Computers in Human Behavior 108 (2020) 106332

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: http://www.elsevier.com/locate/comphumbeh

Full length article

Less Facebook use – More well-being and a healthier lifestyle? An experimental intervention study

Julia Brailovskaia *, Fabienne Ströse, Holger Schillack, Jürgen Margraf

Mental Health Research and Treatment Center, Department of Psychology, Ruhr-Universität Bochum, Germany

ARTICLE INFO

Keywords:
Reduction of Facebook use
Facebook addiction disorder (FAD)
Subjective well-being
Physical activity
Smoking behavior

ABSTRACT

Use of the social platform Facebook belongs to daily life, but may impair subjective well-being. The present experimental study investigated the potential beneficial impact of reduction of daily Facebook use. Participants were Facebook users from Germany. While the experimental group (N = 140; $M_{age}(SD_{age})$ = 24.15 (5.06)) reduced its Facebook use for 20 min daily for two weeks, the control group (N = 146; $M_{age}(SD_{age})$ = 25.39 (6.69)) used Facebook as usual. Variables of Facebook use, life satisfaction, depressive symptoms, physical activity and smoking behavior were assessed via online surveys at five measurement time points (pre-measurement, day 0 = T1; between-measurement, day 7 = T2; post-measurement, day 15 = T3; follow-up 1, one month after post-measurement = T4; follow-up 2, three months after post-measurement = T5). The intervention reduced active and passive Facebook use, Facebook use intensity, and the level of Facebook Addiction Disorder. Life satisfaction significantly increased, and depressive symptoms significantly decreased. Moreover, frequency of physical activity such as jogging or cycling significantly increased, and number of daily smoked cigarettes decreased. Effects remained stable during follow-up (three months). Thus, less time spent on Facebook leads to more well-being and a healthier lifestyle.

1. Introduction

Young adults and adolescents today spent less time on face-to-face ("offline") interaction with peers than older generations. Instead they engage in extensive use of online media (Shensa et al., 2020; Twenge, Spitzburg, & Campbell, 2019). This, however, may negatively impact their subjective well-being (Lin et al., 2016; Marino, Gini, Vieno, & Spada, 2018; Primack et al., 2017). In a recent study, individuals who used online media more than 1 h daily reported lower levels of well-being than those who spent less time online (Twenge & Campbell, 2019).

Use of social networking sites (SNSs) belongs to the main online media activities (Brailovskaia & Margraf, 2018). With its over 2.4 billion members Facebook is currently the largest SNS (Roth, 2019). Currently existing longitudinal correlational studies point to a negative impact of Facebook use on well-being: For example, Kross et al. (2013) who measured participants' in-vivo behavior daily over a period of two weeks found Facebook use to predict decline in life satisfaction. Similar results were reported by Shakya and Christakis (2017) for the period of three years. In one of the few available experimental studies to date, Tromholt (2016) demonstrated that at least in the short run individuals who completely waived Facebook use for a one-week period had significantly higher levels of life satisfaction and positive mood than those who kept using Facebook as usual. The author concluded that "quitting Facebook leads to higher levels of both cognitive and affective well-being" (Tromholt, 2016, p. 665).

Even though – due to the lack of follow-up measurements – it is unclear how longstanding this positive effect on well-being remains, Tromholt's findings raised significant concerns about negative effects of Facebook use on subjective well-being and underscored the need of further experimental investigations including longitudinal measurements. The concerns were reinforced by research that demonstrated intensive Facebook use to contribute to the development of a pathological emotional bond to the SNS that is linked to an obsessive need to stay permanently online (Brailovskaia, Margraf, & Köllner, 2019; Brailovskaia, Rohmann, Bierhoff, & Margraf, 2018; Marino et al., 2018). This phenomenon was called Facebook Addiction Disorder (FAD; Fenichel, 2009) and defined by six characteristics/symptoms (Andreassen, Torsheim, Brunborg, & Pallesen, 2012) that were adopted from research on media-related behavioral addictions (e.g., computer or Internet game

* Corresponding author. Mental Health Research and Treatment Center of Ruhr-Universität Bochum, Massenbergstr. 9-13, 44787, Bochum, Germany.
E-mail address: Julia.Brailovskaia@rub.de (J. Brailovskaia).

https://doi.org/10.1016/j.chb.2020.106332
Received 22 November 2019; Received in revised form 2 March 2020; Accepted 3 March 2020
Available online 6 March 2020

playing, Griffiths, 2002): salience, tolerance, mood modification, relapse, withdrawal symptoms, conflict. FAD is positively associated with experience of daily stress, insomnia, depression and anxiety symptoms (Andreassen et al., 2012; Atroszko et al., 2018; Brailovskaia & Margraf, 2017; Brailovskaia et al., 2019; Koc & Gulyagci, 2013). In addition, physical activity such as jogging and swimming was negatively linked to FAD in a longitudinal study (Brailovskaia et al., 2018).

Based on evidence that emphasizes the potential negative impact of Facebook use, it seems highly desirable to understand how well-being of Facebook users can be protected. Therefore, the present study aimed to investigate the influence of controlled experimental reduction of daily time spent on Facebook (not a complete waiving) on subjective well-being and FAD over a longer period of time (up to three months). Many members use Facebook during leisure and at work, to communicate with family, friends and colleagues, and for searching information. It is conceivable that a complete quitting of Facebook for more than one week may negatively impact their social and/or working life and well-being. In contrast, we hypothesized that a reduction of the amount of daily Facebook use may have positive consequences for members' well-being, as they get more time to engage in offline activities without completely losing connection to the Facebook world.

In the study of Tromholt (2016), particularly individuals who intensively engaged in passive Facebook use – observation of Facebook activities of other members (e.g., browsing others' status updates) without directly interacting with them and without presenting own information (Verduyn, Ybarra, Résibois, Jonides, & Kross, 2017) – benefited from the one-week waiver. To investigate the generalizability of this finding for reduction of Facebook use time, we separately considered passive and active – engaging in direct interaction with other members and presentation of own information (e.g., positing status updates) (Verduyn et al., 2017) – Facebook use.

With regard to Facebook variables, we hypothesized that the reduction of daily time spent on Facebook is accompanied by a reduction of both active and passive Facebook use (Hypothesis 1a), as well as of Facebook use intensity/integration of Facebook use into daily life (Hypothesis 1 b). Because earlier research showed high amounts of Facebook use to contribute to the development of FAD (Brailovskaia, Rohmann, et al., 2018; Marino et al., 2018), we assumed that reduction of daily Facebook use time decreases the level of FAD (Hypothesis 1c).

Based on previous findings (Kross et al., 2013; Tromholt, 2016) and the dual-factor model of subjective well-being that emphasizes the importance of considering both positive and negative factors (Keyes, 2005), we expected the reduction to contribute to an increase of life satisfaction (Hypothesis 2a) and to a decrease of depressive symptoms (Hypothesis 2 b).

Less time on Facebook enables more time for offline activities. Therefore, we additionally investigated how the reduction influences (un)healthy lifestyle that is operationalized as physical activity (such as swimming, jogging, cycling) and smoking behavior. People often use Facebook to escape from daily stress, to find relief and to experience positive emotions (Brailovskaia, Rohmann, Bierhoff, Schillack, et al., 2019). The omission of this possibility might contribute to the use of alternative sources of positive experiences such as physical activity (Wunsch, Kasten, & Fuchs, 2017). Based on this reasoning, we expected to find an increase of the frequency of physical activity (Hypothesis 3). The link between Facebook use and smoking behavior remains inconclusive. On the one hand, more free time and less possibilities for positive experiences online might enhance smoking behavior that provides at least short-term satisfaction (Szrek, Chao, Ramlagan, & Peltzer, 2012). On the other hand, the expected positive effect of the reduction of daily time spent on Facebook on subjective well-being and on physical activity might also contribute to a reduction of smoking behavior. Therefore, a research question was formulated: How does the reduction of daily time spent on Facebook influence smoking behavior? (Research Question).

2. Materials and methods

2.1. Procedure

The current investigation was designed as a randomized controlled trial that included an experimental group (EG) and a control group (CG). Participants of the EG decreased their daily Facebook use time over a period of 14 days (= experimental manipulation), while participants of the CG maintained their usual Facebook use time.

To determine the reduction time of daily Facebook use for the EG, in the first step, over 20 studies available in 2017 (e.g., Pempek, Yermolayeva, & Calvert, 2009, p. 28 min; Sinclair & Grieve, 2017, p. 126 min) that explicitly measured daily Facebook use time (search in international databases like PsycINFO) were identified. In the second step, the mean of the reported time values that was about $M = 62$ min ($SD = 80$ min) was calculated. Considering the described concerns about a complete waving of Facebook use, a reduction of the daily Facebook use time of about 20 min – a third of this time – was chosen as experimental manipulation. Thus, members of the EG were advised to reduce the duration of their daily Facebook use for 20 min over 14 days.

