Facebook in context(s): Measuring emotional responses across time and space

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Abstract
This article advances a contextual approach to understanding the emotional and social outcomes of Facebook use. In doing so, we address the ambiguity of previously reported relationships between Facebook use and well-being. We test temporal (shorter vs longer time spans) and spatial (at home vs away from home) dimensions of Facebook activity using an innovative approach. By triggering smartphone surveys in response to users' naturalistic Facebook posting, we captured the immediate context of both mobile and desktop activities during daily life. Findings indicated positive—yet fleeting—emotional experiences up to 10 minutes after active posting and higher arousal for 30 minutes following posting at home. Nonetheless, Facebook activities predicted no changes in aggregate mood over 2 weeks, despite showing positive relationships to bridging social capital during the same period. Our results call attention to fleeting experiences (vs

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enduring consequences) and encourage future research to specify temporal and spatial boundaries.

Facebook users are increasingly diverse with regard to when and where they engage with the platform, as well as *how much* time and *how many* places they do so. Yet little is known about how temporal and spatial factors matter empirically, despite the longevity of personal Facebook accounts and acceleration of mobile Facebook practices. This article extends efforts to clarify the multifaceted role of Facebook by measuring use across contexts. To do so, we build on theoretical work suggesting the user experience of Facebook is strongly shaped by temporality (Kaun and Stiernstedt, 2014) and mobility (Goggin, 2014), and evaluate emotional responses over different timescales and locations.[1] We first capture the *immediate context* of active posting, or how a person feels in the moments following a Facebook post. In doing so, we are able to compare mood based on where one is using the platform, or spatial context, at the time of the Facebook activity. We then contrast this momentary snapshot with a long-term perspective on the aggregate effects of these Facebook posts over 2 weeks.

The two temporal contexts—momentary experiences and cumulative consequences—have the potential to reveal divergent stories about the links between Facebook and emotional states. By considering these temporal frames concurrently, this study pursues a multi-layered understanding of the user experiences that shape the platform. In the sections below, we review extant work on the emotional implications of Facebook use, discuss how contextual factors are likely to moderate the relationship between Facebook use and socio-emotional outcomes, and provide an overview of our approach to measuring "active" Facebook user experiences. We argue that understanding these contextual effects may help to reconcile current ambiguities around positive and negative effects of Facebook use (e.g. Burke et al., 2010; Kross et al., 2013). When first introduced, nearly all new technologies are subject to utopian and dystopian claims about their impacts on individuals and society (Sturken et al., 2004). Similar to other technologies, Facebook is unlikely to have a uniformly positive or negative relationship for all users with regard to "well-being," a state that depends on cultural norms, personality traits, academic definitions, and—as we argue—time and place.

Indeed, the seemingly contradictory findings from prior research are more consistent when decomposed into social and emotional outcomes. In terms of social outcomes, a substantial body of research has examined the role of Facebook in augmenting or compromising perceptions of social support, feelings of social connection, and access to diverse ties and information (Burke and Kraut, 2011; Rozzell et al., 2014; Sheldon et al., 2011; Song et al., 2014). Overall, this area of research provides evidence that Facebook use complements or supplements—rather than substitutes or undermines—users' social resources (Anderson et al., 2012). In terms of emotional outcomes, however, research

suggests mixed relationships with Facebook use. With some exceptions (e.g. Oh, Ozkaya, & LaRose, 2014), research on Facebook use has typically focused on either social or emotional implications independently, obscuring the source of divergent effects.

Review of Facebook and emotion

A growing body of research has explored the relationship between Facebook use and emotional experiences. Across these studies, measurement of emotion has varied in terms of the specific operationalization, as well as across setting (survey, in-lab, in situ) and timescale (cross-sectional, short-term, long-term). Some research has revealed positive correlations between Facebook and life satisfaction (Valenzuela et al., 2009; Wang et al., 2014) and no evidence for depressive consequences (Jelenchick et al., 2013). Other cross-sectional studies have observed negative emotional outcomes, such as increased psychological distress (Chen and Lee, 2013). Chou and Edge (2012) found that people who spent more time on Facebook were more likely to feel that others had better lives than their own. Similarly, Lee (2014) found relationships between social comparison and the "Facebook Intensity" measure, along with a positive correlation between making comparisons on Facebook and overall negative comparisons. Thus, there is some evidence of negative emotional consequences when using Facebook in certain ways, such as engaging in upward social comparison.

A series of in-lab studies have also evaluated the short-term emotional responses to Facebook activities, contributing to an increasingly complex story. In contrast to the findings of Chou and Edge (2012) and Lee (2014) above, Johnson and Knobloch-Westerwick (2014) found fewer negative effects of social comparison on Facebook when participants were experimentally placed in a negative mood beforehand. Gonzales and Hancock (2011) provided experimental evidence that viewing and updating one's Facebook profile leads to enhanced self-esteem. Toma and Hancock (2013) further confirmed the self-affirming value of viewing one's own profile by showing that individuals are more likely to turn to Facebook after receiving negative (vs neutral) feedback on their public speaking. These studies provide examples of how daily offline emotions can transfer over to engagement with Facebook (rather than vice versa), as well as the potential for individuals to rebound on Facebook after threats to their self-esteem. Finally, Sagioglou and Greitemeyer (2014) found evidence for the negative influence of Facebook on mood: users felt that their Facebook activity lacked "meaning" and overestimated how happy Facebook would make them feel, thereby falling victim to an "affective forecasting error."

