

Instagram, Depression, and Dark Flow - Using Social Media as a Maladaptive Coping Mechanism

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Abstract

Background: Instagram is a popular social media platform which uses algorithms to tailor content to the specific interests of individual users. We proposed that this tailored content induces a flow state where users become completely absorbed and time passes imperceptibly, creating a highly satisfying experience. For those who use Instagram to escape from depression, Instagram may provide the relief that they seek, but at a cost – neglecting real-life social supports and work/academic commitments. This neglect leads to further problems that prompt greater Instagram dependence.

Methods: Using a repeated-measures design, 114 participants engaged in three conditions (Control, Generalized, and Personalized) for 10 minutes each. Participants answered questions about flow and positive affect (after each condition), as well as their Instagram use habits, depression, reasons for using Instagram, and time spent on Instagram.

Results: We demonstrated that Instagram's algorithms were effective. Participants experienced significantly greater flow and positive affect when using their tailored-content Instagram compared to a generalized account based on the interests of 30 random users. As evidence for our proposed cycle of dependence, we showed significant associations between depression, flow, and a measure of problematic Instagram use, as well as associations between being motivated to use Instagram to escape problems and problematic Instagram use.

Conclusions: These results suggest that, at least for a subset of individuals with depression, Instagram serves as a maladaptive, escape-coping mechanism which induces flow and elevates mood, but ultimately leads to more problems due to overextended Instagram use.

1. Introduction

Social media is an umbrella term comprising social networking sites, messaging platforms, blogs, etc. [1,2]. Carr and Hayes define social media as “Internet-based channels that allow users to opportunistically interact and selectively self-present, either in real-time or asynchronously, with both broad and narrow audiences who derive value from user-generated content and the perception of interaction with others” (p. 50) [3]. As Marino et al., state, it is “a way of being” (p. 1) among adolescents and young adults [4].

1.1. The Growing Popularity of Instagram

Studies on social media sites tend to focus on Facebook. However, growing in its popularity, yet limited in research, is Instagram.

Instagram is a social media platform owned by Meta, previously known as Facebook, that focuses on photo and video sharing. As of December 2021, Instagram has reached two billion active users worldwide [5]. Over 66% of these users are under 35 making this platform quite popular among “Gen Z” and “Millennials” [6].

Instagram's popularity is derived from its constantly evolving new features and its front as a strong social integrator with other social media platforms (i.e., Facebook, Twitter, Flickr) [7]. Core features of Instagram include Reels (short multi-clip entertaining vertical videos with popular audio), Stories (personal 24-hour short-lasting posts), Messenger (private direct messages across Instagram or Facebook), Video (full-screen videos regardless of length),

Shopping (product tags and buying directly with checkout), and Search & Explore features (search engine and posts curated by Instagram) [8].

Most striking is Instagram's high degree of *personalization* – the tailoring of its content to the specific individual user. For example, the continuous scroll Search & Explore feature is deliberately designed to allow users to “view more of a topic [they] like based on posts [users have] engaged with and topics searched for in the past” which lets this platform autogenerate similar content for users to “discover and go deep on topics that inspire [them]” resulting in a customized feed [8,9]. While no formal research exists, it seems intuitive that users may find feeds tailored to their interests, more engaging than more general content. One goal of this study is to provide such evidence.

1.2. Effects of Problematic Social Media Use on Well-Being

Problematic social media usage takes place when the platform is perceived as an important mechanism to relieve stress, loneliness, or depression [10]. Although users may temporarily elevate their mood while on platforms like Instagram, there may be long-term consequences if users elect to engage in social media at the expense of other important types of social engagement. Hence, spending too much time on Instagram may lead to ignoring real-life relationships, and work and/or education conflicts [11]. As a result, Xu and Tan posit that the consequences of neglecting important relationships cause a lowering of mood which then triggers increases in social media usage as a way to alleviate these negative emotional states [10]. Thus, a downward spiralling cyclical pattern ensues whereby increasing social media use to relieve negative moods creates isolation from others, which in turn may lower mood, which paradoxically is alleviated by further utilization of social media. This continuous cycle ultimately results in an increased psychological dependency on social media.

