



Related metacognitions, desire thinking and identity differentially predict compulsion and withdrawal symptoms in problematic Instagram use

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ABSTRACT

Work has identified that metacognitive thought results in desire-based thinking and perpetuates the magnitude and severity of maladaptive behaviour including problematic social media use, and also that one's ingroup identity is related to increasing problematic behaviour. No evidence has ascertained the relative contribution of these as related differential factors in the experience of problematic social media use. The current study explored the comparative importance of components of desire thinking, positive and negative metacognitions and dimensions of ingroup identity on degree of problematic use among 147 current Instagram users. Results showed that for predicting general problematic Instagram use negative metacognitive beliefs and the verbal perseveration component of desire-based thinking were significant. Importantly, however, different factors appeared to be important for predicting distinct aspects of problematic Instagram. For compulsivity indicators, negative metacognitions and verbal perseveration were essential, whereas for the withdrawal component identity centrality (and no other dimensions of identity) and imaginal prefiguration emerge as the sole independent predictors.

1. Introduction

Instagram has more than one billion active monthly users (Statista, 2022) who are predominantly young adults (Auxier & Anderson, 2021). Given this popularity there is a developing concern about any psychological and social harms that might be associated with repeated and problematic use (Kuss and Griffiths, 2017; Kircaburun & Griffiths, 2018; Rozgonjuk, et al., 2020). Unlike other forms of social networking (e.g., Başer et al., 2022; Cataldo, Billieux, Esposito & Corazza, 2022), research examining motivations for Instagram use and misuse is less prominent and the evidence that is apparent has resulted in equivocal findings (see Faelens et al., 2021 for systematic review). For instance, whilst there is a positive association between the frequency of Instagram use and problematic use, evidence concerning the relationship between its use with depression, anxiety, loneliness, and self-esteem is mixed (e.g., Limniou, Ascroft & McLean, 2021; Ponnusamy et al., 2020; Stapleton et al., 2017; Rozgonjuk et al., 2020; Martinez-Pecino & Garcia-Gavilán, 2019). In addition, Instagram has been shown to be associated with increased depressive symptoms among those who follow fewer people online (Yang, 2016; Stapleton et al., 2017; Lup et al., 2015) whereas other work has shown no such links (Rozgonjuk et al., 2020). Whilst this evidence is at best inconsistent it is also limited to the extent that it does not provide

explanatory understanding for problematic Instagram use *per se* but rather focuses on the outcomes of overuse. This is important given the wider debate for considering social media use (including Instagram use) as potential behavioural addictions whilst avoiding any likelihood of overly pathologizing everyday behaviours (Brand et al., 2020; Kardefelt-Winther et al., 2017; Moretta et al., 2022). In this spirit, for the present study we have adopted an understanding of problematic Instagram use as reflecting decreased control over online activity that is rewarding in nature, and which might continue despite detriments to psychological and social wellbeing and function (Xanidis & Brignell, 2016; Antons et al., 2020). In other words, we have adopted a definition incorporating the core aspects of compulsion and withdrawal to reflect dysfunctional control over Instagram use, craving its use, social and psychological impairment as result of its use, and growing tolerance with sustained use. This is reflected in the adoption of the Social Media Use Questionnaire (SMUQ) in the present study which delineates the factors withdrawal and compulsion as defining criteria for measuring severity of problematic (Instagram) use (Xanidis & Brignell, 2016) and which itself is based on standards used for categorising gambling disorder in DSM-5, the Fagerstrom Test for Nicotine Dependence and the Internet Addiction Test (see Cataldo et al., 2022 for review of relevant measures).

With this in mind there is a need to delineate candidate explanatory

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factors in predicting Instagram use and the magnitude of this use. The present study aims to do this by testing the relationship between known predictors of the severity of addictive behaviours, namely social identity (e.g., Frings & Albery, 2015, 2021), positive and negative metacognitions (e.g., Casale, Musico & Spada, 2021; Casale, Caplan, & Fioravanti, 2016; Casale, Fioravanti, & Spada, 2021) and desire thinking (e.g., Caselli & Spada, 2011), with problematic Instagram use above and beyond other factors known to be associated with measures of use (i.e., frequency of exposure and participation and experiential factors).

1.1. Social identity in addictive behaviours

Social identities, or one's experienced psychological affiliations between the self and a social category (Tajfel & Turner, 1979), are important for the functioning of health-related behaviours (see Haslam, Haslam, Jetten, Cruwys, & Steffens, 2021). This includes behaviours that are adaptive (e.g., recovery processes in addiction (Buckingham, Frings, & Albery, 2013; Frings & Albery, 2021; Frings & Albery, 2015; Callaghan et al., 2021), healthy eating beliefs (Albery et al., 2022)) or maladaptive (e.g., problematic Facebook use (Albery, Nosa, Spada, & Frings, 2021), risky drinking (Hertel, Baldwin, Peterson, & Lindgren, 2021), tobacco use (Meijer, Vangeli, Gebhardt, & van Laar, 2020); gambling (Albery et al., 2024; Montes, 2020); and substance use (Montes & Pearson, 2021)). Given this understanding it is of little surprise that work has begun to develop identity-based interventions as a potential mechanism for behaviour change (see Steffens, LaRue, Haslam, Walter, Cruwys, Munt, Haslam, Jetten & Tarrant, 2021).

This evidence suggests that one's identity acts to reinforce the understanding of self-concept through our membership of groups we value to the extent that these groups influence our belief sets and ongoing relevant behaviours through a strong desire to be a member (Frings & Albery, 2021; Frings, Wood, & Albery, 2021). This process of self-identifying as a group member is determined by one's assessment of those similarities shared with other in-group members (i.e., *self-definition*) and a personally experienced sense of significant *self-investment* with that in-group (Leach et al., 2008). In Leach et al.'s (2008) hierarchical model of in-group identification these higher order dimensions of identity, *self-definition* and *self-investment*, have a number of related components. *Self-definition* is comprised of individual *self-stereotyping* (i.e., how far one thinks of oneself as similar to the perceived in-group prototype), and *in-group homogeneity* (i.e., how homogenous one perceives the in-group to be and how distinct they are from out-group members). *Self-investment* is composed of *satisfaction* (i.e., how positively evaluated the in-group is thought to be), *solidarity* (i.e., a sense of belonging and connection to an in-group), and *centrality* (i.e., how salient and important the in-group is for one's self-identity). Recent work has detailed the importance of recognising these sources for understanding the mechanics of identity experienced as an in-group member in explaining engagement across several addictive behaviours (Albery et al., 2021; Hertel et al., 2019; Lindgren et al., 2017). For instance, Hertel and colleagues (2019) reported identity investment (i.e., how frequently one's thoughts are associated with one's identity as a drinker) as positively associated with drinking practice and alcohol use disorder. In terms of social network sites, Albery et al. (2021) showed that increasing problematic Facebook use was *only* associated with how self-invested one is with an in-group. In other words, increased problematic Facebook use was found to be significantly associated with (a) how chronically salient one's group membership is for the self (i.e., centrality) and, to a lesser degree, (b) an increasing sense of belonging and attachment to other group members (i.e., solidarity). In line with this work, it is also likely that increasing problematic Instagram use is likely to be influenced by greater self-investment in the identity of an Instagram user and that this identity will be characterised most particularly by how salient one's identity is for an individual.