Data of both groups were collected at five measurement time points via online surveys in German language. Measurements took place on the day prior to the beginning of the experimental manipulation (pre-measurement, day 0 = T1) to assess a baseline of the investigated variables, one week after the beginning of the manipulation (between-measurement, day 7 = T2), after the manipulation (post-measurement, day 15 = T3), one month (follow-up 1 = T4) and three months (follow-up 2 = T5) after post-measurement (see Fig. 1). This procedure enables an investigation of the short-term as well as the longer-term (up to three months) effect of the experimental manipulation of daily time spent on Facebook.

2.2. Participants

Data collection took place from November 2017 to May 2019. Facebook users were recruited by invitations to participate displayed at public places in Germany, at different German universities, and on Facebook. The requirement for participation, which was voluntary and compensated by course credits for students, was a current Facebook membership since at least three months and daily Facebook use of at least 25 min (to prevent a complete quitting of Facebook in the EG). Also, participants had to be at least 18 years old. All requirements were included in the invitation. The responsible Ethics Committee approved the implementation of the present study. Participants were fully informed about the study and provided informed consent to participate online. At the beginning of the first survey (pre-measurement), they were randomly assigned to one of the two groups. The same day, members of the EG received an e-mail including a concrete daily Facebook use time for the duration of the experimental manipulation (= daily Facebook use time indicated by the participant in pre-measurement – 20 min) and a Microsoft Word document ("Daily compliance-diary"). This document included a table where participants were asked to enter daily whether they had complied with the instruction of the experimental condition (0 = *no*, 1 = *yes*). If they answered "no", the reason for non-compliance was asked. After post-measurement, the diary was sent back by e-mail to the principal investigator. Compliance was assessed when participants reported to comply with the instruction for at least two thirds of the experimental period (= nine days). To prevent increased attention on Facebook use, the CG did not receive a compliance-diary.

Experimental Group. The EG consisted of 140 Facebook members (80.7% women; $M_{age}(SD_{age}) = 24.15$ (5.06), range: 18–51; occupation: 82.1% university students, 17.9% employees; marital status: 36.4% single, 57.9% in a relationship but not married, 5.7% married; all Caucasian). Analyses of the compliance-dairies revealed a compliance rate of 94.3% ($n = 132$). Following Tromholt (2016), the eight non-compliers were kept in the sample.

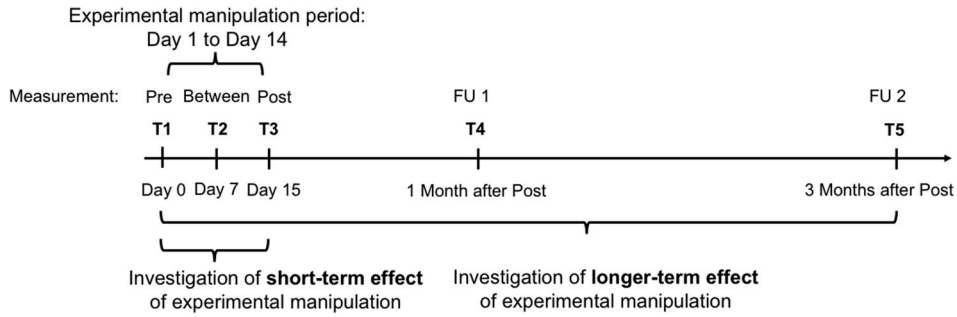

Fig. 1. Investigation timeline (pre-measurement, day 0 = T1; between-measurement, day 7 = T2; post-measurement, day 15 = T3; follow-up 1, one month after post-measurement = T4; follow-up 2, three months after post-measurement = T5).

Control Group. The CG included 146 Facebook members (74.7% women; $M_{age}(SD_{age})$ = 25.39 (6.69), range: 18–59; occupation: 76.7% university students, 23.3% employees; marital status: 34.9% single, 54.1% in a relationship but not married, 11% married; all Caucasian).

All participants met the study requirements. No participants were excluded.

Independent samples t-tests revealed no significant group differences considering demographic variables. A priori power analyses (G*Power program, version 3.1) indicated that a total sample size of $N = 122$ ($n = 61$ per group) was required for valid results (repeated measure analyses of variance (ANOVAs), within-between factor-design; power ≥ 0.80, $\alpha = 0.05$, effect size: $f = 0.10$; Mayr, Erdfelder, Buchner, & Faul, 2007).

2.3. Measures

2.3.1. Media use

Facebook use. Participants indicated duration of their membership on Facebook (in months). To assess the quantity of Facebook use, participants were asked about the duration of their daily use of the platform (in minutes; current mean test-retest reliability (r_{mtrr}, T1 to T5): EG: $r_{mtrr} = 0.44$, CG: $r_{mtrr} = 0.38$). Similar to Tromholt (2016), the quality of Facebook use was operationalized by ten items assessing frequency of active and of passive Facebook activities rated on a 5-point Likert scale (1 = *never*, 5 = *very often*): six items measured *active use* (posting status updates, positing pictures, commenting status updates, writing private messages, participation in conversations in discussion groups, playing games), four items assessed *passive use* (browsing status updates, browsing posted pictures, browsing profiles, reading private messages). To attain a composite index for both forms of Facebook use, respectively, the ratings of the six indicators of active use (current reliability: EG: Cronbach's $\alpha = 0.59$-0.67, $r_{mtrr} = 0.68$; CG: $\alpha = 0.63$-0.74, $r_{mtrr} = 0.66$) and of the four indicators of passive use (current reliability: EG: $\alpha = 0.71$-0.79, $r_{mtrr} = 0.63$; CG: $\alpha = 0.69$-0.78, $r_{mtrr} = 0.62$) were summed up. Intensity of Facebook use and its integration into daily life was measured with the Facebook Intensity Scale (FIS; original version: (Ellison, Steinfield, & Lampe, 2007; German version: Brailovskaia, Rohmann, et al., 2018) that consists of six items rated on a 5-point Likert scale (e.g., "Facebook is part of my everyday activity"; 1 = *disagree strongly*, 5 = *agree strongly*; current reliability: EG: $\alpha = 0.81$-0.84, $r_{mtrr} = 0.74$; CG: $\alpha = 0.73$-0.79, $r_{mtrr} = 0.68$).

Facebook Addiction Disorder (FAD). The level of FAD was measured with the brief version of the Bergen Facebook Addiction Scale (BFAS; original version: Andreassen et al., 2012; German version: Brailovskaia & Margraf, 2017). It includes six items (e.g., "Felt an urge to use Facebook more and more?") according to the six characteristics of FAD (i.e., salience, tolerance, mood modification, relapse, withdrawal, conflict). Items are rated on a 5-point Likert scale (1 = *very rarely*, 5 = *very often*; current reliability: EG: $\alpha = 0.84$-0.89, $r_{mtrr} = 0.59$; CG: $\alpha = 0.81$-0.86, $r_{mtrr} = 0.60$).

Additionally, frequency of general Internet use was rated on a 7-point Likert scale (1 = *very rarely*, 7 = *very often*; current reliability: EG: $r_{mtrr} = 0.33$, CG: $r_{mtrr} = 0.35$).

2.3.2. Subjective well-being

Life satisfaction. To assess global life satisfaction the Satisfaction with Life Scale (SWLS; original version: Diener, Emmons, Larsen, & Griffin, 1985; German version: Glaesmer, Grande, Braehler, & Roth, 2011) was included. This instrument consists of five items rated on a 7-point Likert scale (e.g., "In most ways, my life is close to my ideal"; 1 = *strongly disagree*, 7 = *strongly agree*; current reliability: EG: $\alpha = 0.87$-0.91, $r_{mtrr} = 0.75$; CG: $\alpha = 0.85$-0.88, $r_{mtrr} = 0.73$).

Depressive Symptoms. The depression subscale of the Depression Anxiety Stress Scales 21 (DASS-21; original version: Lovibond & Lovibond, 1995; German version: Nilges & Essau, 2015) measured depressive symptoms with seven items that are rated on a 4-point Likert scale (e.g., "I couldn't seem to experience any positive feeling at all"; 0 = *did not apply to me at all*; 3 = *applied to me very much or most of the time*; current reliability: EG: $\alpha = 0.90$-0.92, $r_{mtrr} = 0.67$; CG: $\alpha = 0.85$-0.88, $r_{mtrr} = 0.67$).

