming habits, with measures of social anxiety correlating positively with playtime and relating to specific playstyles (singleplayer, multiplayer) differently. However, these findings have overwhelmingly focused on small, localized samples, limiting their generalizability. This paper aims to address this limitation by analyzing a large, global sample of survey respondents (N = 12,440) who reported their gaming habits and self-assessed their Generalized Anxiety Disorder 7 (GAD-7) and Social Phobia Inventory (SPIN) scores. Correlation analyses revealed weak but statistically significant associations between gaming hours and anxiety scores, and SPIN item-level analyses showed that this association was strongest among avoidance-related symptoms. Group comparisons displayed clear but modest distinctions across playstyles: the single-player group had the highest SPIN and avoidance item scores, while the multiplayer group with real-life friends had the lowest. Network models (correlation and bipartite) visually reinforced these results, while displaying their small effect sizes. Findings suggest that online gaming habits are linked to social anxiety, especially avoidance symptoms, yet account for little variance in each. Limitations include self-reported data, overrepresentation of Western participants, and cross-sectional design. Future research should prioritize longitudinal design and unbiased sampling to establish causal relationships and improve generalizability.

KEYWORDS: Social and Behavioral Science, Psychology, Social Anxiety, Online Gaming, Network Analysis.

Introduction

Online gaming has become a widespread phenomenon over the past few decades, with individuals (particularly adolescents) often spending multiple hours each day engrossed in online worlds. The adverse effects of excessive online gaming have been the subject of widespread research, but there is still significant exploration to be made. This paper focuses on one of these effects, social anxiety (i.e., social phobia), an intense fear or anxiety about social or performance situations involving possible scrutiny, leading to avoidance or distress.[1] Prior research has suggested that positive associations between social anxiety and online gaming do exist, particularly regarding playtime,[2] withdrawals,[3] and addictive or problematic use.[4,5] In addition, different "social playstyles" of gaming (e.g., singleplayer, multiplayer with strangers, multiplayer with friends) have been found to associate differently with measures of social anxiety.[6,7] However, most of these explorations have lacked global scope, while failing to address specific symptoms of social anxiety, potentially obscuring the inner workings behind any general associations. This paper aims to fill these gaps in research by using a large, global dataset to analyze measures of social anxiety, including specific symptoms, against online gaming habits, including different playstyles. This study employs network models, which represent systems of variables as interconnected elements (nodes and edges),[8] recently becoming an important tool in psychology for their ability to capture mutual reinforcement among behavioral symptoms.[9] By employing correlation and bipartite networks to visualize symptom-level associations with gaming playtime and playstyles, this paper aims to investigate the underlying behaviors that dictate anxiety-gaming associations. Hence, the following research questions will be addressed: 1) How is online gaming playtime associated with reports of social anxiety and its symptoms? and 2) How are different playstyles of online gaming – singleplayer, multiplayer with strangers, multiplayer with online acquaintances or teammates, and multiplayer with real-life friends – differently associated with the measures and symptoms of social anxiety?

Literature Review:

Social Anxiety:

Social anxiety is a common human experience characterized by an intense and persistent fear of being evaluated, judged, or scrutinized in social situations. When it reaches a level of severity such that basic social functioning is highly impaired or impossible, it is referred to as Social Anxiety Disorder (SAD).[10] According to DSM-5,[1] the diagnostic criteria of SAD include but are not limited to: significant fear or anxiety about social situation(s) in which the individual is exposed to scrutiny; fearing that they will be judged for their anxiety symptoms; social situations almost always provoking fear or anxiety; social situations being avoided or endured with strong fear or anxiety; and the anxiety being disproportionately greater than the actual threat posed by the situation. For diagnostic criteria to be met, children's symptoms of anxiety must occur in peer settings rather than only in interactions with adults. Additionally, the duration of SAD symptoms must be greater than 6 months for a diagnosis to be considered; otherwise, the symptoms may be more indicative of common social fears.[1]

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The prevalence of SAD varies from 7.1% to 18.7% depending on the level of interference/distress required for diagnosis.[11] SAD is also thought to have a greater prevalence among adolescents and young adults.[12] In a study consisting of people aged 16-29, 36% met the criteria for SAD.[12] Retrospective data taken from adults with SAD indicate that the mean age of onset is in mid-adolescence.[13] However, SAD can be identified in children as young as 8 years old.[13] SAD's age of onset has been investigated to understand how it affects psychiatric and mental health outcomes later in life.[14] Researchers used data from Wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions, and identified four groups of participants based on SAD onset age. Childhood onset (<12 years, N = 658), adolescence onset (12-17 years, N = 663), early-adulthood onset (18-39 years, N = 663), late-adulthood onset (>39 years, N = 415), and a control group with no history of SAD (N = 32,205). It was concluded that a later onset of SAD was associated with poorer mental health outcomes and diminished quality of life, though earlier-onset individuals seek help for anxiety symptoms less frequently.[14]

Online Gaming:

Digital gaming refers to playing games that are enabled or run by digital technologies, including consoles, mobile devices, desktop computers, and other electronic systems. Online gaming is the most popular form of digital gaming, enabled by modern communication technologies and taking place on internet-based platforms. Online games place players in virtual environments, and can be played individually or with other players.[15] Many players enjoy the competitive nature of online games, while others seek an escape from reality, and others cherish the opportunities for social interaction provided by multiplayer options. Among the many types of online games are: puzzle, logic, and card games; action, strategy, and sports games; casual and social games; and persistent multiplayer universe games. Importantly, Massively Multiplayer Online Role-Playing Games (MMORPGs) are an incredibly popular category of online gaming, allowing players to assume a new identity and interact with others in a "realistic" yet fantastical setting. Players are enticed to return to these games by the roles and stories they experience within them, in a place different from the one they physically occupy.[15]

The prominence of online gaming was analyzed during an investigation into Internet Gaming Disorder, where adults of varied ages were surveyed regarding their usage of online games.[16] Four investigations were conducted, consisting of young adults 18-24 years old from the United States (N = 1,247), adults 18 years and older from the United Kingdom (N = 1,899), young adults aged 18-24 from the United Kingdom, United States, Germany and Canada (N = 10,009), and adults aged 18 and older from the United States (N = 5,777). The 4 investigations found recent online gaming participation rates of 86.3%, 85.2%, 80.6%, and 64.6%, respectively.[16] These results suggest that online gaming is extremely common among adults, particularly young adults. However, these investigations only considered individuals located in highly developed Western countries; in less developed or culturally different environments, online gaming may be less common.

