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Maladaptive daydreaming and problematic online behaviors: A network analysis approach

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ABSTRACT

Previous evidence showed that Maladaptive Daydreaming (MD) is positively associated with different Problematic Online Behaviors (POBs). This study aimed to investigate the mutual relationship between MD and several POBs. Data were collected from 1209 participants, aged 18–73 ($M = 30.59$, $SD = 12.26$), through self-report questionnaires assessing MD and POBs, including problematic online gambling, problematic online gaming, problematic cybersex, Problematic Social Media Use (PSMU), problematic online shopping, and cyberchondria. Two psychometric network analyses were performed to examine the associations between all POBs at item levels, and between MD and POBs at construct levels. Results revealed six distinct communities, supporting the specificity of each POB. Furthermore, MD was found to be more strongly associated with PSMU and cyberchondria, and weakly associated with problematic online gaming, problematic cybersex, and problematic online shopping. The mutual relationships between MD and POBs might have relevant implications for the assessment and treatment of these clinical conditions.

1. Introduction

Daydreaming is the experience of immersing oneself in fantasies while awake, which might potentially serve as an adaptive mental activity (Singer, 1966). However, there is evidence suggesting that some individuals exhibit a dysfunctional form of daydreaming, termed Maladaptive Daydreaming (MD), characterized by intense absorption in vivid fantasies over a great amount of time which impairs individual functioning (Chefetz et al., 2023; Soffer-Dudek and Theodor-Katz, 2022; Somer, 2002). Despite diagnostic manuals such as the Diagnostic and Statistical Manual of Mental Disorders (DSM-5-TR; American Psychiatric Association, 2022) or the International Classification of Diseases (ICD-11; World Health Organization, 2022) do not actually include it among mental disorders, previous research has shown that MD is a specific clinical syndrome, as distinct from other dysfunctional mental processes and mental disorders (Schimmenti et al., 2019), and that it endures over time and increase the risk for psychological distress (Musetti et al., 2023b; Soffer-Dudek and Somer, 2018). Furthermore, MD may co-occur with a wide plethora of mental disorders and clinical symptoms (Mariani et al., 2021) including anxiety, depression (Musetti et al., 2021; Somer et al., 2017a), attention deficit hyperactivity disorder, obsessive-compulsive disorder (Bigelsen et al., 2016; Somer et al., 2017a), and dissociation (Bigelsen et al., 2016; Soffer-Dudek and Somer, 2018). There is also evidence that MD may serve to provide relief from painful mental states and negative emotions. For example, previous research showed that some individuals with MD reported a history of traumatic experiences (Ferrante et al., 2022; Somer et al., 2016b, 2021), high levels of emotion dysregulation (Greene et al., 2020), and high attachment insecurities (Sándor et al., 2023).

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1.1. Maladaptive daydreaming and problematic online behaviors

It is noteworthy that MD could be conceptualized as a behavioral addiction, as it includes difficulties in controlling fantasy activity, rewarding experiences from this activity, and significant adverse effects in relationships, school, work, and other domains of daily life (Pietkiewicz et al., 2018; Sharma and Mahapatra, 2021; Soffer-Dudek et al., 2021; Somer et al., 2017b). Accordingly, MD shares some specific features with other addictive-like phenomena. Clinical reports and empirical evidence suggest that MD is associated with excessive and problematic engagement in Internet activities (e.g., Somer, 2018; Zsila et al., 2018). For example, Somer (2018) described a case of a 25 years-old male with MD who was excessively engaged Internet use for escapist purposes. An addictive vicious cycle emerged in which excessive time spent in escapist activities led to functional impairment, thus in turn leading to increased MD and excessive internet use to relieve distress.