2.3.3. (Un)healthy lifestyle

Physical activity. Frequency of physical activity was assessed with the item "How frequently do you engage in physical exercise (e.g., swimming, cycling, jogging)?" rated on a 5-point Likert scale (1 = *never*, 5 = *four times a week and more*; current reliability: EG: $r_{mtrr} = 0.60$, CG: $r_{mtrr} = 0.67$). This brief instrument was previously shown to be a valid and reliable measure of physical activity (see Brailovskaia, Teismann, et al., 2018; Milton, Bull, & Bauman, 2011).

Smoking behavior. Participants were asked whether they regularly consume any tobacco products, such as cigarettes (0 = *no*, 1 = *yes*; current reliability: EG: $r_{mtrr} = 0.68$, CG: $r_{mtrr} = 0.78$). Those who indicated to consume tobacco products were asked how many of them they consumed daily (Brailovskaia et al., 2018; Szrek et al., 2012).

The time instructions (e.g., over the previous week, over the last month) of the questionnaires were adapted to the requirements of the individual surveys. For all used instruments higher scores indicated higher levels of the investigated variable. Investigated variables were assessed at all five measurement time points. Exceptions were duration of Facebook membership (only T1), duration of daily Facebook use and frequency of general Internet use (only T1, T4 and T5). Note that between T1 and T3, the duration of daily Facebook use of the EG was experimentally manipulated, while the CG should not focus on the usage time.

2.4. Statistical analysis

Statistical analyses were conducted with the Statistical Package for the Social Sciences (SPSS 24). There was no missing data. After descriptive analyses, repeated measure analyses of variance (ANOVAs; within-between factor-design) to test possible short-term and longer-term effects (up to five measurement time points) and to compare the two investigated groups (EG vs. CG) were calculated. For all variables

there was a violation of the assumption of sphericity (Mauchly's test). Therefore, the Greenhouse-Geisser correction (ε) was applied. Partial eta-squared (η^2_p) served as the effect-size measure of main effects and of interaction effects, Cohen's d was included as effect-size measure of post-hoc comparisons between groups, Cohen's $d_{Repeated\ Measures}$ (Morris, 2008) was used as effect-size measure of post-hoc comparisons within groups. Post-hoc comparisons were all Bonferroni-corrected (level of significance: $p < .05$, two-tailed).

3. Results

Table 1 summarizes descriptive statistics of the investigated variables in both groups at the different measurement time points. Mean duration of Facebook membership was *M(SD)* = 82.66 (26.74) months in the EG and *M(SD)* = 83.61 (25.71) months in the CG. Note, 23.6% (n = 33) of the members of the EG and 21.9% (n = 32) of the members of the CG regularly consumed tobacco products.

Fig. 2 (variables of media use) and Fig. 3 (variables of well-being and lifestyle) visualize results of the ANOVAs.

While Table 2 summarizes results of pairwise comparisons between both groups, results of comparisons within each group are presented in Table 3 and in Table 4.

Table 1
Descriptive statistics of investigated variables (T1 to T5).

	Group	T1	T2	T3	T4	T5
		M(SD)	M(SD)	M(SD)	M(SD)	M(SD)
Time on FB (in minutes)	Exp	56.14 (24.98)			35.66 (31.16)	32.21 (34.06)
	Con	56.27 (27.76)			56.05 (50.22)	52.11 (43.44)
Active FB use	Exp	12.72 (3.23)	11.92 (3.06)	11.64 (2.91)	11.77 (2.79)	11.49 (2.80)
	Con	12.82 (3.30)	12.08 (3.20)	11.62 (2.77)	11.99 (2.88)	12.02 (3.30)
Passive FB use	Exp	13.24 (3.09)	12.13 (3.00)	12.27 (3.11)	12.29 (3.17)	12.25 (2.96)
	Con	13.16 (3.05)	12.46 (3.00)	12.00 (3.27)	12.74 (3.15)	13.16 (2.76)
FB use intensity	Exp	2.62 (.83)	2.30 (.75)	2.14 (.78)	2.13 (.80)	2.06 (.80)
	Con	2.51 (.75)	2.38 (.74)	2.20 (.73)	2.26 (.71)	2.28 (.78)
FB Addiction Disorder	Exp	9.87 (4.32)	10.34 (4.38)	9.59 (4.13)	8.66 (3.51)	8.25 (3.41)
	Con	9.77 (3.92)	9.01 (3.92)	8.53 (3.28)	9.02 (3.64)	9.12 (3.68)
General Internet use	Exp	6.52 (.90)			6.33 (.94)	6.31 (1.00)
	Con	6.63 (.76)			6.42 (1.08)	6.49 (.82)
Life satisfaction	Exp	24.17 (5.71)	24.22 (6.14)	24.72 (6.45)	25.24 (6.42)	25.39 (6.06)
	Con	24.52 (5.43)	25.05 (5.63)	25.29 (5.36)	25.10 (5.83)	24.60 (5.92)
Depressive symptoms	Exp	5.21 (4.89)	4.69 (4.69)	4.32 (4.57)	4.02 (4.44)	3.99 (4.39)
	Con	4.84 (4.35)	4.07 (4.09)	4.45 (4.45)	4.24 (4.54)	4.79 (4.63)
Physical activity	Exp	3.21 (1.30)	3.31 (1.11)	3.44 (1.13)	3.59 (1.02)	3.63 (.96)
	Con	3.23 (1.12)	3.25 (1.11)	3.25 (1.11)	3.21 (1.24)	3.22 (1.13)
Smoking behavior	Exp	8.09 (10.15)	8.85 (10.05)	9.00 (7.58)	5.58 (7.67)	5.67 (7.54)
	Con	7.97 (6.02)	7.84 (6.41)	7.66 (7.03)	7.69 (6.31)	7.78 (6.27)

Notes. Experimental Group (Exp): N = 140, Control Group (Con): N = 146, exception: smoking behavior: Experimental Group: n = 33, Control Group: n = 32; T1 to T5 = measurement time points; M = Mean; SD = Standard Deviation; Min = Minimum; Max = Maximum; FB=Facebook; smoking behavior: number of daily used tobacco products.

For duration of daily Facebook use, the ANOVA revealed a significant main effect (F (1,940) = 19.171, $p < .001$, $\eta^2_p = .063$), and a significant interaction effect (F (1,940) = 12.089, $p < .001$, $\eta^2_p = .041$). While in the EG mean time spent daily on Facebook considerable decreased, it only slightly decreased between T4 and T5 in the CG (see Fig. 2a). Pairwise comparisons indicated significant differences between groups at T4 and T5 (both: EG < CG), and significant differences within the EG (T1>T4, T1>T5).

For active Facebook use, the ANOVA showed a significant main effect (F (3,493) = 18.653, $p < .001$, $\eta^2_p = .062$). The interaction effect did not become significant (F (3,493) = 0.990, p = .405). Fig. 2b shows a remarkable decrease of active Facebook use in both groups between T1 and T3. In the EG – after a slight increase between T3 and T4 – the use further decreased between T4 and T5. In the CG, the use increased between T3 and T5. While pairwise comparisons revealed no significant differences between both groups, a similar significant change pattern was found within both groups (both: T1>T2, T1>T3, T1>T4, T1>T5; see Table 3, Table 4).

Results of the ANOVA revealed a significant main effect (F (3,456) = 13.896, $p < .001$, $\eta^2_p = .047$), and a significant interaction effect (F (3,456) = 4.338, $p = .003$, $\eta^2_p = .015$) for passive Facebook use. In both groups, the initial level of passive Facebook decreased (see Fig. 2c). However, while in the EG the use remained on a similarly low level between T3 and T5 (after a slight enhancement between T2 and T3), it raised again between T3 and T5 in the CG. Pairwise comparisons indicated a significant difference between groups at T5 (EG < CG), as well as significant differences within both groups (EG: T1>T2, T1>T3, T1>T4, T1>T5; CG: T1>T2, T1>T3, T2<T5, T3<T4, T3<T5).

For intensity of Facebook use, the ANOVA revealed a significant main effect (F (3,233) = 49.003, $p < .001$, $\eta^2_p = .147$), and a significant interaction effect (F (3,233) = 6.166, $p < .001$, $\eta^2_p = .021$). In both groups, Facebook use intensity decreased between T1 and T3. While this decrease continued in the EG between T3 and T5, use intensity slightly enhanced between T3 and T5 in the CG (see Fig. 2d). Due to pairwise comparisons, there was a significant difference between groups at T5 (EG < CG) and significant differences within groups (both: T1>T2, T1>T3, T1>T4, T1>T5, T2>T3; additionally EG: T2>T4, T2>T5).

