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Predicting tendencies towards the disordered use of Facebook's social media platforms: On the role of personality, impulsivity, and social anxiety

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ABSTRACT

The present study aimed at investigating personality underpinnings of Social Networks Use Disorder. Instead of focusing on social media in broad or on a single platform, specifically, it was focused on various social media platforms, namely, Facebook, WhatsApp, and Instagram, each offering different functions to their users.

$N = 494$ ($n = 358$ males) participants filled in questionnaires on the Big Five of personality, impulsivity, and social anxiety. Additionally, participants who endorsed using Facebook, and/or WhatsApp, and/or Instagram also completed scales assessing tendencies towards Facebook, and/or WhatsApp, and/or Instagram Use Disorder.

Generalized linear models revealed that impulsivity and especially extraversion were positively associated with Facebook, WhatsApp, and Instagram Use Disorder scores. Conscientiousness (negatively) and particularly neuroticism (positively) were only significantly related to Facebook Use Disorder scores. However, the non-significant associations of WhatsApp and Instagram Use Disorder scores with neuroticism were most likely due to neuroticism's overlap with impulsivity and social anxiety.

In conclusion, the present study provides insights into potential common and distinct predisposing factors for the development of Use Disorders of various social media platforms providing different content and functions to their users. Future studies should aim at causally investigating why different platforms are addictive to people with distinct personality profiles.

1. Introduction

Internet Use Disorder (IUD) represents a heavily researched topic in the last decade (searching for ""Internet use disorder" OR "Internet addiction"" in Google scholar leads to around 17,300 publications within 2009–2019 [08.11.2019]). However, the actual nature of IUD(s) is still a matter of debate and aside from Gaming Disorder, IUD is not officially recognized in the International Classification of Diseases 11th Revision (ICD-11) or the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (Montag et al., 2019b; American Psychiatric Association, 2013; World Health Origanization, 2019). Next to unspecified IUD, researchers emphasize the importance of investigating specific forms of IUD, such as Internet Communication Disorder, recently coined Social Networks Use Disorder (SNUD) (Brand et al., 2016; Montag et al., 2015a, 2019b; Starcevic and Aboujaoude, 2017). Among others, Internet communication can take place via social media platforms, by means of text and voice messages, comments, pictures, or videos (Wegmann et al., 2018). The term "Disorder" is used in line with the terminology of "Gaming Disorder" in the ICD-11 and should draw attention to the fact that SNUD does not only deal with time-consuming use of social networks but also includes specific symptoms and negative consequences due to the excessive use (Montag et al., 2019b; Pontes et al., 2015). Therefore, SNUD can be defined as disordered use of Internet communication tools, such as social media platforms, and symptoms such as salience, tolerance, mood modification, withdrawal, conflict, and relapse, as well as problems or negative consequences on one's life are discussed (Andreassen, 2015; Griffiths et al., 2014). As such, SNUD can be seen as the extreme pole on a dimension from no/normal via problematic to disordered social media use. It needs to be noted, though, that it is hotly debated among researchers to what extent the application of traditional substance-related criteria to modern addictive behaviors is appropriate (Kardefelt-Winther et al., 2017). But given the increasing impact of digitalization and online communication on today's society, SNUD must be treated as an important topic, especially because it has already been associated with, for example, depression symptoms (Shensa et al., 2017). Therefore, the present study aimed at investigating personality related underpinnings of SNUD with a focus on different social media platforms.