In addition to cross-sectional and lab-based research, some recent studies have also evaluated in situ short-term mood effects of Facebook using experience sampling method (ESM; Kahneman et al., 2004). Kross et al. (2013) used ESM and found a negative correlation between self-reported time spent on Facebook and positive emotion. By contrast, Mark et al. (2014) found no effect for recent time spent on Facebook (last 5 minutes) on emotional valence at work—but still showed that more time on Facebook at work was associated with better mood at the end of the day. Whereas these studies suggest generalized Facebook activity can be associated with both positive and negative emotional responses, Gonzales (2014) used ESM to evaluate how the quality of the social interaction

influences self-esteem. This study found that having *more meaningful* text-based communication (i.e. Facebook, short message service [SMS], e-mail) during daily life predicted higher self-esteem, while face-to-face or calling conversations did not. Gonzales (2014) suggested that these results stemmed from the enhanced capacity for self-disclosure of computer-mediated communication—that is, increased self-presentational control leads to greater information sharing and intimacy.

One possible reason for the contrary findings reviewed above is that Facebook use does not happen in a social vacuum; contextual factors are likely to influence emotional effects. Yet, with a few exceptions, research on Facebook and emotion has neglected the roles of spatial and temporal context. Spatial context is crucial given that Facebook is not only a desktop or browser-based channel; it is a dynamic platform with over a billion mobile users. Temporal context is needed because social media, and Facebook in particular, "structure our temporal experiences in fundamental ways" (Kaun and Stiernstedt, 2014: 1164). Facebook functions both as a long-term social archive and a "live" social feed with a short-term flow experience (Kaun and Stiernstedt, 2014), and these uses may be associated with distinct emotional outcomes. Some shifts in emotional state may only be visible over weeks, months, and years, whereas other emotional states change on the order of minutes or seconds.

The mixed findings also suggest the need for researchers to differentiate *how* users are engaging with the platform. Increasingly, scholarship in this space has contrasted more "active" and "passive" activities on the site (Burke and Kraut, 2011, 2016; Frison and Eggermont, 2015; Verduyn et al., 2015; Wise et al., 2010). Active uses include posting and commenting, whereas passive uses are limited to browsing the News Feed and Profile pages without leaving feedback. Using electromyography (EMG) to measure physiological responses, Wise et al. (2010) revealed that browsing was perceived as less pleasant than more active practices. Supporting this finding, an experiment by Verduyn et al. (2015) showed a strong negative relationship between positive affect and passive use. With regard to "active" uses, Burke et al. (2010) and Deters and Mehl (2013) showed that certain active Facebook practices were tied to lower loneliness. Finally, Frison and Eggermont (2015) also found negative correlations between mood and between passive use (and also mood and active public use), but not active private use. As a whole, research shows that passive use is associated with more negative emotions, but provides a mixed record on active posting. For instance, the Verduyn et al. (2015) experiment also observed a positive trend—yet insignificant relationship— between active use and positive affect.

Current research

Given the current state of research, we suggest that understanding the emotional implications of Facebook requires an increased focus on the immediate context of active posting. In response, we developed a method to capture mood in the minutes directly following participants' own Facebook posts. In addition, we assess the long-term implications of these emotional responses over 2 weeks and compare them with a social dimension of well-being: bridging social capital, a form of perceived social network resources consistently linked to Facebook use in previous work. Taken together, this

research study pursues a more complex interpretation of Facebook that attends to both fleeting experiences and enduring consequences.

Mobile Facebook and immediate context

Scholarship on mobile media suggests that consideration of when and where Facebook users access the platform—not just what they are doing—is also important for understanding platform effects (e.g. Ling and Campbell, 2010). Since Facebook is used increasingly "on-the-go" through mobile applications, users' emotional responses may be shaped by mobile affordances such as locatability (e.g. via global positioning system [GPS]) and portability (Chan, 2015; Schrock, 2015). In particular, mobile Facebook use allows individuals to post at any chosen moment and post from a wider variety of locations. Such capabilities enable individuals to engage with Facebook in very different ways, such as "checking-in" with location-aware features (Wilken, 2014). As Goggin (2014) writes, "the practices, possibilities, imaginaries and mobilities of mobile Facebook certainly take on different forms in particular places and cultural settings" (p. 1075).

By excluding mobile activities, many methods may obscure immediate emotional reactions to Facebook use in daily life. As detailed above, the majority of studies have focused on long-term mood using cross-sectional surveys or short-term mood effects using in-lab manipulations. Unfortunately, such methods circumvent more naturalistic forms of use (e.g. mobile practices) and are more vulnerable to demand characteristics and "good subject" biases that may artificially shape experiences. Indeed, an emotional response may be quite different when an individual spontaneously decides to post after getting a new job, as opposed to being instructed to do so in-lab. This possibility is particularly likely if measurement occurs an extended period of time after posting. For example, a status update about how one is feeling "right now" may provide an emotional release that evaporates before a survey response is captured hours, weeks, or months later. Thus, reliance on gross measures of activity or in-lab conditions may mask the underlying dynamics of how Facebook use shapes mood.