As online gaming has spread to greater shares of the population, it has come with several adverse effects. Excessive online gaming can pose a serious threat to one's mental health, relationships, education, work, and even hobbies.[17] Gamers may become preoccupied with gaming, constantly thinking about gaming even when they are offline, resulting in other areas of life (social, educational, etc.) being neglected as gaming becomes one's greatest priority. Additionally, online gaming can cause people to lose interest in other activities or hobbies, as their sole point of fascination becomes the game. Individuals may show great interest and passion in sports or arts, but gaming can cause them to withdraw from these interests completely. Excessive online gaming can also cause social withdrawal, as a once outgoing individual may become isolated to spend more time on their game. Finally, individuals (particularly adolescents) who game excessively may develop anger issues and become extremely defensive about problematic gaming use. When parents or partners attempt to intervene, the individual may become angry, irrational, or even violent. The drug-like "high" provided by achievements and status in-game may exacerbate these issues, inflating one's ego and making them feel powerful.[17]

Associations Between Online Gaming and Social Anxiety:

Given that excessive online gaming has been linked to a myriad of adverse effects, particularly mental health issues, the associations between online gaming habits (playtime and playstyle) and social anxiety have been subject to significant research. In one study, the association between mobile game addiction and mental health difficulties such as depression, loneliness, and social anxiety among adolescents was examined via questionnaire.[4] The study consisted of students (N = 578; mean age = 15.0) in 7th, 8th, and 9th grades in Guizhou Province, China. Results showed that adolescents with mobile game addiction had higher rates of social anxiety, depression, and loneliness, likely due to increased social isolation as a result of excessive gaming use.[4] In another investigation, researchers in Northern Taiwan examined the associations between heavy online game use and social anxiety among college students (N = 174, mean age = 19.09).[2] Each student completed a questionnaire consisting of three sections: the individual's frequency and time spent on online games, the quality of their interpersonal relationships, and their social anxiety. Analysis of the responses revealed that as the amount of time spent playing online games increased, social anxiety levels increased, establishing a clear relationship between playtime and anxiety for this particular sample.[2] Next, a study from Northern Italy analyzed online gaming and mental health effects among schoolchildren.[3] A survey measuring video game use, social anxiety, and clinical outcomes was administered to 359 children attending primary, secondary, and high schools in Northern Italy (mean age = 12.81). Results showed that individuals with social anxiety had stronger withdrawal symptoms from video games.[3] Although this does not explicitly establish an association between the volume of online gaming and measures of social anxiety, the

presence of heightened withdrawal symptoms may be indicative of frequent or prolonged gaming use, suggesting that the socially anxious children were engaging in greater amounts of online gaming. Importantly, each of these three studies analyzed data from a homogeneous sample in a single location – Chinese middle school students, Taiwanese college students, and Northern Italian schoolchildren, respectively. As a result, their findings cannot be generalized to broader populations of online gamers, as differences in cultural norms and development across borders are likely to impact reports of gaming habits and social anxiety.

Another related study investigated pathological internet use, social anxiety, and expressions of true self in-game as predictors of problematic gaming use.[5] Data was collected from adult MMORPG players via an online survey (N = 626). Results indicated that social anxiety and a need to express one's true self in-game were predictors of problematic gaming use.[5] While these observations add to the numerous findings suggesting that social anxiety and excessive gaming are linked, they may also be indicative of online gaming's relationship with specific anxiety symptomatology: a need to express one's true self in-game may come from individuals fearful of judgment in real-life interactions. Authentic self-expression was found to predict problematic gaming use, suggesting that a fear of judgment or negative evaluation is a specific symptom of social anxiety associated with excessive online gaming. Although this particular study was not localized, the sample was limited to MMORPG players. Thus, these results cannot be generalized to the various other forms of online gaming, which may have different relationships with the predictors analyzed by this study.

Finally, a 2022 systematic review of 26 empirical studies analyzed the role of avoidance (an important symptom of social anxiety) as a motivator in problematic online gaming.[18] Consistent patterns in analyses revealed that avoidance and escapism were significant predictors of excessive online gaming, directly supporting the notion that increased online gaming associates with avoidance-based symptoms of social anxiety.[18] However, the majority of the items in this review focused on clinical and at-risk samples, potentially introducing bias as already-problematic gamers were the main focus of analysis, rather than online gamers as a whole.

Online Gaming and Social Anxiety Across Playstyles:

In addition to the time one spends on online games, specific playstyles of online gaming (singleplayer, multiplayer with strangers, multiplayer with friends) have been observed to associate differently with social anxiety symptoms and outcomes. A 2021 study investigated the effects of single-player gaming and multiplayer gaming on mental health during the COVID-19 pandemic.[6] Researchers posted a questionnaire on various online forums, in which voluntary participants (N = 260) shared their playing habits as well as details about their psychosocial well-being. Participants who predominantly engaged in multiplayer games (N = 128) reported being motivated to play for socialization purposes. However, motivations for single-player participants (N = 132) included anxiety and stress reduction, as well as general escapism. These contrasting findings suggested that online gaming playstyles may be associated with different psychological profiles. Multiplayer gamers value stronger social engagement, and thus potentially have lower social anxiety, while singleplayer gamers feel the need to escape anxiety-related issues in their daily life, suggesting that singleplayer gaming is a greater indicator of social anxiety. The same study also found that certain playstyles may be associated with distinct symptoms of social anxiety. Singleplayer gamers emphasized escapism and avoiding real life as major motivators, suggesting that specifically avoidance-based symptoms of social anxiety may be more closely associated with singleplayer gaming.[6] This study was limited to a relatively small sample size of 260 respondents during the COVID-19 pandemic, and did not explicitly investigate associations with social anxiety and its symptoms, making these results difficult to generalize.