Satici and Uysal demonstrated a relationship between well-being and problematic Facebook use [12]. They showed that problematic Facebook use was negatively correlated with life satisfaction and subjective ratings of happiness, both of which uniquely accounted for variance of problematic usage. They found that low scores on life satisfaction were the strongest predictor for problematic Facebook use, leading to lower sense of well-being.

Similarly, there are significant associations between social media use and depression among young adults (e.g., university/college-aged adults). Although the causal directionality of this relationship is currently unclear, it is important to note that whether individuals with depression tend to use social media more, or alternatively, increased social media use increases the subsequent development of depression, either pathway perpetuates an unhealthy negative cycle of usage [13].

1.3. Effects of Flow and Dark Flow

Given the possibility of incurring negative long-term consequences,

one may ask what exactly is the allure of platforms like Instagram? One potential explanation involves flow. Flow is a state of deep concentration and absorption in an activity where people feel that they are in effortless control and at the peak of their abilities [14]. This creates a state where both time perception and emotional problems appear to vanish, elevating mood, but also extending the user's time on the platform since time passage becomes distorted.

The intrinsically optimal state fostered by flow is a critical determinant of online experiences, including web browsing, which can be extended to social media sites [15]. For example, Pelet and colleagues argue that telepresence, the subjective immersion into a virtual environment, leads to and enhances the flow state [16]. For these authors, the experience of flow produces a “sensation of being there” (p. 121) causing users to find social media platforms especially enjoyable.

Relatedly, Agarwal and Karahanna reason that cognitive absorption – a state of deep involvement with software – influences behavioural intentions to use certain technologies [17]. The authors also note that the characteristics of different technologies may vary in the degree to which absorption occurs, suggesting possible differences between social media applications based on which specific features are offered.

While flow is typically associated with the tenets of positive psychology, when flow is experienced in situations involving human-machine interactions like social media, there can be negative consequences such as spending more time than intended. In recognition of these negative consequences, Dixon et al., have used the term dark flow to represent such experiences especially among depressed individuals. Dark flow is a pleasurable, but maladaptive state whereby individuals are completely engrossed in the human-machine interaction, which provides an escape from depressing thoughts [18]. Thus, identical to flow in terms of focus and enjoyment, dark flow differs from flow only in the negative consequences such as spending more time than planned, and in the case of slot-machine gambling, losing more money than intended [19]. This dark side of flow is implicated when there is continued dependence on an activity that achieves or is associated with the experience of flow, creating compulsions to re-engage in such activities [20].

Dixon et al., report a positive correlation between depressive symptomatology and the endorsement of experiencing dark flow while playing slot machines [21]. They propose that for these individuals, the sights and sounds of slot machines serve to corral their attention, and prevent them from thinking about the depressing aspects of their lives. This reined-in attention leads to a state of dark flow, which in turn elevates their mood. Thus, slot machines provide players with relief by elevating mood which reinforces gambling behaviours [21].

In the context of problem video gaming, similar effects occur:

those who endorse gaming to escape problems in daily life show correlations with both depression and problematic gaming [22]. Like their gambling counterparts, depressed gamers may experience relief from their depression when they play immersive games but spending too much time gaming leads to neglecting important social supports, which can exacerbate the problems which prompted the escape behaviours in the first place [11,16,17].

It is therefore possible that like slot machines and immersive computer games, social media sites may induce dark flow and foster the same downward spiralling cycle of dependency. Indeed Masur et al., have shown that of the many motives for using Facebook, (self-presentation, entertainment, information seeking, socializing, and meeting new people), the motive that is most highly correlated with Facebook addiction is escapism ($r = .57, p < .001$) [23].

A recent study on different Instagram features revealed that active engagement (e.g., leaving likes and comments on others' posts) is both directly and indirectly associated with problematic Instagram use through escapism and co-presence ("feeling[s] of being together with others in a computer-generated world at the same time even though people are in separate places" (p. 2) [24,25]. The authors suggest that viewing videos and content from people to whom users feel emotionally attached (e.g., close friends, family, or popular celebrities/influencers) helps them escape from unpleasant realities and modify their moods to positive emotional states.