Whether this relationship between social identity and problematic social media use is maintained when other social cognitive factors

known to predict use and misuse are included in any understanding is not known. For instance, theoretically one's understanding of oneself as an in-group member to enable self-perception of, for example, worthiness and esteem may co-occur with behavioural beliefs that reflect our thoughts about their self-regulatory and control-based nature (i.e., metacognitive beliefs). In addition, our identities might be associated with an increasing *desire* to undertake behaviours that reflect the key defining characteristics of our in-group membership i.e., behaviours that group members undertake. To this end the current study included measures of Instagram-related positive and negative metacognitions and desire thinking.

1.2. Metacognitions and desire thinking in addictive behaviour

Metacognition, or one's knowledge about one's own or another's thoughts, feelings, and motivations (Flavell, 1979), has been the focus of significant attention for understanding psychological dysfunction and maladaptive coping strategies. The argument is that beliefs related to our experiences and how these beliefs are agents in controlling these experiences (i.e., metacognitive beliefs) initiate and maintain coping stratagems (i.e., rumination, worry and threat monitoring) that maintain any psychopathology (Wells & Matthews, 1994), including the development and maintenance of addictive behaviours (see Spada et al., 2013). These metacognitive beliefs may reflect either the advantages of behaving in a certain manner as a form of self-regulation (i.e., positive metacognitions, "Using Instagram makes me feel sociable.") or beliefs related to thoughts about the (un)controllability of behaving in a certain way (i.e., negative metacognitions, "I continue to use Instagram despite thinking it would be better to stop."). The former is important as a motivational source to initially engage in a behaviour (Spada et al., 2013) whilst the latter is argued to prompt negative emotional states once behaviour has been adopted and acts (perhaps counter-intuitively) to reinforce the addictive behaviour to overcome these experienced negative thoughts (Spada et al., 2015). Two recent systematic reviews have argued that this understanding is consistent across a range of addictive behaviours including technological addictions (i.e., internet gaming disorder, problem internet use, problem smart phone use and problem social network site use (Casale, Musico & Spada, 2021; Hamonniere & Varescon, 2018)). Theoretically, these metacognitive beliefs activate a style of cognition labelled the cognitive attentional syndrome (CAS) (Spada, Caselli & Wells, 2013) which is characterised by cognitive coping strategies (threat monitoring, avoidance and thought suppression) but also by so called "extended" thinking comprised of worry, rumination and, significantly, desire thinking (e.g., Spada et al., 2015).

Desire thinking is a controlled style of thinking that is characterised by a perseverative focusing on memories, images and information associated with a desired-for target or goal (Caselli & Spada, 2011). People engage in desire thinking to divert one's attention away from an existing craving experience to diminish the psychological uneasiness produced by that experience (Caselli & Spada, 2010, 2016). Paradoxically, however, undertaking desire thinking increases the prominence of the craving experience since the anticipated target, whilst fixated on, is not achieved (Caselli & Spada, 2011). This results in the target being perceived of as the only route to achieve relief from any intensifying distress (Marino et al., 2019; Caselli & Spada, 2015). Prospective and experimental work in clinical and nonclinical samples has shown desire thinking to be associated with severity and magnitude indicators across numerous addictive behaviors (e.g., for a recent systematic review and meta-analysis see Mansueto et al., 2019; Albery & Spada, 2021; Khosravani et al., 2022; Allen, Kannis-Dymand, & Katsikitis, 2017). Problematic social media is no exception (e.g., Spada, Caselli, Slaifer, Nikčević, & Sassaroli, 2014; Marino et al., 2019; Brandtner et al., 2021, 2023; Brandtner & Brand, 2021; Sharifi Bastan et al., 2022; Başer et al., 2022) with desire thinking being associated with increased problematic general social networking site use (Khosravani et al., 2022), mobile

(cell) phone use (Gao et al., 2023), Facebook use (Albery et al., 2021; Marino et al., 2019), internet pornography use (Marino et al., 2023) and internet use (Spada et al., 2014; Brandtner & Brand, 2021; Dragan and Grajewski, 2021). However, the nature of desire thinking in Instagram use has not been the subject of any empirical assessment to date.

This significance of desire thinking (and metacognitive thought) in understanding the development and persistence of problematic internet use has resulted in the revision of the I-PACE model (Person-Affect-Cognition-Execution Model (Kircaburun & Griffiths, 2018)) to specifically include desire thinking and metacognitive thoughts as core mechanisms (see Brandtner et al., 2021). This model argues that a desire thinking state is triggered by both internally and externally generated cues via the activation of related positive and negative metacognitive beliefs (Caselli & Spada, 2015). This manifests itself through two separate pathways, one pleasure-orientated (i.e., hedonic expectations of desire) and the second relief-orientated (i.e., compensatory expectations of desire). Once desire thinking is operational in terms of imagery- and verbally-based thoughts directed at *both* offsetting negative feelings and maximising gratification any craving experience is reinforced resulting in ongoing risky or problematic use and, with repeated experience, a strengthening of this use overtime (Brand et al., 2019).

To the extent that one's social identity provides an experientially based and internally generated mechanism implicated in the generation of numerous addictive behaviours (e.g., Albery et al., 2024; Albery et al., 2022; Albery et al., 2021; Frings, Albery & Kim, 2022; Frings & Albery, 2021), how it relates to other core components within the I-PACE framework is of significance. For example, theoretically increasing identity as an Instagram user is likely to be associated with related positive and negative metacognitive structures as well as heightened desire thinking for the fulfilment of expected or anticipated goals. Together how these mechanistic factors covary as cognitive components should provide a more explanatory framework for individual differences in problematic behaviours including Instagram use.

1.3. Aim of the study

In a sample of current UK-based Instagram users, this study aimed to provide an *exploratory* account of the how Instagram-related metacognitive beliefs, thoughts about one's desires to use Instagram and how much people identify as Instagram users covary in accounting for increasingly problematic Instagram use above and beyond Instagram usage frequency indicators.

2. Method

2.1. Participants

One hundred and forty-seven participants (111 [75.5 %] females, 35 [23.8 %] males, 1 [0.7 %] marked as other) aged on average 26.66 years ($SD = 7.47$, range = 18–54) were recruited. Participants were predominantly single (70.3 %), either in full-time (34.4 %) or part-time employment (13.3 %) or students (43.4 %). Approximately one half were white (49.3 %), and 42.2 % declared their highest educational qualification as an undergraduate degree.

