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A brief overview of the relationship between academic achievement and problematic internet use of adolescents and young adults: What are the main mediators?

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Introduction

Academic achievement is an important factor that plays a role in shaping a person's outlook on life, future plans and subjective well-being (Steinmayr et al., 2016; Bücker et al., 2018). Also, it is related to both personal and social outcomes by predicting higher self- efficacy, lower stress (Zajacova et al., 2005), positive health behavior (Eide et al., 2010) and national economic growth (Cheung and Chan, 2008). Therefore, determining the negative factors affecting academic achievement in adolescents and young adults has been an important research topic for many years. One of the important risk factors for academic achievement is PIU. With the Covid-19 pandemic, education switched from face-to-face to online learning in an unexpected way; therefore, the relationship between PIU and academic success gained a different dimension. In this opinion paper, we collate the available empirical evidence to gain more insight into the relationship between academic achievement and PIU.

Studies that addressed the relationship between academic achievement and PIU mainly focused on grade point average (GPA), but findings are mixed. Some of the studies found a negative relationship (Akhter, 2013; Lepp et al., 2014; Türel and Toraman, 2015; Hawi and Samaha, 2016) while others found no relationship between these two variables (Ellore et al., 2014; Usman et al., 2014). One of the reasons for these mixed results could be the effect of PIU on learning motivation, whether or not it impaired GPA. Indeed, several studies demonstrated the direct adverse effect of PIU on learning motivation (Reed and Reay, 2015; Zhang et al., 2018; Truzoli et al., 2020). Nevertheless, there are several indirect theoretical links between PIU and learning motivation as well. First, PIU has a wide range of adverse effects on cognitive capabilities including impulse control, planning, ability to experience rewards (Reed and Reay, 2015; Zhou et al., 2016), and, consequently, problems in these skills reduce learning motivation (Kuo et al., 2018).

Second, PIU is closely related to depression, anxiety, anger, and loneliness among adolescents and young adults (Kitazawa et al., 2018; Mamun et al., 2019; Moretta and Buodo, 2020; Sela et al., 2020; Haddad et al., 2021), and these psychiatric problems also have adverse effects on learning motivation (Froiland et al., 2012; Elmelid et al., 2015; Dirzyte et al., 2021).

Another variable that is considered when examining the relationship between PIU-academic achievement is screen time. Screen time (ST) refers to time spent on the internet and social media, or communicating *via* text message, playing videogames, or watching movies and TV programmes (Oswald et al., 2020).

Studies demonstrated that higher levels of ST are associated with lower academic achievement (Sharif et al., 2010; Aguilar et al., 2015; Corder et al., 2015; Trinh et al., 2015; Kantomaa et al., 2016; García-Hermoso and Marina, 2017; Yan et al., 2017), lower school functioning and school-life satisfaction among adolescents (Cao et al., 2011; Finne et al., 2013; Kantomaa et al., 2016). A recent review showed that higher levels of ST are associated with slower learning and acquisition, and an increased risk of premature cognitive decline, which are, in turn, related to academic and occupational achievement among young adults (Neophytou et al., 2021).

However, recent studies have shown that the types of ST are also an effective factor in the relationship between ST and academic achievement. A study that examined young people's approaches to socio-digital participation in three age groups (elementary school 6th grade, high school 1st year and university 1st year) demonstrated that using screens for social networking was related to lower study engagement or to higher study burnout; higher action gaming was related to lower engagement; and using digital tools to gain and share knowledge was, in contrast, related to higher study engagement. The results demonstrate that students' digital activities reflect multiple dimensions that are related in different ways to academic well-being (Hietajärvi et al., 2019). Another study with 4,013 children confirmed the effect of different types of ST on educational outcomes. Passive ST, like watching TV, was associated with worse outcomes, but educational ST, like using a computer for homework and interactive video games, had a positive effect on educational outcomes (Sanders et al., 2019).

In this opinion paper, we investigated which mediating factors might be effective in the relationship between PIU and academic achievement. In light of the studies, we identified two important factors including attention problems (e.g., Attention Deficit Hyperactivity Disorder, ADHD), and sleep quality.

