



Relationships Between Social Media Addiction, Social Media Use Metacognitions, Depression, Anxiety, Fear of Missing Out, Loneliness, and Mindfulness

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Abstract

Recent research has suggested that metacognitions about social media use may play a role in social media addiction. The aim of the present study was to investigate (a) the contribution of positive and negative social media use metacognitions in explaining social media addiction after accounting for a range of risk factors related to negative affect and (b) the mediating roles of positive and negative social media use metacognitions in associating depression, anxiety, fear of missing out (FoMO), loneliness, and low trait mindfulness with social media addiction. A sample of 810 Australians ($M_{\text{age}} = 66.39$ years; 63.6% female) completed an anonymous online survey. Both positive and negative social media use metacognitions accounted for a significant proportion of unique variance in social media addiction after controlling for age, sex, social media engagement, depression, anxiety, FoMO, loneliness, and mindfulness. Serial mediation models indicated that depression, anxiety, FoMO, loneliness, and mindfulness had a direct effect on social media addiction, as well as an indirect effect that was mediated by positive and negative metacognitions. The present study's findings show the mediating role of social media use metacognitions in the relationship between negative affect and social media addiction.

Keywords Social media addiction · Metacognitions · Fear of missing out · Depression · Anxiety · Loneliness · Mindfulness

Over the past decade, a large number of empirical studies have investigated problematic social media use, indicating the importance of the topic for researchers, policymakers, the media, and the general public. Some researchers have argued that social media is addictive and have provided evidence showing that some individuals who engage in excessive social media use experience symptoms similar to those experienced by individuals addicted to gambling or addictive substances (i.e. salience, mood modification, tolerance, withdrawal, relapse, and conflict; Andreassen et al., 2016; Kuss & Griffiths, 2017). Social media addiction can be defined as a maladaptive psychological dependency on social media to the extent that behavioural addiction symptoms occur (Sun & Zhang, 2021).

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Negative Affect as a Risk Factor for Social Media Addiction

One key motive for engaging in all addictive behaviours, including social media, is the need to regulate negative emotions (Montag et al., 2024). Consistent with this motive, a broad range of empirical evidence suggests that social media addiction is predicted by specific psychosocial characteristics that indicate tendencies for negative affective experiences resulting from poor mental health (e.g. depression, anxiety) or unsatisfied psychosocial needs (e.g. loneliness, fear of missing out). Risk factors related to negative affect have been posited to drive social media engagement as a compensatory coping strategy as a way of managing negative emotional experiences (Wegmann & Brand, 2019). Over time, this compensatory mood regulation strategy can lead to the development of social media addiction because the behaviour becomes more common and problems such as functional impairments emerge as a result of excessive online behaviour (Montag et al., 2024).

Well-established psychological risk factors for social media addiction that are related to negative affect include depression, anxiety, loneliness, fear of missing out, and low mindfulness (Akbari, Seydavi, et al., 2021a, 2021b; Huang, 2020; Meynadier et al., 2024). While these psychological factors may also be outcomes of social media addiction, they can be viewed as risk factors due to their role in motivating compensatory social media use which can lead to the development of social media addiction (Wegmann & Brand, 2019). A meta-analysis by Huang (2020) reported that problematic social media use was associated with depression ($r = .31$; $k = 59$), anxiety ($r = .30$; $k = 17$), and loneliness ($r = .21$, $k = 29$). These three risk factors represent tendencies for different kinds of negative affective experiences that motivate social media engagement as a mood regulation strategy.

Fear of missing out (FoMO) is another important risk factor that refers to a pervasive apprehension that others are having rewarding experiences that the individual is not part of, accompanied by a persistent desire to stay connected to others in an individual's social network (Przybylski et al., 2013). FoMO motivates compensatory social media use because it is characterised by a pervasive feeling of apprehension related to anxiety, as well as a behavioural strategy for reducing such anxiety by using social media to stay connected to others (Elhai et al., 2021). A meta-analysis by Akbari, Seydavi and et al., (2021a, 2021b) reported that FoMO was associated with problematic *Facebook* use ($r = .35$, $k = 11$) and problematic *Instagram* use ($r = .49$, $k = 3$).

Another well-established risk factor for social media addiction is trait mindfulness, which refers to a tendency to maintain awareness of the present moment in a nonreactive and non-judgemental manner (Carpenter et al., 2019). A meta-analysis by Meynadier et al. (2024) reported that problematic social media use is associated with lower trait mindfulness ($r = -.37$, $k = 14$). This relationship is complemented in the meta-analysis by Carpenter et al. (2019) who reported that individuals with trait mindfulness report fewer negative affective symptoms ($r = -.53$, $k = 91$). Individuals with low levels of trait mindfulness may be more motivated to use social media to regulate negative affective states.

Social Media Engagement for Mood Regulation and Social Media Addiction

A key behaviour that underlies the development of social media addiction is using social media for mood regulation, which is one of the six core components in Griffiths' (2005) model of addictive behaviour. Griffiths et al. (2014) suggested that the transition from normal social media use to problematic or addictive social media use occurs when individuals view social media engagement as an important (or exclusive) method of relieving stress, loneliness, or depression. A persistent habit or strategy of using social media for mood regulation can be viewed as problematic because the experiences of gratification and/or compensation that result from this behaviour reinforce this mood regulation strategy through reinforcement learning (Brand et al., 2016). Over time, an individual's habit of using social media for mood regulation may become excessive and eventually lead to problems in their personal and professional life. The interpersonal and/or intrapsychic conflict resulting from these problems is a key component of addiction in Griffiths' (2005) model. This conflict causes distress, leading the individual to further engage in social media use to alleviate this distress, which may further exacerbate the problems causing distress (Griffiths et al., 2014). This cyclical pattern, in which an individual's psychological dependency on using social media for mood regulation increases the more they use social media for mood regulation, is an example of a reinforcing spiral effect (Slater, 2007), in which a behaviour (i.e. social media addiction) is caused by one of its outcomes (i.e. using social media for mood regulation).

Metacognitions and the Self-Regulatory Executive Function (S-REF) Model

Metacognitions can be broadly defined as knowledge that an individual has about their own cognitions, motivations, and emotions (Flavell, 1979). The Self-Regulatory Executive Function (S-REF) model (Wells & Matthews, 1996) was the first to suggest that metacognitions play a key role in psychological disorders. This model proposes that metacognitions (also called metacognitive beliefs) are linked to the activation of specific coping strategies (e.g. worry, rumination, threat monitoring, thought suppression, and avoidance) that lead to the perpetuation of psychological distress. These coping strategies are dysfunctional because they paradoxically cause negative emotions to persist, but are consistently applied to alleviate processes that are perceived as distressing even though successful long-term alleviation of the distress fails to be achieved (Spada et al., 2015). Over time, the consistent application of these dysfunctional coping strategies leads to a vicious cycle whereby the individual develops metacognitive beliefs about the uncontrollability and harm of these coping strategies, which leads to further distress that activates the same coping strategies (Spada et al., 2015).