Therefore, previous studies on the emotional correlates of Facebook use have disregarded the immediate context of sharing "in the wild"—how people feel directly after sharing on Facebook in their everyday lives (cf. Mark et al., 2014). Hence, this study explores the more fleeting facets of emotion in combination with Facebook activity. By concentrating on the *immediate context*, the current research evaluates the temporary, yet still meaningful, implications of active Facebook use. Specifically, we combine unobtrusively logged Facebook activity with in vivo self-reported surveys while also accounting for current spatial context. In doing so, we were able to sample the most proximal dimensions of mood that surround active Facebook activity, including emotional valence (positive to negative), emotional arousal (low energy to high energy), and state self-esteem (Kuppens et al., 2013; Toma, 2013).

Based on the above literature, we proposed two hypotheses regarding emotional experience in the immediate context of active posting on Facebook. First, the act of sharing with others has been shown consistently to produce positive emotions, above and beyond the original experience being shared (Rime, 2009). In other words, it is not just good news that makes people happy; the act of sharing itself allows for a positive echo effect

(Lambert et al., 2012). Therefore, active Facebook posting may produce positive affect, even if it dissipates quickly due to subsequent activities (e.g. passive use; Verduyn et al., 2015). This affective response may also be more pronounced if participants choose when and where they post, as opposed to being instructed to do so in the research lab. Consequently, we hypothesize that logged Facebook use will be associated with more positive mood in the immediate context of an active post, compared to control periods that do not immediately follow posting (H1).

Second, psychological research has established that (1) spatial context can affect mood (Stone et al., 1996), (2) environments can impact how people process information (Semin and Smith, 2013), and (3) people sometimes change their environments to restore positive emotional states (Maner et al., 2007). For these reasons, spatial context may also shape the emotional experience of Facebook use. We were particularly interested in this contextual dimension given the range of locations in which people now use the platform. Location has been considered in research on the uses and gratifications of mobile devices (Leung and Wei, 2000), but has been neglected in relation to Facebook and emotion. We build on research suggesting that average mood increases with greater movement away from one's typical location (i.e., "home"; Frank et al., 2013) and that communicating more through mobile devices is associated with more frequent positive affect (Chan, 2015). Based on the positive emotional correlates of being "out-and-about" and mobile communication, we hypothesize that posting on Facebook while away from home will be associated with better mood than posting while at home (H2):

> *H1*. Active Facebook use will be associated with *better short-term mood*.

> *H2*. Location will *moderate* the relationship between active Facebook use and mood, such that posting while away from home will be associated with better short-term mood than posting while at home.

Long-term mood and bridging social capital

As a comparison to the short-term *experiences* of Facebook, we also evaluate how active Facebook posting may relate to long-term *consequences*. This distinction between experiences and consequences represents an important, yet under-theorized, issue within the ambiguous literature on emotional effects. In some cases, immediate mood may mirror more enduring psychological metrics (e.g. life satisfaction). Conversely, individuals may have meaningful experiences that are not detected by common measures of long-term well-being, or vice versa. Even if emotional effects are limited to short-term experiences, the same Facebook practices may influence other long-term factors, such as perceptions of social resources. Thus, another potential source of the contradictory views of Facebook is the lack of integration of multiple strands of research, including the emotional and social consequences of use.

One measure of social resources, bridging social capital, indexes one's access to diverse ideas and a broader community (Steinfield et al., 2012) and can be viewed as a long-term asset within a personal network. As such, bridging social capital is often considered in conjunction with network structure and linked to broader social networks.

Importantly, the most reliable relationship between Facebook use and social resources occurs for perceived bridging social capital (Steinfield et al., 2012). Early work on Facebook and its enhancement of bridging social capital focused on general measures of Facebook use (e.g. Valenzuela et al., 2009). Recent work on the topic suggests social capital perceptions are influenced by specific user practices on the site, including active and passive practices. For instance, previous research has revealed a modest relationship between active Facebook use and bridging capital, but that this occurred primarily through receiving posts from others (Burke and Kraut, 2011). At the same time, individuals who post requests for action on Facebook report more bridging capital (Ellison et al., 2014). Furthermore, Lee et al. (2014) observed that most self-reported Facebook behaviors are positively correlated with bridging social capital, with the largest correlations occurring for active use.

For the current purposes, we sought to examine how active Facebook use might have differential effects on perceptions of long-term mood (including valence, arousal, and self-esteem) and self-reported bridging social capital. We hypothesize that increased active Facebook use would predict higher levels of perceived bridging social capital (H3) but advance a research question for long-term mood (RQ1) given the contradictory state of the literature on emotional outcomes:

H3. Facebook use will predict *increased bridging social capital* over 2 weeks.

RQ1. Does Facebook use predict *changes in mood* over 2 weeks?

Method

Sample

Participants included 154 undergraduates at a large university in the United States. A total of 1656 undergraduates were randomly selected by the Registrar's Office to receive an e-mail describing the study and an invitation to participate, along with a link to an online screening form. Screened individuals ($n=364$) were automatically and immediately informed of their eligibility during the screening based on their responses. To be eligible, an undergraduate was required to be 18 years or older, own a smartphone, have a US phone number, and report posting content to Facebook "daily or almost daily" (in order to limit the sample to moderately active users). All 220 eligible participants were invited to participate in the main study, 159 participants completed the first phase of the study, and 154 participants completed all phases. Within the final sample, 67% of participants identified as female, 74% identified as White, 23% identified as fraternity/sorority members, and 83% reported that one or both parents had a college degree or graduate education. The average age was 20.34 years (standard deviation [SD]=2.02).

