Examining the links between active Facebook use, received likes, self-esteem and happiness: A study using objective social media data

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A R T I C L E   I N F O

A B S T R A C T

For social media users, profile updating and receiving Likes may feel like a reward, and elicit positive emotions, reinforcing use of the platform. Could this mechanism have consequences for users' self-esteem and happiness? Previous findings on the topic are mixed, and typically limited by use of self-reports of online activity. In the present study, we used objective behavioral data to examine the hypotheses that receiving Likes on Facebook would relate to 1) users' level of perceived self-esteem, and 2) increased happiness via the mediating role of self-esteem. We recruited 2,349 adult Facebook users (589 men, 1,760 women; 67% aged 18–25, 26% aged 26–35, 7% aged > 35 years). Participants answered an online survey and provided access to their objective Facebook data (i.e., profile updates and received Likes). We found that frequency of users updating their profile and sharing personal content (e.g., self-generated texts, images, friends and location tags) had a direct effect on the frequency and intensity of the feedback (i.e., Likes) they received from other users in their online social network. Additionally, analyses supported a positive link between the frequency and intensity of positive feedback received by users and perceived happiness that was mediated in part by an increase in self-esteem. Overall, findings demonstrate a process linking positive online social feedback and perceived well-being.

1. Introduction

Social media platforms are widely used among the general population with Facebook remaining the leading platform worldwide in terms of active users (2.7 billion monthly active users as of the second quarter of 2020; Statista, 2020a), in spite of the growing competition of other platforms (e.g., Facebook's Instagram, or China's Sina Weibo). Everyday, Internet users use social media platforms to post and share personal content, which can be seen and endorsed ("Liked") by other users in their online network, generating a massive dataset of digital traces with potential connections to their behavioral and psychological characteristics (Settanni et al., 2018).

Because of the pervasiveness of social media use in individuals' everyday lives, researchers have questioned whether usage of social media platforms, as well their specific features, may affect users' well-being (e.g., Kross et al., 2013; Tromholt, 2016). Regarding Facebook, there exists increasing evidence that passive social media use, which includes browsing the own and other users' feeds without direct interactions with other users, may have a negative impact on affective well-being, possibly by eliciting upward social comparison and feelings of envy (e.g., Appel, Crusius, & Gerlach, 2015; Krasnova et al., 2013; Verduyn et al., 2015). In turn, findings indicate that active social media usage, such as posting a new picture or updating one's own status, shows a positive association with well-being (for a review, see Verduyn et al., 2017). In particular, findings indicate that active social media usage may increase users' well-being by increasing their social capital (e.g., Burke et al., 2011; Lee et al., 2014, for a review see Ellison & Vitak, 2015), offering users opportunities to experience social support by their own online social network (e.g., Frison and Eggermont, 2016; Tang et al., 2016) and fostering feelings of social connectedness and belongingness (Deters & Mehl, 2013). Additionally, in accordance with self-affirmation theory (Sherman & Cohen, 2006; Steele, 1988), because social media platforms provide users with the ability to micro-manage their online self-presentation through the self-selection of uploaded information, active usage of the platforms has been shown to fulfill specific ego needs (Toma and Hancock, 2013) increasing feelings of self-worth (Toma, 2013) and subjective well-being (Kim & Lee, 2011).

One key feature of social media platforms that could play a role in these processes is the ability for social media users to receive positive social feedback by other users, such as comments or Likes, on their own updates. Consistent with sociometer theory, findings indicate that Likes could act as an important resource to boost self-esteem, in particular when we receive positive social feedback from close friends (Scissors et al, 2016). Indeed, according to sociometer theory, self-esteem depends on social feedback, i.e. whether (one perceives that) others include or exclude/reject oneself (Leary et al., 1995). Further, Leary (2005) conceptualized that self-esteem is not upheld on a certain level by a person per se, but such regulation processes always need to be viewed in the context of peer evaluations of the person. Hence, self-esteem could be seen as a measure of success in increasing one's own "relational value and social acceptance" (p. 75, Leary, 2005). In the context of Facebook, experiencing positive feedback (or lack thereof) in the form of Likes, is expected to induce a feeling of in- or exclusion and, ultimately, affect one's self-esteem and happiness (Baumeister et al., 2003).

Findings also suggest that posting content on social media and receiving positive feedback is experienced by users like a social reward (Rosenthal-von der Pütten et al., 2019), and thus has the potential to elicit positive emotions (e.g., Campos et al., 2013). This mechanism is supported by observations from brain imaging studies, showing that receiving Likes for one's own posted pictures (such as on Instagram) results in activity of the brain's reward circuitry (Sherman et al., 2016, 2018). For an involvement of the nucleus accumbens region in Facebook use, providing additional support for the rewarding aspects of Facebook usage, see also the MRI-work by Montag et al. (2017). Furthermore, it is well known that the ventral striatum responds to gains in reputation (for a review see Izuma, 2012). Interestingly, the neural signal underlying gains in reputation can even predict future Facebook use (Meshi et al., 2013). In this context it is even debated if elements such as Likes built into social media platforms may foster "addictive" tendencies towards the platforms (see Marengo et al., 2020; Meshi et al., 2015; Montag et al., 2017; Montag et al., 2019; for an overview see Schou Andreassen & Pallesen, 2014).