According to the S-REF model, metacognitive beliefs also guide the activation and maintenance of specific coping strategies that involve thought suppression and avoidance through engagement in addictive behaviour (Hamonniere & Varescon, 2018). Previous research has shown that metacognitive beliefs are involved in various addictive behaviours including alcohol use (Spada & Wells, 2008, 2010; Spada et al., 2013), nicotine use (Nikčević et al., 2015, 2017; Spada et al., 2007), gambling (Caselli et al., 2018; Spada &

Roarty, 2015), online gaming (Akbari, Bahadori, et al., 2021a; Marino et al., 2020; Spada & Caselli, 2017), and social media use (Albery et al., 2024; Bocci Benucci et al., 2024; Marino et al., 2019).

Researchers have more recently applied the S-REF model directly to addictive behaviour by proposing that individuals who engage in such behaviour develop dysfunctional metacognitions about cognitive-affective states specifically related to addictive behaviour (Spada et al., 2015). Specific metacognitive beliefs about engagement in addictive behaviour can be separated into positive and negative metacognitions, which have different roles in the initiation and perpetuation of addictive behaviour (Spada et al., 2015). Positive metacognitions refer to an individual's beliefs about the positive effects of engaging in addictive behaviour on emotion and cognition (e.g. "Alcohol helps me to relax" or "Gambling helps me when I feel depressed"). Positive metacognitions are involved in the initiation of addictive behaviour by motivating individuals to engage in it as a method of regulating their thinking and emotional state.

In contrast, negative metacognitions refer to beliefs about the uncontrollability of cognitive-affective experiences associated with engaging in addictive behaviour (e.g. "Once I start online gaming it is difficult to stop"), as well as the dangers of engaging in this addictive behaviour (e.g. "Online gaming interferes with my functioning"). Negative metacognitions develop in later stages of addiction and play a key role in the continuation of addictive behaviour (Spada & Roarty, 2015). Negative metacognitions strengthen the individual's perception of being unable to control their engagement in addictive behaviour, leading them to give up attempting to control their behaviour, which further perpetuates the addictive behaviour. Additionally, negative metacognitions strengthen the individual's perception of the harmful effects of engaging in addictive behaviour on their functioning and of their inability to control this engagement, leading to a sense of danger, hopelessness, and inefficacy. This perception of their engagement in addictive behaviour as uncontrollable and harmful triggers negative emotional states which, in turn, further perpetuates the addictive behaviour as a means of regulating those emotional states (Casale et al., 2021a, 2021b).

The Mediating Role of Metacognitions

The Interaction of Person-Affect-Cognition-Execution (I-PACE) model (Brand et al., 2016) is a prominent cognitive-behavioural model of specific internet use disorders that provides a detailed framework of the processes that underlie social media addiction (Brand et al., 2016). This model describes how various affective and cognitive mechanisms (e.g. cue reactivity, craving, cognitive biases) cause the activation and maintenance of a style of coping with negative emotional experiences through engagement in addictive behaviour and proposes that engagement in this coping style underlies the shift from healthy engagement in social media use to the development of social media addiction (Brand et al., 2019). These affective and cognitive mechanisms are viewed as core mechanisms in the I-PACE model because they not only strengthen a coping style that involves engagement in addictive behaviour, but also are reinforced by engagement in this coping style. They therefore play a key role in a mutually reinforcing cycle that strengthens an individual's engagement in addictive behaviour over time (Brand et al., 2019).

The I-PACE and S-REF models provide complementary theoretical frameworks explaining how a dysfunctional coping style involving engagement in addictive behaviour underlies

the development and persistence of addictive behaviour. The positive and negative metacognitions posited by the S-REF model are specific kinds of cognitive biases which are considered a core mechanism in the framework provided by the I-PACE model (Brandtner et al., 2021). According to the I-PACE model, negative emotional experiences trigger the activation of cognitive biases such as positive and negative metacognitions that lead to experiences of craving. This craving leads to engagement in addictive behaviour as a way of coping and, in turn, the engagement in this coping style causes experiences of gratification and compensation that reinforce positive and negative metacognitions (Brandtner et al., 2021). Here, the I-PACE model proposes a reinforcing cycle in which metacognitions strengthen a coping style that involves social media engagement and are also reinforced by this copying style.

The reinforcing cycle proposed by the I-PACE model explains how metacognitions mediate the association between well-established psychological risk factors for addictive behaviour (e.g. depression, anxiety, FoMO, loneliness, low trait mindfulness) and social media addiction. According to the I-PACE model, these risk factors create negative emotional experiences that cause the activation of positive metacognitions about the usefulness of the social media for distracting the mind from negative thoughts and emotions and (in later stages of addiction) negative metacognitions about being unable to control engagement in social media use for cognitive-affective regulation. The activation of these positive and negative metacognitions causes engagement in a coping style that involves using social media which, in turn, reinforces positive and negative metacognitions that strengthen this coping style and, over time, this pattern of behaviour leads to social media addiction.

The theoretical framework of the S-REF model provides a more detailed description of the different mediating roles of positive and negative metacognitions in the association between psychological risk factors and social media addiction (Hamonniere & Varescon, 2018). This model proposes that psychological risk factors cause negative emotional experiences that activate positive metacognitions which drive social media engagement for mood regulation (Casale et al., 2021a, 2021b). These positive metacognitions play a key role in an individual's initial engagement in addictive behaviour and establishing a coping style that involves social media engagement. Over time, this coping style that is influenced by positive metacognitions leads to the development of negative metacognitions. Once these negative metacognitions have developed, they perpetuate addictive behaviour by causing experiences of distress. This distress results in a downward spiral in which social media is used to regulate the distress that results from using social media (Hamonniere & Varescon, 2018).

Previous studies have supported the theoretical assumptions of both the I-PACE model and S-REF model by reporting that positive and negative metacognitions about addictive behaviour mediate the relationship between psychological risk factors and various addictive behaviours such as smoking dependence (Nikčević et al., 2017), problematic internet use (Caselli et al., 2021), internet gaming disorder (Marino et al., 2020), problematic smartphone use (Casale et al., 2021a, 2021b), and social media addiction (Albery et al., 2024; Bocci Benucci et al., 2024; Casale et al., 2018). Additionally, one study reported that positive and negative metacognitions are serial mediators in the relationship between psychological risk factors and social media addiction (Bocci Benucci et al., 2024).