Results of the ANOVA that considered FAD showed a significant main effect (F (3,569) = 12.089, $p < .001$, $\eta^2_p = .041$), and a significant interaction effect (F (3,569) = 10.347, $p < .001$, $\eta^2_p = .035$). As presented in Fig. 2e, both groups showed opposed change pattern. In the EG, after a slight increase from T1 to T2, the FAD level continuously decreased from T2 to T5. In the CG, the FAD level first decreased up to T3 and then increased up to T5. Due to pairwise comparisons, there were significant differences between groups at T2 (EG > CG), T3 (EG > CG), and T5 (EG < CG). Also, significant differences within groups were found (EG: T1>T4, T1>T5, T2>T3, T2>T4, T2>T5, T3>T4, T3>T5; CG: T1>T3).

The ANOVA indicated a significant main effect (F (1,894) = 6.135, p = .003, $\eta^2_p = .021$), and a not significant interaction effect (F (1,894) = 0.256 p = .762) for general Internet use. As shown in Fig. 2f, there was a decrease of general Internet use between T1 and T5 in the EG. In the CG, after a decrease between T1 and T4, there was a slight increase of general Internet use between T4 and T5. However, pairwise comparisons between groups and within groups indicated no significant results.

Considering life satisfaction, the ANOVA showed a significant main effect (F (3,488) = 3.482, p = .011, $\eta^2_p = .012$), and a significant interaction effect (F (3,488) = 3.331, p = .014, $\eta^2_p = .012$). Fig. 3a shows that in the EG life satisfaction continuously increased between T1 and T5. In the CG, the change pattern of life satisfaction indicates a reversed u-shape (i.e., increase between T1 and T3, decrease almost to the initial level between T3 and T5). Pairwise comparisons indicated no significant differences between groups, and significant differences within the EG (T1<T5, T2<T4).

For depressive symptoms, the ANOVA revealed a significant main effect (F (3,708) = 5.051, p = .001, $\eta^2_p = .017$), and a significant

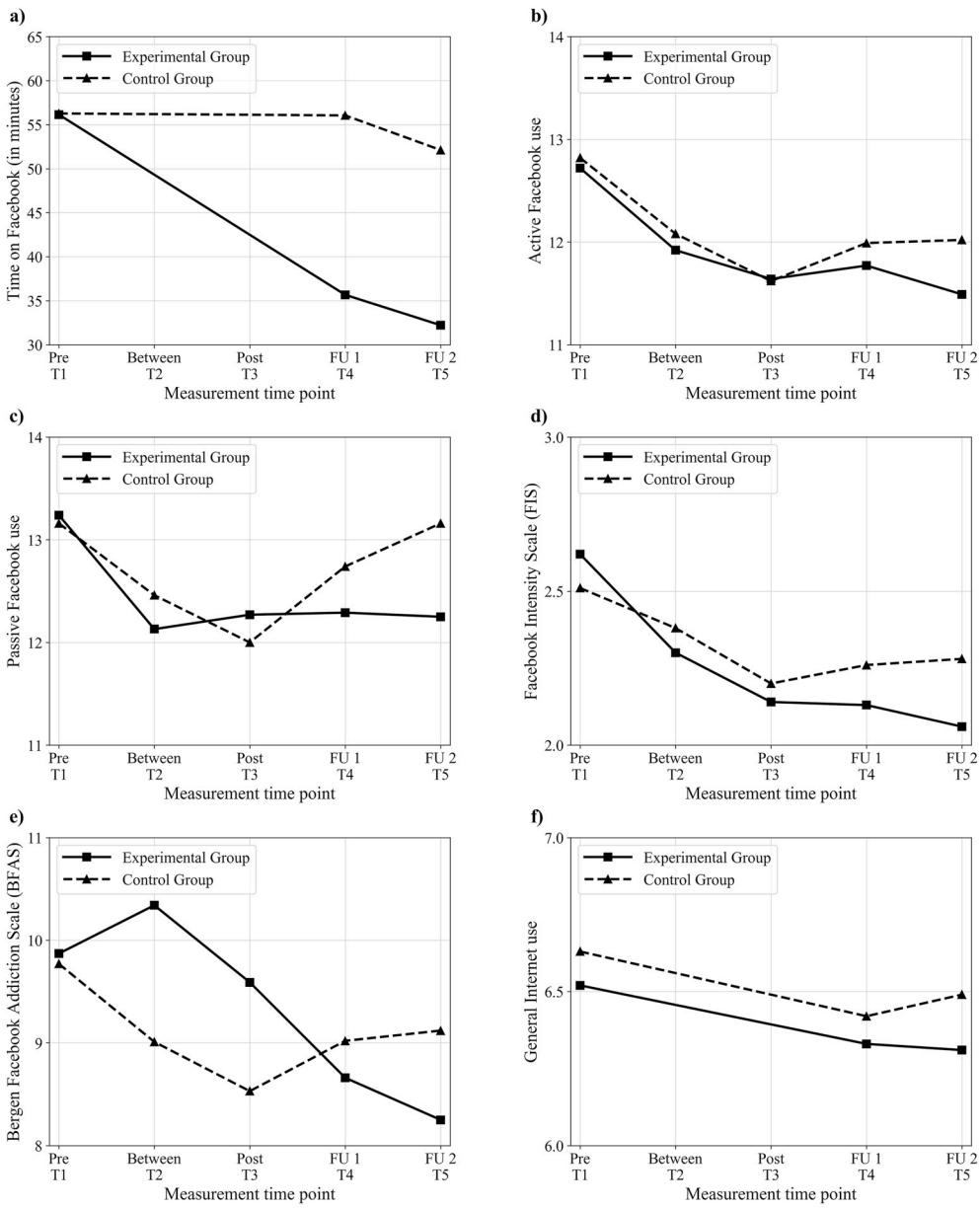

Fig. 2. Results of repeated measure analyses of variance (ANOVAs; pre-measurement, day 0 = T1; between-measurement, day 7 = T2; post-measurement, day 15 = T3; follow-up 1, one month after post-measurement = T4; follow-up 2, three months after post-measurement = T5) for variables of media use variables: (a) daily time on Facebook, (b) active Facebook use, (c) passive Facebook use, (d) Facebook use intensity, (e) Facebook Addiction Disorder, (f) general Internet use (Experimental Group: N = 140, Control Group: N = 146).

interaction effect (F (3,708) = 3.284, p = .013, η^2_p = .011). In the EG, depressive symptoms continuously decreased between T1 and T5 (see Fig. 3b). In the CG, depressive symptoms decreased between T1 and T2, increased between T2 and T3, slightly decreased between T3 and T4, and increased again between T4 and T5 (almost to the initial level). Pairwise comparisons indicated no significant differences between groups, and significant differences within the EG (T1>T3, T1>T4, T1>T5).

For physical activity, the ANOVA showed a significant main effect (F (3,686) = 4.369, p = .002, η^2_p = .015), and a significant interaction effect (F (3,686) = 5.250, p = .001, η^2_p = .018). As presented in Fig. 3c, while there was a continuous enhancement of physical activity in the EG, it remained at the same level in the CG. Pairwise comparisons indicated significant differences between groups at T4 and T5 (both: EG < CG), and significant differences within the EG (T1<T3, T1<T4, T1<T5, T2<T4, T2<T5).

For smoking behavior, the ANOVA revealed no significant main effect (F (1,985) = 2.783, p = .066), as well as no significant interaction effect (F (1,985) = 2.605, p = .078). However, note that only a small percentage of both groups engaged in smoking behavior. Thus, a larger subsample size could lead to significant findings. As presented in Fig. 3d, in the EG smoking behavior enhanced between T1 and T3, and remarkably decreased between T3 and T4, followed by a slight increase between T4 and T5. In contrast, in the CG, smoking behavior only slightly decreased between T1 and T3, and slightly increased between T3 and T5. Pairwise comparisons revealed no significant differences between groups, and significant differences within the EG (T1<T2, T3>T4, T3>T5).

4. Discussion

Our results demonstrate that reduction of daily time spent on Facebook by 20 min over the period of two weeks not only significantly influences Facebook use habits, but also has a substantial positive effect on subjective well-being and (un)healthy lifestyle. In contrast to the CG, effects within the EG show a similar pattern for all investigated variables and remain stable until the end of the three months follow-up period.