Given the prominence of Facebook's Like feature, as well as similar mechanisms on other popular platforms such as Instagram, or China's WeChat (Montag et al., 2018), we aimed to explore how receiving Likes relates to self-esteem and happiness, accordingly. Overall, findings from studies investigating the links between self-esteem and number of received Facebook Likes are mixed, with some authors reporting a positive association (e.g., Burrow & Rainone, 2017; Forest & Wood, 2012) and others failing to support the link (e. g., Hong et al., 2017; Metzler & Scheithauer, 2017). One limitation of existing studies is the reliance on self-report measures of Facebook activity, which are known to be biased (Junco, 2013) when compared to objective measures of activity (Marino et al., 2017). Further, the aforementioned studies did not investigate links with measures of subjective well-being. Of note, a study leveraging on digital footprints by Burke & Kraut (2016) demonstrated links between greater well-being and receiving feedback by one's close friends, but self-esteem was not assessed in this study. In turn, Scissors et al. (2016) concentrated on self-esteem, self-monitoring and valuing Likes, but failed to explore the direct relationship between received Likes and self-esteem, and to collect a measure of well-being.

Therefore, open questions remain on associations between these variables: is the actual number of received Likes positively linked to self-esteem and perceived happiness? If this is the case, is the relationship between number of Likes and happiness possibly mediated by self-esteem? From a general psychological perspective, one would expect a Like to be a positive reinforcer in line with positive emotionality. It should therefore enhance self-esteem and happiness (at least from a short-term perspective), consecutively. Valkenburg et al. (2006) provided support for this potential mediation effect in the context of early social media platforms (e.g., MySpace, Friendster). In their study, Valkenburg and colleagues explored associations between social media use frequency, the number of reactions received by other users, the tone of received reactions, and both self-esteem and psychological well-being in a sample of adolescent Internet users. They found support for a simple indirect effect linking social media use frequency and well-being passing through self-esteem. Additionally, they discovered a serial mediation effect passing through both frequency of received reactions and overall tone of received reactions. Overall, their findings indicated that an increase in online activity frequency might influence users' well-being by means of increased frequency of positive social feedback affecting their self-esteem.

In the present study, we refer to the theoretical model proposed by Valkenburg and colleagues (2006) to examine relations between active Facebook use frequency, the frequency and intensity of positive feedback received by other users (i.e., Facebook Likes), self-esteem and current happiness. Following the model proposed by the authors, we hypothesize that participants' current happiness may relate to their online Facebook activity through the impact of receiving positive feedback (i.e., a Like) on users' self-esteem, and consequently, on happiness. In analyzing the received positive feedback, we distinguish between frequency of received feedback (e.g., number of Facebook updates receiving at least one Like) and intensity of received feedback (i.e., average number of Likes received per

users' updates). Because self-esteem can be viewed as a measure of one's success in being socially accepted by peers (Leary, 2005), we hypothesize that self-esteem may act as a mediator between the intensity of positive social feedback experienced by users on Facebook, and their level of subjective happiness.

As an additional aim, in the present study we go beyond the model proposed by Valkenburg and colleagues (2006). We examine the role of a specific aspect of participants' self-presentation on Facebook, namely the prevalence of self-generated content, as predictor of both the frequency and intensity of positive social feedback and users' current level of self-esteem and happiness. Our decision to investigate this specific aim is driven by findings indicating that social media posts personally crafted by users by adding user-generated content (e.g., such as texts) tend to receive a wider and more positive feedback by the post audience when compared to posts including content generated by other sources (e.g., Epstein et al., 2015). In particular, audience responses tend to be more intense the more users personalize and add content to their post (e.g., number of words, Wagg et al., 2019; Wang et al., 2013; or photo tags, Jang et al., 2015). These results also echo findings from self-report studies indicating that users being prone to self-disclosure on social media (e.g., via the sharing of updates including personal information, texts and images) tend to experience more intense positive social feedback than users that are less willing to present themselves online (Liu & Brown, 2014; Metzler & Scheithauer, 2017). Guided by these considerations, we hypothesize that Facebook users that are more willing to post user-generated content (e.g., texts, images, friend mentions or location tags) will experience heightened positive social feedback when compared to users showing a higher prevalence of *other-generated* content in their updates (e.g., posts, links, and images either created by other users, or retrieved from sources external to Facebook). In turn, we expect that the increase in positive social feedback might lead to an increase in the user's current self-esteem and happiness.