While researchers have proposed several different terms, *cognitive absorption*, *immersion*, and *dissociation*, all can be seen as core aspects of the dark flow experience. Since flow elevates mood, it may be a prime candidate for escape among those with dissatisfactions in their everyday life. Thus, although experiencing flow while using social media may elevate mood, (which reinforces social media usage), there are costs. Because flow involves time distortion, users may stay on social media longer than intended and neglect important social supports, which worsens their symptoms and creates a cycle of problematic social media use.

1.4. The Current Study

We propose that the algorithms used by Instagram to tailor content to the interests of the specific user may be particularly important in inducing flow because "personalized interactive systems are more effective than one-size-fits-all approaches" (p. 229) [26]. Therefore, the objectives of this study are to determine:

- 1) Whether Instagram fosters problematic usage tendencies among some individuals and,
- 2) Provide evidence for a cycle of dependency involving depression, dark flow (and its reinforcing positive affect), which prompts these users to engage with Instagram to escape.

To investigate these research questions, we presented participants with three conditions:

- 1) A control condition composed of a monotonous task,
- 2) Engaging with a generalized Instagram feed where content has not been tailored to the specific user,
- 3) Engaging with a personalized Instagram feed tailored to the individual user.

We measured flow and positive affect after each condition. We also measured trait-level depression, problematic Instagram use, and whether people cite using Instagram as a means of escape.

Specifically, hypotheses for the current study were as follows: (H1) we expected to find higher levels of flow and positive affect scores in the Personalized condition (participants viewing their own Instagram feed) compared to the flow and positive affect experienced while engaging with the generalized Instagram feed. Both conditions should trigger higher flow and positive affect than the monotonous task; (H2) there should be a positive correlation between dark flow and positive affect in the two Instagram conditions. This finding is a necessary antecedent for the subsequent hypotheses – specifically, flow should induce positive affect which is the rewarding component that people struggling in their day-to-day lives use to cope with their unhappiness; (H3) there should be a positive relationship between problematic Instagram usage and depression. Such a finding would be indirect evidence that at least some depressed people are relying on Instagram to cope with their depression. There should also be (H4) a positive relationship between problematic Instagram usage and escape motivations which would provide evidence that using Instagram to escape fosters addiction. Finally, we tested whether using flow to escape depression, would ultimately be associated with problematic Instagram use in a multiple regression framework. Thus (H5), we predicted problematic Instagram use, using the following independent variables: the amount of time spent on Instagram, dark flow, depression, and finally escape motivations for using Instagram.

2. Methods

All methods and procedures were approved by the University of Waterloo's Office of Research Ethics (ORE #44440 and #44648). Our data and statistical code can be found on the Open Science Framework (OSF; <https://tinyurl.com/ybtsupyw>).

2.1. Participants

The study collected data from 121 undergraduate students from the University of Waterloo, all of whom self-selected to participate in exchange for course credit. Four participants were excluded due to deleting the daily record of their Instagram usage. One person was removed because their reported daily usage was 480 minutes (a value that was more than 3 standard deviations above the mean of our sample). Additionally, we excluded the data of two participants for not following the experimental protocol (e.g., participants went on their phones during the Control condition).

The final sample consisted of 114 participants, ranging in age

from 17 to 38 ($M = 19.64$, $SD = 2.9$). There were: 80 women, 31 men, 2 non-binary, and 1 participant who chose not to disclose their gender. Eligible participants self-reported on a pre-screen questionnaire that they engaged in a minimum of daily- to near-daily use of Instagram, had normal or corrected-to-normal vision and hearing, and were not diagnosed, in treatment, and/or taking medication for social media addiction at the time of the study.

Prior to conducting the main study, we recruited a pool of 30 participants (21 female), ranging in ages from 17 to 63 ($M = 22.9$, $SD = 7.88$) to create our Generalized Instagram account. Each of these participants used our Generalized account for 15 minutes. This caused the algorithms to tailor the content not based on a single user, but on the interests of 30 different people. Instagram usage of these participants ranged from using Instagram more than once per day (63%), once per week (23%), every other day (3%), and not using Instagram or using it less than once per week (10%).