The term "problematic Internet use" (PIU) refers to the uncontrolled usage of Internet platforms, resulting in significant impairments in individual functioning (Spada, 2014). Although PIU entails addictive-like symptoms, it might be understood as a compensatory strategy for temporary relief from stressful events and coping with one's own difficulties (Kardefelt-Winther, 2014). Moreover, relevant constraints exist in conceptualizing PIU as a unitary clinical condition, as it entails different maladaptive Internet-related behaviors (Musetti et al., 2016; Starcevic and Billieux, 2017). According to the "spectrum hypothesis", Problematic Online Behaviors (POBs) can be classified within a spectrum of maladaptive Internet-related behaviors that are associated but distinct from each other. Their specificity is supported not only because they are associated with different clinical symptoms (Starcevic and Billieux, 2017) but also because they appear to be driven by different underlying motivations (Schimmenti, 2023). Using a correlation network approach, Baggio et al. (2022) provided additional evidence supporting the specificity of different POBs. Specifically, they identified six clusters corresponding to the following POBs: problematic online gaming; problematic online gambling; Problematic Social Media Use (PSMU); problematic online shopping; and cyberchondria (i.e., the excessive searching for health information online which increases health anxiety; Starcevic, 2017).

A limited number of empirical studies have considered MD in relation to specific POBs. Specifically, Chirico et al., 2024 have observed that individuals with high levels of MD reported higher levels of PSMU than individuals with low levels of MD. This relationship could be better understood by considering that MD can serve as a coping strategy to deal with adverse experiences and psychological vulnerabilities (Musetti et al., 2023a). In this regard, Costanzo et al. (2021) found that MD mediated the associations between preoccupied and fearful attachment styles (i.e., anxious attitudes in close relationships that underlie a negative representation of the self; Bartholomew and Horowitz, 1991) and PSMU. Thus, individuals high in attachment anxiety might excessively resort on PSMU to maintain vivid fantasies that entail an idealized representation of the self. Sharma and Mahapatra (2021) illustrated the case of an adolescent who exhibit both MD and problematic online gaming. They observed that the patient used role-playing games to re-enact traumatic situations from his daily life and co-create alternative fantasy scenarios (e.g., punishing his bullies). Overall, despite the clinical relevance of understanding the relationship between MD and specific POBs, the existing literature is still incipient in this area. Thus, we aimed to thoroughly investigate the interrelationships between MD and specific POBs, including problematic online gaming, problematic online gambling, problematic cybersex, PSMU, problematic online shopping, and cyberchondria through an exploratory network analytic approach.

The psychometric network analysis is a statistical technique for estimating the conditional associations among variables and displaying them in a network structure. Therefore, this statistical method may be employed to explore the potential patterns of associations – visualized as edges – between the variable of interests – visualized as nodes – within a network structure (Borsboom et al., 2021). Firstly, a network analysis was conducted at the item level to investigate whether the POBs characterized by the uncontrolled usage of Internet platform or addictive-like symptoms may be classified as discernible entities (see Baggio et al., 2022). In accordance with previous research supporting the spectrum hypothesis (Baggio et al., 2018, 2022), we hypothesized that the symptoms of POBs are grouped into different communities within the network, revealing more reciprocal associations between the symptoms of each cluster in comparison to the associations between the symptoms of different communities. Then, a network analysis was conducted at the construct level to examine the reciprocal relationships between the scores on MD and POBs scales. In line with previous literature, MD and POBs might be significantly associated among them, as they might constitute maladaptive coping strategies. Specifically, POBs might represent an attempt to perpetuate one's own fantasy activity. However, POBs might reinforce the MD, as Internet platforms might trigger engagement in fantasies (Pietkiewicz et al., 2018).

2. Methods

2.1. Procedure

A cross-sectional study was conducted on a sample of Italian adults. After acquiring their consent to participate, participants were asked to respond to self-report questionnaires through a link to an online survey. This study was approved by the Research Ethics Board of the University of Parma (protocol number: 0198254), in accordance with the Declaration of Helsinki.

2.2. Participants

A total of 1209 participants from the community, aged 18–73 (M = 30.59, SD = 12.26) were enrolled in the present investigation. Of these, 72.5% were females, 26.6% were males, and 0.8% identified themselves as "other". Concerning education, 47.4% of the sample had a high school diploma, 26.9% had a bachelor's degree, 17.9% had a master's degree, 4.5% had a middle school diploma, 3.1% had a post-graduate specialization, and 0.2% had an elementary school diploma. About marital status, 39.9% of the sample were single, 32.6% were engaged in a relationship, 23.6% cohabited or were married, 3.2% were divorced, and 0.7% were widowed.