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In order to assess SNUD, researchers primarily developed self-report scales assessing either overall social media / social networks or Facebook Use Disorder, specifically (see overview in Andreassen (2015), and Andreassen, Pallesen and Griffiths (2017) and van den Eijnden, Lemmens and Valkenburg (2016)). Scales assessing tendencies towards the disordered use of other social media platforms are scarce. Consecutively, most research focuses either on social media / social networks in broad terms or on Facebook, specifically (Atroszko et al., 2018; Blackwell, Leaman, Tramposch, Osborne, & Liss, 2017; Burnell & Kuther, 2016; Casale & Fioravanti, 2015; Elphinston & Noller, 2011; Moreau, Laconi, Delfour, & Chabrol, 2015). The strong research focus on Facebook is reasonable as it still represents the most important platform in terms of user numbers with currently about 2.3 billion users (Datareportal, 2019). Nevertheless, other platforms such as Instagram have gained influence over the last years (Perrin and Anderson, 2019). Also, administrating self-report scales assessing Use Disorders across social media platforms might yield biased results, because the platforms differ in what content and functions they offer to their users; therefore, most likely also with respect to their addictive potential.

Against this background, the present study focused on three very different social media platforms, namely, Facebook, WhatsApp, and Instagram (a thorough explanation and separation of social media, social networking sites, instant messaging, and smartphone applications as well as their overlaps and associations is not in the scope of the present work; we focus on social media in broad (see also Carr and Hayes, 2015; Howard and Parks, 2012)). These platforms are all owned by Facebook, Inc., located in Menlo Park, CA, USA (https://help.instagram.com/581066165581870; https://www.facebook.com/help/111814505650678/; https://www.whatsapp.com/about/). Therefore, it is likely that Facebook, Inc., develops and maintains their social media platforms in similar ways. In detail, the reward structures to keep users on the platforms might be similar. The current user numbers of the three platforms are 2.3, 1.5, and 1.0 billion (Facebook, WhatsApp, Instagram), strongly underlyning Facebook's dominant position on the social media market and giving way to the rationale of the present study (Datareportal, 2019). Next to the communalities, each of the three platforms offers a different set of functions to users. As such, on Facebook itself users can join groups, subscribe to news outlets (via Facebook's news feed), sell and buy products (via the marketplace), or share and read messages, videos, pictures, and status messages with / of others, to name but a few (https://www.facebook.com/help). The messenger platform WhatsApp offers the opportunity to send and receive text and voice messages, emoticons, gifs, photos, videos, documents, and locations, as well as voice and video calls (https://www.whatsapp.com/features/). Moreover, users can share status messages with their contacts. Instagram is a picture- and video- based social media platform. It offers various kinds of filters to edit pictures before uploading them. Also, Instagram offers the opportunity to upload or watch picture- and video-based status messages (https://help.instagram.com/).

Given the commonalities but also differences between these three platforms, it is of great interest to investigate whether they differ in terms of their addictive nature. One line of research to understand disordered use of social media platforms stems from personality psychology. Personality describes rather time stable characteristics of a person in the realm of motivation, emotion, and cognition (Montag and Panksepp, 2017) and is discussed to be of high relevance for the development of IUD(s) (Montag and Reuter, 2017). According to the Interaction of Person-Affect-Cognition-Execution (I-PACE) model, personality constitutes one of the core characteristics of a person influencing the development of specific IUDs, such as SNUD (Brand et al., 2016). One personality trait explicitly highlighted in the model is (low) conscientiousness. This trait is one of the Big Five personality traits and describes individuals who are punctual, diligent, and reliable (John et al., 1991). Oftentimes scores in conscientiousness have been negatively associated with measures of SNUD, which might be explained by less priority given to duties, and/or higher procrastination in people scoring low in conscientiousness (Andreassen et al., 2012; Lee et al., 2006). Moreover, positive associations of SNUD measures with neuroticism, and oftentimes extraversion of the Big Five have been observed. With respect to the remaining Big Five dimensions (agreeableness, openness), results seem less striking. Moreover, we also explicitly mention that contradictory findings have been reported (Andreassen et al., 2013, 2012; Atroszko et al., 2018; Blackwell et al., 2017; Bodroža & Jovanović, 2016; Kircaburun, Alhabash, Tosuntaş, & Griffiths, 2018; Kircaburun & Griffiths, 2018; Sindermann et al., under review; Tang, Chen, Yang, Chung, & Lee, 2016; Wilson, Fornasier, & White, 2010). Such conflicting evidence can be explained by different inventories used to assess both personality and SNUD, but clearly might also be due to the different nature of different social media platforms.