Only participants of our EG significantly reduced their daily initial Facebook use time of about 56 min to 32 min. Furthermore, they significantly reduced the level of passive Facebook use (confirmation of

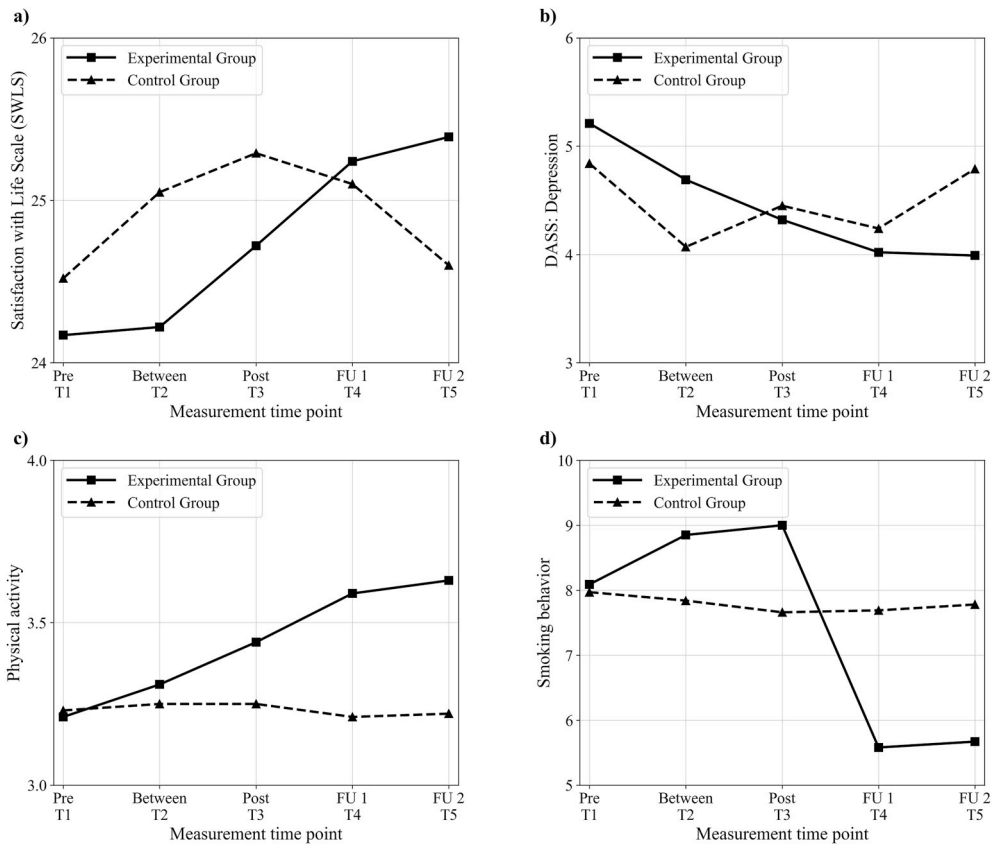

Fig. 3. Results of repeated measure analyses of variance (ANOVAs; pre-measurement, day 0 = T1; between-measurement, day 7 = T2; post-measurement, day 15 = T3; follow-up 1, one month after post-measurement = T4; follow-up 2, three months after post-measurement = T5) for variables of well-being and lifestyle: (a) life satisfaction, (b) depressive symptoms, (c) physical activity, (d) smoking behavior (Experimental Group: $N = 140$, Control Group: $N = 146$; exception: smoking behavior: Experimental Group: $n = 33$, Control Group: $n = 32$).

Table 2
Pairwise comparisons between experimental group and control group (T1 to T5).

	T1		T2		T3		T4		T5	
	md, 95%*CI*	d	md, 95%*CI*	d	md, 95%*CI*	d	md, 95%*CI*	d	md, 95%*CI*	d
Time on FB	-.12, [-6.28, 6.03]						**−20.39**, [-30.17, -10.62]**	**.49**	**−19.90**, [-29.01, -10.79]**	**.51**
Active FB use	-.10, [-.86, .66]		-.15, [-.88, .58]		.03, [-.64, .69]		-.22, [-.88, .44]		-.53, [-1.24, .19]	
Passive FB use	.08, [-.64, .79]		-.33, [-1.03, .37]		.27, [-.47, 1.02]		-.45, [-1.19, .28]		**-.91*, [-1.57, -.24]**	**.32**
FB use intensity	.11, [-.08, .29]		-.08, [-.25, .09]		-.06, [-.24, .11]		-.14, [-.31, .04]		**-.22*, [-.41, -.04]**	**.28**
FB Addiction Disorder	.10, [-.86, 1.06]		**1.34*, [.37, 2.30]**	**.32**	**1.06*, [.19, 1.93]**	**.29**	-.36, [-1.20, .47]		**-.87*, [-1.70, -.05]**	**.25**
General Internet use	-.11, [-.30, .09]						-.10, [-.33, .14]		-.18, [-.39, .03]	
Life satisfaction	-.35, [-1.65, .95]		-.83, [-2.20, .54]		-.57, [-1.95, .81]		.14, [-1.29, 1.57]		.82, [-.58, 2.21]	
Depressive symptoms	.37, [-.71, 1.45]		.62, [-.40, 1.65]		.15, [-.90, 1.20]		-.21, [-1.26, .83]		-.80, [-1.85, .25]	
Physical activity	-.01, [-.29, .27]		.07, [-.19, .33]		.19, [-.07, .45]		**.37*, [.11, .64]**	**.34**	**.41*, [.17, .65]**	**.39**
Smoking behavior	.12, [-4.03, 4.28]		1.01, [-3.19, 5.20]		1.34, [-2.28, 4.97]		−-2.11, [-5.60, 1.37]		−-2.12, [-5.96, 1.33]	

Notes. Experimental Group: $N = 140$, Control Group: $N = 146$, exception: smoking behavior: Experimental Group: $n = 33$, Control Group: $n = 32$; T1 to T5 = measurement time points; md = mean difference; *CI*=Confidence Interval; d = Cohen's d, effect-size measure of post-hoc comparisons between groups; FB=Facebook; pairwise comparisons are Bonferroni-corrected ($p < .050$, two-tailed); significant results are marked in bold. $^{**}p < .010$, $^{*}p < .050$.

Hypothesis 1a). This is noteworthy, considering that passive Facebook use leads to upward social comparisons and feelings of envy because other users are judged to be happier and more successful than oneself which negatively impacts subjective well-being (Appel, Gerlach, & Crusius, 2016; Fardouly, Diedrichs, Vartanian, & Halliwell, 2015). Also, the level of active Facebook use was reduced after the experimental intervention (confirmation of Hypothesis 1a). Typically, individuals who actively use Facebook have many online friends and perceive online social support (Manago, Taylor, & Greenfield, 2012; Sinclair & Grieve, 2017) which however may contribute to the development of FAD (Brailovskaia, Rohmann, Bierhoff, Schillack, et al., 2019). Furthermore, our intervention significantly reduced Facebook use intensity (confirmation of Hypothesis 1 b) – a further predictor of FAD (Brailovskaia, Rohmann, et al., 2018).

As visualized in Fig. 2e, after a slight enhancement within the first week of the experimental manipulation, FAD significantly decreased (confirmation of Hypothesis 1c). This result pattern is well-known in interventions on addictive behavior such as nicotine, alcohol and drug use (e.g., Gawin, 1991; Wetterling, Veltrup, & Junghanns, 1996): after an initial craving period linked to enhanced salience, withdrawal and relapse, addiction symptoms decrease. Note previous research described frequency of Facebook use to be a positive predictor of FAD (Brailovskaia et al., 2018). In line with this finding, less time spent on Facebook contributed to the reduction of addictive symptoms in the

Table 3
Pairwise comparisons of time points within groups (T1 to T5; Part 1).