Procedure

The data collection was completed in March–April 2014 and included three components: (1) an online baseline questionnaire with demographic items, (2) six daily ESM surveys

over 14 days, and (3) an online endpoint questionnaire. During the ESM component, participants received six surveys each day for 2 weeks, spaced semi-randomly during each day. The sixth and final survey each day was longer than the other five, asking questions about the full day in addition to the standard questions. Participants were paid for completing surveys in three complementary ways to motivate participation: (1) US$0.50 for each regular survey completed, (2) US$1.00 for each end-of-day survey completed, and (3) an additional US$1.50 for completing all six of the surveys in a given day. The final completion rate was 89% (range: 33–100%), with 128 of 154 participants completing 80% or more of the 84 ESM surveys.

Mixed-context experience sampling

To measure Facebook activity in "real time," we paired two types of data collection used separately in past research: logged usage data via the Facebook application programming interface (API) and ESM. We developed an algorithm that distributed ESM surveys semi-randomly during waking hours, excluded class and work periods, and accounted for the time since last survey (such that participants received survey prompts approximately every 2 daylight hours). We set up a system such that ESM surveys were sent in response to real-time Facebook activity. Specifically, when a participant posted content to Facebook, our triggering system would send them an ESM survey in the next 5 minutes (unless the participant had received a survey in the last hour, or had already received all of their ESM surveys for the day). Participants were instructed to complete a survey "right away" after receiving it, but not to answer a survey once a newer one had arrived. The survey questions were designed such that they could be answered whenever the participant opened the survey link, even if the text had been delivered at an earlier point, and regardless of the time lapsed since posting. The surveys were typically completed in less than 2 minutes given their short length.

   Triggering surveys in response to actual usage results in more accurate data than standard surveys about past behavior (Möller et al., 2013), and captures a different dimension of user experience than self-reported estimates or sums of logged activity. Our method, similar to recent "context-triggered" approaches (Chang et al., 2015), allowed us to detect mood in the minutes following real-time posting during daily life, when perceptions are more likely to be accurate and salient. Although our consent procedure described collection of both wall data and the in vivo survey method, the ESM surveys did not indicate what triggered them, thus minimizing demand characteristics. Likewise, the exact time (1–5 minutes) between post and survey was randomized in order to limit the chances that participants would realize that surveys were triggered via Facebook posting. Finally, participants received control surveys at matched times of day that were not linked to posting. Altogether, the protocol was designed to reduce bias in the data collection, such that participants would not be able to easily differentiate between the Facebook-triggered and regular surveys.

Measures

At the baseline and endpoint appointments, participants completed a survey on perceptions of bridging social capital taken from Williams (2006). The scale includes items

such as "Interacting with people in my social network makes me feel like part of a larger community" and "Interacting with people in my social network makes me want to try new things." Within each ESM survey, questions were asked about participants' current location (A), emotional valence (B), emotional arousal (C), and self-esteem (D): (A) "*Where are you right now?*" with responses "at my home," "walking outdoors," "riding in a car," "riding on public transportation," "at someone else's home," "at work," "at school," "in public indoors," "in public outdoors," (B) "*How negative or positive do you feel right now?*" with responses from "very negative" to "very positive," (C) "*How low energy or high energy do you feel right now?*" with responses from "very low energy" to "very high energy," and (D) "*I have high self-esteem right now*" with responses ranging from "not at all true of me" to "very true of me." Other items (not reported here) asked about their most recent social interaction (see Bayer et al., 2016). To test H1 and H2 related to changes in mood, we ran models with three separate dependent variables (valence, arousal, and self-esteem). Given that seemingly small temporal differences can matter when evaluating mood (Mark et al., 2014), we tested models at both 10-minute and 30-minute intervals.

During the 2-week ESM period, participants' Facebook Timeline activities were logged via the Facebook API. The Timeline includes all content posted to the owner's Facebook Friends network, content shared with the owner by other users, and some automated logs of Facebook activity (e.g. participant likes/comments, new friendships, tagged photos). We grouped these logged posts into the following seven categories: wall posts, public statuses, comments, attended events (i.e. RSVPs), new friendships, tagged photos, and received posts. The location variable was recoded as "home" versus "away," with "away" including all categories other than the "at my home" option. To test our hypotheses related to temporal factors, we recoded the logged API data. For the momentary emotional state models (H1, H2), dichotomous variables were created based on whether an active Facebook post occurred within a specific time span preceding the survey (i.e. 10 minutes, 30 minutes). Active posts were defined as status updates, wall posts, and comments made by the participant. Hence, for any given smartphone survey, if a participant posted in the 30 (or 10) minutes prior to when that survey was started, then the Facebook variable was coded as a "1" (vs "0") for that survey. For the cross-sectional and longitudinal analysis of cumulative effects (H3, RQ1), the seven logged categories were summed for the 2-week period in order to evaluate how total usage predicted social capital and average mood over the 2 weeks. Over the course of 2 weeks, there were 4508 total posts recorded and 2203 active posts recorded (721 comments, 661 statuses, and 821 wall posts). On average, we recorded 29.27 total posts (min = 0, max = 204) and 14.31 active posts (min = 0, max = 70) per participant over the study period.