2.2. Measures

2.2.1. Flow Short Scale

Flow was measured retrospectively using the Flow Short Scale, a 7-point scale (1 = *Not at all*; 4 = *Partly*; 7 = *Very Much*) consisting of 10 items that tap into fluency of performance and absorption by activity [27]. Participants indicated the extent to which they experienced each item (e.g., “I have no difficulty concentrating”; “I am totally absorbed in what I am doing”). This scale has been validated by Engeser and Rheinberger and has been shown to have strong internal reliability ($\alpha = .92$) [28]. Flow scores were calculated by averaging the responses to the 10 items.

2.2.2. Positive and Negative Affect Schedule

To assess positive affect, we used the Positive and Negative Affect Schedule, a 20-item scale consisting of two factors, positive affect (e.g., “Interested” or “Excited”) and negative affect (e.g., “Distressed” or “Irritable”), in which participants indicated the extent to which they felt each emotion after each task using a 5-point scale (1 = *Very slightly or not at all*; 5 = *Extremely*) [29]. Scores for positive affect were calculated by averaging the ratings on the 10 positive affect items.

2.2.3. Depression, Anxiety, and Stress Scale 21

Depression was measured using the Depression subscale from the Depression, Anxiety, and Stress Scale 21 [30]. The Depression subscale consists of seven items that are rated on a 4-point scale (0 = *Did not apply to me at all*; 3 = *Applied to me very much or most of the time*). Participants were asked to indicate how much each statement applied to them over the past week (e.g., “I couldn’t seem to experience any positive feeling at all”; “I felt that I had nothing to look forward to”). Depression scores were calculated by averaging the ratings of the seven depression items.

2.2.4. Instagram Use Questionnaire

We assessed problematic Instagram use via the Instagram Use Questionnaire [25]. This is a 9-item measure that uses a 5-point

scale (0 = *Never*; 4 = *Always*) to assess problematic Instagram use tendencies in general (e.g., “I feel angry, when I am not able to access my Instagram account”; “I use Instagram, when I am in the company of friends). To develop this scale, the authors used the Social Media Questionnaire, replacing the words “social media” with “Instagram” and using confirmatory factor analysis to show that the IUQ is a valid, reliable measure of assessing problematic Instagram use among adolescents and adults with a high internal validity of .89 [31]. Scores were calculated by averaging the responses to the nine items.

2.2.5. Reasons for Instagram Use Scale

To understand users’ motivations to use Instagram, we used the Reasons for Facebook Use scale developed by Chaudhry (2020) from an unpublished manuscript and replaced the word “Facebook” with “Instagram” (similar to Kircaburun and Griffiths in their development of the IUQ) [25]. The Reasons for Instagram Use (RIU) scale consists of six items that utilized a 7-point scale (1 = *Completely disagree*; 7 = *Completely agree*). Although no formal psychometric analyses exist for this newly developed scale, factor analysis indicated that three of the items loaded onto a single conceptual factor that we have labelled “escape motivations” (e.g., “I use Instagram to escape, and to distract myself from day-to-day issues”; “I use Instagram mostly because Instagram takes my mind off of my everyday worries”; “I use Instagram because it provides a break from reality”). Scores were calculated by averaging the responses to the three escape motivation items.

2.2.6. Time Spent on Instagram

To measure Instagram usage, we used the platform’s calculation of the time participants spend on Instagram per day, based on their usage over the course of the preceding week. To standardize all scores, we converted all averages into minutes.

2.3. Tasks

2.3.1. Pegboard Control Task

Participants completed a 10-minute block of a computerized monotonous peg-turning task in the Control condition [32,33]. In this task, participants were asked to turn virtual pegs by double-clicking on the “pegs”. Double-clicking on a peg causes the peg to turn clockwise, by 90 degrees, whereupon participants move to the next adjacent peg. Each peg takes approximately three seconds to turn roughly equivalent to how long it would take to engage with a single piece of content while scrolling on Instagram. After turning all the pegs in the top row, they then proceeded to the bottom row and then started over at the top left once done.

2.3.2. Generalized Instagram Task

Participants engaged in unstructured, free-form use of Instagram using the lab-created generalized Instagram (based on the interests of 30 people in pre-study). They interacted with the account for 10 minutes. Participants were told to use Instagram how they normally would with a few restrictions. First, participants were to refrain from following accounts or liking content that would

provide personal identifying information (i.e., following their own Instagram account or friends' Instagram account, following non-meme private accounts, liking posts from their own or friends' Instagram accounts). They were also to refrain from direct messaging, creating Instagram Stories, and using inappropriate language while leaving comments on Instagram posts. The main task was for participants to engage with the safe-for-work content that was already on the account (i.e., the Home page and Search & Explore page).