Next to the Big Five, also high impulsivity is a personality trait linked to higher tendencies towards specific IUDs in the I-PACE model (Brand et al., 2016). In line with this, empirical research shows that impulsivity is positively linked to measures of SNUD as well as Facebook intensity (Burnell and Kuther, 2016; Gerson et al., 2016; Rothen et al., 2018; Savci and Aysan, 2016; Wu et al., 2013). Of importance, impulsivity has also been linked to various kinds of other addictive behaviors and substance use (Coskunpinar, Dir, & Cyders, 2013; Lee et al., 2012; Peterka-Bonetta, Sindermann, Elhai, & Montag, 2019; Walther, Morgenstern, & Hanewinkel, 2012).

Finally, social anxiety also constitutes a person's core characteristic predicting specific IUDs according to the I-PACE model (Brand et al., 2016). It is a clinical phenomenon but can also be assessed in non-clinical samples. As such, social anxiety has already been positively linked to measures of SNUD (Bodroža and Jovanović, 2016; Casale and Fioravanti, 2015; Dempsey et al., 2019; Lee-Won et al., 2015; Wegmann et al., 2015). Face-to-face interactions causing stress for individuals with high social anxiety might be circumnavigated by communicating via social media ultimately resulting in higher tendencies towards SNUD (see also links between autistic traits and IUD (Romano et al., 2014)).

To our knowledge no studies exist, which investigate the variables of the Big Five, social anxiety, and impulsivity in the context of all Facebook owned platforms in one study. As these platforms partly differ in what they offer to their users, we believe that it is of significant interest to investigate how person characteristics are associated with the disordered use of the different platforms. We nevertheless expect tendencies towards Use Disorders of each platform to be associated with lower conscientiousness, higher neuroticism, higher impulsivity, and higher social anxiety. However, given the different functions offered by each platform, we were also interested in carving out potential differences with respect to the aforementioned associations.

2. Methods

2.1. Procedure

The present study was implemented as an online survey in English. Advertisements were placed offline as well as online and cross-nationally (e.g. the link was presented alongside interviews with the authors online). Every individual with access to the Internet, who was at least 12 years old (given parent/legal guardian consent) and who was able to read and understand English could participate (both prequisites were mentioned as inclusion criteria prior to participation). As an incentive for filling in the survey questionnaires, among others participants received feedback on their personality. The study was conducted in line with the latest revision of the declaration of Helsinki and approved by the local ethics committee at Ulm University, Ulm, Germany. All participants provided informed digital consent prior to participation.

2.2. Sample

A total of $N = 515$ participants provided data for the present study. After data cleaning (see Supplementary Material) a final sample size of $N = 494$ participants ($n = 358$ males, $n = 136$ females) remained. The mean age of the sample is $M = 24.72$ years ($SD = 8.08$), the median age is 23 years (25% quantile: 19 years, 75% quantile: 29 years), and the age range is 12–55 years. Most participants reported being from France ($n = 104$), followed by Poland ($n = 38$), Spain ($n = 33$), and Austria ($n = 31$). Out of the $N = 494$ participants, $n = 50$ reported not using Facebook, WhatsApp, or Instagram. Hence, final analyses on SNUDs rely on the subsamples of $N = 444$ participants ($n = 314$ males, $n = 130$ females) (see Supplementary Fig. 1. for the distribution of users across different platforms).