ESM data analysis

Our analysis plan for H1 and H2 was developed around the hierarchical nature of the ESM data. Linear mixed models were used in order to account for non-independence of observations within participants and days. Hence, in each model, day (1–14 for the 2 weeks) was nested within participants (1–154) with intercept terms specified as

random effects (i.e. allowed to vary across days and participants). Models were run in R using the lmer function via restricted maximum likelihood (REML) estimation within the lme4 package, and the lmerTest and arm packages were used to assess model fit and coefficients. Linear mixed models represent a robust way to take advantage of this large data set, as they allowed us to model effects using information about the full sample with limited observations within close proximity to logged Facebook posts. To empirically determine the temporal periods for our model comparisons, we analyzed the data using the logged Facebook and logged survey completion time stamps. All models included covariates for gender and age, which have been shown to be important predictors for Facebook use in other work (Anderson et al., 2012). To confirm that we were not simply observing general effects of disposition on mood, we controlled for the lagged effects of the previous emotional response within the same day (time $T-1$) on current response (time T).

Results

Linear mixed models for short-term effects

In all models, significant positive main effects were observed between the DVs and being away from home. Thus, participants uniformly expressed more positive emotions when away from home, independent of Facebook activity. This relationship has been observed before (Frank et al., 2013) and was not the main focus of the current investigation, but is controlled for in all models below. In total, there were 380 "active" Facebook posts that occurred in the 10 minutes before a survey was started and 588 posts that occurred in the 30 minutes before a survey was started. For all models, we tested two versions: (1) models including main effects only and (2) parallel models including our theorized interaction with location. Conducting separate analyses in this way helped to clarify the conditional nature of the observed effects.

We first examined the effect of active Facebook posting in the previous 10 minutes on current emotional valence. Emotional valence was significantly more positive if an active post was made in the previous 10 minutes. However, previous posting behavior was not related to emotional valence when extending the time window to 30 minutes before. These relationships did not depend on location, such that the interaction term between posting and location was not significant (see Table 1).

We next examined the effect of Facebook posting behavior on emotional arousal, observing a positive effect for posts occurring in the previous 10 minutes. However, as shown in Table 2, we also found a significant interaction with location, which clarified the relationship between active posting and arousal. Specifically, those who posted in the 10 or 30 minutes prior to being surveyed expressed higher levels of emotional arousal when at home. By contrast, Facebook posting was not associated with different levels of arousal when individuals were away from home. The observed moderation effect for location by posting behavior is presented in Figure 1.

Finally, we examined the effect of posting behavior on current self-esteem. There was no significant main effect of posting on self-esteem in the previous 10 nor 30 minutes, nor for the interaction term with location. In sum, H1 (posting effect) was supported for

Table 1. Linear mixed-effects models for short-term valence.

| | Main effect (H1) | | | | Interaction effect (H2) | | | |
| | 30 minutes | | 10 minutes | | 30 minutes | | 10 minutes | |
Random effects	ICC	Var	ICC	Var	ICC	Var	ICC	Var
Day[a] (intercept)	.05	.04	.05	.04	.05	.04	.05	.04
Participant (intercept)	.14	.12	.14	.12	.14	.12	.14	.12
Fixed effects	γ	*t-value*	γ	*t-value*	γ	*t-value*	γ	*t-value*
Day	−.02***	−6.14	−.02***	−6.08	−.02***	−6.11	−.02***	−6.07
Day[b]	.00	1.08	.00	1.10	.00	1.06	.00	1.10
Age	−.03	−1.13	−.03	−1.18	−.03	−1.13	−.03	−1.18
Gender	.09	1.45	.09	1.47	.09	1.46	.09	1.49
Mood^{T-1}	.26***	24.33	.26***	24.64	.26***	24.35	.26***	24.64
Location	−.12***	−6.13	−.13***	−6.48	−.13***	−6.27	−.13***	−6.47
Facebook[b]	.05	1.15	.11*	2.24	−.01	−0.10	.09	1.25
Location × Facebook	–	–	–	–	.11	1.34	.05	0.54
Observations	8103		8256		8103		8256	

ICC: intraclass correlation coefficients.
All reported coefficients are standardized.
[a]As described in the text, the first random intercept represented day nested within participant.
[b]As indicated at the top of the table, we tested each hypothesis at two temporal thresholds: <10 minutes since last Facebook post and <30 minutes since last Facebook post.
#$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

emotional valence in the next 10 minutes but was not supported for arousal or self-esteem. H2 (location effect) was not supported for valence nor self-esteem, and actually revealed the opposite relationship for arousal (active posting was associated with increased arousal when participants were at home).[2]

Cross-sectional and longitudinal models for cumulative effects

To test the hypothesis that Facebook use is positively correlated with perceived bridging social capital (H3), we first correlated logged counts of Facebook use over 2 weeks with the social capital measures collected at baseline and endpoint. All bivariate correlations are presented in Table 3. The zero-order correlations demonstrated that people who added Friends, $r(152) = .42$, $p < .001$, and said they would attend events, $r(152) = .23$, $p < .005$, during the 2-week period had higher baseline perceptions of social capital. We also correlated each logged post type with a difference score of social capital, thereby indexing the change in perceptions over the 2-week period. We observed a significant positive correlation between the number of tagged photos and change in bridging social capital, $r(152) = .17$, $p < .04$, and insignificant relationships for all other recorded

Table 2. Linear mixed-effects models for short-term arousal.