Aims and Hypotheses

The primary aim of the present study was to investigate how positive and negative social media use metacognitions relate to social media addiction and key risk factors for addictive behaviour. The study focused specifically on risk factors for social media addiction that are associated with negative affect (depression, anxiety, FoMO, loneliness, and low mindfulness). According to the S-REF model, these risk factors will be associated with stronger positive and negative social media use metacognitions, and these stronger metacognitions will be associated with social media addiction (Spada et al., 2015). Based on this theoretical model, the present study evaluated whether positive and negative social media use metacognitions are associated with social media addiction and the aforementioned risk factors for social media addiction: depression, anxiety, FoMO, loneliness, and low mindfulness.

The I-PACE model posits that cognitive biases such as positive and negative metacognitions independently influence the development of social media addiction over and above the influence of various demographic, social, psychopathological, and personality risk factors for addictive behaviour (Brand et al., 2019). Based on this theoretical model, the present study evaluated whether positive and negative social media use metacognitions both predict a significant proportion of unique variance in social media addiction after controlling for demographic variables (age and sex), social media engagement, and the risk factors for social media addiction examined in the study (i.e. depression, anxiety, FoMO, loneliness, and low mindfulness).

According to the I-PACE model, cognitive biases such as metacognitions are mediators of the relationship between demographic, social, psychopathological, and personality risk factors for addictive behaviour and social media addiction (Brand et al., 2019). Additionally, the S-REF model posits that positive metacognitions guide initial engagement in addictive behaviour which, over time, leads to the development of negative metacognitions that further perpetuate the engagement in addictive behaviour (Hamonniere & Varescon, 2018). Based on these two theoretical models, the present study also evaluated whether positive and negative social media use metacognitions are both stand-alone and serial mediators of the relationship between risk factors for social media addiction and social media addiction. The study investigated social media use metacognitions as stand-alone mediators by evaluating whether risk factors for social media addiction cause greater levels of positive and negative social media use metacognitions, which in turn cause greater levels of social media addiction. Additionally, the study investigated positive and negative social media use metacognitions as serial mediators, by investigating whether risk factors for social media addiction cause greater levels of positive social media use metacognitions which, in turn, cause greater levels of negative social media metacognitions, resulting in greater levels of social media addiction.

The secondary aim of the present study was to evaluate the factor structure and validity of the scale assessing social media use metacognitions developed by Akbari et al. (2023). Drawing on theoretical predictions of the I-PACE model, S-REF model, and previous research findings (Akbari et al., 2023; Bocci Benucci et al., 2024; Casale et al., 2021a, 2021b), the following hypotheses (H_s) related to the primary aims of the study were tested:

- Higher levels of positive and negative social media use metacognitions would be associated with higher levels of depression, anxiety, FoMO, loneliness, and social media addiction, and lower levels of mindfulness (H_1).

- Positive and negative social media use metacognitions would both predict a significant proportion of unique variance in social media addiction, after controlling for age, sex, social media engagement, depression, anxiety, FoMO, loneliness, and mindfulness (H_2).
- The relationship between depression and social media addiction would be sequentially mediated by positive and negative social media use metacognitions (H_3).
- The relationship between anxiety and social media addiction would be sequentially mediated by positive and negative social media use metacognitions (H_4).
- The relationship between FoMO and social media addiction would be sequentially mediated by positive and negative social media use metacognitions (H_5).
- The relationship between loneliness and social media addiction would be sequentially mediated by positive and negative social media use metacognitions (H_6).
- The relationship between mindfulness and social media addiction would be sequentially mediated by positive and negative social media use metacognitions (H_7).

Method

Participants and Procedure

The sample comprised 810 participants (515 females; 63.6%) living in Australia, with a mean age of 66.39 years ($SD=12.63$). Participants reported using an average of 2.50 ($SD=1.30$) social media platforms at least once per week. Table 1 shows the number of participants using each social media platform at least once per week, for males, females, and the overall sample.

Prior to commencing the study, ethics approval was received from the host university's Human Research Ethics Committee. Participants were recruited through sponsored posts displayed on the *Facebook* newsfeed. These posts contained a link which directed them to an anonymous online survey hosted on *Qualtrics* (Provo, UT). The sponsored posts advertising the study were only shown to individuals living in Australia at the time of the study.

Table 1 Social media platforms used on a weekly basis by males ($n=295$), females ($n=515$), and the total sample ($N=810$)

Social media platform	Number of female users	Number of male users	Total number of users
<i>Facebook</i>	510 (99.0%)	293 (99.3%)	803 (99.1%)
<i>Instagram</i>	195 (37.9%)	64 (21.7%)	259 (32.0%)
<i>Snapchat</i>	19 (3.7%)	12 (4.1%)	31 (3.8%)
<i>TikTok</i>	34 (6.6%)	18 (6.1%)	52 (6.4%)
<i>YouTube</i>	256 (49.7%)	187 (63.4%)	443 (54.7%)
<i>Reddit</i>	38 (7.4%)	19 (6.4%)	57 (7.0%)
<i>Twitter</i>	46 (8.9%)	33 (11.2%)	79 (9.8%)
<i>LinkedIn</i>	49 (9.5%)	46 (15.6%)	95 (11.7%)
<i>WhatsApp</i>	131 (25.4%)	46 (15.6%)	177 (21.9%)
<i>Discord</i>	12 (2.3%)	9 (3.1%)	21 (2.6%)
<i>WeChat</i>	1 (0.2%)	1 (0.3%)	2 (0.2%)
<i>Weibo</i>	0	1 (0.3%)	1 (0.1%)

The sponsored *Facebook* posts were displayed to 55,138 unique users, resulting in 147,394 impressions (number of times the posts were seen), and the link to the survey was clicked 3619 times. After being directed to the *Qualtrics* survey, each participant was asked to read an information sheet before providing implied consent. When consenting to participate in the study, the participants confirmed that they met the three inclusion criteria for the study: being 18 years of age or older, proficiency in English, and using social media daily. Participants first provided demographic information and details about the social media platforms they use at least once a week. This was followed by the scale assessing social media use metacognitions and the remaining scales being presented in a random order. No incentive was offered for participation in the study. On average, the survey took 10.23 min ($SD=6.28$) to complete.