2.3. Self-report measures

2.3.1. Facebook, WhatsApp, and Instagram Use Disorder

If participants reported having a Facebook account, they were further asked to complete a Facebook Use Disorder scale based on the 10-item Smartphone Addiction Scale - Short Version (SAS-SV). The word smartphone was replaced with the term Facebook. Items were answered on a 6-point Likert–scale ranging from 1 = "Strongly disagree" to 6 = "Strongly agree". The same questionnaire was already used by Sha, Sariyska, Riedl, Lachmann, and Montag (2019) and also Sindermann et al. (under review) in the German language. Internal consistency of this scale assessed using Cronbach's alpha is alpha = 0.91 in the present sample of Facebook users ($n = 247$ males, $n = 108$ females).

Reworded versions of the SAS-SV (Kwon et al., 2013) were also applied to measure WhatsApp and Instagram Use Disorder in participants reporting to use WhatsApp or to have an Instagram account, respectively. The internal consistencies of these scales are alpha = 0.92 (WhatsApp; $n = 207$ males, $n = 94$ females) and alpha = 0.91 (Instagram; $n = 177$ males, $n = 109$ females).

Please note that we also assessed tendencies towards Snapchat Use Disorder for another research project. Data on this platform will not be presented given the focus on the Facebook owned platforms.

2.3.2. Big Five Inventory

Participants completed the original (English) Big Five Inventory (BFI) (John et al., 1991). This questionnaire comprises 44 items, answered on a 5-point Likert-scale, which ranges from 1 = "Disagree strongly" to 5 = "Agree strongly". Scores of the five broad factors, as well as two subscales for each of the broad factors can be calculated. In the current work we will focus on the broad factors. Internal consistencies for the five scales are: openness: alpha = 0.76, conscientiousness: alpha = 0.80, extraversion: alpha = 0.84, agreeableness: alpha = 0.75, neuroticism: alpha = 0.85.

2.3.3. Barratt Impulsiveness Scale – 15

Participants answered the 15-item Barratt Impulsiveness Scale–15 (BIS-15) (Spinella, 2007). This self-report measure comprises one total and three subscales. In the present work the total scale is of interest. The items are answered on a 4-point Likert–scale from 1 = "Rarely/never" to 4 = "Almost always/always". The internal consistency of the total scale is alpha = 0.80.

2.3.4. Interaction Anxiousness Scale

To assess social anxiety, the Interaction Anxiousness Scale (IAS) (Leary, 1983) was used. The scale comprises 15 items answered on a 5-point Likert–scale ranging from 1 = "Not at all characteristic of me" to 5 = "Extremely characteristic of me". The internal consistency of this scale in the present sample is alpha = 0.88.

2.4. Statistical analyses

Data cleaning and all statistical analyses were implemented in R version 3.5.2 (R Core Team, 2018), R studio version 1.1.463 (RStudio Team, 2015), and several R-packages including car (Fox and Weisberg, 2011), DescTools (ASem, 2019), dplyr (Wickham et al., 2019b), Hmisc (Harrell and with contributions from Charles Dupont and many others, 2019), lsr (Navarro, 2015), ppcor (Kim, 2015), psych (Revelle, 2018), readxl (Wickham et al., 2019a), reshape2 (Wickham, 2007).

Descriptive statistics, associations with age, and gender differences in all variables were investigated and are presented in the Supplementary Material alongside Spearman correlations between the Use Disorder scores and personality.

To investigate Facebook, WhatsApp, and Instagram Use Disorder scores, generalized linear models were conducted. In detail, we opted for gamma models with a log link function given the right skewed distribution, positive only scores, and heteroscedasticity of the Facebook, WhatsApp, and Instagram Use Disorder scores. In more detail, for each of the scales assessing one Use Disorder, three models were calculated. The first model included age and gender (block 1) (see significant results in the Supplementary Material). The second model included age and gender (block 1), and added the Big Five, BIS-15, and IAS scales (block 2). The third model included block 1 and 2 variables, and the interaction effects of gender with each Big Five scale, with the BIS-15, and with the IAS (block 3).