2.3.3. Personal Instagram Task

Participants engaged in 10 minutes of unstructured, free-form use of Instagram using their personal Instagram account (i.e., where the content was tailored to their interests). Participants were told to use Instagram how they normally would. They could: search for and follow accounts they found enjoyable, view content and "like" or comment on Instagram posts they found enjoyable, and engage with any of Instagram's features, including, but not limited to Reels, Search & Explore, Stories, Direct Messaging (for sharing content with friends).

2.4. Design

The experimental design employed three conditions. The *Control* condition – the monotonous task (pegboard task) –, the *Generalized* condition and the *Personalized* condition. The study involved testing two participants simultaneously.

Participants always completed the *Control* condition first. Here we sought to essentially stack the deck against our hypotheses – by having the most non-engaging task completed first, we sought to avoid exacerbating the boredom that might ensue had we presented the monotonous task after the two (more engaging) Instagram tasks. Next, participants completed the two Instagram tasks in counterbalanced order. When Participant A was engaging in the *Personalized* condition task, Participant B was simultaneously engaging with the *Generalized* condition. Participants then switched conditions – Participant A engaged with the generalized Instagram feed, and Participant B engaged with their own feed.

2.5. Procedure

Once participants entered the lab and provided informed consent, each participant was randomly assigned to the *Personalized* or the *Generalized* workstations.

Each workstation was equipped with either an Apple iMac computer or a Windows desktop computer, along with a set of headphones and a Samsung tablet (Model SM-T560NU). Participants first filled out a demographics survey on Qualtrics using the computer (age, sex, and gender), then used the tablet to log into their personal Instagram account and disable any time limits or reminders on their Instagram account (if applicable). Since Instagram allows for multiple accounts to be logged in at the same time, the generalized Instagram was already preloaded on both tablets. Thus, participants were able to switch between

both their own accounts and the generalized account based on the randomization of the conditions.

The *Control* condition (always administered first), required participants to engage in the monotonous pegboard task for 10 minutes. After the 10-minute block was over, participants filled out the Flow Short Scale and Positive and Negative Affect Schedule (PANAS) on Qualtrics. Next, participants engaged with the two experimental Instagram conditions in counterbalanced order for 10 minutes each after which they answered the same questions about flow and affect. Participants then switched out of the current account they were using to the other Instagram account that was on the tablet, engaged with this account, then filled out the Flow Short Scale and the PANAS.

At the end of the experiment, participants used Qualtrics to complete the Depression subscale from the Depression Anxiety Stress Scale 21, Reasons for Instagram Use scale, Instagram Use Questionnaire, and Time Spent on Instagram using daily average scores taken from participants' personal Instagram accounts. After completing the questionnaires, participants were asked to log out of their Instagram account, reminded to re-enable any time limits or daily reminders, and be sure not to save any of their login information onto the tablets.

3. Results

All statistical analyses were conducted using SPSS (version 29). Due to occasional errors with the Instagram server precluding users from logging into their personal Instagram accounts on the tablet, some participants engaged with the *Personalized* condition on their personal phones. We conducted an independent sample t-test to determine whether there were any differences in flow and positive affect between tablet and phone users and found no statistically significant difference in either flow scores, $t(112) = .013$, $p = .99$, or positive affect scores, $t(112) = -1.54$, $p = .127$. Therefore, all participants ($n = 114$) were included in the main, hypothesis-driven analyses.

Flow scores and positive affect scores were analysed using separate, repeated-measures ANOVAs comparing scores across the *Control*, the *Generalized* and the *Personalized* conditions. In cases where sphericity was violated, Greenhouse-Geisser corrections were applied to the degrees of freedom. For flow, there was a significant main effect of Condition, $F(1.57, 176.87) = 65.82$, $MSE = .52$, $p < .001$, $\eta^2 = .37$. Pairwise comparisons with Bonferroni corrections revealed that in the *Control* condition, flow was significantly lower ($M = 4.02$) than both the *Personalized* condition ($M = 4.97$), $p < .001$, and *Generalized* condition ($M = 4.65$), $p < .001$. Crucially, flow in the *Personalized* condition was significantly greater than the *Generalized* condition $p < .001$. These effects can be seen in panel A of Figure.