To our knowledge, this is the first study exploring the proposed mediation effects in the context of Facebook. In exploring these novel research aims, the present study improves over the existing literature by leveraging on objective measures of online activity on Facebook (i.e., frequency and content of Facebook updates as well as received Likes) that are obtained by inspecting participants' Facebook activity logs (i.e., Facebook's user feed), as opposed to relying on self-report data.

2. Material and methods

2.1. Procedure and participants

Participants were recruited by disseminating an online web-application on Facebook. We employed a snowball sampling approach, starting with a seed sample of 10 university students. By accessing the application, participants were informed about the study's characteristics, and (if agreeing) provided informed consent; then participants were administered questionnaires assessing demographic characteristics and study measures. Additionally, the landing page included a Facebook login box that could be used by participants to log into the web-application using their Facebook credentials. The Facebook login box was used to obtain authorization to collect participants' Facebook objective activity data (i.e., posts and Likes). As an incentive for participation in the research and donating their Facebook activity data, participants were provided personalized feedback based on their responses to the questionnaires and Facebook activity data (e.g., line charts representing frequency of online posting, and received Likes during the previous 12 months of activity on Facebook). Inclusion criteria were fluency in Italian language, legal age, and an active Facebook account. The university institutional review board (#88721) approved the research.

Data collection took place from March to June 2018. Eventually, 2,998 users accessed the application. Analyses were performed on a subsample of 2,349 participants who provided us with both self-report data and authorization to access to their Facebook activity data (589 men, 1,760 women; 67% in the 18–25 age group, and 26% in the 26–35 age group, 7% aged > 35).

2.2. Objective Facebook activity data

Facebook activity data were collected by submitting requests through Facebook's Graph application-programming interface (API). We retrieved information about users' online activity from up to 12 months before the survey. In order to obtain information about users' recent activity on Facebook, we inspected participants' feed and computed the following indicators: total number of Facebook updates over the prior 3 months (i.e., all actions performed on Facebook during the last 90 days which result in a new post published on users' wall, e.g., status-updates, comments, picture/video uploading, sharing of content with other users, etc.); number of updates receiving at least one "Like", and the average number of received Likes per update received by participants in the same period. Our focus was on a relatively short period of online activity (i.e., recent 3 months), because findings suggest a stronger, direct association between recent life events (e.g., up to 3 months from self-report) and subjective well-being, when compared to older events (Suh et al., 1996). In our dataset, over a period of 3 months, users' mean number of updates was 27.20 (SD = 47.80, Range = 1–275), mean number of updates receiving at least one Like was 20.38 (SD = 34.23, Range = 1–275), and the mean of per-update average received Likes was 13.27 (SD = 17.28, Range = 0–209.50).

Based on examined collected data, we also aimed to retrieve information about the prevalence of self-generated content in users' Facebook updates, which we operationalized as the ratio of Facebook updates including *self-generated* content over the total number of updates. In more detail, we coded Facebook updates as *self-generated* content if they included either one or more of the following types of self-generated data: textual updates (e.g., updates including personal written content); visual updates (i.e., updates consisting of the upload of personal images, such as profile pictures, photos, videos, and live broadcasts); location updates (i.e., updates including information about the user's own current or recent geographic location, including check-ins and events they participated in); updates including mentions (i.e., tags) of other users; and updates consisting of the sharing of a previous post which was updated with new

content (e.g., *memory* posts). In turn, we coded updates as *other-generated* content if they consisted only of the sharing of other users' posts, links, pictures, and videos, as well as the sharing of links, pictures, and videos from external sources (e.g., news sites, other social media platforms) on the users' own Facebook wall. Overall, over a period of 3 months, on average users' ratio of self-generated content over the total number of Facebook updates was 0.56 (SD = 0.33, Range = 0.00–1.00).

2.3. Self-report data

We collected information about participants' gender (male, female) and age (age groups: 18–25 years, 26–30 years, 31–35 years, 36–45 years, 46–55 years, 56–65 years, > 65 years). Next, we administered two single-item scales assessing self-esteem and happiness. We used single-item measures as a strategy to reduce administration time and limit the impact of missing data.

Regarding self-esteem, we administered the single-item self-esteem scale (SISE, Robins et al., 2001). The SISE was developed as a brief alternative to the Rosenberg Self-Esteem scale, showing remarkably similar correlations with external criterion measures, including demographic variables, personality traits, depression and anxiety (e.g., Brailovskaia and Margraf, 2016; Harris et al., 2018; Robins et al., 2001). Participants are asked to indicate to what extent the following statement applies to them: "I have high self-esteem." Answers are rated on a 7-point rating scale ranging from 1-"Not at all true of me" to 7-"Very true of me". In our sample, the average value for the SISE was 4.31 (SD = 1.80, Range = 1–7).