3. Results

For the generalized linear models (gamma models with log link function) on tendencies toward Facebook, WhatsApp, and Instagram Use Disorder, the second models (including block 1 and 2 variables) showed the lowest Akaike Information Criterion (AIC) (Facebook: $\Delta AIC_{model1\text{-}model2} = 75.46$, $\Delta AIC_{model3\text{-}model2} = 6.52$; WhatsApp: $\Delta AIC_{model1\text{-}model2} = 17.02$, $\Delta AIC_{model3\text{-}model2} = 4.64$; Instagram: $\Delta AIC_{model1\text{-}model2} = 24.21$, $\Delta AIC_{model3\text{-}model2} = 0.86$). In detail, most ΔAICs were above 10, indicating that except the second models, no other model had empirical support. Some ΔAICs lied between 4 and 7, therefore, the respective models had considerably less support than the respective second model. Only the ΔAIC of model 3 versus 2 of Instagram Use Disorder was below 2 and, therefore, model 3 had empirical support (Burnham and Anderson, 2016). However, analyses of deviances indicated that the second models were significantly better fitting than the first models, but the third models were not significantly better fitting than the second models (see note under Table 1). Therefore, to investigate tendencies towards Facebook, WhatsApp, and Instagram Use Disorder, the second models (including block 1 (age, gender) and block 2 (Big Five, BIS-15, and IAS scales) variables) are presented in Table 1.

As can be seen in Table 1, age is significantly linked to tendencies towards all three Use Disorders. Whereas age is positively associated with Facebook Use Disorder, it is negatively related to WhatsApp and Instagram Use Disorder. Female gender is associated with higher scores in WhatsApp and Instagram Use Disorder. Conscientiousness is negatively related only to tendencies towards Facebook Use Disorder, whereas extraversion is positively linked to tendencies towards each of the three Use Disorders. Neuroticism is positively associated with tendencies towards Facebook Use Disorder, only. Whereas the BIS-15 is positively related to all Use Disorder scores, the IAS is not significantly linked to any of the scores.

Of note, when manually applying strict Bonferroni correction (i.e., alpha = 0.05/3 = 0.0167; because three generalized linear models were calculated), not all associations would remain significant. Of the associations with personality, only the ones of Facebook Use Disorder with extraversion and neuroticism and the ones of WhatsApp and Instagram Use Disorders with extraversion remain significant.

Table 1
Generalized linear models investigating tendencies towards Facebook, WhatsApp, and Instagram Use Disorder.

	Facebook (n = 355)				WhatsApp (n = 301)				Instagram (n = 286)			
	Model 2: McFadden R^2 = 0.13				Model 2: McFadden R^2 = 0.10				Model 2: McFadden R^2 = 0.13			
	B	*SE*	*t*	*p*	*B*	*SE*	*t*	*p*	*B*	*SE*	*t*	*p*
	0.51	0.03	17.37	<.001	0.50	0.03	14.65	<.001	0.46	0.03	13.04	<.001
Age	0.06	0.03	2.33	.021	-0.07	0.03	-2.42	.016	-0.13	0.03	-4.13	<.001
Gender	0.04	0.06	0.77	.439	0.23	0.06	3.63	<.001	0.27	0.06	4.32	<.001
Openness	-0.01	0.03	-0.38	.702	-0.01	0.03	-0.19	.847	0.02	0.03	0.57	.570
Conscientiousness	-0.07	0.03	-2.12	.035	-0.00	0.04	-0.05	.964	-0.00	0.04	-0.03	.976
Extraversion	0.14	0.03	3.93	<.001	0.11	0.04	2.67	<.008	0.15	0.04	3.64	<.001
Agreeableness	-0.01	0.03	-0.23	.818	-0.04	0.03	-1.23	.221	-0.03	0.03	-0.79	.431
Neuroticism	0.11	0.03	3.56	<.001	0.03	0.04	0.83	.405	0.05	0.04	1.39	.167
BIS-15	0.08	0.04	2.20	.028	0.08	0.04	2.03	.044	0.08	0.04	2.15	.033
IAS	0.04	0.04	1.09	.274	0.06	0.04	1.39	.165	0.05	0.04	1.25	.214