Next, a 2016 study surveyed World of Warcraft players (N = 161) in order to examine how social anxiety and loneliness differ for players while in-game versus real life.[7] The study reported that individuals had significantly lower levels of social anxiety while playing online games than in their daily life. Importantly, this effect was especially pronounced among players who displayed stronger interactions with others in-game by engaging with friends, partnering with guild members, and using voice chat.[7] This implies that multiplayer gaming with strong social connections may be associated with reduced social anxiety compared to multiplayer gaming without such strong aspects of socialization. However, this study aimed to compare virtual symptoms and real-life symptoms, and did not explicitly explore the connection between online gaming and overall social anxiety, making the associations drawn an extrapolation from different conclusions. Additionally, the study was limited to a small sample size of 161 individuals, making it difficult to create generalizations.

Introduction to Network Models:

To complement numerical results, this paper employs network models (NMs) to visualize how symptom scores are associated with gaming playtime and playstyles. In particular, the models clarify the comparative strength of those associations, highlighting the relative importance of anxiety symptoms and gaming habits.

NMs provide a mathematical and graphical framework for representing systems of variables as interconnected elements. Rather than analyzing individual variables, NMs emphasize relationships between elements, allowing for complex relationships to be visualized in intuitive ways. In NMs, units of interest are represented as nodes, while edges capture associations between them.[8] Edges may be binary (presence of association) or weighted (strength of association) and may be directional or lacking in direction depending on the context. This structure has allowed researchers to examine centrality (which nodes are most influential) and clustering (which nodes group together). Inferences are also often made solely based on edge weights, which are an effective visual for association strengths between variables.[8]

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In psychology and psychiatry, NMs have become a subject of great interest. Borsboom and Cramer's 2013 paper argued that mental disorders can (and often should) be conceptualized as networks of interacting variables (symptoms) rather than as indicators of individual factors or measures.[9] This approach highlights that psychological problems often result from a "network" of self-reinforcing interactions between symptoms. For example, avoidance behaviors leading to social isolation and reinforcing fears of judgment, which in turn amplify social anxiety, which in turn may lead to even more avoidance. By analyzing these phenomena using NMs, researchers can identify central symptoms and thus effective intervention targets.

The types of NMs relevant to this paper's analysis are correlation networks and bipartite networks. In correlation networks, edges represent statistical associations between variables, and are most often weighted but undirected. Additionally, nodes with stronger associations are often pulled closer together, allowing proximity to be used as a visual indicator of association strength between variables, though precise statistics remain in the edge weights rather than the distances themselves. This provides a clear visualization of cross-variable relationships and often creates clusters of strongly-correlated nodes.[19] In this study, such networks show the relative strength of associations between social anxiety symptoms and playtime to clarify each symptom's role in gaming-anxiety relationships. Furthermore, clustering visualizes playtime's integration in the symptom network, displaying the strength of its correlation with social anxiety.

Next, bipartite networks contain two distinct sets of nodes (e.g., individuals and symptoms, behaviors and outcomes, treatments and results) with weighted edges connecting items between sets but not within them. This makes bipartite networks effective for visualizing patterns of association across categories and for revealing whether certain groups (individuals, behaviors) are consistently associated with particular outcomes.[20] In this paper, a bipartite network compares different gaming playstyles in relation to avoidance-related anxiety symptoms, clarifying whether some playstyles tend to be linked to higher or lower levels of avoidance across items rather than to any single symptom.

The importance of NMs lies in their ability to visualize interconnected patterns, clarifying which variables are central and which are not. Traditional regression-based approaches tend to treat predictors as independent, but psychological processes often arise from mutually reinforcing dynamics, making NMs a valuable tool in psychological and behavioral analyses.

Present Study:

Prior research has indicated several relationships between online gaming playtime and social anxiety: studies found that measures of social anxiety associated positively with gaming playtime,[2] gaming withdrawal symptoms,[3] and excessive or addictive gaming.[4, 5] Additionally, a systematic review of various empirical papers found that excessive online gaming predicted avoidance behaviors,[18] which are symptomatic of social anxiety.[1] Finally, a study on MMORPG players reported that in-game expressions of one's true self were deemed a significant predictor of problematic gaming use,[5] which may indicate that anxiety symptoms relating to a fear of negative evaluation or judgment are associated with heightened playtime. Except for the systematic review, each of these studies relied on small, homogeneous samples, making their results difficult to generalize. Data taken from individuals in one specific location have been influenced by distinct cultural and socioeconomic factors, which likely differ from those of other locations, and data taken from individuals who play one specific type of game have not accounted for potential differences in psychological profiles across genres. The aforementioned systematic review was conducted on a much larger scale, but focused primarily on at-risk and clinical samples,[18] and is thus unlikely to apply to any larger population of online gamers.

Existing literature has also suggested several differences in social anxiety across gaming playstyles: a 2021 study of online gamers during the COVID-19 pandemic found that multiplayer gamers were primarily motivated to play for socialization purposes,[6] suggesting that they may embrace social engagement and experience lower levels of social anxiety. On the other hand, singleplayer gamers sought to avoid real life, reduce anxiety, and cope with stress,[6] not only indicating that they experience heightened social anxiety but also that they tend to avoid. This investigation involved a small sample of 260 participants and was conducted during the COVID-19 pandemic,[6] during which lockdowns and other isolating policies may have had an effect on reports of social anxiety, making its results difficult to generalize to all online gamers. Finally, a 2016 study of World of Warcraft players addressed differences in anxiety within multiplayer playstyles based on the amount of socialization present.[7] In general, players reported significant reductions in anxiety when gaming in comparison to their daily life, but this effect was especially pronounced for gamers who engaged with social aspects of the game, such as voice chat and guild activities,[7] potentially indicating that multiplayer gaming with stronger social connections is associated with reduced social anxiety. However, this study focused solely on World of Warcraft players, and its results may not be representative of multiplayer online gamers as a whole.

Given the existing research and its limitations, this paper aimed to address the observed associations between online gaming habits and measures of social anxiety using a large, global, and otherwise varied dataset, so that results can be generalized to a broader population of online gamers. Four hypotheses were constructed based on the literature:

Hypothesis 1: Online gaming playtime is positively associated with measures of social anxiety.

Hypothesis 2: Levels of social anxiety differ systematically across playstyles, with the following descending order: singleplayer, multiplayer with strangers, multiplayer with acquaintances/teammates, and multiplayer with real-life friends.