	Main effect (H1)				Interaction effect (H2)			
	30 minutes		10 minutes		30 minutes		10 minutes	
Random effects	ICC	Var	ICC	Var	ICC	Var	ICC	Var
Day[a] (intercept)	.05	.04	.05	.05	.05	.04	.05	.05
Participant (intercept)	.08	.08	.08	.08	.08	.08	.08	.08
Fixed effects	γ	t-value	γ	t-value	γ	t-value	γ	t-value
Day	−.01***	−4.42	−.01***	−4.28	−.01***	−4.38	−.01***	−4.21
Day[b]	.00	1.64	.00	1.46	.00	1.61	.00	1.46
Age	−.03	−1.54	−.03	−1.44	−.03	−1.54	−.03	−1.44
Gender	.10#	1.86	.10#	1.82	.10#	1.87	.10#	1.84
Mood^{T-1}	.27***	24.90	.26***	24.38	.27***	24.87	.26***	24.32
Location	−.28***	−12.56	−.29***	−12.97	−.29***	−12.70	−.30***	−13.24
Facebook[b]	.09#	1.86	.14*	2.48	.00	−0.07	.00	−0.01
Location × Facebook	–	–	–	–	.19*	2.01	.29**	2.60
Observations	8076		8228		8076		8228	

ICC: intraclass correlation coefficients.
All reported coefficients are standardized.
[a]As described in the text, the first random intercept represented day nested within participant.
[b]As indicated at the top of the table, we tested each hypothesis at two temporal thresholds: <10 minutes
 since last Facebook post and <30 minutes since last Facebook post.
#$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

activities. Overall, these analyses demonstrate small positive relationships (event attendance or RSVPs, tagged photos) and one larger relationship (new friendships) with perceived bridging social capital.

In order to test the hypothesis that photo tagging is positively correlated with change in bridging social capital (H3) in a more robust manner, we also ran a multiple regression model with the following predictors: bridging social capital (baseline), age, gender, fraternity/sorority affiliation, self-reported frequency of Facebook posting, self-reported time spent on Facebook, average mood (index of valence, arousal, and self-esteem measures over the 14-day period), and logged count of tagged photos. By controlling for baseline social capital, the model tested whether tagged photos were associated with increased bridging social capital since the start of the study period. The resulting model (Table 4) showed that tagged photos remained a significant positive predictor of bridging social capital (T2) while controlling for other demographic variables, Facebook-specific activity, and average mood. To test whether Facebook use predicts changes in daily mood (RQ1), we examined Facebook use in relation to mood averaged across the 2-week period, and mood changes from the study start (days 1 and 2) to study end (days 13 and 14). We tested RQ1 using multiple
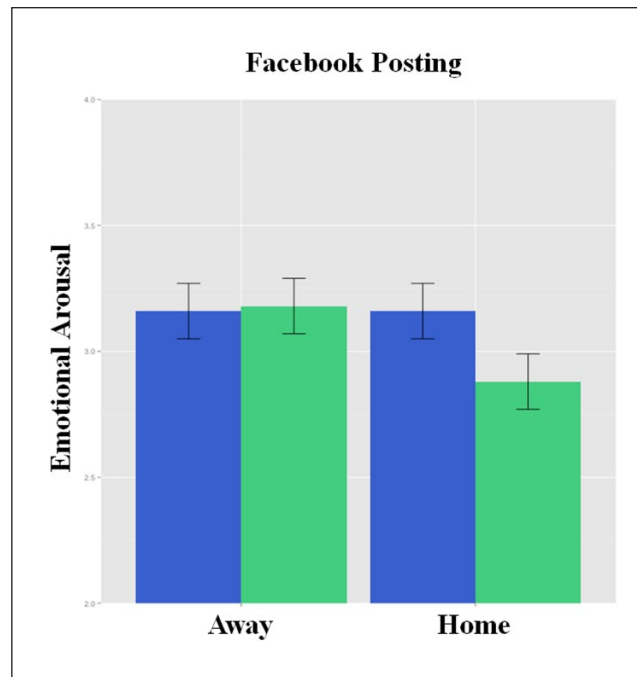
Figure 1. The interaction effect between active Facebook use and location for emotional arousal (H2) is presented above. Blue bars represent observations in which a logged Facebook post occurred in the 10 minutes preceding a survey response. Error bars were created using the standard error of the interaction term in the mixed-effects model. Results revealed that when participants were home (right), Facebook posting was associated with significantly higher emotional arousal (vs. no activity).

Table 3. Bivariate correlations between logged Facebook use and social capital (white) and mood (gray) are displayed for variables aggregated across the 2-week study period.

Logged Facebook use (14 days)	Bridging capital baseline	Bridging capital endpoint	Bridging capital change	Valence change	Arousal change	Self-esteem change
Friendships	.41**	.38**	.05	.02	.10	−.05
Wall posts	.15	.16*	.04	.05	.05	−.03
Statuses	.12	.19*	.11	.12	−.02	.08
Tagged photos	.12	.23*	.17*	.07	.02	.14
Received	.07	.15	.11	.12	.00	.03
Events	.23**	.28**	.11	.11	.11	.02
Comments	.05	.05	.00	.04	−.06	−.01

*$p < .05$; **$p < .01$.

analytic techniques; however, we found no evidence that long-term mood was related to Facebook activity of any kind.[3]

Table 4. Multiple regression model predicting bridging social capital at study endpoint.