Note: BIS-15 = total Barratt Impulsiveness Scale–15; IAS = Interaction Anxiousness Scale; *B* = Coefficient (not standardized). Formula (R): glm(Use Disorder score ~ age + gender + Openness + Conscientiousness + Extraversion + Agreeableness + Neuroticism + BIS-15 + IAS, family = Gamma(link = "log")). All parameters except gender (and the Use Disorder scores) were z-standardized; gender was dummy-coded with 0 = male and 1 = female. Analyses of deviances (by means of ANOVA using the *F*-statistic): Facebook model 1 vs. model 2: $F(7,345) = 12.19$, $p < .001$ (McFadden R^2 = 0.01 vs. 0.13), model 2 vs. model 3: $F(7,338) = 0.90$, $p = .507$ (McFadden R^2 = 0.13 vs. 0.13); WhatsApp model 1 vs. model 2: $F(7,291) = 3.84$, $p < .001$ (McFadden R^2 = 0.06 vs. 0.10), model 2 vs. model 3: $F(7,284) = 1.10$, $p = .366$ (McFadden R^2 = 0.10 vs. 0.11); Instagram: $F(7,276) = 4.94$, $p < .001$ (McFadden R^2 = 0.08 vs. 0.13), model 2 vs. model 3: $F(7,269) = 1.62$, $p = .130$ (McFadden R^2 = 0.13 vs. 0.15); models 1 and 3 are, therefore, not shown in this table.

4. Discussion

The present study investigated personality related underpinnings of tendencies towards Facebook, WhatsApp, and Instagram Use Disorder. Results showed that extraversion and impulsivity were significantly positively associated with tendencies towards each Use Disorder under investigation. Conscientiousness (negatively) and neuroticism (positively) were only related to tendencies towards Facebook Use Disorder.

The results regarding extraversion are in line with several other studies reporting positive associations of this trait with various measures of SNUD (Andreassen et al., 2012; Atroszko et al., 2018; Wilson et al., 2010). Extraversion is defined as being socially active, talkative, and assertive (John et al., 1991). Therefore, it seems plausible that this trait is positively associated with the use of various social media platforms, all of which offer the opportunity to communicate with others and express oneself. This is underlined by research showing that extraversion is most strongly related to the number of friends on a social media platform as compared to other social media activities (Liu and Campbell, 2017) and research showing that online social relationships explain most of the variance in Facebook Use Disorder scores (Tang et al., 2016) (although extraversion was not significantly associated with Facebook Use Disorder scores in the study by Tang et al. (2016)).

Also, the results regarding impulsivity and its positive link to all Use Disorders under investigation are supported by the findings of other studies (Burnell and Kuther, 2016; Rothen et al., 2018; Savci and Aysan, 2016; Wu et al., 2013). These findings underline the importance of impulsivity as a factor associated with various behavioral addictions (for example Internet and Smartphone Use Disorder (Peterka–Bonetta et al., 2019), Internet Use Disorder and gambling addiction (Lee et al., 2012)). The items of the BIS-15 assess motor, non-planning, and attention impulsiveness (Spinella, 2007). In a study by Rothen and colleagues (2018), among others the lack of perseverance scale, which is similar to the attention impulsiveness items of the BIS-15, was associated with problematic Facebook use. In line with the argumentation of the authors, impulsivity might be linked to SNUD due to attentional fluctuation, i.e. people engage in social media when losing attention to another task (Rothen et al., 2018).