Participants' current happiness was assessed using the following single-item measure: "In general, how happy are you these days?" which was adapted from the cross-national study by Hart and colleagues (2018). Participants indicated their degree of happiness on a 5-point Likert-scale from 1-"very unhappy" to 5-"very happy". Use of single items in measuring happiness is considered to be reliable and valid, demonstrating remarkably similar concurrent validity with the Satisfaction with Life Scale (SWLS, Diener et al., 1985) compared to multiple-item happiness measures (Abdel-Khalek, 2006). Furthermore, the measure used in the present study is similar to other single-item measures widely used in academic research (Veenhoven, 2004, 2020). In the present sample, the average happiness value was 3.39 (SD = 0.86).

2.4. Data analysis

First, we examined zero-order associations between the study measures by computing Spearman correlation coefficients. Next, we performed a serial mediation analysis via multiple linear regression. The diagram is shown in Fig. 1. More specifically, we examined 1) the role of Facebook update frequency (i.e., number of Facebook updates) and users' engagement in self-presentation (i.e., the ratio of self-generated content over the total updates) as predictors of current perceived happiness and 2) the role of both frequency (i.e., number of Facebook updates receiving Likes) and intensity (i.e., the average number of Likes received per update) of positive feedback received by other users, as well as self-esteem, as mediators of these links. Please note that in assessing mediation, we refer to the criteria proposed by Hayes (2017). Estimation of all path coefficients and 95% confidence intervals were estimated using non-parametric bootstrapping with 10,000 samples and the HC4 heteroscedasticity-consistent estimator by Cribari-Neto (2004). We used this estimation approach because it relaxes distributional assumption on residuals, allowing for inference even if residual errors do not follow normal distributions or constant error variance (e.g., Efron and Tibshirani, 1993; Fox, 2015; Hayes & Cai, 2007). In all analyses, we also controlled for effects of gender (female = 1, male = 0) and age. For the purpose of examining age effects, we created a dummy variable distinguishing between adolescents and young adults aged ≤ 25, which were coded as 0 (67% of participants) and older adults aged ≥ 26 years, coded as 1 (33% of participants). All effects were deemed important if 95% confidence intervals did not span zero. Estimation of path coefficients was performed using SPSS, version 23, and the Process macro (Preacher & Hayes, 2004).
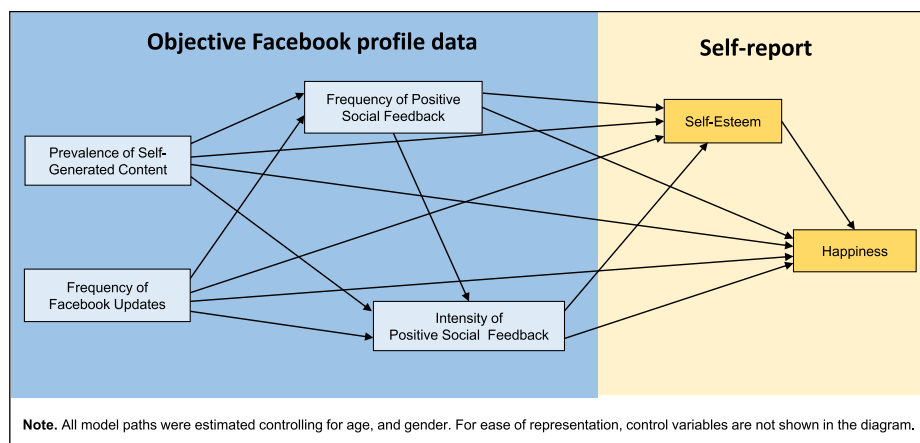

Fig. 1. Diagram for the serial mediation model.

3. Results

3.1. Associations between study measures

Results of Spearman correlations computed among the study measures are shown in Table 1. The frequency by which users posted updates on their Facebook page showed a strong positive correlation with the frequency of users receiving positive social feedbacks by their social network (i.e., the number of status updates receiving at least one Like), a small negative correlation with intensity of positive social feedbacks (i.e., average number of Likes received by each update) and a small positive correlation with age. The latter also showed a small positive association with the frequency of positive social feedback. In turn, the prevalence by which users shared self-generated content in their Facebook updates (i.e., the ratio of updates including self-generated content and the total number of updates) showed a moderate positive correlation with the intensity of positive social feedbacks, which in turn showed small positive correlations with both self-reported self-esteem and happiness. Finally, self-esteem showed a small positive correlation with age, a small negative correlation with female gender and a moderate positive correlation with happiness. Remaining correlations were either non-significant or negligible in size ($\rho < 0.10$).

3.2. Mediation analyses

Fig. 2 illustrates the model's path coefficients and relative 95% confidence intervals for main effects, while results for control variables are only reported in the text. Results showed that Facebook update frequency was a strong positive predictor of frequency of positive social feedback received by other Facebook users and a negative predictor of the average intensity of positive social feedback received. Additionally, the prevalence of self-generated content in users' Facebook updates emerged as a positive predictor of both the frequency and intensity of positive social feedback received by the updates.