	Group	T1 vs. T2		T1 vs. T3		T1 vs. T4		T1 vs. T5		T2 vs. T3	
		md, 95%*CI*	d_{RM}	md, 95%*CI*	d_{RM}	md, 95%*CI*	d_{RM}	md, 95%*CI*	d_{RM}	md, 95%*CI*	d_{RM}
Time on FB	Exp					**20.48*, [12.29, 28.67]**	**.21**	**23.93*, [15.30, 32.56]**	**.19**		
	Con					.21, [-7.81, 8.23]		4.16, [-4.29, 12.61]			
Active FB use	Exp	**.80*, [.21, 1.39]**	**.32**	**1.08*, [.49, 1.66]**	**.44**	**.95*, [.31, 1.59]**	**.31**	**1.23*, [.52, 1.93]**	**.41**	.28, [-.21, .77]	
	Con	**.75*, [.17, 1.32]**	**.30**	**1.21*, [.63, 1.78]**	**.44**	**.83*, [.20, 1.46]**	**.31**	**.80*, [.11, 1.49]**	**.26**	.46, [-.02, .94]	
Passive FB use	Exp	**1.11*, [.57, 1.66]**	**.46**	**.97*, [.32, 1.62]**	**.36**	**.96*, [.30, 1.62]**	**.42**	**.99*, [.23, 1.75]**	**.30**	-.14, [-.63, .34]	
	Con	**.71*, [.17, 1.24]**	**.33**	**1.16*, [.53, .18]**	**.45**	.43, [-.22, 1.07]		.01, [-.74, .75]		.46, [-.02, .93]	
FB use intensity	Exp	**.32*, [.19, .46]**	**.55**	**.49*, [.35, .63]**	**.72**	**.50*, [.34, .66]**	**.67**	**.56*, [.38, .74]**	**.71**	**.16*, [.06, .26]**	**.42**
	Con	**.14*, [.01, .26]**	**.24**	**.32*, [.18, .45]**	**.61**	**.25*, [.09, .41]**	**.39**	**.23*, [.06, .40]**	**.33**	**.18*, [.08, .28]**	**.42**
FB Addiction Disorder	Exp	-.47, [-1.28, .34]		.28, [-.60, 1.15]		**1.21*, [.35, 2.08]**	**.28**	**1.62*, [.62, 2.63]**	**.33**	**.75*, [.05, 1.45]**	**.24**
	Con	.76, [-.04, 1.56]		**1.23*, [.38, 2.09]**	**.42**	.75, [-.10, 1.60]		.64, [-.34, 1.63]		.47, [-.21, 1.15]	
General Internet use	Exp					.19, [-.04, .43]		.21, [-.01, .44]			
	Con					.21, [-.02, .43]		.14, [-.07, .36]			
Life satisfaction	Exp	-.05, [-.95, .85]		-.55, [-1.61, .51]		−1.07, [-2.17, .03]		**−1.21*, [-2.33, -.10]**	**.26**	-.50, [-1.34, .34]	
	Con	-.53, [-1.41, .35]		-.77, [-1.82, .27]		-.58, [-1.66, .50]		-.05, [-1.14, 1.05]		-.25, [-1.06, .57]	
Depressive symptoms	Exp	.51, [-.31, 1.34]		**.89*, [.05, 1.72]**	**.22**	**1.18*, [.23, 2.13]**	**.28**	**1.21*, [.23, 2.20]**	**.27**	.37, [-.39, 1.14]	
	Con	.77, [-.04, 1.58]		.66, [-.16, 1.49]		.60, [-.34, 1.53]		.04, [-.93, 1.01]		-.10, [-.85, .65]	
Physical activity	Exp	-.10, [-.30, .10]		**-.23*, [-.44, -.02]**	**.22**	**-.37*, [-.61, -.13]**	**.34**	**-.31*, [-.68, -.15]**	**.30**	.13, [-.32, .06]	
	Con	-.02, [-.22, .18]		-.03, [-.24, .18]		.01, [-.22, .25]		.01, [-.25, .27]		-.01, [-.19, .18]	
Smoking behavior	Exp	**-.76*, [-1.38, -.13]**	**.53**	-.91, [-4.09, 2.28]		2.52, [-.92, 5.95]		2.42, [-1.21, 6.06]		-.15, [-3.24, 2.93]	
	Con	.13, [-.51, .76]		.31, [-2.92, 3.55]		.28, [-3.21, 3.77]		.19, [-3.51, 3.88]		.19, [-2.95, 3.32]	

Notes. Experimental Group (Exp): $N = 140$, Control Group (Con): $N = 146$, exception: smoking behavior: Experimental Group: $n = 33$, Control Group: $n = 32$; T1 to T5 = measurement time points; md = mean difference; *CI*=Confidence Interval; $d_{RM} = d_{Repeated\ Measures}$, effect-size measure of post-hoc comparisons within groups; FB=Facebook; pairwise comparisons are Bonferroni-corrected ($p < .050$, two-tailed); significant results are marked in bold. $^{**}p < .010$, $^{*}p < .050$.

longer-term.

As assumed by Twenge and Campbell (2019) and corresponding to Tromholt (2016), the level of subjective well-being improved after the restriction of daily time spent on Facebook. Both life satisfaction and depressive symptoms continuously improved (confirmation of Hypothesis 2a and of Hypothesis 2b). Note, during data collection of the current study, an investigation from the U.S. with a similar research design was published that mainly focused on negative factors of well-being (Hunt, Marx, Lipson, & Young, 2018). In line with present results, Hunt et al. (2018) reported a reduction of depressive symptoms in a group of undergraduate students who reduced their daily use of social platforms for a period of three weeks. The following considerations may partly explain the improvement of subjective well-being observed in our study. Intensive use of Facebook fosters the decrease of life satisfaction, as well as the increase of negative mood and depressive symptoms (e.g., Kross, et al., 2013; Primack et al., 2017; Yuen et al., 2018). Specifically, passive browsing of Facebook pages may contribute to the experience of envy which impacts well-being (Verduyn et al., 2015; Yuen et al., 2018). Active Facebook use is linked to the perception of social support by online friends (Verduyn et al., 2017). However, experience of social support on Facebook may contribute to the development of addictive tendencies (Brailovskaia, Rohmann, Bierhoff, Schillack, et al., 2019). Two recent longitudinal studies reported FAD to be a positive predictor of depressive symptoms and of suicide related-outcomes (Brailovskaia et al., 2019; Brailovskaia et al., in press.). In the current study, the experimental reduction of daily time spent on Facebook contributed to the decrease of active and passive online activity, of Facebook use intensity, and of FAD. This might improve the well-being of participants in the EG. Thus, the present findings and these of Hunt et al. (2018) emphasize the necessity to discuss time spent on Facebook during treatment of individuals with depressive symptoms in order to reduce Facebook use under controlled conditions within the therapeutic setting (compare Kuss & Pontes, 2019).

Moreover, reduction of Facebook use time contributed to changes in (un)healthy lifestyle, such as a significant continuous enhancement of frequency of physical activity that particularly increased in the months after the experimental period (confirmation of Hypothesis 3), and a decrease of smoking behavior (see Research Question). After a slight enhancement within the experimental period that might have served as compensation for the lack of satisfaction typically gained on Facebook, the mean number of daily smoked tobacco products decreased from about eight (T1) to less than six (T5) in the EG. Thus, it seems that participants who were experimentally randomized to less Facebook activity used the new available time to engage in physical activities. Individuals who regularly engage in physical activities often experience flow – a state of total involvement in the conducted task that is linked to happiness, enjoyment and satisfaction (Csikszentmihalyi, 1990). Facebook use may also contribute to the experience of flow (Khang, Kim, & Kim, 2013). Thus, it may be assumed that flow experienced during physical activities replaces the online flow. This might at least partly explain the increase of physical activity in the EG. The reduction of smoking behavior might then follow from the enhancement of physical activity time and well-being. In any case, the potential causal relationships discussed here should be investigated in future studies.

Current results are of great importance as, on the one hand, it is well-known that physical activity buffers the negative effect of daily stress,

Table 4
Pairwise comparisons of time points within groups (T1 to T5; Part 2).