2.3. Measures

Maladaptive Daydreaming. MD was assessed using the 16-item Maladaptive Daydreaming Scale (MDS-16; Somer et al., 2016a; Italian validation by Schimmenti et al., 2020). Participants rated each item on an 11-point Likert scale ranging from 0% (never/not at all) to 100% (extremely frequent/all the time). Total MDS-16 score consists of the average of items, where higher scores on the MDS-16 indicate higher levels of MD. The omega coefficient in the present sample was 0.93.

Problematic online gaming. Problematic online gaming was assessed using an Italian adaptation of the 10-item Internet Gaming Disorder Test (IGDT-10; Király et al., 2017). Responses were coded on a binary scale (never/often), resulting in total scores based on the sum of the items. Higher scores on the scale correspond to high levels of problematic online gaming. The omega coefficient in the present sample was 0.85.

Cyberchondria. An Italian version of the 12-item Cyberchondria Severity Scale (CSS-12; McElroy et al., 2019) was used to measure cyberchondria. The CSS-12 is a self-report instrument in which respondents rate each item on a 5-point Likert scale (1 = never; 5 = always). Summing the scores of these items yields the total score. High CSS-12 levels correspond to higher levels of cyberchondria. The omega coefficient in the present sample was 0.92.

Problematic cybersex. Problematic cybersex was assessed using an

Italian adaptation of the 12-item Short Internet Addiction Test - Sex (SIAT-SE; Laier et al., 2013), based on the Short Internet Addiction Test (SIAT; Pawlikowski et al., 2013). Each item could be answered using a 5-point Likert scale (1 = Never; 5 = Very often). Overall SIAT-SE score is based on the sum of the item scores, where higher ratings indicated higher levels of problematic cybersex. The omega coefficient in the present sample was 0.95.

Problematic online shopping. The problematic online shopping was assessed through the Italian adaptation of the 12-item Short Internet Addiction Test – Shopping (SIAT-SH; Trotzke et al., 2015), based on the SIAT (Pawlikowski et al., 2013). Each item is rated on a 5-point Likert scale (1 = Never; 5 = Very often). The overall SIAT-SH score is obtained by summing the item scores, where higher levels indicate more problematic online shopping. The omega coefficient in the present sample was 0.93.

Problematic social media use. The PSMU assessment was conducted through an Italian adaptation of the 18-item Internet Addiction Test (Young, 1998) modified for the use of social networking sites (IAT-SNS; Rothen et al., 2018). Items were coded on a five-point scale (1 = Never; 5 = Always). The total score is obtained by summing the item scores. Higher IAT-SNS scores correspond to higher PSMU. The omega coefficient in the present sample was 0.95.

Problematic online gambling. Problematic online gambling was assessed through an Italian version of the 9-item Problem Gambling Severity Index (PGSI; Currie et al., 2013). Participants were asked to indicate their level of problematic online gambling by rating each item on a four-point scale (0–3). The total score is determined by summing the scores of all items. Higher total PGSI scores indicate higher levels of problematic online gambling. The omega coefficient in the present sample was 0.95.

2.4. Data analysis

Descriptive statistics and zero-order correlations among POBs and MD were calculated through IBM SPSS version 25 (IBM Corporation, 2017). Afterwards, two psychometric network analyses were carried out using R version 4.2.2 via the bootnet (Epskamp et al., 2018), mgm (Haslbeck and Waldorp, 2020), qgraph (Epskamp et al., 2012), and networktools (Jones, 2017) packages.

The first network analysis, including items from the IGDT-10, CSS-12, SIAT-SE, SIAT-SH, IAT-SNS, and PGSI scales as nodes, was performed to investigate whether symptoms of POBs are gathered in discernible clusters. Since data were a mixture of continuous-like (≥5 response options), ordered-categorical (<5 response options) and binary items, we estimated a weighted, undirected, mixed graphical model (MGM) by selecting the regularization parameter using the extended Bayesian information criterion (EBIC; Chen and Chen, 2008) with hyperparameter γ at 0.50. Thereafter, we examined whether POB items constituted different communities through the Walktrap algorithm, a data-driven detection method based on the principle that short-distance random walks tend to belong to the same community (Yang et al., 2016). To investigate the role of each node in connecting different communities of POBs, bridge strength was calculated as a centrality metric (Jones et al., 2021).