Prior to conducting any analyses, 61 participants were removed from the initial sample of 871 participants. First, 17 participants were removed for having a response time < 240 s. Any completion of the survey in less than 4 min was deemed not long enough to seriously engage with the survey's items. Second, five participants were removed for reporting an age < 18 years, which was below the requirement for participation. Third, 27 responses were removed for having an unrealistic responding score calculated by *Qualtrics* ($Q_RelevantIDFraudScore$) > 30 , which indicated the response was likely fraudulent and a bot. Finally, 12 participants were removed for having "other" or "prefer not to say" as their response to the question asking participants to indicate their sex. These participants were excluded in order to create a dummy-coded sex variable to investigate the relationship between sex and other key study variables.

Measures

Social Media Platforms Used

Participants were asked whether they used the following social media platforms "at least once per week": *Facebook*, *Instagram*, *Snapchat*, *TikTok*, *YouTube*, *Reddit*, *Twitter*, *LinkedIn*, *WhatsApp*, *Discord*, *WeChat*, and *Weibo*. The number of social media platforms used by participants was estimated by summing the number of the aforementioned social media platforms that participants reported using on a weekly basis.

Social Media Use Metacognitions

Social media use metacognitions were assessed with the 12-item Metacognitions about Social Media Use Scale (MSMUS; Akbari et al., 2023). Each item is rated on a 4-point Likert-type scale from 1 (*Do not agree*) to 4 (*Agree very much*). The MSMUS comprises two 6-item subscales: positive metacognitions about social media use and negative metacognitions about social media use. Positive metacognitions about social media use refer to beliefs about the positive effects of social media use on emotion and cognition (e.g. "Using social media reduces my anxious feelings" and "Using social media helps me to control my negative thoughts"). Negative metacognitions about social media use refer to beliefs about the uncontrollability of social media use (e.g. "I continue to use social media despite thinking it would be better to stop") and beliefs about the dangers of social media use (e.g. "Thoughts about using social media interfere with my functioning"). Scores for both subscales range between 6 and 24, with higher scores indicating higher levels of positive or negative social media use metacognitions. Akbari et al. (2023) confirmed this two-factor

structure and provided evidence of validity and reliability for the Persian version of the MSMUS. The present study presented the English MSMUS items in the same order that they are presented in Akbari et al. (2023).

Confirmatory factor analysis (CFA) was used with the present study's sample ($N=810$) to evaluate the factor structure of the English version of the MSMUS. The root mean square error of approximation (RMSEA), standardised root mean square residual (SRMR), comparative fit index (CFI), and Tucker-Lewis fit index (TLI) were used to evaluate the level of model fit. Acceptable model fit was suggested by RMSEA and SRMR values $\leq .08$ and CFI and TLI values $\geq .95$ (Schreiber et al., 2006). Results of the CFA showed close to satisfactory model fit for a two-factor solution, supporting the finding of the two factors identified in Akbari et al. (2023); RMSEA = .092 (90% CI [.084, .101]), SRMR = .052, CFI = .930, TLI = .913. A follow-up CFA was used to evaluate model fit for a three-factor structure which treats negative metacognitions about uncontrollability of social media use and negative metacognitions about danger of social media use as separate factors. This three-factor model was supported for the Metacognitions About Online Gaming Scale (MOGS) developed by Spada and Caselli (2017), from which the items for the MSMUS were adapted by replacing "online gaming" with "using social media". Results of the CFA showed marginally improved, but not satisfactory model fit for a three-factor solution of the MSMUS; RMSEA = .085 (90% CI [.077, .094]), SRMR = .048, CFI = .943, TLI = .926. Because the model fit for the three-factor solution of the MSMUS was only slightly improved and still not satisfactory, the MSMUS as a two-factor scale was used to seek parsimony, following the rationale of Marino et al. (2020) for analysing the MOGS as a two-factor scale. In the present study, internal consistency as assessed by Cronbach's α was .80 for negative social media use metacognitions (McDonald's $\omega = .80$), .91 for positive social media use metacognitions (McDonald's $\omega = .91$), and .86 for overall scale of social media use metacognitions (McDonald's $\omega = .85$).

Social Media Engagement

Social media engagement was measured by a series of questions developed by Przybylski et al. (2013) assessing the extent of social media engagement throughout the day. The scale asks participants to reflect on how often they used social media in the past week and then to rate the following statements using an 8-point Likert-type scale ranging from 1 (*Not one day last week*) to 8 (*Every day last week*): "Within 15 min of waking up" ($M=5.95$, $SD=3.92$), "When eating breakfast" ($M=4.64$, $SD=3.85$), "When eating lunch" ($M=4.18$, $SD=3.47$), "When eating dinner" ($M=2.97$, $SD=3.16$), and "Within 15 min of going to sleep" ($M=4.47$, $SD=3.79$). Scores range between 5 and 40, with higher scores indicating higher levels of social media engagement. The following examples of social media platforms were listed: *Facebook*, *Instagram*, *Snapchat*, *TikTok*, *YouTube*, *Reddit*, *Twitter*, *LinkedIn*, *WhatsApp*, *Discord*, *WeChat*, and *Weibo*. Cronbach's α for the scale was .68 in the present study (McDonald's $\omega = .66$).

Social Media Addiction

The Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016) was used to assess six core components of social media addiction: salience, mood modification, tolerance, withdrawal, relapse, and conflict. The 6-item scale was adapted from the Bergen Facebook Addiction Scale by replacing the word "*Facebook*" with "social media"

(Andreassen et al., 2012). The BSMAS asks participants about their use of all social media platforms in the past year. An example item is “How often during the past year have you tried to cut down on the use of social media without success?” We listed the following examples of social media platforms: *Facebook, Instagram, Snapchat, TikTok, YouTube, Reddit, Twitter, LinkedIn, WhatsApp, Discord, WeChat, and Weibo*. Participants are asked to indicate how much each statement applies to them over the past year using a 5-point Likert-type scale ranging from 1 (*Very rarely*) to 5 (*Very often*). Scores range between 6 and 30, with higher scores indicating higher levels of social media addiction. The BSMAS has demonstrated good psychometric properties and evidence of validity and reliability in many different populations (e.g. Balcerowska et al., 2019; Chen et al., 2020). This scale showed good internal consistency in the present study ($\alpha = .78$, McDonald’s $\omega = .79$).