For positive affect, there was also a significant main effect of Condition, $F(1.62, 183.16) = 85.45$, $MSE = .28$, $p < .001$, $\eta^2 = .43$.

Using pairwise comparisons with Bonferroni corrections, results showed patterns similar to flow, where positive affect in the Control condition ($M = 1.53$) was significantly lower than the Personalized condition ($M = 2.31$), $p < .001$ and Generalized condition ($M = 2.16$), $p < .001$. Positive affect was also significantly greater in the Personalized condition than the Generalized condition, $p = .005$. These results are shown in panel B of Figure.

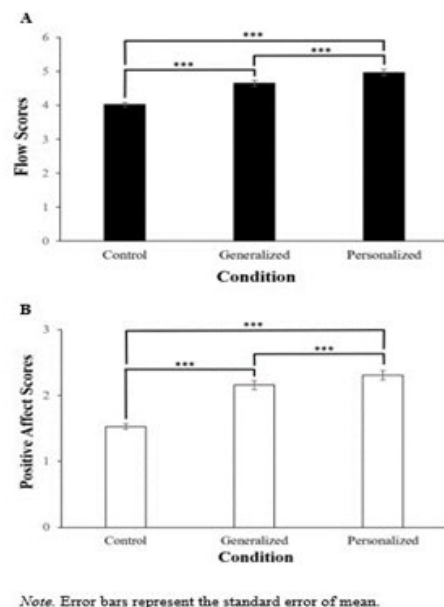


Figure: Flow and Positive Affect across the Conditions

Prior to evaluating our hypotheses related to individual differences (depression, problematic Instagram use, motivations for using Instagram), we conducted a Pearson correlation between habitual Instagram usage (average minutes spent on Instagram during the last week) and scores on our Problematic Instagram Use measure (IUQ). These two measures were positively correlated, $r(112) = .294$, $p = .001$ providing a validity check for our Problematic Instagram Usage measure (i.e., those who used Instagram more tended to score higher in terms of problematic Instagram use). To evaluate our hypothesis that flow scores would be related to positive affect, we conducted Pearson correlations and found positive significant correlations between dark flow and positive affect in both the Personalized condition, $r(112) = .544$, $p < .001$, and in the Generalized condition, $r(112) = .509$, $p < .001$.

Our predicted correlation between flow and problematic Instagram use (IUQ) was supported $r(112) = .216$, $p = .021$, as was our prediction that those who were depressed (DASS-21) would show elevated problematic Instagram use scores (IUQ), $r(112) = .243$, $p = .009$, and that those who endorsed having escape motivations for using Instagram (RIU) would be prone to having higher problematic Instagram use scores (IUQ), $r(112) = .498$, $p < .001$.

Finally, we used hierarchical multiple regression to predict

problematic Instagram usage scores. We entered usage minutes as a validity check at Step 1, followed by dark flow, depression, and escape motivations at Steps 2, 3, and 4. Usage minutes accounted for 8.7% of problematic Instagram use variance, $F(1, 112) = 10.62$, $p = .001$. Dark flow scores significantly increased R^2 by 3.8%, F change $(1, 111) = 4.83$, $p = .03$. Depression scores also significantly increased R^2 by 4%, F change $(1, 110) = 5.55$, $p = .02$. Crucially, escape motivations accounted for a significant additional 13% of problematic Instagram usage variance, F change $(1, 109) = 20.49$, $p < .001$.

4. Discussion

In the current study, we had participants engage with a personalized and a general Instagram account, along with a monotonous peg-turning task. In line with our hypotheses, the Personalized condition (i.e., having users engage with their personal Instagram account in which algorithms tailor the content to their interests) induced significantly higher levels of both flow and positive affect than either the Generalized or Control conditions. This finding essentially provides direct evidence of the effectiveness of the algorithms used by Instagram that tailor content to the individual user. People interacting with this personalized content reported both deeper flow and higher positive affect than people interacting with a “generalized” account based on the interest of 30 different people. This finding provides further evidence that social media platforms such as Instagram, are able to cause users to experience a gratifying and rewarding state of mind that is achieved through flow [15-17].