Eighty-eight (59.9 %) participants had been using Instagram for over five years, with 100 (68 %) reporting using every day of the week. In terms of average duration of a single use session, 79 (53.7 %) reported using for 30 min or less, whilst 68 (46.3 %) used for one or more hours at a time. One-hundred and twenty-seven Instagram users (55.8 %) reported "never" posting ($n = 22$, 15 %), "rarely posting" ($n = 60$, 40.8 %), or "sometimes" posting ($n = 45$, 30.6 %) with 20 (13.6 %) reporting posting either "often" or "always". Age was shown to be significantly negatively associated with time as an Instagram user ($r = -0.29$, $p < .001$), weekly Instagram use ($r = -0.21$, $p < .05$), and duration of single session use ($r = -0.18$, $p < .05$). Posting behaviour was not associated with age ($r = -0.05$, $p = .59$). In terms of gender differences,

males ($M = 6.57$, $SD = 1.27$) reported significantly greater number of days per week use of Instagram compared to females ($M = 5.60$, $SD = 2.11$, $t(144) = 2.59$, $p < .01$). All other Instagram use and gender comparisons were not significant, $0.19 < ps < 0.80$.

2.2. Design

A cross-sectional correlational design was utilised to explore the relationships between Instagram use and misuse, Instagram-related positive and negative metacognitions, Instagram-related desire thinking and in-group identification as an Instagram user.

2.3. Materials

2.3.1. Demographics

Age (years), gender (male, female, other), marital status (married, single, divorced, separated, widowed, co-habiting, civil partnership), and employment status (full-time employment, part-time employment, student, self-employed, retired, unemployed, carer, looking after home/family, voluntary work) were taken initially.

2.3.2. General Instagram use

Participants were asked: "How long have you been an Instagram user for?" (Scale options: "0–6 months", "6–12 months", "1–2 years", "3–5 years" and "more than 5 years"); "On average when you use Instagram how many minutes do you use it for?" (Scale options: "0–10 min", "10–20 min", "half an hour", "one hour", and "over 2 h"; In an average week, on how many days do you use Instagram? (Scale options: "one day", "two days", "three days", "four days", "five days", "six days", and "seven days"), and; "How often do you post on Instagram" (Scale options: "Never", "Rarely", "Sometimes", "Often", "Always").

2.3.3. Problematic Instagram Use (PIU)

To measure PIU we adapted the Social Media Use Questionnaire (Xanidis & Brignell, 2016) for Instagram use (SMUQ-IU). The SMUQ-IU comprised nine items (Cronbach's $\alpha = 0.88$) across two subscales: Compulsion symptoms (four items, Cronbach's $\alpha = 0.87$; e.g., "I stay on Instagram longer than I initially intended.") (SMUQ-IU-Comp) and Withdrawal symptoms (five items, Cronbach's $\alpha = 0.83$; e.g., "I struggle to stay in places where I won't be able to access my Instagram account.") (SMUQ-IU-With). Participants responded to items by marking on five-point scales how often they experienced each (Response options were: "Never" = 1, "Rarely" = 2, "Sometimes" = 3, "Often" = 4, "Always" = 5). Increased scores were indicative of increased PIU. Items were presented to each participant in a random order.

2.3.4. In-group identification with Instagram users

To measure in-group identification Leach et al.'s (2008) 14-item scale developed to operationalise *self-definition* (Cronbach's $\alpha = 0.87$) and *self-investment* dimensions ($\alpha = 0.88$) were used. Self-investment comprised three sub-scales; solidarity (e.g., "I feel solidarity with Facebook users") (Cronbach's $\alpha = 0.82$), satisfaction (e.g., "I think that Facebook users have a lot to be proud of") (Cronbach's $\alpha = 0.88$), and centrality (e.g., "The fact that I am a Facebook user is an important part of my identity") (Cronbach's $\alpha = 0.88$). Self-identification was composed of two sub-scales, individual self-stereotyping (e.g., "I am similar to the average Facebook user") (Cronbach's $\alpha = 0.84$) and in-group homogeneity (e.g., "Facebook users have a lot in common with each other") (Cronbach's $\alpha = 0.87$). All statements were presented on seven-point Likert-type scales (1 = "strongly disagree" to 7 = "strongly agree") with higher scores indicative of greater levels of component measures of identity. Items were presented in random order for each participant.

2.3.5. Positive and negative metacognitions in Instagram users

The Metacognitions about Online Gaming Scale (MOGS) (Spada & Caselli, 2017) was adapted for Instagram use for the current study. The

adapted scale comprised twelve items across two subcomponents. The first, positive metacognitions about Instagram use (P-MIU), is concerned with beliefs about the usefulness of Instagram as a cognitive-affective self-regulatory strategy (six items, Cronbach's $\alpha = 0.88$; e.g., "Using Instagram makes my worries more bearable."). The second, negative metacognitions about Instagram use (N-MIU), concerns the uncontrollability and dangers of Instagram-related thoughts (six items, Cronbach's $\alpha = 0.87$; e.g., "I continue to use Instagram despite thinking it would be better to stop."). Participants responded to each of these items using a four-point Likert type scale ("Strongly Disagree", "Disagree", "Agree", "Agree and "Strongly Agree".) with increased scores indicative of greater endorsement of their beliefs about related thoughts. Items were presented in random order for each participant.

2.3.6. Instagram use-related desire thinking

The Desire Thinking Questionnaire (DTQ) (Caselli & Spada, 2011) was adapted for Instagram use. It comprised ten statements across two factors measuring (i) verbal perseveration (DTQ-VP, five items) – the perseveration or prolonging of verbal thoughts about desire-related content/experiences (e.g., "When I begin to think about using Instagram I find it difficult to stop."; " When I begin to think about using Instagram I continue until I manage to engage in it.") - and (ii) imaginal prefiguration (DTQ-IP, five items) - the tendency to prefigure images about desire-related content/experience (e.g., "I imagine myself using Instagram."; "I begin to imagine using Instagram every time it comes to my mind."). Responses were made on four-point scales labelled "Almost Never", "Sometimes", "Often" and "Almost Always". Higher scores on the total measure and on DTQ-IP and DTQ-VP subcomponents indicated increased levels of related desire thinking (possible score range = 10–40). Cronbach's $\alpha = 0.92$, DTQ-Total: M = 14.43, SD = 5.67, range 10–36; DTQ-IP: M = 7.46, SD = 3.16, range 5–19; DTQ-VP: M = 6.97, SD = 2.79, range 5–17. Items were presented in random order for each participant.

2.4. Procedure

Participants were recruited through the social media platforms Instagram, Snapchat and Reddit and using a Research Participation Scheme (RPS) in exchange for course credit at the host University. The study was programmed and presented via the Gorilla platform (<https://www.gorilla.sc>). After consent had been gathered all participants completed demographic information (age, gender, marital status, employment status, etc.), and quantity / frequency measures of daily and weekly Instagram use. Participants then completed the Social Media Use Questionnaire for Instagram use (SMUQ-IU), positive and negative metacognitions about Instagram use (P-MIU and N-MIU), the Desire Thinking Questionnaire (adapted for Instagram use) (DTQ), and the in-group (Instagram users) self-identification measures. For these latter four instruments order was counterbalanced across participants using a Latin square design.

The study procedures were carried out in accordance with ethical guidance provided by the British Psychological Society. The University Research Ethics Panel of London South Bank University approved the study.