Participants' frequency of Facebook updates emerged as negative direct predictor of self-esteem, but showed no significant direct association with current happiness. The frequency of positive social feedback was a direct positive predictor of both positive social feedback intensity, and participants' self-esteem, but showed no significant direct association with current happiness. In turn, intensity of received positive social feedback was a direct positive predictor of both self-esteem and happiness. Self-esteem showed a strong positive association with participants' happiness.

Regarding control variables, age showed a positive effect on the frequency (b = 1.189, *95%CI* [0.186, 2.193], β = 0.016) and a negative effect on the intensity (b = -2.142, *95%CI* [-3.404, −0.881], β = -0.058) of positive social feedback received. Age also showed a positive effect on self-esteem (b = 0.402, *95%CI* [0.252, 0.552], β = 0.105). Female gender was associated with lower self-esteem (b = -0.758, *95%CI* [-0.913, −0.603], β = -0.183), but greater happiness (b = 0.232, *95%CI* [0.158, 0.307], β = 0.117).

Examination of indirect effects (see Table 2) showed evidence of both simple and serial mediation effects linking participants' Facebook update frequency and prevalence of self-generated content to happiness. It is worth noting that emerging indirect effects were generally quite small.

With regard to simple mediation effects, results showed that frequency of Facebook updates indirectly affected happiness via the positive mediation of frequency of positive social feedback and via distinct simple negative mediation effects passing through intensity of positive social feedback and self-esteem. In turn, prevalence of self-generated content showed an indirect effect on happiness via the simple positive mediation effect of the intensity of positive social feedback.

As regards the hypothesized serial mediation effects, we found evidence of significant indirect effects passing through all the proposed mediators, namely frequency and intensity of positive social feedback, and self-esteem. Specifically, we found that both Facebook update frequency and prevalence of self-generated content showed significant, positive indirect effects on happiness by route of an increase in frequency of positive social feedback, which in turn affected the intensity of positive social feedback, and ultimately increasing users' self-esteem. Of note, all possible serial mediation effects revealed positive indirect effects, except for a negative serial mediation effects linking the frequency of Facebook updates to happiness by route of intensity of positive social feedback and self-esteem (but not passing through frequency of positive social feedback).

Table 1
Spearman correlations between study measures.

		1	2	3	4	5	6	7
1	Frequency of Facebook Updates	–						
2	Prevalence of Self-Generated Content in Facebook Updates	−0.133[**]	–					
3	Frequency of Positive Social Feedback	0.965[**]	−0.065[**]	–				
4	Intensity of Positive Social Feedback	−0.170[**]	0.430[**]	−0.044*	–			
5	Age	0.189[**]	0.027	0.172[**]	−0.045*	–		
6	Gender	0.033	0.001	0.056[**]	0.077[**]	−0.010	–	
7	Happiness	−0.057[**]	0.021	−0.041*	0.106[**]	0.035	0.053[**]	–
8	Self Esteem	−0.010	0.032	0.006	0.099[**]	0.101[**]	−0.177[**]	0.353[**]

Note. * p < .05, **p < .01. Gender is coded: Female = 1, Male = 0. Age is coded: ≥ 26 years = 1, 18 – 25 years = 0.
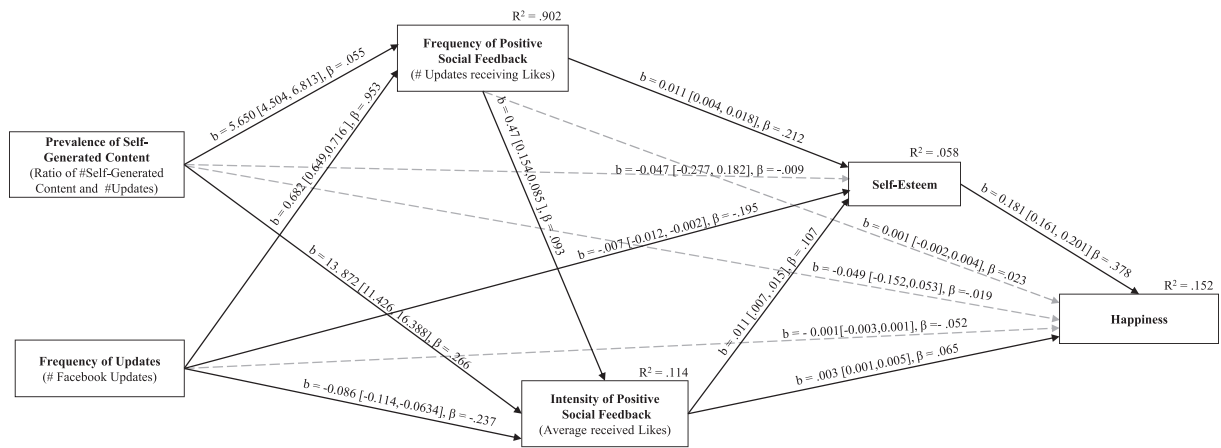
Fig. 2. Serial mediation model: Unstandardized effects (b) with 95% confidence interval and standardized effects (β) for model paths.