The second network analysis was conducted at the construct level to examine the potential reciprocal relationships between MD and POBs as discrete entities. Specifically, we estimated a regularized Gaussian Graphical Model (GGM) using the graphical Least Absolute Shrinkage and Selection Operator algorithm (g LASSO; Friedman et al., 2008) with the EBIC (Chen and Chen, 2008) to select the optimal regularization parameter ($\gamma = 0.50$). This form of regularization produces a sparse and more conservative network structure by limiting the sum of absolute partial correlations, resulting in many edge estimates shrinking to exactly zero and being dropped from the model (Epskamp et al., 2018). To deal with skewed data, nonparanormal transformations were applied (Liu et al., 2009). Node strength was calculated as a centrality metric (Opsahl et al., 2010), and its stability was examined through the case-dropping subset bootstrap approach (5000 replications; Epskamp et al., 2018). Based on the latter, a correlation-stability (CS) coefficient was calculated, where values above 0.50 suggest a reasonable degree of stability (Epskamp et al., 2018). Similarly, according to Epskamp and colleagues (2018), the accuracy of edge weights was examined through non-parametric bootstrap confidence intervals (5000 replications).

3. Results

3.1. Descriptive statistics

Descriptive statistics and bivariate correlations between POBs and MD are reported in Table 1. As expected, all POBs significantly correlated with each other. Moreover, MD significantly correlated with PSMU, cyberchondria, problematic cybersex, problematic online shopping, problematic online gambling, and problematic online gaming.

3.2. Clusters of problematic online behaviors

The Walktrap algorithm detected six distinct communities of nodes, corresponding to the six theoretically-defined POBs under investigation: problematic online gaming, cyberchondria, problematic cybersex, problematic online shopping, PSMU, and problematic online gambling. Fig. 1 visualizes the MGM model. The network was quite sparse, with 199 out of 2628 possible edges. Items within the same POB were strongly clustered together, exhibiting numerous connections to each other. Moreover, no items were nested within two different clusters of POBs, highlighting their distinctiveness. Bridge strength estimates revealed that the IGDT item 9 ("Have you risked or lost a significant relationship because of gaming?"), IAT-SNS item 12 ("How often do you lose sleep due to being on social networking sites late at night?"), SIAT-SE item 7 ("How often do you feel preoccupied with online sexual activities when offline or fantasize about being on Internet sex sites?"), PGSI item 8 ("Has your gambling caused any financial problems for you or your household?"), and SIAT-SH item 6 ("How often do you lose sleep due to being on Internet shopping sites late at night?") were the most important nodes in connecting different clusters of POBs (see Supplementary Figure 1).

3.3. Maladaptive daydreaming and problematic online behaviors

The EBICglasso network examining the interrelationships between MD and POBs at the construct level is shown in Fig. 2. The number of non-zero edges was 18 out of 21 possible edges. The weights matrix is reported in Supplementary Table 1. POBs were extensively related to each other: the strongest associations emerged between problematic cybersex and problematic online gambling ($r_{partial} = 0.27$), between cyberchondria and problematic online shopping ($r_{partial} = 0.24$), and between problematic online shopping and PSMU ($r_{partial} = 0.23$). Furthermore, the network model revealed a conditional dependence between MD and PSMU ($r_{partial} = 0.25$), as well as between MD and cyberchondria ($r_{partial} = 0.23$). Although very weak, MD was also related to problematic online gaming ($r_{partial} = 0.09$), problematic cybersex ($r_{partial} = 0.08$), and problematic online shopping ($r_{partial} = 0.05$). In terms of centrality metrics, PSMU scored the highest on the strength index, followed by cyberchondria, problematic cybersex, and MD (see Fig. 3). Importantly, the edge weights demonstrated satisfactory accuracy, as indicated by the relatively narrow bootstrap confidence intervals (see Supplementary Figure 2), while the CS-coefficient of 0.60 for node strength justified interpreting the centrality estimates (e.g., Zagaria et al., 2023).

4. Discussion

Previous research showed that MD is associated with increased PIU

Table 1
Descriptive statistics and bivariate correlations between POBs and MD.