Hypothesis 3: Online gaming playtime correlates differently with distinct symptoms of social anxiety, and this correlation is strongest among symptoms relating to avoidance and fears of negative evaluation.

Hypothesis 4: Singleplayer gaming is most strongly linked to avoidance-based symptoms of social anxiety in comparison to other playstyles.

Methods

Participants:

Participants (N = 13,646; 94% male) aged 18-63 (M = 20.39) responded to the survey. Participants' geographical location ranged across 109 different countries, with most coming from the USA (33%), Germany (10%), the United Kingdom (7%), and Canada (7%).

Design:

The survey consisted of six parts; the three relevant for this paper's analysis included the dependent variables: the Generalized Anxiety Disorder 7 (GAD-7) scale and the Social Phobia Inventory (SPIN) as well as the independent variables: questions regarding the respondent's gaming habits, including estimated average playtime per week and preferred playing style (singleplayer, multiplayer with strangers, multiplayer with acquaintances, multiplayer with real-life friends, etc.).

Measures:

The Generalized Anxiety Disorder (GAD-7) scale was used in the survey to measure the anxiety level of the respondent. The scale is composed of 7 statements, scored 0-3 by the participant, whose scores are summed to determine their anxiety level, ranging from a sum of 0 (no anxiety) to 21 (severe anxiety).[21] The initial prompt asks the respondent, "Over the last 2 weeks, how often have you been bothered by the following problems?" The 7 statements that follow encompass symptoms of Generalized Anxiety Disorder, including nervousness, feeling on edge, restlessness, fear, and difficulty controlling worries. A score of 0 denotes "not at all", 1 denotes "several days", 2 denotes "more than half the days", and 3 denotes "nearly every day". Scores of 5, 10, and 15 correspond to cutoffs for mild, moderate, and severe anxiety disorder. The GAD-7 scale is primarily strong in assessing generalized anxiety disorder, with a sensitivity of 89% and specificity of 82% at a cutoff score of 10. However, it also performs well at screening for SAD, with an overall sensitivity of 72% and specificity of 80%. The scale has been affirmed as a valid tool for screening in the general population, with high internal consistency.[21]

The Social Phobia Inventory (SPIN) was used in the survey to measure the social anxiety levels of the participants – a much more sensitive measure for SAD and for each individual's social anxiety in general.[22] The scale assesses fear, avoidance, psychological arousal, and other symptoms of SAD for the week prior to the test. A 5-point scale (0-4) is used for 17 items measuring how bothered the respondent was by specific problems – these problems include fears of authority, fears of parties, avoidance of strangers, avoidance of speeches, etc. These scores are summed out of a maximum of 68, and the level of social anxiety is determined based on the results as follows: 0-18 points is interpreted as "none"; 19-30 points as "mild"; 31-40 points as "moderate"; 41-50 points as "severe"; and 51-68 points as "very severe".[22]

Procedure:

Data were collected by Marian Sauter in 2017, while the dataset's manuscript was procured by both Sauter and Dejan Draschkow.[23] Sauter aimed to allow for more powerful investigation into associations between gaming habits and psychological well-being by creating and publishing, to his knowledge, the largest openly accessible dataset measuring mental health in video game players. To achieve this, Sauter implemented the GAD-7, SPIN, basic demographical information, and questions regarding online gaming habits into a questionnaire; though not relevant to this study, his survey also included the Single Item Narcissism Scale (SINS) and the Satisfaction With Life Scale (SWLS). Sauter posted the questionnaire via Google Forms on various Reddit gaming communities where participants voluntarily responded, particularly from the /r/leagueoflegends community. All responses were self-reported by participants, who evaluated themselves on the various scales and measures provided by the survey. Participants responded anonymously, and no compensation was offered.[23]

Materials:

The dataset was sourced from a Kaggle post made by Divyansh Agrawal in August of 2020.[24] As mentioned previously, the original data were collected by Sauter and Draschkow in 2017; Agrawal's Kaggle listing simply republishes the dataset, explicitly crediting Sauter and Draschkow.[24] For this paper, the original search for a suitable dataset was conducted on Kaggle, which is why Agrawal's data was used rather than the original; his post contains no changes from the original dataset.

Initially, the dataset contained 55 columns and 13,464 rows. Columns not relevant to this study (e.g., Age, Game, Platform, Earnings) were removed prior to analysis. Next, rows with incomplete or impossible data were removed; these included two samples that reported over 168 hours of gaming per week, and 689 samples with incomplete SPIN data. The 689 samples removed did not meaningfully affect analysis, as their reported weekly hours and anxiety scores did not differ from the rest of the data in any statistically significant way.

The playstyle category had 5 common responses: "Multiplayer – online – with real life friends", "Multiplayer – online – with online acquaintances or teammates", "Multiplayer – online – with strangers", "Multiplayer – offline (people in the same room)", and "Singleplayer". Additionally, 287 samples had provided written responses rather than choosing from these 5 options. Since these samples cannot be analyzed for their playstyles, and their hours/anxiety results were not significantly different from the rest of the data, they were removed prior to analysis. Finally, the offline multiplayer group consisted of only 46 samples, which were also removed, as this category was not relevant to this paper's analysis. After cleaning the data to remove incompleteness, 12,440 samples remained and were used for the study.

This study's analyses were conducted in Python. All NMs were created by Python's NetworkX library.[25]

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Results and Discussion

Participants (N = 12,440 after cleaning) reported an average of 21.4 hours of online gaming per week (SD = 13.3) and mean scores of 5.2 and 19.9 on the GAD-7 and SPIN, respectively, as shown in Table 1.

Table 1: Descriptive statistics. Participants reported an average of 21.4 weekly hours of online gaming, with mean scores of 5.2 on the GAD-7 and 19.9 on the SPIN.

Variable of Interest	Mean	SD	Max
Hours Played per Week	21.42	13.30	100
GAD-7 Score	5.19	4.69	21
SPIN Score	19.87	13.46	68

Weekly Hours and Total Anxiety Scores:

Pearson correlations revealed a weak but statistically significant positive association between weekly online gaming hours and total GAD-7 scores ($r = 0.099$, $p < 0.001$) as well as total SPIN scores ($r = 0.102$, $p < 0.001$). Spearman correlations yielded slightly weaker but otherwise similar results ($\rho = 0.068$ and $\rho = 0.091$, $p < 0.0001$), as shown in Table 2.