Table 2
Estimated indirect effects and 95% confidence intervals (10,000 bootstrap samples).

Route of Indirect effect	Effect	95% Confidence Interval		Standardized Effect
		Lower Limit	Upper Limit	
Frequency of Updates → Frequency of Feedback → Happiness	0.0004	−0.0014	0.0024	0.0225
Frequency of Updates → Intensity of Feedback → Happiness	−0.0003	−0.0005	−0.0001	−0.0154
Frequency of Updates → Self-Esteem → Happiness	−0.0013	−0.0023	−0.0004	−0.0738
Frequency of Updates → Frequency of Feedback → Intensity of Feedback → Happiness	0.0001	0.00003	0.0002	0.0058
Frequency of Updates → Frequency of Feedback → Self-Esteem → Happiness	0.0014	0.0006	0.0022	0.0764
Frequency of Updates → Intensity of Feedback → Self-Esteem → Happiness	−0.0002	−0.0003	−0.001	−0.0095
Frequency of Updates → Frequency of Feedback → Intensity of Feedback → Self-Esteem → Happiness	0.0001	0.00002	0.0001	0.0036
Prevalence of Self-Generated Content → Frequency of Feedback → Happiness	0.0034	−0.0123	0.0192	0.0013
Prevalence of Self-Generated Content → Intensity of Feedback → Happiness	0.0451	0.0189	0.0735	0.0173
Prevalence of Self-Generated Content → Self-Esteem → Happiness	−0.0084	−0.0506	0.0330	−0.0032
Prevalence of Self-Generated Content → Frequency of Feedback → Intensity of Feedback → Happiness	0.0009	0.0002	0.0018	0.0003
Prevalence of Self-Generated Content → Frequency of Feedback → Self-Esteem → Happiness	0.0114	0.0045	0.0184	0.0044
Prevalence of Self-Generated Content → Intensity of Feedback → Self-Esteem → Happiness	0.0276	0.0160	0.0402	0.0106
Prevalence of Self-Generated Content → Frequency of Feedback → Intensity of Feedback → Self-Esteem → Happiness	0.0005	0.0002	0.0010	0.0002

4. Discussion

The aim of the present study was to address currently open questions concerning the relationship between receiving Likes from other users on Facebook, perceived self-esteem, and happiness. In particular, following the model proposed by Valkenburg and colleagues (2006), we tested if increased active Facebook use (i.e., frequency of user updates) would reflect in an increased frequency and intensity of positive social feedback received online (i.e., frequency and intensity of the Likes' response), which in turn would positively affect happiness by means of increased self-esteem. As a secondary aim, we explored whether a specific aspect of users' online self-presentation on Facebook, i.e., the prevalence by which users included self-generated content in their updates, would result in an increase in positive social feedback, which in turn might boost their self-esteem and current happiness level. To our knowledge, we investigated these links for the first time in one study – also considering digital footprints of Facebook activity – because earlier works only investigated parts of these associations.

Overall, findings appear to support either direct or indirect associations between active Facebook use frequency and both self-esteem and happiness, partially by route of increased frequency and intensity of positive social feedback received online. In particular, the frequency by which Facebook users updated their profiles showed respectively positive and negative effects on the frequency and intensity of positive feedback received from their social network (i.e., the frequency and mean number of received Likes). Additionally, we found the intensity of positive social feedback experienced from users' audience was positively associated with current happiness both directly and indirectly via increased self-esteem. Overall, these findings are coherent with those reported by Valkenburg and colleagues (2006) in the context of early social media platforms (e.g., MySpace), and suggest an underlying process linking users' social media activity, feedback received by their online social networks, and perceived happiness.

Our findings also highlight that Facebook users showing a higher prevalence of self-generated content in their updates (e.g., personal texts and images, or mentions of friends and current location) tend to receive more frequent and intense positive response from their immediate social network on Facebook. These results are in line with findings indicating that users who are more willing to disclose online and share more about themselves on their social media profiles tend to receive a stronger response by their online social network (e.g., Epstein et al., 2015; Liu and Brown, 2014; Wang et al., 2013). Above already existing literature, we found that this process might indirectly affect users' happiness by route of an increase in self-esteem.