	M (*SD*)	1.	2.	3.	4.	5.	6.
1. Problematic Social Media Use	37.12 (14.93)	–					
2. Cyberchondria	24.40 (10.26)	0.43*	–				
3. Problematic Cybersex	14.90 (6.74)	0.35*	0.25*	–			
4. Problematic Online Shopping	17.27 (7.59)	0.43*	0.40*	0.36*	–		
5. Problematic Online Gambling	0.61 (2.76)	0.16*	0.17*	0.46*	0.27*	–	
6. Problematic Online Gaming	0.92 (1.83)	0.29*	0.15*	0.39*	0.22*	0.32*	–
7. Maladaptive Daydreaming	28.83 (19.71)	0.46*	0.38*	0.24*	0.30*	0.15*	0.24*

Note: *$p < 0.001$.

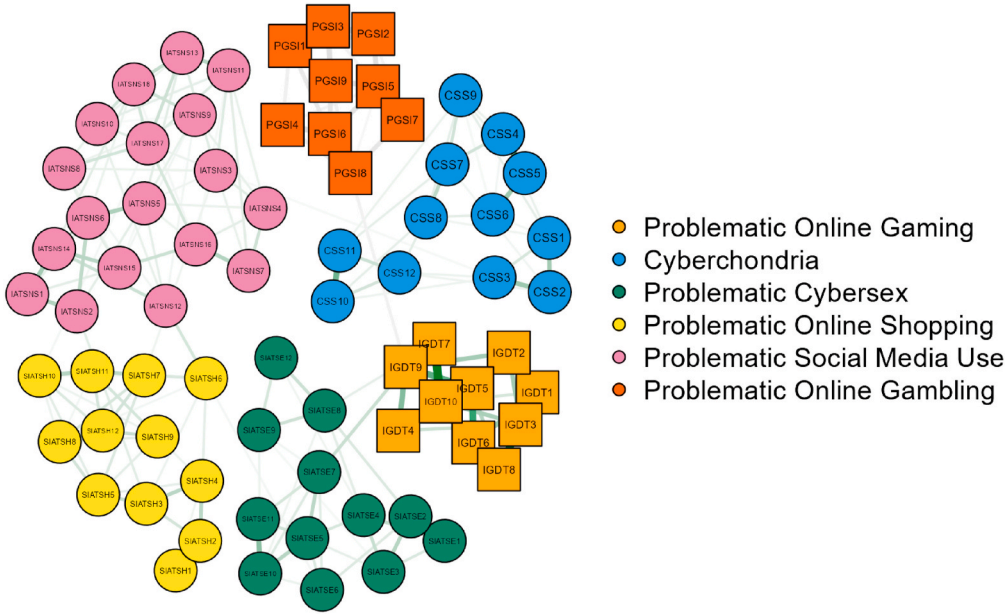

Fig. 1. Mixed graphical model (MGM) with EBIC regularization. Notes: Nodes consist of IGDT-10, CSS-12, SIAT-SE, SIAT-SH, IAT-SNS, and PGSI items. Green and red lines depict positive and negative associations, respectively. The thicker the lines, the stronger the associations. The layout was based on the Fruchterman-Reingold algorithm.

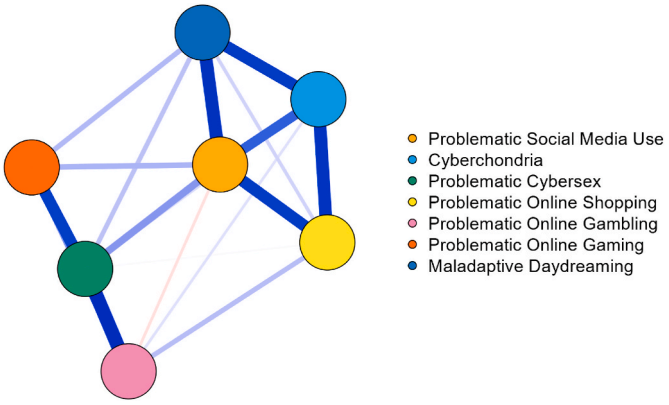

Fig. 2. EBICglasso network of Maladaptive Daydreaming and Problematic Online Behaviors. Note: Nodes consist of composite scores obtained from the IGDT-10, CSS-12, SIAT-SE, SIAT-SH, IAT-SNS, and PGSI scales. Blue and red lines depict positive and negative associations, respectively. The thicker the lines, the stronger the associations. The layout was based on the Fruchterman-Reingold algorithm.