3. Results

3.1. Correlations between criterion and predictor variables

Initial Pearson's r correlation coefficients were calculated between SMUQ-IU, SMUQ-IU-Comp and SMUQ-IU-With and quantity / frequency measures of daily and weekly Instagram use, identity components, desire thinking, and positive and negative metacognitions (see Table 1). Bonferroni corrections for multiple tests were applied within each criterion variable such that only Pearson's r correlations achieving $p < 0.003$ were deemed significant. (Descriptive statistics for variables

Table 1
Descriptive statistics and inter-correlations for variables included in models predicting problematic Instagram use total, Instagram use withdrawal and Instagram use compulsivity.

	X	SD	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. SMUQ-IU	1.08	0.74	0.89*	0.87*	-0.01	0.49*	0.29*	0.25§	0.36*	0.16§	0.49*	0.32*	0.10	0.62*	0.62*	0.56*	0.57*	0.40*
2. SMUQ-IU-Comp	1.46	1.00	-	0.56*	0.01	0.47*	0.32*	0.15	0.27*	0.04	0.31*	0.17§	0.04	0.47*	0.50*	0.40*	0.59*	0.40*
3. SMUQ-IU-With	0.77	0.72	-	-	-0.03	0.39*	0.18§	0.31*	0.38*	0.26*	0.57*	0.42*	0.14	0.64*	0.61*	0.60*	0.40*	0.35*
4. Years IS User	4.29	1.09	-	-	-	0.30*	0.55*	0.29*	0.13	0.06	-0.08	0.04	0.03	0.13	-0.18§	-0.07	-0.07	-0.03
5. Occasion Mins	3.11	1.36	-	-	-	-	0.55*	0.35*	0.42*	0.10	0.26*	0.33*	0.09	0.32*	0.29*	0.31*	0.37*	0.27*
6. IS Weekly Use	5.84	1.98	-	-	-	-	-	0.38*	0.39*	0.23§	0.19§	0.30*	0.04	0.07	0.04	0.08	0.08	0.13
7. IS Post	2.45	0.95	-	-	-	-	-	-	0.42*	0.27*	0.35*	0.34*	0.10	0.24§	0.21§	0.24	0.10	0.14
Average																		
8. ID Solid	3.30	1.40	-	-	-	-	-	-	-	0.40*	0.52*	0.43*	0.11	0.28*	0.24§	0.30*	0.15	0.26§
9. ID Satis	4.07	1.19	-	-	-	-	-	-	-	-	0.38*	0.43*	0.19	0.12	0.08	0.15	-0.12	0.20§
10. ID Central	2.41	1.39	-	-	-	-	-	-	-	-	-	0.53*	0.26§	0.49*	0.51*	0.44*	0.36*	0.30*
11. ID Self-Stereo	3.30	1.39	-	-	-	-	-	-	-	-	-	-	0.33*	0.34*	0.32*	0.33*	0.03	0.21§
12. ID Homog	3.74	1.60	-	-	-	-	-	-	-	-	-	-	-	0.17§	0.12	0.18§	0.08	0.18§
13. DTQ-Total	14.29	5.67	-	-	-	-	-	-	-	-	-	-	-	-	0.95*	0.96*	0.35*	0.49*
14. DTQ-VP	6.97	2.80	-	-	-	-	-	-	-	-	-	-	-	-	-	0.81*	0.53*	0.40*
15. DTQ-IP	7.46	3.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.41*	0.28*
16. N-MIU	1.89	0.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17. P-MIU	1.99	0.63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

$n = 147$; * $p < 0.001$, § $p < 0.05$.
 Note: SMUQ-IU - social media use questionnaire; total; SMUQ-Comp - social media use questionnaire; compulsivity; SMUQ-With - social media use questionnaire; withdrawal; Years IS User - years Instagram use; Occasion Mins - duration of single session use; IS Weekly Use - Instagram use days per week; IS Post Average - frequency of Instagram posting; ID Solid - identity solidarity; ID Satis - identity satisfaction; ID Central - identity centrality; ID Self-Stereo - identity self-stereotyping; ID Homog - identity in-group homogeneity; DTQ-Total - desire thinking total; DTQ-VP - desire thinking verbal perseveration; DTQ-IP - desire thinking imaginal prefiguration; N-MIU - negative metacognitions; P-MIU - positive metacognition

are also reported in Table 1.)

3.2. Analysis process

Inferential analyses involved hierarchical multiple linear regressions comprising SMUQ-IU and SMUQ-IU-Comp and SMUQ-IU-With as criterion factors and measures of quantity/frequency measures of daily and weekly Instagram use, identity components, desire thinking, and positive and negative metacognitions as predictor variables. Using IBM SPSS Version 26 a total of six hierarchical multiple linear regressions were undertaken separately for SMUQ-IU and SMUQ-IU-Comp and SMUQ-IU-With. Separate regressions were performed with DTQ-Total and DTQ-VP plus DTQ-IP as measures of desire thinking.

In terms of assumptions, a sample size of 147 was adequate given a maximum of 14 predictor variables included per regression. Post-hoc power analysis using G-Power (Faul et al., 2007) with a large effect size ($f^2 > 0.35$), $\alpha = 0.05$, sample size = 147 and 14 predictors gives an achieved power of 0.99. In addition, all of the Pearson r correlation coefficients between predictor variables were less than 0.80 ($-0.03 < r < 0.65$) and collinearity statistics were within acceptable limits indicative of low multicollinearity (Tolerances > 0.10 ; VIFs < 10). No significant multivariate outliers were shown after calculation of Mahalanobis distance scores, and residual and scatterplots showed that the normality, linearity and homoscedasticity (all Koenker tests for heteroskedasticity $ps > 0.114$) assumptions were met. Independence of observations (no autocorrelations) was confirmed for all subsequent regressions (Durban Watson values fell between 1.5 and 2.5, range = 1.94–2.01).

Age and gender¹ of participants were entered at step 1 and indicators of general Instagram use (e.g., length of Instagram use, frequency of use, time spent during an Instagram session, posting frequency) were entered in step 2 to enable the proportion of variance to be calculated for relevant measures of desire thinking, metacognitive thinking, and social identity (step 3) beyond that explained by either age, gender, or Instagram usage measures. (See Tables 2, 3 and 4 for all regression summary statistics.)

Sensitivity analyses were undertaken to using the sensemakr program in r (version 4.3.1) to determine the robustness of regression estimates to unobserved confounding (see Cinelli & Hazlett, 2020). More specifically partial r^2 (pr^2) and the robustness value (RV) for each predictor were calculated to measure (a) the percentage of variation of the criterion explained by the predictor after accounting for that explained by the remaining predictors in the regression equation (i.e., how much variation unobserved confounders would need to explain to account for any effect), and (b) the minimum strength of association (measure as pr^2) that unobserved confounders would need to have with the predictor and with the criterion to reduce the observed effect estimate to zero.