Depression and Anxiety

Depression and anxiety were assessed with two subscales from the 21-item Depression Anxiety Stress Scale (Henry & Crawford, 2005). Participants were asked to indicate how much each statement applied to them over the past week on a 4-point Likert-type scale ranging from 1 (*Never*) to 4 (*Almost always*). Both depression (e.g. “I felt that I had nothing to look forward to”) and anxiety were assessed with seven items (e.g. “I felt I was close to panic”). Scores on the two subscales range between 7 and 28, with higher scores indicating higher levels of depression and anxiety. Previous research has reported evidence of validity and reliability for the scale (Henry & Crawford, 2005). Internal consistency in the present study was excellent for the depression subscale ($\alpha = .91$, McDonald’s $\omega = .91$) and good for the anxiety subscale ($\alpha = .76$, McDonald’s $\omega = .76$).

Fear of Missing Out (FoMO)

FoMO was assessed with the 10-item Fear of Missing Out Scale (Przybylski et al., 2013). Participants rated items on a 5-point Likert-type scale ranging from 1 (*Not at all true for me*) to 5 (*Extremely true for me*). An example item is “I fear others are having more rewarding experiences than me”. Scores range between 10 and 50, with higher scores indicating higher levels of FoMO. Previous research has reported evidence of validity and reliability for the scale (Przybylski et al., 2013). The scale showed good internal consistency in the present study ($\alpha = .81$, McDonald’s $\omega = .80$).

Loneliness

Loneliness was assessed with the 6-item Revised UCLA Loneliness Scale (Wongpakaran et al., 2020). Participants rated items on a 4-point Likert-type scale ranging from 1 (*Never*) to 4 (*Often*). An example item is “How often do you feel alone?” Scores range between 6 and 24, with higher scores indicating higher levels of loneliness. Previous research has reported evidence of validity and reliability for the scale (Wongpakaran et al., 2020). Internal consistency of the scale in the present study was excellent ($\alpha = .91$, McDonald’s $\omega = .91$).

Mindfulness

Trait mindfulness was assessed with the 8-item Short Freiburg Mindfulness Inventory (Kohls et al., 2009). The scale assesses two underlying dimensions of trait mindfulness: acceptance (e.g. “I am friendly to myself when things go wrong”) and presence (e.g. “I pay attention to what’s behind my actions”). Each item is rated using a 4-point Likert-type scale ranging from 1 (*Rarely*) to 4 (*Almost always*). Scores range between 8 and 32, with higher scores indicating higher levels of trait mindfulness. Previous research has reported evidence of validity and reliability for the scale (Kohls et al., 2009). Internal consistency of the scale in the present study was very good ($\alpha = .85$, McDonald’s $\omega = .85$).

Statistical Analyses

To test the study hypotheses, data were analysed using SPSS Version 29 and Hayes’ (2022) PROCESS macro. The CFA was conducted using AMOS version 29. Statistical analyses used to test the hypotheses included (i) estimating Pearson’s correlation coefficients between the main study variables; (ii) a hierarchical multiple regression to evaluate whether social media addiction was predicted by age, sex, social media engagement, depression, anxiety, FoMO, loneliness, and mindfulness (Step 1), negative social media use metacognitions (Step 2), and positive social media use metacognitions (Step 3); and (iii) five mediation analyses using Hayes’ (2022) PROCESS macro (model 6) to investigate whether positive and negative social media use metacognitions were serial (and stand-alone) mediators of the relationship between social media addiction and the following five predictors: depression, anxiety, FoMO, loneliness, and mindfulness.

Ordinary least squares regression assumptions (normality, multicollinearity, and homoscedasticity) were tested prior to conducting the regression and mediation analyses to determine the suitability of the data. Variation inflation factors were all below 5, indicating that multicollinearity was not an issue. The assumption of homoscedasticity was not met, so heteroscedasticity consistent standard error (HC3) estimators were used in the mediation analyses. Age and sex as covariates were added in the mediation models because these variables were significantly associated with social media addiction in the present study. To test the significance of indirect effects in the mediation models, 10,000 bootstrap samples were used to create 95% confidence intervals (CI). Indirect effects were significant if the CI did not include zero.

Results

Table 2 shows the means, standard deviations, and bivariate correlations for the study variables. Pearson correlations showed that higher levels of negative and positive social media use metacognitions were associated with higher levels of depression, anxiety, FoMO, loneliness, social media engagement, and social media addiction, and lower levels of mindfulness.

Predictors of Social Media Addiction

A hierarchical multiple regression examined whether negative and positive social media use metacognitions both accounted for a significant proportion of unique variance in

Table 2 Pearson's correlations between study variables ($N=810$)

	1	2	3	4	5	6	7	8	9	10	11
1. NSMUM	-										
2. PSMUM	.35***	-									
3. Depression	.32***	.26***	-								
4. Anxiety	.25***	.27***	.59***	-							
5. FoMO	.31***	.31***	.33***	.34***	-						
6. Loneliness	.30***	.33***	.57***	.40***	.46***	-					
7. Mindfulness	-.33***	-.23***	-.50***	-.36***	-.28***	-.37***	-				
8. SME	.28***	.21***	.16***	.15***	.28***	.21***	-.13***	-			
9. SMA	.58***	.44***	.37***	.38***	.45***	.40***	-.28***	.42***	-		
10. Age	-.15***	-.20***	-.14***	-.10***	-.19***	-.17***	.16***	-.16***	-.14***	-	
11. Sex	.13***	.16***	.06	.09**	.05	.08*	-.05	.06	.16***	-.06	-
<i>M</i>	8.33	9.04	11.10	9.20	20.22	13.28	23.29	22.21	9.92	66.39	-
<i>SD</i>	2.91	3.66	4.26	2.61	8.55	5.04	5.13	12.04	3.92	12.63	-

NSMUM = negative social media use metacognitions, PSMUM = positive social media use metacognitions, FoMO = fear of missing out, SME = social media engagement, SMA = social media addiction. Sex is coded as male = 1, female = 2

* $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed)

Table 3 Hierarchical regression of the relationship between social media addiction and key psychological and demographic predictors

Predictors	Step 1			Step 2			Step 3		
	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β	<i>B</i>	<i>SE</i>	β
Age	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.04
Sex	0.78	0.23	0.10***	0.50	0.21	0.06*	0.37	0.20	0.05
Depression	0.07	0.04	0.08	0.03	0.03	0.04	0.04	0.03	0.04
Anxiety	0.22	0.05	0.15***	0.20	0.05	0.14***	0.18	0.05	0.12***
FoMO	0.10	0.02	0.22***	0.08	0.01	0.17***	0.07	0.01	0.15***
Loneliness	0.08	0.03	0.11**	0.07	0.03	0.09**	0.05	0.03	0.06*
Mindfulness	-0.03	0.03	-0.05	0.02	0.02	0.03	0.02	0.02	0.03
SME	0.10	0.01	0.29***	0.07	0.01	0.22***	0.07	0.01	0.22***
NSMUM				0.54	0.04	0.40***	0.49	0.04	0.37***
PSMUM							0.17	0.03	0.16***
Model summary									
Variance explained by model							$R^2 = 0.519$		
Change in variance explained by step							$\Delta R^2 = 0.020$		
Statistical significance of model							$F(10, 799) = 86.12***$		
Statistical significance of step							$\Delta F(1, 799) = 32.85***$		