Table 2: Pearson and Spearman correlations between weekly gaming hours and total GAD-7/SPIN scores, along with p-values for each. Both Pearson and Spearman results show weak but statistically significant positive associations between weekly gaming hours and total GAD-7 and SPIN scores.

Variable of Interest	Pearson *r*	Pearson *p*-Value	Spearman *ρ*	Spearman *p*-Value
Total GAD Score	0.099	<0.001	0.068	<0.001
Total SPIN Score	0.102	<0.001	0.091	<0.001

Playstyles and Total Social Anxiety Scores:

Next, because differences between online gaming playstyles were of interest (hypothesis 2), total SPIN scores were compared across playstyles (Figure 1). Welch's t-tests were used to identify statistically significant differences between "consecutive" playstyles as they were described in hypothesis 2. Singleplayer participants reported the highest social anxiety scores (M = 22.1, SE = 0.5), scoring significantly higher than individuals who primarily played multiplayer online games with strangers (M = 20.5, SE = 0.2; Δ = 1.67, p = 0.003). Anxiety scores for the strangers group and the acquaintances/online teammates group were nearly identical (M = 20.5 vs. 20.6, respectively), and their difference was not statistically significant (p = 0.745). Finally, online gamers who primarily played with real-life friends scored significantly lower than those who played with acquaintances, and this result was statistically significant (M = 18.8 vs. 20.6, respectively; Δ = -1.80, p < 0.001). These findings revealed a clear gradient in social anxiety severity by playstyle, with single-player highest, followed by strangers and acquaintances/teammates (near-identical), and real-life friends lowest.

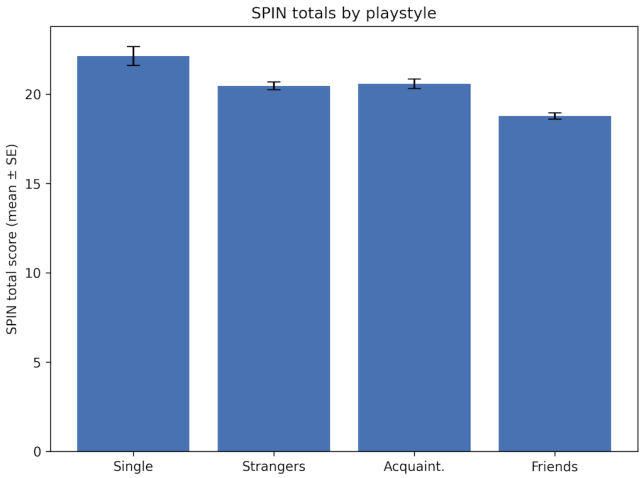

Figure 1: Mean SPIN scores for each gaming playstyle with standard error bars. "Single", "Strangers", "Acquaint.", and "Friends" corresponded to singleplayer, multiplayer with strangers, multiplayer with online acquaintances or teammates, and multiplayer with real-life friends, respectively. Mean SPIN scores followed a clear gradient by playstyle, with singleplayer highest and multiplayer with real-life friends lowest.

Weekly Hours and Symptoms of Social Anxiety:

Next, since weekly playtime's association with specific symptoms of anxiety (avoidance, fears of negative evaluation) was of interest, Pearson correlations were calculated for each SPIN item with regard to weekly gaming hours (Table 3), providing symptom-specific associations with playtime. SPIN items denoting avoidance of parties and avoidance of speeches (8 and 11, respectively) yielded the strongest correlations. In addition, SPIN items 9 (avoidance of situations where the individual is the center of attention), 6 (avoidance of embarrassing interactions/activities), 14 (fear of doing things when others may be watching), and 4 (avoidance of strangers) were the next most correlated items, respectively.

Importantly, every avoidance-related symptom (SPIN 4, 6, 8, 9, 11) except SPIN 16 was present among the 6 strongest links to weekly hours. However, symptoms of fearing negative evaluation (SPIN 5, 12) were further down the rankings (see Table 3). All correlations were statistically significant ($p < 0.001$) except SPIN 1, which appeared to have no meaningful association with weekly hours.

Table 3: Pearson correlations between weekly gaming hours and scores (0-3) for each SPIN item, ordered by the strength of the association. Shortened descriptions of each SPIN item were included. Avoidance-related SPIN items showed the strongest correlations with weekly gaming hours. Overall, the item-level correlations remained small.

SPIN Item	Shortened SPIN Description	Correlation With Weekly Hours (*r*)	*p-Value*
8	Avoids parties	0.104	<0.001
11	Avoids giving speeches	0.096	<0.001
9	Avoids being the center of attention	0.082	<0.001
6	Avoids interactions or activities for fear of embarrassment	0.080	<0.001
14	Fears doing things while being observed	0.079	<0.001
4	Avoids speaking to strangers	0.074	<0.001
15	Greatly fears embarrassment and looking stupid	0.072	<0.001
3	Fears parties and social events	0.072	<0.001
13	Bothered by heart palpitations when around others	0.071	<0.001
12	Would do anything to avoid criticism	0.070	<0.001
16	Avoids speaking to authority	0.066	<0.001
7	Distressed by sweating in front of others	0.063	<0.001
10	Fears speaking to strangers	0.060	<0.001
17	Distressed by trembling or shaking around others	0.057	<0.001
5	Greatly fears being criticized	0.031	<0.001
2	Bothered by blushing in front of others	0.028	0.002
1	Fears authority	0.006	0.522

Figure 2 complements the tabular results. Avoidance nodes tended to cluster closely around the "Hours" node, while other nodes were farther away, providing a clear visual of weekly playtime's stronger link to avoidance. However, Figure 2's edge weights and colors were fairly uniform, suggesting that all correlations with weekly hours are fairly weak, even among avoidance items.