3.3. Overall problematic Instagram use (SMUQ-IU)

For predicting SMUQ-IU, at step 1 neither age nor gender were significant, $F(2, 140) = 0.79$, $p = .46$, $R^2 = 0.019$, Adj. $R^2 = 0.00$. The addition of quantity / frequency measures of daily and weekly Instagram use was shown to significantly predict the criterion, $F(6, 136) = 9.52$, $p < .001$, $R^2 = 0.30$, Adj. $R^2 = 0.27$, and increase the proportion of variance accounted for by 29 %, $\Delta F(4, 136) = 13.74$, $p < .001$.

Introducing DTQ-Total, positive, and negative metacognitions and the identity components into the equation at step 3 also resulted in a

¹ Age and gender were controlled for since latest figures from Statista (2024, accessed March 23rd, 2024) show that of UK Instagram users 55.3% were female and 47.7% were male which differed from the sample distribution, $\chi^2(1) = 25.37$, $p < 0.001$. In addition, the proportion of UK users aged 18–24 (24.1%), 25–34 (29.9%), 35–44 (20.3%) and over 45 (25.8%) was shown to differ from the sample achieved, $\chi^2(5) = 75.64$, $p < 0.001$.

significant regression equation, $F(14, 128) = 12.94$, $p < .001$, $R^2 = 0.59$, Adj. $R^2 = 0.54$, Cohen's $f^2 = 1.44$,² accounting for an additional 29 % of variance explained, $\Delta F(8, 128) = 11.22$, $p < .001$. In the final model, DTQ-Total ($sr^2 = 0.05$) and negative metacognitive thoughts (N-MIU) ($sr^2 = 0.04$) were the only significant predictors ($ps < 0.05$). Sensitivity analysis showed that unobserved confounders would need to explain 26.7 % and 28.0 % of the residual variance of DTQ-Total, and N-MIU with SMUQ-IU to eliminate their effects.

For step 3 in the model including DTQ-VP and DTQ-IP as the separate components of DTQ-Total the regression equation was also significant, $F(15, 127) = 12.80$, $p < .001$, $R^2 = 0.59$, Adj. $R^2 = 0.54$, Cohen's $f^2 = 1.17$, accounting for an additional 29 % of variance explained, $\Delta F(9, 127) = 10.01$, $p < .001$. For this model, DTQ-VP ($sr^2 = 0.02$) and negative metacognitive thoughts (N-MIU) ($sr^2 = 0.04$) were the only significant predictors ($ps < 0.05$). Sensitivity analysis showed that unobserved confounders would need to explain 16.7 % and 27.5 % of the residual variance of DTQ-VP and N-MIU respectively with SMUQ-IU to eliminate their effects.

3.4. Compulsivity in problematic Instagram use (SMUQ-IU-Comp)

At step 1 age and gender did not predict SMUQ-IU-Comp $F(2, 140) = 0.25$, $p = .780$, $R^2 = 0.01$, Adj. $R^2 = 0.00$. The inclusion of quantity / frequency measures of daily and weekly Instagram at step 2 resulted in a significant equation, $F(6, 136) = 8.28$, $p < .001$, $R^2 = 0.27$, Adj. $R^2 = 0.24$, and a significant change in explained variance, $\Delta F(4, 136) = 12.25$, $p < .001$. Introducing DTQ-Total, positive, and negative metacognitions and the identity components into the equation at step 3 also resulted in a significant regression equation, $F(14, 128) = 9.35$, $p < .001$, $R^2 = 0.51$, Adj. $R^2 = 0.45$, Cohen's $f^2 = 1.04$, accounting for an additional 24 % of variance explained, $\Delta F(8, 128) = 7.71$, $p < .001$. In the final model, days of Instagram usage per week (days) ($sr^2 = 0.03$), negative metacognitions (N-MIU) ($sr^2 = 0.09$), and DTQ-Total ($sr^2 = 0.02$) were all significant predictors ($ps < 0.05$). Sensitivity analysis showed that unobserved confounders would need to explain 21.5 %, 19.1 % and 34.0 % of the residual variance of weekly use, DTQ-Total and N-MIU respectively and SMUQ-IU-Comp to eliminate their effects.

In the model including DTQ-VP and DTQ-IP as the separate components of desire thinking in step 3 in addition to positive, and negative metacognitions and the identity components the regression equation was also significant, $F(15, 127) = 8.85$, $p < .001$, $R^2 = 0.51$, Adj. $R^2 = 0.45$, Cohen's $f^2 = 1.04$, accounting for an additional 24 % of variance explained, $\Delta F(9, 127) = 7.03$, $p < .001$. For this model, Instagram usage per week (days) ($sr^2 = 0.03$), negative metacognitions (N-MIU) ($sr^2 = 0.08$), and DTQ-VP ($sr^2 = 0.02$) were all significant predictors ($ps < 0.05$). Sensitivity analysis showed that unobserved confounders would need to explain 21.1 %, 16.2 % and 33.5 % of the residual variance of weekly use in days, DTQ-Total and N-MIU respectively and SMUQ-IU-Comp to eliminate their effects.

3.5. Withdrawal in problematic Instagram use (SMUQ-IU-With)

For predicting SMUQ-IU-With, at step 1 the inclusion gender and age did not result in a significant regression equation, $F(2, 140) = 1.23$, $p < .2951$, $R^2 = 0.01$, Adj. $R^2 = 0.00$. The addition of quantity / frequency measures of daily and weekly Instagram at step 2 produced a significant regression equation, $F(6, 136) = 7.03$, $p < .001$, $R^2 = 0.24$, Adj. $R^2 = 0.20$, and a 22 % increase in variance explained, $\Delta F(4, 136) = 9.78$, $p < .001$. The inclusion of total desire thinking, metacognitions and identity components at step 3 also resulted in a significant equation, $F(14, 128) = 10.57$, $p < .001$, $R^2 = 0.54$, Adj. $R^2 = 0.49$, Cohen's $f^2 = 1.17$, and an additional 30 % in explanatory variance, $\Delta F(8, 128) = 10.33$, p

² Small, medium, and large effect sizes are $f^2 \geq 0.02$, $f^2 \geq 0.15$, and $f^2 \geq 0.35$, respectively (Cohen, 1988).

Table 2
Regression statistics for predicting overall problematic Instagram use from relevant variables.