As regards the link between Facebook Likes and self-esteem, our findings shed new light on heterogeneous findings in the literature, where a positive link between positive feedback on Facebook and self-esteem was observed by some authors (e.g., Burrow & Rainone, 2017; Forest & Wood, 2012), but not by others (e.g., Hong et al., 2017; Metzler & Scheithauer, 2017). We stress that, comparably, our findings might be more valid in some ways, because we included objective recordings of users' updates and their received Likes in our work. Hence, we did not rely on self-report with respect to received Likes, avoiding issues related to social desirability and problems in memory recall. In this context, a study by Deters & Mehl (2013) relying on objective measures of Facebook activity needs to be mentioned. In their study, the authors found that posting more than normal due to the experimental condition was associated with decreased loneliness but it was not associated with happiness. Additionally, the response received by other users (e.g., comment and Likes) did not affect the impact of frequency of posting on users' well-being. Accordingly, these findings are not in line with our findings on the positive role of Likes on users' subjective happiness. However, the experimental nature of the study by Deters & Mehl (2013) makes it difficult to compare it to our study. Additionally, their study did not include a measure of self-esteem, which makes the present study innovative.

Our study also shows interesting residual associations between user activity on Facebook, self-esteem and happiness. More specifically, in our study we found that, after controlling for frequency and intensity of Likes' response, active Facebook use (i.e., the number of Facebook updates posted by the user in the considered time frame) had a negative direct association with self-esteem. Moreover, active Facebook use showed a negative indirect effect on happiness passing through a decrease in self-esteem. Hence, it appears that once the positive effect of receiving a positive response from one's own social network is partialized out, active social media use may show negative residual effects on self-esteem and happiness. Because we could not find other studies examining the same set of effects as those explored in our study using measures of Facebook activity, a comparison of our results with previous findings is difficult. However, we believe our findings to be coherent with those emerging from a recent study by Wang and colleagues (Wang et al., 2019) exploring the links between activity on WeChat (i.e., China's most popular social media app, Statista, 2020b) and self-reported self-esteem in a sample of Chinese adults. More specifically, they explored the links between frequency of active WeChat use (i.e., the number of status updates, also referred to as WeChat Moments), the number of received Likes and self-esteem. In their manuscript, the authors highlighted the existence of a positive association between receiving Likes and self-esteem. In turn, when controlling for the number of received Likes, the frequency of active WeChat use emerged as a negative direct predictor of self-esteem. Combined with results emerging from our study, these findings are in line with those reported by previous studies concerning the negative link between self-promotional behaviors and self-esteem (Mehdizadeh, 2010), as well as the potential negative effect that excessive social media use may exert on self-esteem (e.g., by route of upward social comparisons, Chou & Edge, 2012; Vogel et al., 2014). At the same time, it is possible that users' reporting low self-esteem might like using social media more than individuals with higher self-esteem scores (Liu and Baumeister, 2016; Mehdizadeh, 2010). Because of the cross-sectional nature of the data reported in our study (as well as in the study by Wang and colleagues), we refer to future longitudinal studies to provide a clearer view on the direction of these links.

Overall, we believe our findings on Likes support the hypothesis that receiving Likes might trigger reinforcement learning to return to Facebook. According to our data, receiving Likes might increase self-esteem, and consequently produce a state of happiness. In line with this, Sherman et al. (2016) demonstrated that receiving Likes activated brain regions related to reward processing fostering this aforementioned reinforcement learning. In this context, we also mention work from neuroscience that receiving a Like might be similar to a gain in reputation, which also activates the ventral striatum (Izuma, 2012; Meshi et al., 2013). This means that Like-related activities are learned and upheld, resulting in an increase in positive affect. However, although our data suggests that receiving Likes is linked to happiness (in part via increased self-esteem), it is important to note that the Like feature might also trigger upward social comparison processes, thus resulting in envy and even depressed symptoms (Steers et al., 2014). Accordingly, future studies should consider also the number of Likes one's friends receive to investigate comparison processes in more detail.

Overall, it is important to reflect on what a Like means - both from the side of the person who provides it and from the receiver. A deeper elaboration of what Likes mean shows that individuals tend to like posts due to the content, due to the person and one's relation to the person who posted it, or due to social reasons, hence, to show support or signal that one has seen the post. Moreover, liking a post due to perceived obligation can be a reason to spread Likes (Levordashka et al., 2016). When motives for giving Likes can be different, putatively also the interpretation of Likes by the receiver can differ. For example, Scissors et al. (2016) provided evidence that individuals with low-esteem and high self-monitoring might evaluate the importance of Likes differently. Therefore, future studies might also want to investigate self-monitoring or further investigate self-esteem not only as a mediator – as in our work – but also as a personality trait moderating the link between receiving Likes and well-being (see also Leary & Baumeister, 2000). Moreover, a study by Carr and colleagues (Carr et al., 2016), among others, reports that perceived social support from a Like (or similar constructs on other websites) is lower when the perceiver thinks that the provider of a Like sends Likes automatically without thinking. This also indicates that who sends the Likes might influence their impact on the receiver. With the present study, we cannot test to what extent the perceived motives of Likes by the receiver as well as who the sender is influence the effects of Likes, but future studies might want to consider this for further exploration.