The fact that both – extraversion and impulsivity – are positively associated with Facebook, WhatsApp, and Instagram Use Disorder scores underlines their importance in explaining the disordered use of social media platforms independently of specific functions offered by the platforms. Moreover, these similarities in the associations between each Use Disorder and personality might also explain part of the correlations between Facebook, WhatsApp, and Instagram Use Disorder presented in the Supplementary Material. Nevertheless, especially the associations with impulsivity need further investigation and replication given the non-significance of the findings after applying strict Bonferroni correction for multiple testing.

Next to common underpinnings, conscientiousness and neuroticism were only significantly associated with Facebook Use Disorder scores. In several other studies, these two factors were strongly associated with measures of Social Media Use Disorders, including Instagram Use Disorder (Andreassen et al., 2013, 2012; Blackwell et al., 2017; Bodroža and Jovanović, 2016; Kircaburun et al., 2018; Kircaburun and Griffiths, 2018; Sindermann et al., under review; Tang et al., 2016; Wilson et al., 2010). In line with this and aside from the generalized linear models, the Spearman correlations of neuroticism with WhatsApp and Instagram Use Disorder scores presented in the Supplementary Material were significantly positive. Therefore, the non-significant findings in the generalized linear models might be due to the overlap with other variables, such as impulsivity and social anxiety. Additionally, regarding conscientiousness and WhatsApp Use Disorder a non-significant association might be explained by the fact that WhatsApp is used also for work purposes (Yougov (2017) as cited in Statista (2017)). Therefore, highly conscientious individuals might use WhatsApp to respond to colleagues quickly. Accordingly, highly conscientious people might not experience symptoms of overuse, because they do not experience the excessive use of WhatsApp and its consequences as overtly negative. Nevertheless, it is important to consider results of a study reporting that the actual time spent on WhatsApp (tracked by a smartphone application) was negatively associated with conscientiousness (Montag et al., 2015b). However, there are marked differences between the time spent on a platform and a Use Disorder: The latter one (which was investigated in the present study) focuses on the adverse symptoms associated with the excessive use (Griffiths et al., 2014). Lastly, it again needs to be noted that the association between Facebook Use Disorder and conscientiousness in the generalized linear model would not survive the strict manually applied Bonferroni correction. Nevertheless, also the bivariate correlation of conscientiousness with Facebook Use Disorder is higher than its correlation with WhatsApp and Instagram Use Disorder ($rho_p = -0.22$ vs. $rho_p = -0.10$ vs. $rho_p = -0.11$; see Supplementary Material).

Finally, it is well known that social media platforms use various

mechanisms to prolong the time users spend on the platform, ultimately promoting development of a Use Disorder (Montag et al., 2019a). On the one hand, extraversion and impulsivity as well as neuroticism and (low) conscientiousness might amplify the risk to develop an addictive behavior towards (specific) social media platforms per se. On the other hand, it is also likely that certain personality characteristics increase the susceptibility to the aforementioned mechanisms. For example, each of the social media platforms under investigation makes use of so-called push notifications, which appear on screen (e.g. of the smartphone) to inform the user of an informational update, or that something "has happened" on the platform when the user is not on the platform. Being able to ignore such messages is potentially negatively associated with impulsivity, hence, involving self-regulation abilities (see also results on positive associations between boredom proneness, which, in turn, is positively associated with impulsivity, and frequency of disrupted daily activities from interruptive notifications (Elhai et al., 2019; Watt and Vodanovich, 1992)). Such built-in elements on social media platforms might drive the link between impulsivity and time spent on social media platforms, and ultimately SNUD (note that push notifications are not explicitly mentioned by Montag et al. (2019a)). In our view, the investigation of person characteristics and response to/interaction with different features of social media platforms (such as push notifications) will be important to shed light on why different personality traits are associated with the Use Disorder of social media platforms.