Predictor	β	t	p^2 (%)	RV (%)	sr^2	R	R^2	ΔR^2
Step 1						0.11	0.01	0.01
Age	-0.10	1.17	0.71	8.10	0.02			
Gender	-0.06	0.71	0.33	5.62	0.00			
Step 2						0.54	0.30	0.29***
Age	-0.06	0.75	0.41	6.23	0.00			
Gender	-0.03	0.44	0.14	3.69	0.00			
Years IS User	-0.27	3.04***	6.53	23.17	0.05			
Occasion Mins	0.44	4.96***	15.53	34.66	0.13			
IS Weekly Use	0.13	1.27	1.53	10.21	0.01			
IS Post Average	0.13	1.64	1.89	12.35	0.01			
Step 3a DTQ-Total						0.77	0.59	0.29***
Age	-0.05	0.76	0.54	7.10	0.00			
Gender	-0.01	0.15	0.02	1.33	0.00			
Years IS User	-0.07	0.93	0.69	7.98	0.00			
Occasion Mins	0.15	1.85	2.59	15.03	0.01			
IS Weekly Use	0.14	1.66	2.18	13.84	0.01			
IS Post Average	-0.02	0.27	0.06	2.43	0.00			
DTQ-Total	0.31	4.09**	11.11	26.65	0.05			
N-MIU	0.35	3.75***	9.84	28.03	0.04			
P-MIU	-0.07	0.88	0.60	7.45	0.00			
ID Solid	0.01	0.17	0.02	1.50	0.00			
ID Satisfaction	0.05	0.73	0.42	6.28	0.00			
ID Central	0.17	1.99	3.63	17.65	0.02			
ID Self-Stereo	0.03	0.38	0.11	3.31	0.00			
ID Homogeneity	0.04	0.62	0.30	5.34	0.00			
Step 3b DTQ-IP and DTQ-VP						0.77	0.59	0.29***
Age	-0.06	0.85	0.54	7.13	0.00			
Gender	-0.01	0.16	0.02	1.36	0.00			
Years IS User	-0.06	0.84	0.56	7.23	0.00			
Occasion Mins	0.15	1.89	2.73	15.42	0.01			
IS Weekly Use	0.14	1.63	2.04	13.42	0.01			
IS Post Average	-0.02	0.27	0.06	2.43	0.00			
DTQ-IP	0.10	0.95	0.66	7.84	0.00			
DTQ-VP	0.24	2.09*	3.25	16.72	0.02			
N-MIU	0.34	3.66**	9.47	27.53	0.04			
P-MIU	-0.08	0.98	0.75	8.32	0.00			
ID Solid	0.02	0.28	0.07	2.56	0.00			
ID Satisfaction	0.06	0.82	0.53	7.07	0.00			
ID Central	0.16	1.81	2.49	14.75	0.01			
ID Self-Stereo	0.03	0.33	0.09	2.91	0.00			
ID Homogeneity	0.03	0.49	0.20	4.34	0.00			

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

<.001. In the final model, identity centrality ($sr^2 = 0.03$) and DTQ-Total ($sr^2 = 0.07$) were the only significant predictors ($ps < 0.01$). Sensitivity analysis showed that unobserved confounders would need to explain 33.2 % and 23.5 % of the residual variance of DTQ-Total and ID Centrality respectively and SMUQ-IU-With to eliminate their effects.

For step 2 in the model including DTQ-VP and DTQ-IP as the separate components of desire thinking the regression equation was also significant, $F(15, 127) = 9.79, p < .001, R^2 = 0.54, \text{Adj. } R^2 = 0.48, \text{Cohen's } f^2 = 1.17$, accounting for an additional 30 % of variance explained, $\Delta F(9, 127) = 9.12, p < .001$. For this model, identity centrality ($sr^2 = 0.03$) and DTQ-IP ($sr^2 = 0.02$), were significant predictors. Sensitivity analysis showed that unobserved confounders would need to explain 19.9 % and 23.0 % of the residual variance of DTQ-IP and ID Centrality respectively and SMUQ-IU-With to eliminate their effects.

4. Discussion

Evidence has consistently shown that metacognitive thoughts result in increased desire-based thinking which may produce and perpetuate the magnitude and experienced severity of addictive behavioural patterns in general (e.g., Mansueto et al., 2019; Caselli & Spada, 2015; Albery & Spada, 2021) and excessive social media use, in particular (e.g., Brandtner et al., 2021). In addition, it has also been established that the chronicity of one's experienced identity as a member of a relevant ingroup is fundamental in describing addictive behavioural patterns generally (e.g., Frings & Albery, 2021, 2015; Lindgren et al., 2017)

including problematic social media use (Albery et al., 2021). Theoretically, it is plausible to predict that elicited problematic behaviour (e.g., excessive Instagram use) is likely to be the result of personal thoughts about our desire to do the behaviour which are grounded in our positive (i.e., motivational beliefs that reflect the advantages of behaving in a certain manner as a form of self-regulation prior to behavioural enactment) and negative (i.e., beliefs about the (un)controllability of our behaviour once it has been enacted and which influences repeated actions to overcome experienced negative emotional states) metacognitive makeup. These themselves are likely to be influenced by our need (i.e., motivation) to appraise ourselves as a regarded member of an ingroup that shares common beliefs, values, and aspirations to self-affirm. The current study aimed to test this additive formulation by examining how positive and negative metacognitions about Instagram use, desire thinking about Instagram use and experienced social identity as an Instagram user was associated with withdrawal and compulsion dimensions of problematic Instagram use above and beyond pre-existing differences in frequency measures of Instagram use.

4.1. General problematic Instagram use

After controlling for the effects of Instagram usage measures, our analysis showed that increasing problematic Instagram use was explained by the combination of increasing desire thinking, increasing perceived identity as an Instagram user (across measures of ingroup solidarity, centrality, satisfaction, self-stereotyping and ingroup

Table 3
Regression statistics for predicting compulsivity component of problematic Instagram use from relevant variables.

Predictor	β	t	p^2 (%)	RV (%)	sr^2	R	R^2	ΔR^2
Step 1						0.06	0.00	0.01
Age	-0.06	0.65	0.32	5.48	0.00			
Gender	-0.04	0.41	0.12	3.42	0.00			
Step 2						0.52	0.27	0.26***
Age	0.01	0.11	0.01	0.78	0.00			
Gender	0.00	0.03	0.00	0.24	0.00			
Years IS User	-0.23	2.53*	4.47	19.43	0.03			
Occasion Mins	0.43	4.72***	14.00	33.02	0.12			
IS Weekly Use	0.22	2.06*	3.02	16.15	0.02			
IS Post Average	-0.01	0.93	0.01	0.79	0.00			
Step 3a DTQ-Total						0.71	0.51	0.24***
Age	0.01	0.14	0.01	0.98	0.00			
Gender	-0.00	0.04	0.00	0.34	0.00			
Years IS User	-0.10	1.20	1.11	10.04	0.01			
Occasion Mins	0.15	1.72	2.24	14.03	0.01			
IS Weekly Use	0.26	2.73**	5.56	21.49	0.03			
IS Post Average	-0.08	1.02	0.81	8.66	0.00			
DTQ-Total	0.20	2.39*	4.31	19.08	0.02			
N-MIU	0.48	4.75***	14.93	34.02	0.09			
P-MIU	-0.11	1.18	1.08	9.92	0.01			
ID Solid	0.03	0.31	0.08	2.76	0.00			
ID Satisfaction	0.04	0.44	0.15	3.81	0.00			
ID Central	0.04	0.41	0.12	3.47	0.00			
ID Self-Stereo	-0.02	0.24	0.04	2.01	0.00			
ID Homogeneity	-0.03	0.46	0.17	4.03	0.00			
Step 3b DTQ-IP and DTQ-VP						0.72	0.51	0.24***
Age	-0.02	0.28	0.07	2.63	0.00			
Gender	-0.00	0.06	0.00	0.51	0.00			
Years IS User	-0.09	1.07	0.89	9.02	0.00			
Occasion Mins	0.16	1.78	2.41	14.54	0.01			
IS Weekly Use	0.25	2.65**	5.36	21.13	0.03			
IS Post Average	-0.08	1.02	0.82	8.69	0.00			
DTQ-IP	-0.01	0.09	0.01	0.74	0.00			
DTQ-VP	0.28	2.32*	3.05	16.24	0.02			
N-MIU	0.47	4.64***	14.48	33.54	0.08			
P-MIU	-0.12	1.34	1.39	11.21	0.01			
ID Solid	0.04	0.79	0.18	4.13	0.00			
ID Satisfaction	0.05	0.58	0.27	5.03	0.00			
ID Central	0.02	0.19	0.03	1.73	0.00			
ID Self-Stereo	-0.03	0.31	0.08	2.73	0.00			
ID Homogeneity	-0.02	0.28	0.06	2.39	0.00			