PIU and ADHD

Many studies have shown a relationship between prolonged or uncontrolled ST and PIU (e.g., general multifaceted internet use/online behavior) and symptoms of ADHD. Findings from the studies have revealed that children and adolescents with PIU are two times more likely to have ADHD than their non-addicted counterparts (Wang et al., 2017). Furthermore, a meta-analysis reported a correlation between frequent screen media use and attention problems (Nikkelen et al., 2014). A recent longitudinal study of adolescents without significant symptoms of ADHD at the start of the study revealed a significant relationship between more frequent use of screen media and ADHD symptoms after 24 months of follow-up (Ra et al., 2018). Although these studies have focused almost solely on children and adolescents, this relationship has been found in people of all ages (Schou Andreassen et al., 2016).

Previous evidence has recognized some ways in which PIU may impact youths' attentional capabilities, but the mechanism underlying the relationship is still uncertain. For instance, this connection might be partly explained by repetitive attentional shifts and multitasking, which can undermine an individual's executive functioning (Nikkelen et al., 2014).

It is possible that people with ADHD and/or emotional problems have a higher risk of developing PIU, but an alternative explanation is that PIU may increase the risk of ADHD and/or emotional problems. Cognitive dysfunction concerning impulse control and decision-making could be implied in the pathogenesis of PIU (Chamberlain et al., 2018). It is also necessary to examine the relationship between ADHD-PIU types more closely. In terms of studies on the relationship between PIU and ADHD, two specific problematic internet-related subtypes have been recognized, namely gaming disorder (GD), and excessive smartphone use (ESU).

Gaming disorder and ADHD

Previous studies have mainly addressed two hypotheses when exploring the relationship between ADHD and GD: (1) Is ADHD a risk factor for GD? (2) Is gaming a risk factor for developing ADHD?

A recent systematic review demonstrated that there is an important link between ADHD and GD among all studies (Dullur et al., 2021). Specifically, there are studies that showed the link between inattention (Mazurek and Engelhardt, 2013; Strittmatter et al., 2015; Panagiotidi, 2017; Chauchard and Amélie Simon, 2018; Paulus et al., 2018; Stavropoulos et al., 2019; Wartberg et al., 2019; Schoenmacker et al., 2020) and hyperactivity and impulsivity (Baer et al., 2011; Strittmatter et al., 2015; Paulus et al., 2018; Stavropoulos et al., 2019; Wartberg et al., 2019), but inattention seemed to be more strongly associated with GD (Dullur et al., 2021). In terms of predicting effect, Wartberg et al. (2019) demonstrated that higher baseline inattention scores predicted higher GD symptoms while Peeters et al. (2018) showed that baseline GD predicted higher inattention and social vulnerability. Various variables have been suggested to explain the relationship between GD and ADHD symptoms. The first variable is the

time spent on gaming. Increased time spent on gaming leads to less time devoted to other social/academic activities, which interferes with the development of impulse control, resulting in attention problems (Gentile et al., 2012). The second variable is the content. One study demonstrated the effect of violent games on attentional symptoms over time (Gentile et al., 2011). Third, individual factors including time management skills, introversion, neuroticism, and escapism could be underlying features that are associated with both conditions (Tolchinsky and Jefferson, 2011; Chauchard and Amélie Simon, 2018; Evren et al., 2019).

Excessive smartphone use and ADHD

To date, many studies have discussed the differences between general PIU and excessive smartphone use (ESU). Recently, Montag et al. proposed that ESU is a specific type of PIU derived from specific problematic uses of smartphone applications (e.g. Whatsapp, and Instagram) (Montag et al., 2021).

Studies that addressed the effect of ESU on cognitive functioning demonstrated that heavy smartphone users have impaired attention; reduced inhibitory control and numerical processing capacity; and increased impulsivity, hyperactivity and negative social concern/awareness (Pertierra et al., 2017; Wacks and Weinstein, 2021).

A recent study that examined the effect of limiting smartphone-related distractions showed that limiting reduces hyperactivity but not inattention symptoms (Wasmuth et al., 2022), so ESU may have a lasting effect on cognitive functions. ESU is also associated with ADHD, depression, anxiety, OCD, and low psychological and mental well-being (Wacks and Weinstein, 2021), which have negative impacts on academic achievement.

Sleep quality

Sleep quality is related to adequate sleep time and a healthy sleep-wake cycle (Hirshkowitz et al., 2015). It is necessary for cognitive performance, learning, memory, emotional balance, and concentration. Poor sleep quality is associated with low academic achievement and PIU is associated with poor sleep. In detail, a recent review by Peracchia et al. indicated that video game exposure alters the sleep pattern by reducing total sleep time, increasing sleep onset latency, modifying REM sleep, and increasing sleepiness-fatigue. It was also associated with post-sleep sustained attention and verbal memory problems (Peracchia and Curcio, 2018). The authors concluded that playing video games for longer periods and in the evening can cause low sleep quality and possible adverse effects on cognition in subsequent days. Although this review addressed video gaming studies in general, it seems important because, nowadays, digital games are mostly played online.