NSMUM = negative social media use metacognitions, PSMUM = positive social media use metacognitions, FoMO = fear of missing out, SME = social media engagement. *B* = unstandardised coefficient, β = standardised coefficient, *SE* = standard error

p* < .05, *p* < .01, *****p* < .001

social media addiction after controlling for age, sex, depression, anxiety, FoMO, loneliness, mindfulness, and social media engagement (see Table 3). The final model estimated in the third step accounted for 52% of the total variance in social media addiction and identified FoMO, anxiety, loneliness, social media engagement, negative social media use metacognitions, and positive social media use metacognitions as significant predictors of social media addiction. Age, sex, depression, and mindfulness were not significant predictors in the final model ($ps > .05$). Negative social media use metacognitions significantly predicted social media addiction after controlling for other predictors in the second step of the model. Positive social media use metacognitions significantly predicted social media addiction after controlling for other variables in the third step of the model. The proportion of variance in social media addiction explained by the model significantly increased from adding negative metacognitions in Step 2 and adding positive metacognitions in Step 3.

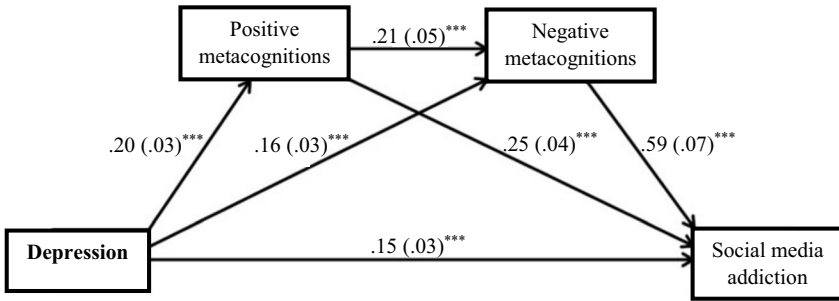
Mediation Analyses

Five mediation models were used to test the mediation hypotheses. All five models used social media addiction as the dependent variable and positive social media use metacognitions and negative social media use metacognitions as serial mediators. Only the independent predictor variable differed in each model. Figure 1 and Table 4 show the direct, indirect, and total effects in all five mediation models. All direct and indirect effects were statistically significant.

Discussion

The present study investigated how social media use metacognitions are associated with social media addiction, as well as several risk factors for social media addiction related to negative affect (i.e. depression, anxiety, FoMO, loneliness, and low mindfulness). The findings of the present study supported the hypothesis that higher levels of positive and negative social media use metacognitions would be associated with higher levels of depression, anxiety, FoMO, loneliness, and social media addiction, and lower levels of mindfulness (H_1). These findings are consistent with previous research investigating the psychological risk factors for addiction associated with metacognitions about social media use (Bocci Benucci et al., 2024; Casale et al., 2018) and other addictive behaviours such as online gaming (Marino et al., 2020) and gambling (Caselli et al., 2018). The findings are also consistent with the I-PACE and S-REF models which posit that metacognitions play a central role in the development of addictive behaviour through the activation and persistence of dysfunctional coping strategies for managing negative affective states (Brandtner et al., 2021).

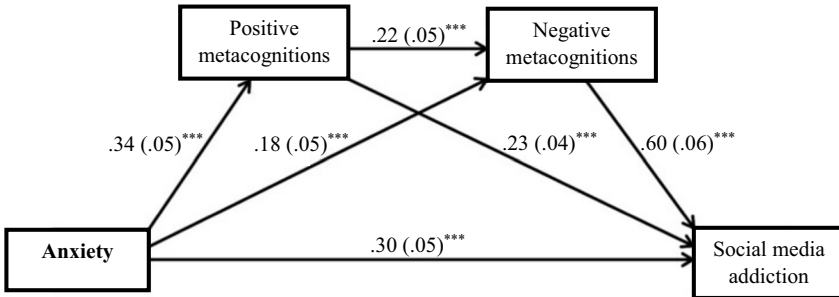
The findings supported the hypothesis that positive and negative social media use metacognitions would both account for a significant proportion of unique variance in social media addiction after controlling for age, sex, social media engagement depression, anxiety, FoMO, loneliness, and mindfulness (H_2). These findings support the I-PACE model which posits that cognitive biases such as social media use metacognitions have a significant influence on the development of social media addiction beyond the influence of any social, personality, and psychopathological risk factors for addictive behaviour (Brand et al., 2016). In the final regression model, negative metacognitions ($\beta = 0.37$) predicted social media addiction more strongly than positive metacognitions



$R^2 = .43$

Total effect: $B = .32, SE (HC3) = .04, p < .001$

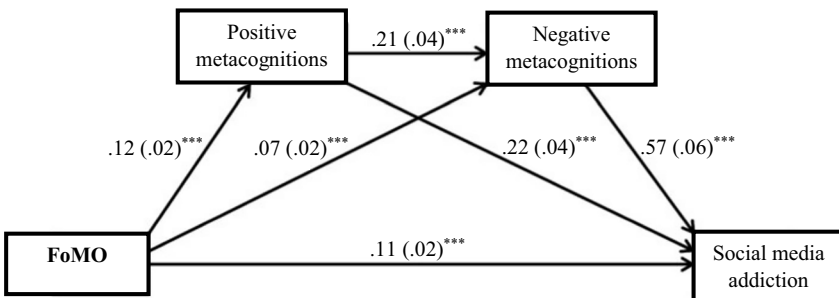
Total indirect effect: $B = .17, SE (HC3) = .03, 95\% CI [.12, .22]$