homogeneity identity components) and positive and negative metacognitive beliefs about Instagram use. Together these factors accounted for a further 29 per cent of variance explained in use beyond the Instagram frequency of use and engagement measures. As predicted these core components are important in explaining increasing problematic use. More importantly, however, only desire thinking (total score), and negative metacognitive thoughts were the only significant predictors. Neither identity measures nor positive metacognitions contributed significant explanatory variance to the equation.

In the model in which desire thinking was divided into its sub-components of imaginal prefiguration and verbal perseverence, while the effect of negative metacognitions was maintained, only that aspect of desire thinking which involves the elaboration of the target of desire in terms of evaluating reasons to behave in the desired way (i.e., verbal perseverence) (Caselli & Spada, 2015) was significant. It seems that the component characterised by an imagery-based elaboration of positive Instagram use factors generated from images and memories of *doing* the desired behaviour (i.e., imaginal prefiguration) is not important. Again, identity as an Instagram user was not shown to be important.

Together these findings suggest that increased problematic Instagram use is explained by (a) increasing endorsement of negative metacognitions and (b) the verbal perseverence of Instagram-related desire thoughts. Individuals who show increasing behavioural tendencies associated with more problematic Instagram use are more likely to believe that their related thoughts are increasingly uncontrollable and dangerous (e.g., "I continue to use Instagram despite thinking it would be better to stop."). If these thoughts are perceived as increasingly and

persistently uncontrollable it is also likely that they will evaluate their behaviour as less self-regulated which manifests itself in a decreasing likelihood that they will limit their ongoing behaviour and the perpetuation of Instagram use (see Casele, Musico & Spada, 2021; Hamonniere & Varescon, 2018; Spada et al., 2015). That positive metacognition, or those thoughts related to the benefits of using Instagram to control ongoing thoughts and mood expectancies (e.g., "Using Instagram helps me control my thoughts", "Using Instagram will improve my mood"), was not significant in predicting problematic use reinforces that finding that these beliefs are less associated with addictive behaviour persistence or escalation and more with behavioural initiation or engagement (Spada et al., 2015). In terms of desire thinking, it is consistently shown that there is a strong relationship between metacognitive thought and desire thinking (e.g., Caselli & Spada, 2015). In the current study, that negative metacognitive beliefs and the verbal perseverence (i.e., persistent self-talk about reaching a desired behavioural goal state) component of desire thinking about Instagram use together predict increasing problematic Instagram use is consistent with the metacognitive model of desire thinking and craving (Spada, Caselli & Wells, 2013; Caselli, & Spada, 2013). This model argues that the relationship between verbal perseverence of desire thinking, and negative metacognitions marks the pathological escalation of desire thinking and explains why neither positive metacognitions nor the imaginal prefiguration component of desire thinking are influential in problem Instagram use.

Our current findings also identify that social identity as an Instagram user was not independently related to problematic use when

Table 4
Regression statistics for predicting withdrawal components of problematic Instagram use from relevant variables.

Predictor	β	t	p^2 (%)	RV (%)	sr^2	R	R^2	ΔR^2
Step 1						0.13	0.02	0.02
Age	-0.13	1.46	1.58	11.90	0.01			
Gender	-0.08	0.87	0.55	7.15	0.01			
Step 2						0.49	0.24	0.22***
Age	-0.12	1.48	0.95	9.33	0.01			
Gender	-0.07	0.82	0.48	6.72	0.00			
Years IS User	-0.25	2.70**	5.05	20.55	0.04			
Occasion Mins	0.35	3.75***	9.49	27.56	0.08			
IS Weekly Use	0.00	0.03	0.00	0.22	0.00			
IS Post Average	0.25	3.05**	6.46	23.05	0.05			
Step 3a DTQ-Total						0.73	0.54	0.30***
Age	-0.08	1.18	1.01	9.60	0.01			
Gender	-0.01	0.22	0.04	1.86	0.00			
Years IS User	-0.02	0.26	0.06	2.35	0.00			
Occasion Mins	0.11	1.30	1.33	10.94	0.01			
IS Weekly Use	-0.02	0.22	0.04	1.86	0.00			
IS Post Average	0.05	0.70	0.37	5.92	0.00			
DTQ-Total	0.36	4.49**	14.19	33.22	0.07			
N-MIU	0.11	1.15	1.04	9.72	0.01			
P-MIU	-0.02	0.18	0.03	1.61	0.00			
ID Solid	-0.01	0.06	0.00	0.42	0.00			
ID Satisfaction	0.06	0.80	0.48	6.68	0.00			
ID Central	0.28	3.05**	6.75	23.53	0.03			
ID Self-Stereo	0.08	0.95	0.70	8.07	0.00			
ID Homogeneity	-0.04	0.56	0.25	4.88	0.00			
Step 3b DTQ-IP and DTQ-VP						0.73	0.54	0.30***
Age	-0.08	1.17	1.02	9.64	0.01			
Gender	-0.02	0.22	0.04	1.95	0.00			
Years IS User	-0.02	0.26	0.05	2.15	0.00			
Occasion Mins	0.11	1.29	1.28	10.75	0.01			
IS Weekly Use	-0.02	0.22	0.04	1.86	0.00			
IS Post Average	0.05	0.70	0.37	5.95	0.00			
DTQ-IP	0.21	2.01*	4.69	19.86	0.02			
DTQ-VP	0.19	1.51	1.78	12.58	0.01			
N-MIU	0.11	1.14	1.01	9.60	0.01			
P-MIU	-0.02	0.19	0.03	1.67	0.00			
ID Solid	-0.00	0.05	0.00	0.42	0.00			
ID Satisfaction	0.06	0.79	0.51	6.89	0.00			
ID Central	0.27	2.98**	6.44	23.02	0.03			
ID Self-Stereo	0.08	0.94	0.68	7.92	0.00			
ID Homogeneity	-0.04	0.54	0.22	4.62	0.00			

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

metacognitive and desire-based thinking were included in the model. In terms of identity, this finding is somewhat surprising to the extent that previous work has shown variance in, for example, Facebook use to be associated with components of in-group identity (e.g., Albery et al., 2021). However, when we examined how these factors separately predicted compulsive and withdrawal components of problem Instagram use a more discriminating understanding becomes apparent [see below].