Importantly, the significant differences in flow and positive affect between the Personalized and Generalized conditions indicate that Instagram’s personalization tactics seem to be more effective in inducing flow and subsequent positive affect than showing users generally interesting one-size-fits-all type of content [26]. This further demonstrates that specific features on social media platforms can cause variations in the levels of flow and engagement when individuals interact with content tailored to their interests [17].

The findings concerning both elevated flow and positive affect in the Personalized condition set the stage for this platform to be maladaptively used as a method to escape from depression, by triggering the urge to repetitively engage with Instagram. The strong positive correlation between dark flow and positive affect in the personalized condition highlights the reinforcing properties of using Instagram. Although correlation cannot be definitively used to infer causality, it is both possible and indeed likely that the dark flow state induced elevations in positive affect and supports the idea that being in a dark flow state while on Instagram creates a highly satisfying and rewarding experience leading to increases in positive affect [14].

When considering the potential harms of social media use, we relied on the Instagram Use Questionnaire [25]. As a validity

check for this measure, we showed a positive correlation between problematic Instagram use tendencies and actual Instagram usage, an objective measure of the average amount of time participants engage with Instagram in a day. Thus, in accordance with our *prima facie* reasoning, those with problematic usage patterns were the ones using Instagram the most.

Having established the validity of this scale we next considered the factors we believe are important in our proposed cycle of Instagram dependency (where depressed individuals maladaptively use Instagram to escape their problems). Arguably the most straightforward means of providing evidence for this maladaptive circuit is the positive correlation between depression and problematic Instagram use. This suggests that for those who experience depression, there may be a subset of individuals who rely on Instagram to cope with their depression. Our results provide support for Xu and Tan who posited that problematic social media usage occurs when the platform is perceived by the user to be an important mechanism to relieve depression [10]. Our findings also support Lin et al., in their demonstration of strong and significant associations between social media use and depression among young adults [13]. Indeed, our findings also show results that are consistent with the findings of Satici and Uysal who showed that lower senses of well-being are related to problematic Facebook use [12]. Taken together, all of this research suggests that Instagram may be being used as a forum to cope with and (temporarily) relieve depression.

The strong positive correlation between escape motivations and problematic Instagram use suggests that using Instagram as a way to escape fosters problematic, addiction-like behaviours. This finding is in line with evidence from Masur et al., demonstrating that escapism is a motivation that is most highly correlated with Facebook addiction [23]. Our finding provides clear evidence that users may be using Instagram to distract themselves from real-life problems or take their minds off of daily struggles which is a maladaptive and unhealthy way to deal with ongoing issues [23,34].

Additionally, we have shown a significant relationship between dark flow and escape motivations ($r = .283$, $p = .002$). Here we show that those who are motivated to use Instagram as a form of distraction from their problems find the relief that they seek in terms of deep, engaging flow. This finding is directly analogous to the findings of Larche et al., who showed that those scoring in the upper tercile of escape motivations showed significantly higher flow while playing an immersive video game than those in the lower tercile of escape scores [22]. If those who are motivated to engage in social media as a way of escaping from their problems are also the ones that experience high degrees of flow, then this might lead to problems in terms of spending too much time on social media and neglecting significant others. Support for this contention comes from the strong positive correlation between escape motivations and problematic Instagram use. Thus, it seems

that Instagram may be acting in a similar manner as slot machines and video games, in that, an external device is reining in attention, leading to dark flow during the activity (with flow's time distortion potentially leading to excessive use, and the ensuing negative consequences in their life) [11]. As a result, our findings suggest that during Instagram use, depressive thoughts and rumination may be temporarily halted, thereby providing users with negative reinforcement that is, relief from low moods via the flow-induced elevation of mood.