	Group	T2 vs. T4		T2 vs. T5		T3 vs. T4		T3 vs. T5		T4 vs. T5	
		md, 95%*CI*	d_{RM}	md, 95%*CI*	d_{RM}	md, 95%*CI*	d_{RM}	md, 95%*CI*	d_{RM}	md, 95%*CI*	d_{RM}
Time on FB	Exp									3.45, [-3.95, 10.85]	
	Con									3.95, [-3.30, 11.19]	
Active FB use	Exp	.15, [-.44, .74]		.43, [-.23, 1.09]		-.13, [-.65, .39]		.15, [-.45, .75]		.28, [-.24, .79]	
	Con	.08, [-.50, .66]		.06, [-.59, .70]		-.38, [-.89, .14]		-.40, [-.99, .19]		-.03, [-.53, .48]	
Passive FB use	Exp	-.16, [-.72, .41]		-.12, [-.83, .58]		-.01, [-.59, .56]		.02, [-.70, .74]		.04, [-.62, .69]	
	Con	-.28, [-.83, .27]		**-.70*, [-1.39, -.01]**	**.23**	**-.74*, [-1.30, -.18]**	**.30**	**1.16*, [-1.86, -.46]**	**.33**	-.42, [-1.06, .22]	
FB use intensity	Exp	**.17*, [.04, .30]**	**.37**	**.24*, [.08, .39]**	**.44**	.01, [-.11, .13]		.07, [-.08, .22]		.06, [-.07, .19]	
	Con	.11, [-.01, .24]		.10, [-.05, .24]		-.07, [-.19, .05]		-.09, [-.23, .06]		-.02, [-.15, .11]	
FB Addiction Disorder	Exp	**1.69*, [.91, 2.46]**	**.46**	**2.09*, [1.20, 2.99]**	**.56**	**.94*, [.20, 1.67]**	**.27**	**1.34*, [.50, 2.19]**	**.37**	.41, [-.35, 1.16]	
	Con	-.01, [-.77, .74]		-.12, [-1.00, .76]		-.49, [-1.20, .23]		-.59, [-1.42, .24]		-.10, [-.84, .64]	
General Internet use	Exp									.02, [-.17, .21]	
	Con									-.06, [-.25, .12]	
Life satisfaction	Exp	**−1.02*, [-2.02, -.02]**	**.25**	−1.16, [-2.34, .01]		-.52, [-1.35, .31]		-.66, [-1.72, .39]		-.14, [-1.21, .93]	
	Con	-.06, [-1.03, .92]		.48, [-.67, 1.63]		.19, [-.62, 1.03]		.73, [-.31, 1.76]		.53, [-.51, 1.58]	
Depressive symptoms	Exp	.66, [-.23, 1.56]		.70, [-.25, 1.65]		.29, [-.54, 1.13]		.33, [-.54, 1.19]		.04, [-.79, .86]	
	Con	-.17, [-1.05, .70]		-.73, [-1.66, .20]		-.07, [-.89, .75]		-.62, [-1.47, .22]		-.56, [-1.37, .26]	
Physical activity	Exp	**-.27*, [-.49, -.05]**	**.30**	**-.31*, [-.57, -.06]**	**.29**	-.14, [-.37, .08]		-.19, [-.43, .06]		-.04, [-.29, .20]	
	Con	.03, [-.18, .25]		.03, [-.22, .27]		.04, [-.18, .26]		.03, [-.20, .27]		-.01, [-.25, .24]	
Smoking behavior	Exp	3.27, [-.22, 6.76]		3.18, [-.52, 6.89]		**3.42*, [.79, 6.05]**	**.67**	**3.33*, [.75, 5.92]**	**.68**	-.09, [-2.22, 2.04]	
	Con	.16, [-3.39, 3.70]		.06, [-3.70, 3.83]		-.03, [-2.70, 2.64]		-.13, [-2.75, 2.50]		-.09, [-2.26, 2.07]	

Notes. Experimental Group (Exp): $N = 140$, Control Group (Con): $N = 146$, exception: smoking behavior: Experimental Group: $n = 33$, Control Group: $n = 32$; T1 to T5 = measurement time points; md = mean difference; *CI*=Confidence Interval; $d_{RM} = d_{Repeated\ Measures}$, effect-size measure of post-hoc comparisons within groups; FB=Facebook; pairwise comparisons are Bonferroni-corrected ($p < .050$, two-tailed); significant results are marked in bold. $^{**}p < .010$, $^{*}p < .050$.

contributes to the protection of well-being and reduces the probability of the development of mental disorders (Wunsch et al., 2017). On the other hand, smoking behavior negatively affects physical and mental health which causes economic burden and substantial financial costs to the community (World Health Organization, 2018). Therefore, we advise to consider restrictions of time spent on Facebook when implementing specific intervention programs aiming to enhance physical activity or to reduce smoking behavior. If our results are confirmed by subsequent research, including the aspect of time spent on Facebook may raise effectivity and reduce costs of programs that often are cost-intensive.

4.1. Limitations and further research

Some limitations are to be considered when interpreting the current findings. First, our sample is comparably young and includes more female than male participants. Further research should replicate present results in more age and gender balanced groups. Second, despite the significance of our results, we cannot be sure that the reduction of daily Facebook use for 20 min included in our investigation is the most effective one, because there are no other studies with a similar design for comparisons of intervention effects. Therefore, we advise future studies to investigate different lengths of time (more and less than 20 min) of reduction of daily Facebook use to determine the one with the highest effectivity. Third, longer follow-up periods than used in our study (for example six months or one year) should be included. Forth, we focused only on the social platform Facebook. Even though Facebook is currently the largest SNS (Roth, 2019), the current experimental design should be replicated on other social platforms such as Instagram and Twitter. This would clarify whether our findings are unique to Facebook or may be generalized to general use of social online media.

4.2. Conclusion

Previous research described extensive Facebook use to contribute to decrease of subjective well-being (Kross et al., 2013; Shakya & Christakis, 2017) and to the development of addictive tendencies that negatively influence a person's offline life (Marino et al., 2018). The experimental design of our study together with the findings of Tromholt (2016) and Hunt et al. (2018) adds to the causal interpretation of these earlier correlational findings. Together, they indicate that a reduction (not a complete waving) of daily time spent on Facebook might be sufficient to prevent a pathological bonding to the platform, to protect subjective well-being, and even to contribute to healthier lifestyle.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

None.

CRediT authorship contribution statement

Julia Brailovskaia: Conceptualization, Methodology, Software, Validation, Investigation, Data curation, Writing - original draft, Writing - review & editing, Visualization, Supervision, Project administration. **Fabienne Ströse:** Methodology, Investigation, Data curation, Project administration. **Holger Schillack:** Methodology, Software, Visualization. **Jürgen Margraf:** Conceptualization, Methodology, Resources, Writing - original draft, Writing - review & editing.

References

Andreassen, C. S., Torsheim, T., Brunborg, G. S., & Pallesen, S. (2012). Development of a Facebook addiction scale. *Psychological Reports, 110*(2), 501–517. https://doi.org/10.2466/02.09.18.PR0.110.2.501-517.

Appel, H., Gerlach, A. L., & Crusius, J. (2016). The interplay between Facebook use, social comparison, envy, and depression. *Current Opinion in Psychology, 9*, 44–49. https://doi.org/10.1016/j.copsyc.2015.10.006.

Atroszko, P. A., Balcerowska, J. M., Bereznowski, P., Biernatowska, A., Pallesen, S., & Andreassen, C. S. (2018). Facebook addiction among Polish undergraduate students: Validity of measurement and relationship with personality and well-being. *Computers in Human Behavior, 85*, 329–338. https://doi.org/10.1016/j.chb.2018.04.001.

Brailovskaia, J., & Margraf, J. (2017). Facebook Addiction Disorder (FAD) among German students – a longitudinal approach. *PloS One, 12*(12), e0189719. https://doi.org/10.1371/journal.pone.0189719.

Brailovskaia, J., & Margraf, J. (2018). What does media use reveal about personality and mental health? An exploratory investigation among German students. *PloS One, 13*(1), e0191810. https://doi.org/10.1371/journal.pone.0191810.

Brailovskaia, J., Margraf, J., & Köllner, V. (2019a). Addicted to Facebook? Relationship between Facebook addiction disorder, duration of Facebook use and narcissism in an inpatient sample. *Psychiatry Research, 273*, 52–57. https://doi.org/10.1016/j.psychres.2019.01.016.

Brailovskaia, J., Rohmann, E., Bierhoff, H.-W., & Margraf, J. (2018a). The brave blue world: Facebook flow and Facebook addiction disorder (FAD). *PloS One, 13*(7), e0201484. https://doi.org/10.1371/journal.pone.0201484.

Brailovskaia, J., Rohmann, E., Bierhoff, H.-W., Margraf, J., & Köllner, V. (2019b). Relationships between addictive Facebook use, depressiveness, insomnia, and positive mental health in an inpatient sample: A German longitudinal study. *Journal of Behavioral Addictions, 8*(4), 703–713. https://doi.org/10.1556/2006.8.2019.63.

Brailovskaia, J., Rohmann, E., Bierhoff, H.-W., Schillack, H., & Margraf, J. (2019c). The relationship between daily stress, social support and Facebook Addiction Disorder. *Psychiatry Research, 276*, 167–174. https://doi.org/10.1016/j.psychres.2019.05.014.

Brailovskaia, J., Schillack, H., Assion, H.-J., Horn, H., & Margraf, J. (2018b). Risk-taking propensity and (un) healthy behavior in Germany. *Drug and Alcohol Dependence, 192*, 324–328. https://doi.org/10.1016/j.drugalcdep.2018.08.027.

Brailovskaia, J., Schillack, H., & Margraf, J. (2018c). Facebook addiction disorder (FAD) in Germany. *Cyberpsychology, Behavior, and Social Networking, 21*(7), 450–456. https://doi.org/10.1089/cyber.2018.0140.

Brailovskaia, J., Teismann, T., & Margraf, J. (in press.). Positive mental health mediates the relationship between Facebook addiction disorder and suicide-related outcomes: A longitudinal approach. Cyberpsychology, behavior, and social networking.

Brailovskaia, J., Teismann, T., & Margraf, J. (2018d). Physical activity mediates the association between daily stress and Facebook Addiction Disorder (FAD) – a longitudinal approach among German students. *Computers in Human Behavior, 86*, 199–204. https://doi.org/10.1016/j.chb.2018.04.045.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal performance*. New York, NY: Cambridge UniversityPress.