Our study has some limitations. First, the use of a convenience sample of Facebook users from Italy derived from a snowballing

technique limits our ability to generalize findings to the overall population of Facebook users, as well as users of other social media platforms. However, because we recruited a relatively large sample of participants, results appear quite robust. Second, the correlational nature of our study is a limitation, because due to this study design we cannot provide conclusive words on the existence of causal effects between the studied variables. However, because the frequency and content of Facebook updates, as well as the number of Likes received by participants, refer to the three months prior to the administration of the survey, whereas self-esteem and happiness were assessed for the current moment, we believe that our data at least in parts support the suggested directional effects. Another limitation concerns the lack of information about users' Facebook friends. Because of privacy limitations, we could not retrieve information about users' number of Facebook friends, as well as distinguish between Likes received from a friend in the users narrower vs. wider social network, something that is without doubt of relevance (Burke & Kraut, 2016). A final, important limitation relates to the use of single-item, as opposed to multi-item measures of self-esteem and happiness, and the fact that results clearly depend on how you operationalize these psychological constructs (see Diamantopoulos et al., 2012). Our choice to use single–item measures of happiness and self-esteem relates to their usefulness in reducing administration time of the online survey, limiting the prevalence of missing observations, and thus increasing the amount of valid data for the study, without significantly compromising the validity of assessment (Abdel-Khalek, 2006; Robins et al., 2001). In spite of the supposed merits of the employed measures, when compared with multi-item measures, the use of single item measures is expected to result in a higher rate of type II errors when examining associations with external criteria (Sarstedt et al., 2016). For this reason, the use of single-items may have had a negative effect on our ability to estimate the size of associations correctly, possibly resulting in a weakening of the strength of emerging effect-sizes. A replication of our study using multi-item measures of self-esteem and happiness would help to validate our findings.

To conclude, in the present study we demonstrated a link between the frequency and the average number of Likes a person received in the last three months on Facebook and happiness by analyzing objective Facebook activity data. Of note, this link is mediated in part by a rise in self-esteem, and depends on both the frequency and the nature of the content of users' Facebook updates. Future work can extend our study by examining this process using a longitudinal framework, with data collected from other social media platforms, to determine the role of these variables in promoting users' wellbeing and, eventually, continued social media use.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Nevertheless for reasons of transparency Dr. Montag mentions that he has received (to Ulm University and earlier University of Bonn) grants from agencies such as the German Research Foundation (DFG). 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. Dr. Montag mentions that he is part of a discussion circle (Digitalität und Verantwortung: https://about.fb.com/de/news/h/gespraechskreis-digitalitaet-und-verantwortung/) debating ethical questions linked to social media, digitalization and society/democracy at Facebook. In this context, he receives no salary for his activities. Finally, he mentions that he currently functions as independent scientist on the scientific advisory board of the Nymphenburg group. This activity is financially compensated. Dr. 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.

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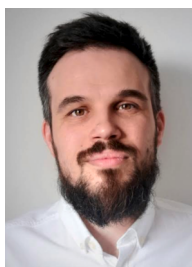
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Christian Montag is interested in the molecular genetics of personality and emotions. He combines molecular genetics with brain imaging techniques such as structural/functional MRI to better understand individual differences in human nature. Adding to this he conducts research in the fields of Neuroeconomics and addiction including new approaches from *Psychoinformatics*. Since more than 10 years he also studies how digitalization impacts on the human brain and psyche.

Cornelia Sindermann is a postdoctoral researcher at Ulm University since April 2019. Her recent research interests focus on the broad topic of digitalization and the data business model, including effects on social media usage, news consumption offline and online, and data privacy and protection. Of major interest in her research is the question about how individual differences in personality traits and characteristics are associated with different behaviors and attitudes about the digitalized world. Another major research interest is the investigation of individual differences in biological variables such as molecular genetics related to psychological phenotypes.

Jon D. Elhai is a professor of Psychology and Psychiatry at the University of Toledo in Toledo, Ohio, USA. He also has an academic affiliation with Tianjin Normal University in Tianjin, China. He has an area of research on posttraumatic stress disorder, studying the disorder's underlying symptom dimensions and relations with cognitive coping processes and externalizing behaviors. He also has a program of research on cyberpsychology and internet addictions, examining problematic Internet and smartphone use, and the fear of missing out on rewarding experiences (FOMO).

Michele Settanni is a professor of Psychometrics at the University of Turin in Turin, Italy. His main interest is in the assessment of symptoms of psychological distress and well-being based on questionnaire data as well as indicators of technology use. He also has interest in research on the predictors and consequences of social media addiction in adolescence and young adulthood.