To provide further evidence for the maladaptive circuit of depressed individuals using dark flow encountered during Instagram use to escape their problems, we used a hierarchical multiple regression approach. At Step 1 we showed (not surprisingly) that actual minutes spent on Instagram accounted for unique problematic Instagram use variance. At Step 2, we entered dark flow because we surmised that it is the flow state that provides relief for those wishing to escape their depression. Indeed, flow accounted for unique problematic Instagram use over and above that accounted for by the time spent on Instagram. Next, we showed that the more depressed the user, the greater the problems with Instagram they encountered. Here the idea is that those with greater severity of depression would have more to "escape" from. In accordance, we showed that entering depression scores at Step 3, accounted for unique variance over and above usage minutes, and dark flow scores. Finally, we showed that people seem to be aware of Instagram's ability to provide relief from their low moods. As such, some people cite these escape-related motivations as the key reasons for using Instagram. In accordance, at Step 4, escape motivations accounted for problematic Instagram usage variance over and above usage, dark flow, and depression.

4.1. Limitations and Significance

The present study is not without limitations. For example, by forcing people to engage in their personalized Instagram account on a tablet rather than on their phone, we may have underestimated the degree of flow and positive affect that people experience in everyday life where their phones are their "go-to" device. Contradicting this limitation, however, recall that some ($n = 23$) were allowed to use their phones to access their personal Instagram account due to problems with the Instagram server and that this subset of people did not differ in terms of their flow and positive affect than those using the tablet. Still, in terms of ecological validity, it may have been preferable to record flow and positive affect while people were using their familiar personal phones. Indeed, 83% of American users use Instagram on mobile devices (i.e., smartphones, not tablets) [35].

Second, the specific model of the tablet was an Android tablet released in 2015 which caused very small but noticeable delays while scrolling on Instagram. Had a newer model or an iOS device been used, the scrolling feature could have been smoother and more seamless to mimic the speed of scrolling on a mobile device. Third, in this study we chose to compare users' personal

Instagram accounts to a lab-created Instagram account that had been engaged with by 30 unique users prior to the study, such that the algorithm is not able to tailor content to one specific individual. Although we were able to show significant differences between the two Instagram conditions, it may raise concerns for ecological validity since the lab-created account is not “real” (i.e., it was not personalized to anyone in particular), and participants were for ethical reasons precluded from accessing any questionable (not safe for work) content. It is possible that a yoked control design where two participants engage with either their own account, versus another’s “real” account might yield stronger differences in flow and positive affect. However, such a design would raise issues regarding ethics and privacy, and/or risk of individuals changing the algorithms on the other person’s account. Finally, we did not consider gender differences in our analyses. The majority of our sample identified as women ($n = 80$ of 114) and research suggests that depression is twice as prevalent among women than men [36,37]. Thus, our findings concerning depression and its relation to flow may have been unduly influenced by our overrepresentation of women in this sample.

5. Conclusion

Despite the aforementioned limitations, the current research fills a literature gap on Instagram use, flow, and depression. We have shown how Instagram is able to induce flow, and specifically, higher levels of flow and positive affect when content is personalized to individual users compared to using a more generalized feed. Our findings objectively show that the algorithms used by Instagram are highly effective because they are associated with greater absorption and positive affect than accounts tailored to a more general audience. As a result, the platform may have unintentionally created a maladaptive coping mechanism for users with depression. We have also shown how escape motivations for using Instagram may be particularly problematic in terms of triggering addictive-like problems for this platform. Future research should look towards replicating these findings using Instagram and extending it onto social media platforms like TikTok which also tailors its content to users in the “For You Page” [38].

Taken together, we provide evidence for how Instagram can be used to maladaptively cope with depression by elevating mood. For individuals that experience low moods in their everyday life due to depression, the attention-capturing elements of Instagram may rein in attention that would otherwise tend to ruminate over depressive thoughts. Instead, going on Instagram leads to flow-induced positive mood elevation. Unfortunately, using Instagram to elevate mood is maladaptive, since the flow state that elevates affect also causes time distortion, the subsequent spending of more time on devices than intended, and neglecting important social supports [10]. Ultimately, users may find the very thing that alleviates depression, may actually cause them to have more to be depressed about, creating a downward spiral of depression, and Instagram over-use to alleviate this depression, and an increase in subsequent depression due to the neglect of social supports – in

other words, the perpetuation of a vicious cycle of usage [39–43].

Data Availability Statement

Our data and statistical code can be found on the Open Science Framework (OSF; <https://tinyurl.com/ybtsupyw>).

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