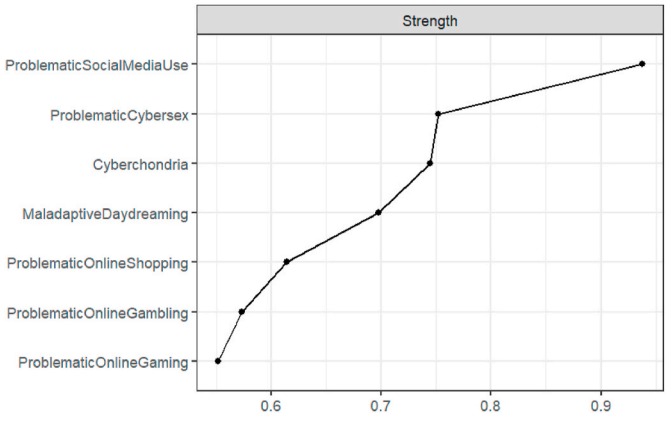

Fig. 3. Centrality plot of the EBICglasso network.

(Zsila et al., 2018). However, few empirical studies have examined the relationships between MD and maladaptive engagement in specific Internet platforms (Costanzo et al., 2021; Chirico et al., 2024). Accordingly, the current study aimed to investigate the interrelationships between MD and distinct POBs (i.e., problematic online gambling, problematic online gaming, problematic cybersex, PSMU, problematic online shopping, and cyberchondria).

In accordance with previous research (Baggio et al., 2022; Rozgonjuk et al., 2023), the first network analysis showed that items within each POB were strongly associated among them, clustering into distinct communities. Also, the six communities, corresponding to different POBs, were connected among them through specific items. For example,

problematic online gaming was mainly associated with problematic online gambling through the positive edge between the IGDT item 9 and the PGSI item 8. Our findings support the understanding of the POBs as maladaptive Internet-related behaviors that are associated with but distinct from each other (Starcevic and Billieux, 2017). Hence, investigating the relationships between MD and each POB might be more pertinent than examining the relationship between MD and PIU as a unitary construct.

Bivariate correlations showed significant positive associations between MD and all POBs. However, the second network analysis revealed that MD showed the strongest associations with PSMU and cyberchondria, weakest associations with problematic online gaming, problematic cybersex and problematic online shopping, and no association with problematic online gambling.

The positive association between MD with PSMU has been previously observed in the literature (Chirico et al., 2024; Costanzo et al., 2021). It is noteworthy that both MD and PSMU might serve as maladaptive coping strategies for temporary relief from emotional distress and interpersonal difficulties (Brenner et al., 2022; Gioia et al., 2021; Santoro et al., 2024; Somer et al., 2016b, 2016c). Also, there is evidence that individuals with MD are typically involved in fantasies in which they have idealized characteristics and are admired by others (Bigelsen et al., 2016; Bigelsen and Schupak, 2011). Thus, MD might increase the risk for PSMU, as social media might allow individuals to manage their own identity in accordance with an idealized self (Costanzo et al., 2021).

Regarding the relationship between MD and cyberchondria, previous research showed that somatic symptoms are involved in both MD (Chirico et al., 2024) and cyberchondria (Santoro et al., 2022). It could be hypothesized that concerns for one's somatic symptoms might lead individuals exhibiting MD to search online health information for reassurance (Starcevic and Berle, 2013). However, increased levels of health anxiety due to health information searches might foster, in turn, the involvement in vivid fantasies for self-regulation purposes.

Although we found weak associations between MD and problematic online gaming, problematic cybersex and problematic online shopping, our findings provide empirical evidence that MD might co-occur with these POBs. It is noteworthy that MD and problematic online gaming may entail the tendency to retreat into imaginary scenarios to escape difficulties in daily life (Deleuze et al., 2019; Giardina et al., 2023; Somer et al., 2020). In fact, individuals with MD may engage in fantasies centred on fictional characters that can be inspired by several media (Bigelsen et al., 2016; Bigelsen and Schupak, 2011). Thus, MD might promote the tendency to resort on online gaming as a coping strategy, increasing the risk of developing problematic patterns of online gaming. The relationship between MD and problematic cybersex can be attributed to the role of fantasy activity as a private experience in both addictive-like behaviors (Castro-Calvo et al., 2018; Somer et al., 2016c). Problematic cybersex may serve not only as a maladaptive emotion regulation strategy but also as a means to anonymously fulfill one's own sexual fantasies that cannot be otherwise satisfied (Wéry and Billieux, 2017). Although fantasies did not primarily involve sexual content in MD (Bigelsen et al., 2016), individuals might engage in cybersex to fulfil their sexual desires (Pietkiewicz et al., 2018).