In addition, two recent systematic reviews underlined the significant associations between another type of PIU, higher level of social media use, and poor sleep quality. They found that sleep quality mediated the relationship between social media use and mental health outcomes among youth (Alonzo et al., 2019, 2021). Furthermore, a study from Iran showed that social network addiction has an indirect negative effect on academic achievement through creating academic procrastination, decreasing sleep quality, and increasing academic stress (Ahmadi and Zeinali, 2018).

However, it should be emphasized that there are some conflicting results. A study from Turkey indicated that PIU is more common among the young adults and adolescents who prefer to use the internet at night and have lower academic achievement than others (Evcil and Yurtsever, 2018), while another study from India demonstrated that college students who used the internet mainly for academic activities and during evening hours were less likely to have PIU (Kumar et al., 2019). Therefore, the relationship seems to be bidirectional and mostly related to usage type.

Conclusions

In conclusion, it is possible that PIU represents a crucial moderator of the association between attention deficits, poor sleep quality, and lower academic achievement. Within this view, an individual who consistently spends longer periods of time on online activities - thus being exposed to greater doses of different online content - will experience more attentional challenges, and neglect school-related obligations. However, it may be that the quality of engagement of a youth's online interactions is more crucial than the time spent on those services.

Besides these, it is worth noting that family and interpersonal problems (i.e., environmental distress), as well as a youth's personality characteristics, may also interfere with different areas of functioning. These hypotheses are not mutually exclusive, and several may apply to a particular youth's behavior. Additionally, the variables considered as academic achievement indicators make it difficult to interpret the results. As is known, ADHD individuals have less attention problems in areas where they are talented or highly motivated than in other areas. For this reason, GPA may be high in ADHD individuals who are receiving a vocational education suited to their abilities, even though they still have attention problems in daily life. Measuring the impact of PIU in different academic fields (for example, examining different course grades such as in mathematics, grammar, geography, etc., or grades from different science areas at a university) will help us gain a more comprehensive understanding of the relationship between PIU-inattention and academic achievement.

When considering the results of the studies, it is important to keep in mind that the samples were mostly clinical groups or college students, based on different types of media use, and that the number of population-based studies is very scarce. More longitudinal research is therefore needed in order to understand the predictors and outcomes of the PIU- academic achievement relationship.

Future directions

- The relationship between PIU and academic achievement appears to be confirmed but there is scarce research to explain its nature.
- A standard terminology and diagnostic criterion for different types of PIU should be established. For instance, both the time- and scale-based measurements have been used to determine either generalized (e.g., multifaceted online behavior), or specific (e.g., online gaming, and social networking) forms of internet use. Furthermore, uniform measures of academic achievement should be adopted.
- The prevention of problem behaviors at school should also include prevention in the field of PIU, which is a rare practice so far.
- As it appears that age is not associated with PIU, studies that last from the beginning of adolescence to the end of young adulthood, and that measure the change of PIU types throughout the process and the effect of different PIU types on academic achievement, are needed. Furthermore, longitudinal studies help identify directions of associations and control confounding variables.
- More in-depth qualitative analyses are needed to identify the nature of alternate internet activity as it can be argued that the impact of different social media platforms on academic achievement varies. For instance, more information is needed regarding social media platforms, whether the platforms where people follow those they care about (e.g., Facebook, Instagram), have a different influence on individual's cognitive function and academic achievement compared to those applications that are generally used to spend time having fun (e.g., TikTok).
- It is still unknown whether ADHD is the risk factor of PIU or a comorbidity. Nevertheless, a higher risk of poor academic achievement does not appear to be limited to PIU and ADHD, and therefore, the role of other influencing factors, and comorbidities should be addressed together. Yet, ADHD is closely related with lower self-efficacy, lower monthly income, and more relationship problems, resulting in higher anxiety and depression among youth populations.
- The effect of PIU on sleep quality should be measured by physiological parameters rather than self-reported notifications to understand its effects on academic performance during the day more clearly.

Author contributions

HG and NM drafted the initial version of the paper. BL-K contributed for the initial draft. NM modified the final version of the draft. All authors have agreed to the submission of this manuscript, and it is not currently being considered for publication by any other print or electronic journal.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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