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49*(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13.

Ellison, N. B., Steinfield, C., & Lampe, C. (2007). The benefits of Facebook "friends:" Social capital and college students' use of online social network sites. *Journal of Computer-Mediated Communication, 12*(4), 1143–1168. https://doi.org/10.1111/j.1083-6101.2007.00367.x.

Fardouly, J., Diedrichs, P. C., Vartanian, L. R., & Halliwell, E. (2015). Social comparisons on social media: The impact of Facebook on young women's body image concerns and mood. *Body Image, 13*, 38–45. https://doi.org/10.1016/j.bodyim.2014.12.002.

Fenichel, M. (2009). Facebook addiction disorder (FAD). . (Accessed 26 July 2019). http://www.fenichel.com/facebook/.

Gawin, F. H. (1991). Cocaine addiction: Psychology and neurophysiology. *Science, 251*(5001), 1580–1586. https://doi.org/10.1126/science.2011738.

Glaesmer, H., Grande, G., Braehler, E., & Roth, M. (2011). The German version of the satisfaction with life scale (SWLS): Psychometric properties, validity, and population-based norms. *European Journal of Psychological Assessment, 27*, 127–132. https://doi.org/10.1027/1015-5759/a000058.

Griffiths, M. D. (2002). *Gambling and gaming addictions in adolescence*. Leicester: British Psychological Society/Blackwell.

Hunt, M. G., Marx, R., Lipson, C., & Young, J. (2018). No more FOMO: Limiting social media decreases loneliness and depression. *Journal of Social and Clinical Psychology, 37*(10), 751–768. https://doi.org/10.1521/jscp.2018.37.10.751.

Keyes, C. L. (2005). Mental illness and/or mental health? Investigating axioms of the complete state model of health. *Journal of Consulting and Clinical Psychology, 73*(3), 539–548.

Khang, H., Kim, J. K., & Kim, Y. (2013). Self-traits and motivations as antecedents of digital media flow and addiction: The Internet, mobile phones, and video games. *Computers in Human Behavior, 29*(6), 2416–2424. https://doi.org/10.1016/j.chb.2013.05.027.

Koc, M., & Gulyagci, S. (2013). Facebook addiction among Turkish college students: The role of psychological health, demographic, and usage characteristics. *Cyberpsychology, Behavior, and Social Networking, 16*(4), 279–284. https://doi.org/10.1089/cyber.2012.0249.

Kross, E., Verduyn, P., Demiralp, E., Park, J., Lee, D. S., Lin, N., et al. (2013). Facebook use predicts declines in subjective well-being in young adults. *PloS One, 8*(8), e69841. https://doi.org/10.1371/journal.pone.0069841.

Kuss, D. J., & Pontes, H. M. (2019). Internet addiction. *Advances in Psychotherapy - Evidence-Based Practice, 41*, 1–79.

Lin, L. Y., Sidani, J. E., Shensa, A., Radovic, A., Miller, E., Colditz, J. B., et al. (2016). Association between social media use and depression among US young adults. *Depression and Anxiety, 33*(4), 323–331. https://doi.org/10.1002/da.22466.

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behaviour Research and Therapy, 33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-U.

Manago, A. M., Taylor, T., & Greenfield, P. M. (2012). Me and my 400 friends: The anatomy of college students' Facebook networks, their communication patterns, and well-being. *Developmental Psychology, 48*(2), 369–380. https://doi.org/10.1037/a0026338.

Marino, C., Gini, G., Vieno, A., & Spada, M. M. (2018). A comprehensive meta-analysis on problematic Facebook use. *Computers in Human Behavior, 83*, 262–277. https://doi.org/10.1016/j.chb.2018.02.009.

Mayr, S., Erdfelder, E., Buchner, A., & Faul, F. (2007). A short tutorial of GPower. *Tutorials in Quantitative Methods for Psychology, 3*(2), 51–59. https://doi.org/10.20982/tqmp.03.2.p051.

Milton, K., Bull, F. C., & Bauman, A. (2011). Reliability and validity testing of a single-item physical activity measure. *British Journal of Sports Medicine, 45*(3), 203–208. https://doi.org/10.1136/bjsm.2009.068395.

Morris, S. B. (2008). Estimating effect sizes from pretest-posttest-control group designs. *Organizational Research Methods, 11*(2), 364–386. https://doi.org/10.1177/1094428106291059.

Nilges, P., & Essau, C. (2015). Die depressions-angst-stress-skalen. *Schmerz, Der, 29*(6), 649–657. https://doi.org/10.1007/s00482-015-0019-z.

Pempek, T. A., Yermolayeva, Y. A., & Calvert, S. L. (2009). College students' social networking experiences on Facebook. *Journal of Applied Developmental Psychology, 30*(3), 227–238. https://doi.org/10.1016/j.appdev.2008.12.010.

Primack, B. A., Shensa, A., Sidani, J. E., Whaite, E. O., yi Lin, L., Rosen, D., et al. (2017). Social media use and perceived social isolation among young adults in the US. *American Journal of Preventive Medicine, 53*(1), 1–8. https://doi.org/10.1016/j.amepre.2017.01.010.

Roth, P. (2019). *Nutzerzahlen: Facebook, Instagram, Messenger und WhatsApp, Highlights, Umsätze, uvm. (Stand Juli 2019)*, 201926 Juli allfacebook.de https://allfacebook.de/toll/state-of-facebook. (Accessed 3 August 2019).

Shakya, H. B., & Christakis, N. A. (2017). Association of Facebook use with compromised well-being: A longitudinal study. *American Journal of Epidemiology, 185*(3), 203–211. https://doi.org/10.1093/aje/kww189.

Shensa, A., Sidani, J. E., Escobar-Viera, C. G., Switzer, G. E., Primack, B. A., & Choukas-Bradley, S. (2020). Emotional support from social media and face-to-face relationships: Associations with depression risk among young adults. *Journal of Affective Disorders, 260*, 38–44. https://doi.org/10.1016/j.jad.2019.08.092.

Sinclair, T. J., & Grieve, R. (2017). Facebook as a source of social connectedness in older adults. *Computers in Human Behavior, 66*, 363–369. https://doi.org/10.1016/j.chb.2016.10.003.

Szrek, H., Chao, L.-W., Ramlagan, S., & Peltzer, K. (2012). Predicting (un) healthy behavior: A comparison of risk-taking propensity measures. *Judgment and Decision Making, 7*(6), 716–727.

Tromholt, M. (2016). The Facebook experiment: Quitting Facebook leads to higher levels of well-being. *Cyberpsychology, Behavior, and Social Networking, 19*(11), 661–666. https://doi.org/10.1089/cyber.2016.0259.

Twenge, J. M., & Campbell, W. K. (2019). Media use is linked to lower psychological well-being: Evidence from three datasets. *Psychiatric Quarterly, 90*, 311–331. https://doi.org/10.1007/s11126-019-09630-7.

Twenge, J. M., Spitzburg, B. H., & Campbell, W. K. (2019). Less in-person social interaction with peers among US adolescents in the 21st century and links to loneliness. *Journal of Social and Personal Relationships, 36*(6), 1892–1913. https://doi.org/10.1177/0265407519836170.

Verduyn, P., Lee, D. S., Park, J., Shablack, H., Orvell, A., Bayer, J., et al. (2015). Passive Facebook usage undermines affective well-being: Experimental and longitudinal evidence. *Journal of Experimental Psychology: General, 144*(2), 480–488. https://doi.org/10.1037/xge0000057.

Verduyn, P., Ybarra, O., Résibois, M., Jonides, J., & Kross, E. (2017). Do social network sites enhance or undermine subjective well-being? A critical review. *Social Issues and Policy Review, 11*(1), 274–302. https://doi.org/10.1111/sipr.12033.

Wetterling, T., Veltrup, C., & Junghanns, K. (1996). Craving-ein ausreichend fundiertes Konzept? *Fortschritte der Neurologie - Psychiatrie, 64*, 142–152. https://doi.org/10.1055/s-2007-996380, 04.

World Health Organization. (2018). Tobacco. http://www.who.int/news-room/fact-sheets/detail/tobacco. (Accessed 15 July 2019).

Wunsch, K., Kasten, N., & Fuchs, R. (2017). The effect of physical activity on sleep quality, well-being, and affect in academic stress periods. *Nature and Science of Sleep, 9*, 117–126. https://doi.org/10.2147/NSS.S132078.

Yuen, E. K., Koterba, E. A., Stasio, M. J., Patrick, R. B., Gangi, C., Ash, P., et al. (2018). *The effects of Facebook on mood in emerging adults*.