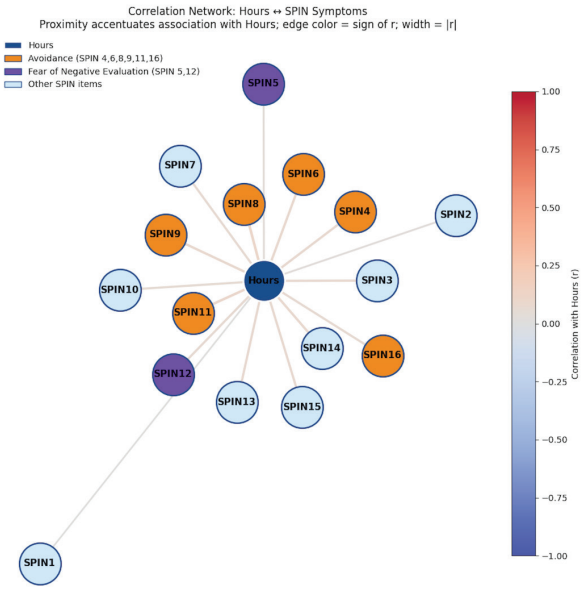

Figure 2: Correlation network including weekly hours and SPIN symptoms. Playtime ("Hours") was centered, and only comparisons involving hours were included in the analysis. Edges were weighted and color-coded by the sign and magnitude of each correlation, and nodes were color-coded by category (hours, avoidance symptoms, negative evaluation symptoms, and others). Proximity differences were also based on association strength, but did not precisely convey any underlying statistics, and were present for purely visual purposes. Avoidance symptoms are positioned closer to the "Hours" node than other symptoms, reflecting comparatively stronger associations with weekly playtime. The edges remain relatively uniform and faint overall, consistent with weak correlations.

Figure 3 illustrates the comparative strength of weekly hours in the network of social anxiety symptoms: the weekly hours node was positioned far from the dense symptom cluster, and its near-colorless edges contrasted with the symptom cluster's mostly red (positive and large) associations. This provides a clear visual representation of playtime's weak correlation with social anxiety, especially when compared to the reinforced symptom cluster, supporting the view that external factors were likely of greater importance when predicting social anxiety scores and symptoms.

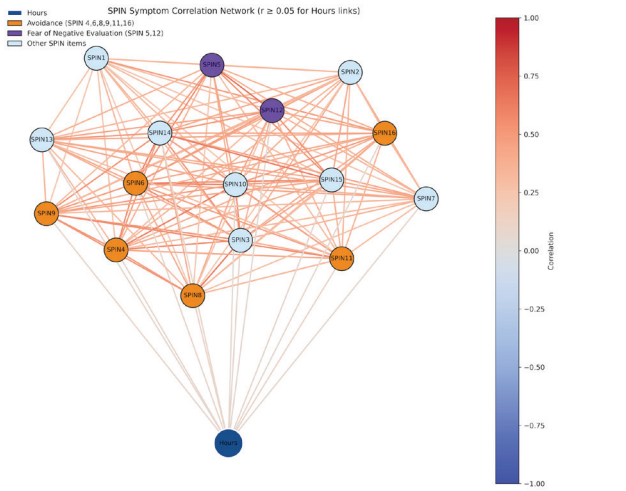

Figure 3: Correlation network including weekly hours and SPIN symptoms. All comparisons were present, including comparisons between symptom nodes. Color-coding for edges and weights remains the same as Figure 2, and similar proximity effects are present. To avoid cluttering, edges involving the "Hours" node were only included if their strength was greater than 0.05. The "Hours" node is distant from the dense symptom cluster, showing that weekly playtime is weakly connected compared to cross-symptom associations.

Playstyles and Symptoms of Social Anxiety:

Because avoidant behaviors were of particular interest (hypothesis 4), the next analysis once again focused specifically on the six SPIN items related to avoidance: SPIN 4, 6, 8, 9, 11, and 16. To account for variations in anxiety due to weekly playtime, each item was residualized by regressing on weekly hours. The resulting residuals represented each item's deviation from its expected score based on weekly playtime alone (Table 4). These residuals were then averaged, summarizing each playstyle's association with the 6 avoidance-based symptoms. Singleplayer participants not only yielded the highest mean residual but also had the highest residuals for every single individual item, showing a consistent association between singleplayer gaming and avoidance issues compared to other playstyles. Conversely, participants who predominantly engaged in multiplayer gaming with real-life friends had the lowest scores for each item, with every residual being negative. While solitary gaming habits were linked to stronger symptoms of avoidance, the inverse appeared to be true of playstyles involving greater social connection, which may reflect greater resistance to avoidant behaviors. However, residuals for each item were quite small, once again highlighting that gaming habits were only weakly associated with anxiety scores and that other factors may have held more importance. Finally, one-sample t-tests confirmed that mean residuals for the single-player and multiplayer with friends groups were statistically significant ($p < 0.001$).

Table 4: Deviations from grand means for each playstyle on avoidance-related SPIN items. Values represent playtime-adjusted residuals, obtained by regressing each item on weekly hours and centering at the sample mean. Simple one-sample t-tests were used to find p-values for each mean residual. Across all six avoidance items, the single-player group had the highest playtime-adjusted residuals, while the real-life friends group had the lowest (negative) residuals.

Playstyle	SPIN4	SPIN6	SPIN8	SPIN9	SPIN11	SPIN16	Mean	*p*-Value
Multiplayer: Real-Life Friends	-0.05	-0.06	-0.15	-0.13	-0.04	-0.05	-0.08	<0.001
Multiplayer: Online Acquaintances	-0.03	0.01	0.09	0.05	0.05	0.00	0.03	0.13
Multiplayer: Strangers	0.05	0.04	0.09	0.09	0.00	0.05	0.05	<0.001
Singleplayer	0.18	0.17	0.31	0.26	0.13	0.10	0.19	<0.001

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Figure 4 visualizes these patterns, linking playstyles to the six avoidance symptoms using the previously calculated residuals. Singleplayer gamers were connected to every avoidance symptom with noticeably thicker edges than multiplayer playstyles, displaying singleplayer gamers' tendency towards higher levels of avoidance. The "Strangers" playstyle had much thinner edges, though all of them were present. Next, the "Acquaint." playstyle had similarly thin edges with SPIN 6, 8, 9, and 11, but no edges at all for SPIN 4 and 16. Finally, the "Friends" playstyle had no edges, only yielding negative residuals, indicating that multiplayer gaming with real-life friends may be linked to greater resistance against avoidance-based anxiety symptoms. Figure 4 provides a visual complement to the table's results, further establishing single-player gaming's consistent association with avoidant behaviors.