Some limitations of the present study need to be addressed. First of all, the SNUD scores in the present samples were rather low indicating that most participants did not show disordered use of Facebook, WhatsApp or Instagram. Moreover, the gender distribution was skewed with more males than females participating in the present work. Statistics show that more social media users are males than females (especially between the ages of 18 and 34 years (Datareportal, 2019) (user statistics from Germany: NapleonCat (2019a, 2019b, 2019c)). However, research also indicates that females tend to use social media more frequently and longer than males do (eMarketer, 2015; Montag et al., 2015b; Morning Consult, 2018). As mentioned above, the time-consuming use taken as a standalone variable does not reflect SNUD (but clearly the disordered use is linked to longer time spent on social media). Nevertheless, the different social media use patterns in males and females underline that the skewed gender distribution is a limitation of the present study. Moreover, half of the participants were between 19 and 29 years old. Therefore, the generalizability of the present results to older samples as well as to adolescents needs to be further investigated in future studies. Next, in the present study we intentionally focused on social media platforms owned by Facebook, Inc., given Facebook's market power and the communalities and differences of the platforms. However, also other platforms exist, which again offer different functions and, therefore, might differ from the Facebook owned platforms in turn of their addictive potential. Additionally, n = 165 participants used each of the platforms under investigation (see Supplementary Material). Therefore, it is likely that these individuals also use the platforms in cohesion (e.g. posting content from one platform on another one). This might have led to higher correlations between the Use Disorders in the present study (and more similar associations with personality) as compared to the true underlying correlations. Therefore, future studies should take the cohesive use of social media platforms into account. Lastly, the present cross-sectional study design does not allow for a causal interpretation of the results. However, in line with the I-PACE model and because personality can empirically be viewed as rather time stable construct, personality might indeed be a predisposing factor to develop a SNUD (Brand et al., 2016; Edmonds et al., 2008).

In conclusion, the present study extends previous literature by investigating the personality related underpinnings of SNUD with a focus on Facebook, WhatsApp, and Instagram. Tendencies towards each of these Use Disorders were linked to higher extraversion and to a lesser extent higher impulsivity. Conscientiousness (negatively) was only significantly related to tendencies towards Facebook Use Disorder. This difference in the potential predisposing factors of Facebook, WhatsApp, and Instagram Use Disorder scores underlines the importance of differentiating between various communication tools when investigating SNUD. Future studies should examine interaction effects of underlying personality predispositions and mechanisms of the platforms on the development of SNUD, in particular in light of what the different platforms offer to their users.

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Data availability

The dataset used for the present study is publicly available at https://osf.io/6mxwy/.

CRediT authorship contribution statement

Cornelia Sindermann: Conceptualization, Formal analysis, Writing - original draft, Writing - review & editing. **Jon D. Elhai:** Writing - review & editing. **Christian Montag:** Conceptualization, Data curation, Writing - review & editing.

Declaration of Competing Interest

Outside the scope of the present paper, Dr. Jon Elhai notes that he receives royalties for several books published on posttraumatic stress disorder (PTSD); is a paid, full-time faculty member at University of Toledo; is a paid, visiting scientist at Tianjin Normal University; occasionally serves as a paid, expert witness on PTSD legal cases; and receives grant research funding from the U.S. National Institutes of Health. Dr. Montag has received (to Ulm University and earlier University of Bonn) grants from the German Research Foundation (DFG) and the German Federal Ministry for Research and Education. Dr. Montag has performed grant reviews for several agencies; has edited journal sections and articles; has given academic lectures in clinical or scientific venues or companies; and has generated books or book chapters for publishers of mental health texts. For some of these activities he received royalties, but never from the gaming or social media industry. Finally, Dr. Montag mentions that he is part of a discussion circle debating ethical questions linked to social media, digitalization, and society/democracy at Facebook (Digitalität und Verantwortung: https://about.fb.com/de/news/h/gespraechskreis-digitalitaet-und-verantwortung/). In this context, he receives no salary for his activities from Facebook. All authors declare that they do not have any conflicting interests.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2020.112793.

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