Regarding the weak relationship between MD and problematic online shopping and the absence of network connections between MD and problematic online gambling, we must consider that these activities may not stimulate escapism into alternative worlds but rather may act as compulsive behaviors aimed at achieving pleasure and avoiding distressing experiences. However, problematic online gaming, problematic cybersex and problematic online shopping might act as triggers for imaginative involvement in individuals who are prone to engage in MD (Pietkiewicz et al., 2018), explaining the significant but weak relationships between MD and these POBs.

Notably, the second network analysis showed several associations between POBs and centrality estimates showed that PSMU, cyberchondria, problematic cybersex, and MD were the strongest nodes in the network. This suggests that the mutual relationships between MD and POBs might be reinforced by certain POBs and provide a potential explanation for significant bivariate associations between MD and all POBs.

The present study is subject to certain limitations. First, the cross-sectional design precludes examining the directionality of the associations within the network structure. Future longitudinal approaches, such as psychometric network models for panel data, are needed to address this gap. Additionally, we employed self-reported measures for MD and POBs, that might introduce biases such as recall and social desirability, and recruited individuals from the community. It is recommended that future studies adopt clinical interviews or rigorous assessment procedures to recruit participants that exhibit clinically relevant levels of MD or POBs. This could further provide relevant insight on the relationships between the variables of interest. Notably, the sample of the study ranged in age from 18 to 73 years old, and a high percentage of participants were females (i.e., 72.5%). Previous research suggest that gender and age might have a relevant role in POBs. For example, meta-analytic findings showed higher levels of PSMU and lower levels of problematic online gaming among females in comparison to males (Su et al., 2020). Moreover, a younger age is associated with increased levels of different POBs, such as PSMU, problematic online gaming and problematic cybersex (e.g., Russo et al., 2022; Studer et al., 2019). Thus, future studies could investigate the relationships between MD and POBs taking into account the effects of gender and age.

In conclusion, our study found significant reciprocal relationships between MD and PSMU and cyberchondria, and weak or absent interrelationships between MD and problematic online gaming, problematic cybersex, problematic online shopping, and problematic online gambling. Thus, the present study highlights the need to investigate MD in relation to distinct POBs, rather than the relationship between MD and PIU as a unitary construct. In this vein, our study might have relevant clinical implications. In fact, it is advisable for clinicians to evaluate the potential role of POBs as a compensatory strategy in individuals who have high levels of MD; conversely, patients who exhibit POBs might benefit from target clinical interventions aimed at reducing the maladaptive immersion in fantasy. Future research should clarify the role of MD in these associations, trying to find out whether it acts as a risk factor, whether POBs foster it, or what variables may be a mediating factor in the relationship between MD and different Internet-related problematic behaviors.

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Ethics approval

Ethical approval was obtained from the Research Ethics Board of the University of Parma (Protocol Number 0198254). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients for being included in the study.

Data availability

The dataset analyzed during the current study is available from the corresponding author on reasonable request.

CRediT authorship contribution statement

Mattia Pezzi: Writing – original draft, Conceptualization. **Andrea Zagaria:** Investigation, Formal analysis. **Alejandro Miguel-Alvaro:** Writing – original draft, Conceptualization. **Manuel Gámez-Guadix:** Writing – review & editing, Conceptualization. **Alessio Gori:** Writing –

review & editing, Supervision, Conceptualization. **Gianluca Santoro:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Alessandro Musetti:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization.

Declaration of competing interest

Mattia Pezzi, Andrea Zagaria, Alejandro Miguel-Alvaro, Manuel Gámez-Guadix, Alessio Gori, Gianluca Santoro, Alessandro Musetti declare that they have no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2024.07.023.

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