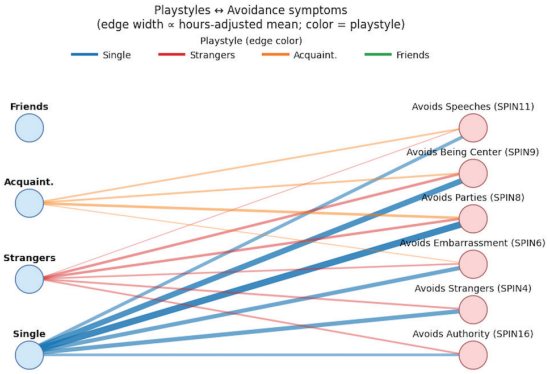

Figure 4: A bipartite network where playstyle nodes are positioned on the left and avoidance-based symptom nodes are positioned on the right. Edges represent the residuals shown in Table 4, and are color-coded by playstyle, with edge thickness corresponding to the magnitude of each positive residual. Negative values are omitted. Singleplayer shows the most prominent positive connections across all avoidance symptoms, with thicker edges than other playstyles. The real-life friends playstyle shows no positive edges because its residuals are negative.

Discussion:

The present study examined relationships between online gaming habits (weekly hours, playstyles) and measures of social anxiety (SPIN, GAD-7) using network and group-comparison methods. Four hypotheses were tested with regard to these relationships. Overall, the hypotheses were supported, albeit weakly. Results are most often aligned with existing literature and extended to a much larger, global sample of online gamers.

Hypothesis 1: Weekly Hours and Social Anxiety

Hypothesis 1 predicted that weekly gaming hours would correlate positively with social anxiety scores (SPIN) as well as general anxiety scores (GAD-7), which was also a viable predictor of social anxiety. Correlation analyses revealed a statistically significant but very weak positive association between weekly hours and scores on both scales. Extreme variations in weekly hours only marginally affected social anxiety results. By itself, the positive association is consistent with prior research which suggested that greater time spent gaming is associated with heightened anxiety scores,[2] and that problematic/addictive online gaming is linked to heightened social anxiety.[4, 5] This may be due to excessive gaming's isolating effects, as individuals may spend more time engrossed in virtual worlds than they spend building real-world connections, exacerbating feelings of loneliness or "other"-ness and thus strengthening social phobias. Likewise, social anxiety itself may lead individuals to spend more time gaming, seeking a coping mechanism and an escape from discomfort. However, the effect size observed in the sample suggested that while gaming use does relate to social anxiety, this relationship is overshadowed by other contributors to an individual's socially anxious profile, indicating that gaming time itself is not a valuable determinant of social anxiety.

Hypothesis 2: Differences in Social Anxiety Across Playstyles:

Hypothesis 2 predicted that single-player gamers would report the highest social anxiety, followed by those who primarily played multiplayer with strangers, then with acquaintances/teammates, and with the lowest levels among those who played with real-life friends. Results largely supported this ranking, but with a lack of significant variation between the middle two playstyles (strangers and acquaintances). Singleplayer participants scored significantly higher on the SPIN than all other groups, while playing with real-life friends was associated with the lowest anxiety levels. These findings are consistent with a prior study during COVID-19, which observed anxiety reduction and interpersonal avoidance as key motivators for single-player gamers,[6] reinforcing that single-player gaming is an indicator of heightened social anxiety. As a coping mechanism against social anxiety, multiplayer online gaming may not provide the desired effect of distancing oneself from others, as interactions with other players may be necessary depending on the game. Single-player gaming guarantees complete isolation, potentially making it the top choice for socially anxious individuals and explaining the observed association. Additionally, the aforementioned study found that multiplayer gamers were motivated by socialization purposes rather than escapism or coping.[6] This is consistent with the stark difference observed between the single-player group and every multiplayer group, supporting the notion that multiplayer gamers are more open to social interaction and, thus, experience less social anxiety. Finally, the finding that the real-life friends group had significantly lower anxiety than other multiplayer groups is consistent with prior research. Specifically, a 2016 survey of World of Warcraft players,[7] which showed that multiplayer gamers who engaged more strongly with the social aspects of the game (friends, voice chat, etc.) had more pronounced effects of reduced social anxiety than those who did not socialize in-game. These results, combined with results from this paper, support the notion that gaming with friends and/or strong socialization indicates greater interconnectedness and a tendency away from social anxiety.

Hypothesis 3: Weekly Hours and Symptoms of Social Anxiety:

Hypothesis 3 predicted that weekly gaming hours would correlate most strongly with avoidance-based symptoms of anxiety (SPIN 4, 6, 8, 9, 11, and 16) and symptoms related to a fear of negative evaluation (SPIN 5 and SPIN 12). Results varied, but were often supportive: SPIN items 8, 11, 9, 6, 14, and 4 had the strongest correlations with weekly hours, in

the given order. The top 4 symptoms were all avoidance-related: avoidance of parties; avoidance of speeches; avoidance of activities where the individual is the center of attention; and avoidance of potentially embarrassing activities/interactions, respectively. Additionally, the 6th most correlated symptom was the avoidance of talking to strangers. Figure 2 visualizes these results, with the aforementioned symptoms drawn much closer to the weekly hours node. Although SPIN 16 (avoidance of authority) was not among the 5 strongest associations, other avoidance-based items consistently yielded the highest correlations with weekly gaming hours, supporting the hypothesis in relation to avoidance. This aligns with prior research findings that avoidance and escapism behaviors are significant predictors of excessive online gaming,[18] and expands said findings from clinical/at-risk samples to a much broader population. Although these results were seemingly aligned with existing knowledge, the observed relationships were still quite weak. Figure 3 affirmed this, as the edges connecting weekly hours and symptom clusters held little weight (represented in Figure 3 by their pale colors), and the "Hours" node was situated far from the symptom cluster. This reaffirms the idea that weekly gaming playtime is not a central predictor of social anxiety and has little effect on overall scores or individual symptoms in comparison with external factors.