$R^2 = .44$

Total effect: $B = .54, SE (HC3) = .06, p < .001$

Total indirect effect: $B = .24, SE (HC3) = .04, 95\% CI [.17, .32]$

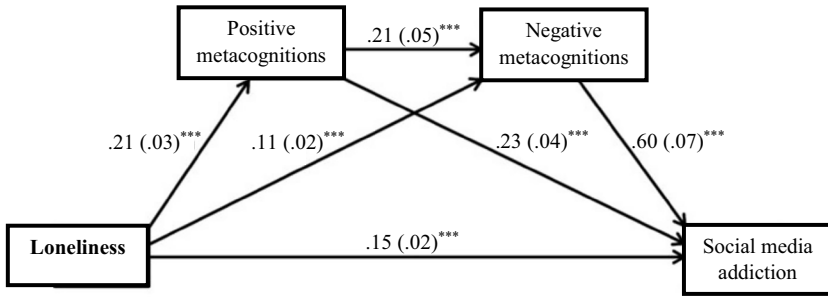


$R^2 = .45$

Total effect: $B = .20, SE (HC3) = .02, p < .001$

Total indirect effect: $B = .08, SE (HC3) = .01, 95\% CI [.06, .11]$

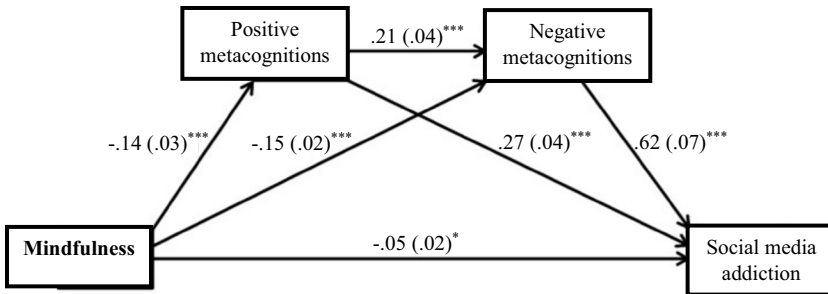
Fig. 1 Effects in serial mediation models for depression, anxiety, fear of missing out, loneliness and mindfulness



$R^2 = .43$

Total effect: $B = .29, SE (HC3) = .03, p < .001$

Total indirect effect: $B = .14, SE (HC3) = .02, 95\% CI [.11, .18]$



$R^2 = .41$

Total effect: $B = -.20, SE (HC3) = .03, p < .001$

Total indirect effect: $B = -.15, SE (HC3) = .02, 95\% CI [-.18, -.11]$

Note. Path coefficients shown are unstandardised linear regression coefficients with heteroscedasticity consistent standard error in parenthesis. Statistics for total indirect effect were estimated with the percentile bootstrap method using 10,000 bootstrap samples. Age and sex were covariates in each model but are not included for simplicity. FoMO = fear of missing out; B = unstandardised coefficient; $SE (HC3)$ = heteroscedasticity consistent standard error.

* $p < .05$, *** $p < .001$

Fig. 1 (continued)

($\beta = 0.16$), which is consistent with previous studies that found that negative metacognitions were more strongly associated with social media addiction than positive metacognitions (Albery et al., 2024; Bocci Benucci et al., 2024). This difference in effect size between positive and negative metacognitions found in the present study is consistent with the more prominent role of negative metacognitions in the development and perpetuation of social media addiction proposed by the S-REF model (Hamonniere & Varescon, 2018). The present findings also support the utility of assessing social media use metacognitions to test theoretical assumptions of the S-REF model in research investigating how social media addiction develops, similarly to how this model has been

Table 4 Indirect effects on social media addiction in five serial mediation models

Mediation path	<i>B</i>	<i>SE</i> (HC3)	95% CI
Depression → PSMUM → SMA	0.05	0.01	[0.03, 0.07]
Depression → NSMUM → SMA	0.09	0.02	[0.06, 0.14]
Depression → PSMUM → NSMUM → SMA	0.02	0.01	[0.01, 0.04]
Anxiety → PSMUM → SMA	0.08	0.02	[0.05, 0.12]
Anxiety → NSMUM → SMA	0.11	0.03	[0.05, 0.18]
Anxiety → PSMUM → NSMUM → SMA	0.05	0.01	[0.02, 0.07]
Fear of missing out → PSMUM → SMA	0.03	0.01	[0.02, 0.04]
Fear of missing out → NSMUM → SMA	0.04	0.01	[0.02, 0.07]
Fear of missing out → PSMUM → NSMUM → SMA	0.01	0.004	[0.01, 0.02]
Loneliness → PSMUM → SMA	0.05	0.01	[0.03, 0.07]
Loneliness → NSMUM → SMA	0.07	0.02	[0.04, 0.10]
Loneliness → PSMUM → NSMUM → SMA	0.03	0.01	[0.01, 0.04]
Mindfulness → PSMUM → SMA	-0.04	0.01	[-0.05, -0.02]
Mindfulness → NSMUM → SMA	-0.09	0.02	[-0.12, -0.06]
Mindfulness → PSMUM → NSMUM → SMA	-0.02	0.01	[-0.03, -0.01]

PSMUM = positive social media use metacognitions, *NSMUM* = negative social media use metacognitions, *SMA* = social media addiction. *B* = unstandardised coefficient, *SE* (HC3) = heteroscedasticity consistent standard error

B, *SE* (HC3), and 95% confidence intervals were calculated with the percentile bootstrap method using 10,000 bootstrap samples

Covariates: age and sex

applied to understand other addictive behaviours (Casale et al., 2021a, 2021b; Spada et al., 2015). Additionally, the findings suggest the potential efficacy of utilising principles of metacognitive therapy (Wells, 2002, 2013) in the treatment of social media addiction.

The present findings supported the hypothesised mediating roles of positive and negative metacognitions in associating depression, anxiety, FoMO, loneliness, and low mindfulness with social media addiction (H_3 – H_7). These serial mediation findings are consistent with the I-PACE model which posits that cognitive biases such as metacognitions act as independent mediators of the relationship between risk factors for addictive behaviour and social media addiction (Brand et al., 2016). These findings are also consistent with the S-REF model which posits that positive and negative metacognitions are serial mediators in the relationship between risk factors for addictive behaviour and social media addiction (Spada et al., 2015).

The serial mediation findings suggest that the risk factors investigated in the present study may indirectly result in social media addiction through the development of metacognitions, as well as directly lead to social media addiction independently of their relationship with metacognitions. These risk factors varied in the proportion of their total effect on social media addiction that was attributable to their direct effect and total indirect effect on social media addiction. For example, anxiety showed a stronger direct effect on social media addiction ($B=0.30$) than total indirect effect on social media addiction ($B=0.24$). On the other hand, mindfulness showed a weaker direct effect on social media addiction ($B=-0.05$) than total indirect effect on social media addiction

($B = -0.15$). The serial mediation findings indicate that there is considerable variability in the degree to which the effect of these risk factors on social media addiction is explained by metacognitions. Some risk factors may cause social media addiction primarily through the development of metacognitions, while other risk factors may cause social media addiction primarily through other psychological mechanisms. It is important to note that although the findings of the present study support serial mediation models in which psychological risk factors and metacognitions have direct and indirect effects on social media addiction, the cross-sectional design of the study does not warrant any conclusions regarding causal relationships between the variables in these mediation models.