Variable	b	SE	t-value	Sig.
Age	.014	.018	0.74	.46
Gender	.087	.077	1.13	.26
Fraternity/sorority membership	.150	.090	1.66	.10
Baseline bridging social capital	.725***	.077	9.46	<.001
Self-reported post frequency	.004	.026	0.13	.89
Self-reported time spent	.000	.001	0.38	.70
Average mood (14 days)	.130	.072	1.81	.07
Logged tagged posts (14 days)	.051*	.211	2.40	.02
	$R^2 = .47$			
	$F(138) = 15.07$***			

SE: standard error.
All reported coefficients are unstandardized.
*$p < .05$; **$p < .01$; ***$p < .001$.

Discussion

We theorized that the divergent conclusions reached in past research might be due to dissimilar contexts, such as being home versus away, and operationalization of core concepts, such as emotional versus social outcomes. In response to such ambiguity, we assessed Facebook use across two contextual dimensions: temporal scale and current location. Active posting behavior was significantly associated with short-term emotional experiences—positive valence and higher arousal when at home—but not related to aggregate mood or bridging social capital over the long term. Nevertheless, other forms of Facebook use (new Friendships, event RSVPs, and tagged photos) were associated with increases in bridging social capital.

Ultimately, our findings demonstrate the lack of a uniform overall "Facebook effect" on individuals, and illustrate the need to build temporal and spatial components into future research on Facebook and the wider social media ecosystem. In contrast to some studies, we find no evidence that active Facebook use is undermining the mood of users in minutes, days, or weeks. To the contrary, we find positive associations between active use and emotional states (under certain conditions). Of course, there is some possibility that our divergent findings reflect differences in sample populations; for example, Sagioglou and Greitemeyer (2014) drew online adult samples from Amazon Mechanical Turk. Similar to most of the broader literature described above, our sample consisted of college students in the United States.

On the other hand, some of the discrepancy between prior negative findings and this study may arise from our measure of social interaction "in the wild." By combining ESM with real-time logged activity data, we reveal how the emotional experience of Facebook is context-dependent. Studies that bring individuals into an artificial context (e.g. research lab) and manipulate their Facebook behavior may not emulate the dynamics uncovered by our method. At the same time, a few limitations should be kept in mind. First, this study focuses on the emotional outcomes of *active* Facebook use—whereas some research suggests that

passive use leads to negative outcomes—and thus our method is less likely to identify negative outcomes. Second, the relatively rare occurrence of active posting presumably limits the total emotional effect in our sample. Finally, although ESM represents a preferred method for measuring daily experiences, such "pop-up" surveys may also bias behavior.

The positive correlations observed for Facebook activity and baseline social capital reaffirms a basic relationship between these variables (Steinfield et al., 2012). One contribution of this study is that it employs recent activity logs to identify the specific activities that are linked to perceptions of social capital (cf., Burke et al., 2011). In doing so, we found insignificant links between active uses (statuses, wall posts, comments) and bridging social capital. In contrast, we found that new friendships and event RSVPs were more strongly tied to baseline and endpoint bridging social capital, and observed a positive relationship between tagged photos and perceived *changes* in social capital over the 2-week study period. These Facebook behaviors are not "active" or "passive" as typically operationalized, but have conceptual links to bridging social capital (e.g. new friendships likely will result in network expansion).

Nonetheless, most events, photos, and friendships are tied to "offline" activities, indicating that these Facebook metrics are also indexing external resources. New Facebook friendships directly increase the span of one's network and attending events indirectly expand one's network through meeting weaker ties and new people. Similarly, tagged photos suggest face-to-face socialization, and these visual records may tap into additional facets of social involvement. Furthermore, the posting of social encounters on a newsfeed may reinforce any social resources acquired during those meetings and thereby enable users to engage in positive social grooming of ties (cf. Ellison et al., 2011). By surfacing new social information, resurfacing offline social activities, and acting as a social lubricant, Facebook may amplify the latent potential for social capital development through face-to-face meetings.

Temporal dimensions of Facebook use

Our results highlight the importance of considering temporal context in understanding Facebook's effects. In particular, social capital effects were observed over longer timescales (weeks), while emotional effects were more ephemeral (minutes). These findings are consistent with the idea that social capital accrual through Facebook is likely to be a slower and enduring process, whereas emotional reactivity is likely to be a faster and fleeting process. The modest effect sizes for *change* in social capital suggests that processes relevant to building bridging social capital may take time to unfold. Indeed, the 2-week period represents a limited time frame to see meaningful change in social resources given the stability of social networks. Since most college students have used Facebook for many years, contemporary practices may serve more to *maintain* existing resources as opposed to *amplify* new resources.

By comparison, posting in the 10 minutes prior to being surveyed was associated with more positive mood—but this effect disappeared when examining even a slightly longer temporal window. The stronger effects observed in the 10 minutes (vs 30 minutes) following Facebook activity demonstrate the limited impact that posting and perhaps other Facebook activities are likely to have on stable mood. As such, this study supports qualitative work

arguing that temporal experiences on Facebook are "predominantly ephemeral" (p. 1165; Kaun and Stiernstedt, 2014). Nevertheless, these shorter experiences should not be dismissed as inconsequential despite their brief emotional half-life. Instead, brief emotions may function more as a determinant of Facebook use than as a potent outcome (see Lai and Yang, 2016). For these reasons, our findings suggest that more attention should be given to fleeting emotions in making sense of Facebook (and perhaps social media use more generally).