On the other hand, SPIN items related to fears of negative evaluation (5 and 12) were not among the strongest correlations with weekly hours, as shown by their weaker edges and further distance from the "Hours" node in Figure 2. This finding is inconsistent with hypothesis 3, and does not align with previous: research into MMORPG players,[5] which found that an individual's need for true self-expression in-game was associated with problematic online gaming. From this, the hypothesized relation to fears of negative evaluation was extrapolated, as needing a virtual outlet for true self-expression may reflect a fear of judgment in real-life interactions. It's possible that this extrapolation was inaccurate or that this finding was more unique to MMORPG players, resulting in inconsistencies with this paper's results.

Hypothesis 4: Singleplayer Gaming and Avoidance Symptoms:

Hypothesis 4 predicted that single-player gaming would be the strongest predictor of avoidance-based symptoms of social anxiety (SPIN 4, 6, 8, 9, 11, and 16). Results strongly supported this expectation: When compared to the multiplayer groups using hours-adjusted residuals (deviations from expected scores), single-player participants yielded greater scores for all avoidance-related items. This distinction was clearly visualized by the bipartite network model, with single players' edges to each avoidance symptom being much thicker than those from other playstyles, many of which had edges that were not present (negative residuals). Importantly, the finding that single-player scores were elevated across all avoidance items indicates an encompassing relationship between single-player gaming and general avoidance, not driven by any single symptom. This affirms previous observations during COVID-19, where single-player gamers emphasized avoidance as a primary motivator for gaming,[6] suggesting that their playstyle was closely linked to avoidance patterns. This prior research, combined with the new findings in this paper, strongly suggests that individuals who primarily play single-player games exhibit stronger avoidance behaviors than multiplayer gamers. As mentioned previously, single-player gaming is superior to multiplayer options in its ability to seclude an individual from others, potentially explaining the motivations observed in the COVID-19 study as well as the observations of the present study.

Limitations:

Several limitations in data quality and analysis were present and should be acknowledged. First, the study relied on self-reported data posted to various forums on Reddit,[23] which may introduce biases in how gaming habits and anxiety symptoms were reported, including the possibility of some participants not taking the questionnaire seriously. Data cleaning was done in an attempt to curb this effect by removing extreme and impossible outliers, which were most likely jokes from respondents, but seemingly normal data may have still been unreliable.

Next, the majority of responses came from the particular Reddit forum /r/leagueoflegends.[23] As a result, 84% of respondents to the original survey listed League of Legends as their preferred game. League of Legends is predominantly a ranked, team-based multiplayer game, and its player base differs from other gaming communities in terms of age groups, play patterns, and community norms, each of which may link to social anxiety in distinct ways. Thus, the overrepresentation of League of Legends players and /r/leagueoflegends members may have introduced substantial bias in analyses involving multiplayer gamers; associations between gaming habits and social anxiety observed in this paper may not map to other titles or platforms. Consequently, the sample, though large, may not be generalizable to all populations of online gamers. Accordingly, findings involving multiplayer playstyles (including overall playtime analysis) should be interpreted as predominantly characterizing a specific subgroup, League of Legends players, with limited applicability to other gaming communities and the population of online gamers as a whole.

An additional source of representation bias may have been in the locations of the participants: Western nations such as the United States, Germany, the United Kingdom, and Canada dominated the sample,[23] with just the 4 countries mentioned totaling 57% of all participants. Although a crucial point of this sample's strength was its global reach, the excess of Western participants may create difficulty in generalizing to populations in Asia, who are often just as active in online games as individuals in Western countries, as well as any other underrepresented populations. Differences in culture, particularly social norms and attitudes towards online gaming, may render this paper's results inapplicable to certain locations. These limitations reflect an overarching issue in analysis, where potential confounders such as location, preferred online game, motivation for playing, work status, education status, and gender were not accounted for, leading to less conclusive results. As such,

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despite the wide reach of the dataset, the observed associations primarily reflect the psychology of Western online gamers.

Finally, the cross-sectional design of the original data collection makes causal inference an impossibility; while statistically significant associations were consistently observed, it remains unclear whether gaming habits contribute to social anxiety, or whether social anxiety drives individuals towards certain gaming habits, and which of these effects is more significant.

Future Implications:

Further research into associations between gaming habits and social anxiety could address the limitations in this study in a number of ways. A useful avenue of exploration would be the usage of longitudinal designs and experimental treatments to clarify causal relationships, yielding much more practically useful results, which could be applicable to psychological practices. Expanding analyses to include more diverse populations, both in terms of preferred online games and location, would strengthen generalizability. Additionally, further analysis could control for confounding variables more rigorously and integrate network modeling more deeply by applying centrality or community detection analyses. Doing so could establish clearer roles for specific symptoms or habits within gaming-related anxiety networks, allowing for more targeted interventions if results indicate that they may be necessary.

■ Conclusion

In conclusion, online gaming habits and social anxiety are linked in a multitude of ways. Weekly gaming playtime correlates positively with social anxiety, and this correlation is especially strong for avoidance-based symptoms of social anxiety. Different online gaming playstyles – singleplayer, multiplayer with strangers, acquaintances, friends – predict social anxiety scores differently. Singleplayer gamers appear to have the highest social anxiety, and multiplayer gamers who primarily play with real-life friends appear to have the lowest. Finally, single-player gaming is most strongly associated with avoidance symptoms compared to multiplayer playstyles.

Despite the clarity of these results, their magnitude tends to be quite small, particularly in associations that involve weekly gaming hours. This suggests that an individual's engagement with online gaming likely provides little explanation for their social anxiety, and the reverse relationship is also unlikely to be strong: other factors should be prioritized as much stronger predictors of anxious behaviors or excessive gaming use. Additionally, sampling biases towards Western participants and League of Legends players limit the scope of these findings, with many analyses applying primarily to these small subgroups rather than the wider population of online gamers. Future studies should prioritize longitudinal approaches, diversified samples, and greater control of confounding factors in order to maximize their accuracy and applicability to psychological practice.

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I attest that the ideas, graphics, and writing in this paper are entirely my own. – Shaayan Saksena

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Shaayan Saksena will graduate from high school in 2026. He plans to study mathematics and computer science, but his motivation for this paper was more personal: after struggling with social anxiety and addictive screen use (including gaming) throughout adolescence, Shaayan sought to understand their relationship, and, in turn, his own psyche.

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