4.2. Compulsivity and withdrawal aspects of problematic Instagram use

It is clear from our findings that when components of problematic Instagram use are differentiated the pattern of predictive significant factors becomes more nuanced than that developed to describe overall problematic use. So, in terms of that component which defines aspects of problematic use according to *compulsivity* elements, DTQ-Total, positive, and negative metacognitions and ingroup identity components together explained significant variance above and beyond frequency of use measures. However, only negative metacognitions and general desire thinking along with frequency of weekly use were significant in this equation. As with general PIU, identity components did not play a significant role. In terms of type of desire thinking our results also showed that verbal perseveration and *not* imaginal prefiguration accounted for desire-based thought along with negative metacognitions. In other words, increasing PIU factors associated with a decreased sense of control over use (i.e., compulsivity) was accounted for by increasing confirmation of beliefs related to aspects of use that are increasingly

uncontrollable and dangerous (i.e., negative metacognitions), as well as Instagram specific desire-related thoughts characterised by the perseverance of self-talk related to the desire to use Instagram. This is consistent with the idea that increasing compulsivity reflects the pathological escalation of desire thinking to achieve end states related to Instagram use (Spada & Caselli, 2013).

A different pattern of responding was apparent for predicting aspects of PIU that are consistent with symptoms associated with *withdrawal*. Whilst desire thinking in general was again associated with increasing withdrawal components, negative metacognitions were not. Importantly, this effect of desire thinking was supplemented by increasing identity as an Instagram user. When we consider the model which distinguishes between imaginal prefiguration and verbal perseveration components of desire thinking, the former was significant in addition to ingroup identity *centrality*.

In terms of dimensions of identity, this implies that increased beliefs indicative of feelings and thoughts associated with *not* being able to use Instagram is related to an increasing sense of purposeful *self-investment* with an in-group, and not by how one thinks about oneself in relation to other in-group members (i.e., self-definition) - a finding consistent with that reported by Albery et al (2021) in their study exploring problematic Facebook use. It also appears that this sense of self-investment is characterised by identity centrality only. In other words, how chronically salient one's in-group membership is as a factor in describing the importance of this membership is fundamental for predicting beliefs about the psychological outcomes of *not* being able to use Instagram (e.

g., negative mood). This again is supported by recent evidence which has shown a positive relationship between identity centrality and problematic Facebook use (Albery et al., 2021).

In addition, our findings also showed that the dimension of desire thinking associated with the tendency to prefigure or anticipate positive imagery about Instagram use experiences and to assign attention to this information (i.e., imaginal prefiguration) was associated with increasing withdrawal based-beliefs. This suggests that increased elaboration of imagery about the anticipated effects of using Instagram is associated with an increasing endorsement of the effects not using Instagram would have when desired. Other work which has explored the operation of imaginal prefiguration has proposed that it is associated more with initiation of the problematic behaviour and is dependent on those metacognitive beliefs which endorse positive effects of the behaviour on thoughts and feelings (see Caselli & Spada, 2015; Brandtner et al., 2021). In the present study neither positive nor negative metacognitions were implicated in predicting the withdrawal component.

These findings implicate both identity centrality and imaginal prefiguration in increasing withdrawal-based problematic Instagram use. What is clear is that these concepts are significantly associated with one another and interrelate to influence increasing withdrawal components. What is not apparent is what the causal nature of that relationship is. Because identity centrality and imaginal prefiguration correlate significantly with positive and negative metacognitions and together all these factors predict withdrawal, it could be that the former two factors are acting as proxies for the independent operation of the metacognitive components, or alternatively that they are acting to suppress the independent effects of metacognitive thought. Future work should aim to establish the position of identity factors more explicitly in the operation of metacognitive thought on desire-based thinking and how these not only generate increased problematic Instagram-related beliefs and behaviours but also how they relate to other addictive behavioural patterns (e.g., alcohol use, gambling, etc.). In addition, future work should also articulate how identity-based components may covary (or not) with metacognitive beliefs to influence other forms of *extended thinking styles* (or elaborative thinking) (e.g., rumination, permissive beliefs and worry) which themselves may result in reinforcing problematic behaviours.

4.3. Limitations and recommendations

This study has provided an account that reinforces differential effects of desire thinking, negative metacognitive beliefs and those aspects of identity concerning the saliency of one's beliefs about being an Instagram user on problematic Instagram use generally and, importantly, aspects of problematic use that concern either compulsive use or beliefs about the effects of not using Instagram (i.e., withdrawal). Nevertheless, a number of limitations temper the conclusions drawn. First, there is a clear need to undertake prospective, or experimental, work to examine whether thoughts of desires associated with Instagram, metacognitive beliefs and identity as an Instagram user have a causal impact in the development of and maintenance of problematic Instagram use which cannot be addressed using the current cross sectional correlational evidence.

Secondly, the current study sample was *not* sufficiently representative of the current Instagram using population in the UK in terms of basic demography (i.e., age and gender). Even though we controlled for age and gender in our analyses to control for any effects on problematic Instagram use (neither age nor gender were shown to account significant variation in problematic Instagram use), our effects require replication in a wholly representative sample to further embed our conclusions.

Third, even though our work suggests the power of key psychological factors in predicting problematic Instagram use these conclusions are limited by the validity of the measures used. In other words, even though our regression models returned large effects sizes and acceptable sensitivity in the predictive power of key identified variables on PIU,

future work should incorporate, for example, other measures of Instagram use (e.g. the Instagram Addiction Scale (Kircaburun & Griffiths, 2018); see Cataldo et al., 2022 for review of relevant measures). This is important to the extent that we adapted numerous scales (e.g., the DTQ, ingroup identification, SMUQ and the positive and negative metacognition scale) to Instagram use. Whilst numerous studies focussing on many other behaviours have successfully applied these measures (e.g., see Brandtner et al., 2021) we cannot claim that these measures are wholly appropriate with certainty for the current behaviour. Validation work utilising various methods of measurement is required to address these issues.

5. Summary

Different factors appear to be important for predicting distinct aspects of PIU. For compulsivity, negative metacognitions and verbal perseveration are essential whereas for the withdrawal component identity centrality and imaginal prefiguration emerge as the sole independent predictors. Whilst this has theoretical significance in terms of describing which set of factors best account for increasingly problematic Instagram using behaviour, it also points to the types of factors that may be targeted by psychological interventions aimed at addressing problematic use. Future work should embrace testing these predictions.

6. Authors' contribution

IA and DF conceived and designed the study. MRN collected data. IA, DF and MRN analysed the data. IA drafted the paper and all authors contributed to the finalisation of the manuscript.

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CRediT authorship contribution statement

Ian P. Albery: Conceptualization, Methodology, Formal analysis, Investigation, Data Curation, Writing – original draft, Supervision, Project administration. **Maria Rapelo Noriega:** Writing – review & editing, Data curation, Conceptualization. **Daniel Frings:** Conceptualization, Formal analysis, Writing – review & editing, Methodology.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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