Spatial dimensions of Facebook use

We also observed different relationships between Facebook posting and emotional arousal when participants reported being at home versus away (Figure 1). Posts from home were associated with higher levels of emotional arousal in the next 10 or 30 minutes, as compared to times when no post occurred. Conversely, no difference was observed when participants were not at home. This result is contrary to our hypothesis that Facebook use away from home would be associated with higher mood. There are a number of possible mechanisms for the location effect, and spatial context may inadvertently index other non-spatial factors. One possibility is that the null relationship for posting while away is due to the increased stimulation when "out-and-about." Indeed, given the heightened baseline emotional states reported by our participants when away from home, an individual's mood "while mobile" may be less sensitive to social media activity. Alternatively, being at home is likely to be associated with other factors that may mediate the effect, including being around closer ties or home alone, or being in a more familiar and less novel setting. The use of Facebook during states of increased arousal at home may index how the platform is used to reduce boredom. Despite the rising role of "mobile" practices, our findings suggest that Facebook use may actually influence emotions more at home.

Moving forward, research exploring the implications of social media use should explicitly consider location and, when appropriate, include measures of spatial context. Notably, we observed an interaction between Facebook posting and self-reported location. Given that most platforms are now highly integrated across mobile devices, emerging research should be careful to isolate location effects from channel effects. Some studies have used GPS features to collect information about spatial context (Miller, 2012), and these tools are certainly useful for measuring location and other environmental conditions (e.g. number of nearby devices via Bluetooth scanning). However, such logged measures of context will be unable to capture other important "place" factors such as the perceptual, emotional, or memory-based dimensions of an experience. As media traverse an increasing range of environments due to portable, mobile, and wearable tech, our study suggests that space will become increasingly germane.

The role of context in future theory and research

Previous findings about the positive or negative influence of Facebook on general well-being are typically limited by the focus on specific Facebook practices in isolation. In line with other recent efforts (e.g. Humphreys et al., 2013; Schrock, 2016), this study advances the need for considering context in conjunction with user practices. We have demonstrated how Facebook activities are associated with differential outcomes according to temporal

scale and spatial location. Significantly, our findings that social capital is more associated with long-term consequences and emotion is more related to short-term experiences are not simply boundary conditions. Rather, contextual dimensions can inform broader theoretical models, such as how Facebook use impacts different outcomes at different speeds, how Facebook user experience follows identifiable trends over time and space, or how certain environmental features can motivate sharing on Facebook as opposed to other channels.

In turn, theory about Facebook processes should adopt more contextual approaches that specify temporal and spatial components. Our implementation of mixed-context experience sampling may be applicable to other studies that seek to understand the role of immediate context in media and technology use. Beyond improving the accuracy and limiting the cognitive biases of self-report, the method allows for a more proximal measure of context in the midst of daily life. In other words, pinging participants in response to real-time media activity assesses "situated use" that is closer to the behavior of interest. This situated perspective produces a distinct lens on media use and offers a useful contrast with behavioral logs or retrospective perceptions. In addition, such viewpoints can help to explain the links between mediated and physical contexts. Indeed, the potential for more situated theories is especially promising given the continued growth of mobile use, which activates a wider range of contexts for a given user and greater variance in contexts between users.

Conclusion

Our results indicate that Facebook's effects are tethered to two contextual dimensions—time and space—that are often overlooked in empirical research. Overall, we find positive relationships between Facebook, emotional experiences, and social resources, but these effects are specific to certain temporal scales. Facebook posting had a fleeting impact on emotion on the order of minutes, whereas certain activities (friendships, events, tagging) suggested an enduring relationship to bridging social capital. The additional finding that the emotional exchanges depended on the current location of the user—in particular, being at home—supports the need to account for spatial factors as well. Combined, this contextual view recognizes a multi-layered user experience and acknowledges the boundaries of Facebook effects. Although more recent studies have identified specific Facebook practices that shape outcomes, future studies should also explicate the contexts in which those uses matter.

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Notes

1. Although temporal ranges are more abstract and less frequently viewed as "contexts" than spatial environments, we believe there is a theoretical value in keeping both contextual dimensions under the same umbrella. Indeed, communication research often assumes that time and space are inextricably linked to one another—and to media cognition (e.g., Bayer, Campell, & Ling, 2016). Given that the broader aim of this article is to empirically demonstrate the multidimensional nature of Facebook use, we leverage the word "context" for

both time and space deliberately in order to highlight how the effects of social media use are contingent upon one's simultaneous perspective on time and space.

2. We further investigated whether the main correlations shifted as a function of the exact time between post and survey. As expected based on the original models, self-reported mood was negatively related to time lapsed since logged posts. In other words, as more time passed following Facebook posts, both valence and arousal decreased reliably, thus supporting the divergent findings of the discrete 10-minute and 30-minute models.

3. We also ran parallel regressions with the other Facebook activity predictors as independent variables, controlling for baseline mood and our other covariates. As implied in the bivariate correlations, these models produced null results. Finally, we ran multilevel models at the day level, which also showed null effects, suggesting that there was not a linear effect of day being overlooked in the aggregate data across the full 2-week period. Altogether, the statistical models provided consistent evidence that Facebook activity was not related to emotional valence or arousal beyond the reported short-term effects.

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