While the present study's cross-sectional design precludes causal inferences, the results of the mediation analyses are consistent with the view that positive metacognitive beliefs are involved in the activation and reinforcement of a coping strategy involving social media engagement that over time leads to the development of negative metacognitions, which then become the key marker of psychological dysfunction and cause the perpetuation of addictive behaviour (Brandtner et al., 2021; Marino et al., 2020). These findings are consistent with previous studies that found evidence for the mediating role of metacognitions in the association between negative affect and technological addictions (Bocci Benucci et al., 2024; Casale et al., 2018, 2021a, 2021b; Marino et al., 2020).

The present study also evaluated the factor structure, reliability, and validity of an English language version of the Metacognitions about Social Media Use Scale (MSMUS; Akbari et al., 2023) which was developed to assess social media use metacognitions. Results of the CFA showed moderate model fit for the two-factor model of social media use metacognitions (negative and positive metacognitions) reported by Akbari et al. (2023), which is consistent with previous studies investigating metacognitions for online gaming (Marino et al., 2020) and gambling (Caselli et al., 2018). However, in the present study, the model fit for a three-factor model of social media metacognitions was marginally better than the model fit for the two-factor model, and the two-factor model showed poorer model fit in comparison to the model fit reported by Akbari et al. (2023). The present study's findings confirmed the reliability for the MSMUS by providing evidence of good internal consistency for the scales assessing positive social media use metacognitions ($\alpha = .91$) and negative social media use metacognitions ($\alpha = .80$).

Limitations and Suggestions for Future Research

Several limitations of the present study should be acknowledged. The study relied entirely on self-report instruments, making the data vulnerable to recall and social desirability biases (Nederhof, 1985) and biases related to the same respondents providing all the data (Podsakoff et al., 2003). Future research could address these limitations by using passive objective measures that track social media use on online devices (Ryding & Kuss, 2020) and by using observer ratings.

The sample was a self-selected group of social media users recruited through *Facebook* with a mean age of 66.39 years, limiting the generalisability of the findings. This mean age is unusually high for research on social media addiction, which generally focuses on adolescents and young adults. However, research suggests that adults over 50 years of age experience levels of social media addiction that are only slightly lower than levels reported by younger adults (Koçak et al., 2021). The present study's findings suggest that older adults may also be influenced by the psychological mechanisms underlying social media

addiction posited by the I-PACE and S-REF models, which posit that age is not considered to be a key factor in the development of addictive behaviour. Research on adolescents and young adults is needed to evaluate whether the present study's findings generalise to younger social media users. Additionally, the high mean age of participants may have contributed to the lack of good model fit the present study found for the two-factor solution of the English version of the MSMUS, which differs from the good model fit reported by Akbari et al. (2023) among Iranian adolescents ($M_{\text{age}} = 16.01$ years). Therefore, future research is needed to investigate the factor structure of the English version of the MSMUS among adolescents and young adults.

Moreover, the cross-sectional design of the present study cannot support causal conclusions regarding the roles of positive and negative metacognitions in the developmental trajectory of addictive behaviour. Future longitudinal and experimental research is needed to investigate the mediating effects of metacognitions in the development of social media addiction to provide robust evidence for temporal relationships involving metacognitions posited by the I-PACE and S-REF models. Such studies should investigate the possible mediating effect of positive metacognitions in the development of negative metacognitions and the subsequent development of social media addiction. Future research could test the possible bi-directional relationship between metacognitions and social media addiction using a cross-lagged effects model (Erhart et al., 2017). Experimental research targeting change in metacognitions would provide further clarity regarding and causal relationships between metacognitions and social media addiction.

The serial mediation analyses generally showed significant but small indirect effects, with the large number of participants potentially contributing to these significant results. Therefore, the findings provide only partial support for hypotheses related to indirect effects. Moreover, the heteroscedasticity in the mediation analyses could have had an effect on the results. Heteroscedasticity consistent standard error (HC3) estimators were used to reduce the chances of a heteroscedasticity effect on the results, but heteroscedasticity might suggest that the model could be improved (see Hayes & Cai, 2007).

Experimental studies are needed to investigate the effects of social media use metacognitions on other cognitive and affective mechanisms underlying social media addiction that are reinforced by a dysfunctional coping style according to the I-PACE model such as craving, cue reactivity, attentional biases, and implicit cognitions. Future studies could investigate whether symptoms of social media addiction are caused by interactions between metacognitions and other key cognitive and affective mechanisms proposed in the I-PACE model (Wegmann et al., 2020). Finally, future experimental studies could investigate whether interventions that target metacognitions, such as metacognitive therapy (Wells, 2002, 2013), are effective for treating social media addiction.

Conclusion

Despite its limitations, the findings of the present study identified positive and negative social media use metacognitions as potential theoretically-based serial mediators associating psychological vulnerabilities for addictive behaviour (depression, anxiety, FoMO, loneliness, and low mindfulness) with social media addiction. Additionally, the findings support the reliability and validity of the English version of the MSMUS as a measure of positive and negative social media use metacognitions. Finally, the study found that social media use metacognitions were important predictors of social media addiction. The present

study extends previous research findings and contributes to the understanding of social media use metacognitions by showing that positive and negative social media use metacognitions are serial mediators in the relationship between psychological risk factors and social media addiction.

Author Contribution Jai Meynadier: conceptualisation, methodology, formal analysis, investigation, writing — original draft and reviewing and editing. John Malouff: conceptualisation, methodology, writing — original draft and reviewing and editing. Nicola Schutte: conceptualisation, methodology, writing — original draft and reviewing and editing. Natasha Loi: conceptualisation, methodology, writing — original draft and reviewing and editing. Mark Griffiths: writing — original draft and reviewing and editing.

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Data Availability The data file that was generated and analysed in the current study is available in the OSF repository, <https://doi.org/10.17605/OSF.IO/SH8AE>.

Declarations

Ethics Approval This study was approved by the University of New England Human Research Ethics Committee. Approval number: HE24-038. 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.

Informed Consent Informed consent was obtained from all participants who took part in the study.

Conflict of Interest The authors declare no competing interests.

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