

Once More with Feeling: Supportive Responses to Social Sharing on Facebook

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ABSTRACT

Life is more than cat pictures. There are tough days, heartbreak, and hugs. Under what contexts do people share these feelings online, and how do their friends respond? Using millions of de-identified Facebook status updates with poster-annotated feelings (e.g., *feeling thankful* or *feeling worried*), we examine the magnitude and circumstances in which people share positive or negative feelings and characterize the nature of the responses they receive. We find that people share greater proportions of both positive and negative emotions when their friend networks are smaller and denser. Consistent with social sharing theory, hearing about a friend's troubles on Facebook causes friends to reply with more emotional and supportive comments. Friends' comments are also more numerous and longer. Posts with positive feelings, on the other hand, receive more likes, and their comments have more positive language. Feelings that relate to the poster's self worth, such as *feeling defeated*, *feeling unloved*, or *feeling accomplished* amplify these effects.

Author Keywords

Emotional support; social network sites; social sharing

ACM Classification Keywords

H.5.3 Group and Organization Interfaces: Web-based interfaces.

INTRODUCTION

Humans have a fundamental need to share feelings in response to emotional events and to receive feedback from others [44], a behavior known as social sharing. Celebrating our victories amplifies joy [33], and venting frustrations can help us cope [40]. Though much of the research on social sharing was developed based on face-to-face communication, a growing body of research is examining emotional expression on Twitter, Facebook, blogs, text messaging, and other computer-mediated communication [1,12,28,29].

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Understanding emotional expression on Facebook and how friends respond is of particular importance because unlike Twitter and blogs, where the audience is comprised of the general public, on Facebook people typically share their thoughts with people they also know offline, and their friend networks usually include their closest confidants [24]. Though strangers and weak ties may provide informational support, emotional support typically comes from close friends [49]. Therefore, the way people express their emotions on Facebook and the way their audience responds may be qualitatively different from patterns on public platforms organized around fan/follower models. We focus on network-visible sharing—status updates that are typically broadcast to the poster's friend network, rather than private messages—because much of the previous research already covers dyadic communication [44] but one-to-many broadcasts are a common use of social media [20], and status updates offer an opportunity to examine how multiple friends respond when no particular person is obligated to (because viewership information is not visible). Furthermore, observing our friends sharing emotions on Facebook and noting how others respond shapes our perceptions about social norms on the site [9]. With 1.4 billion active users [21], the site's size makes it an important phenomenon to examine, as well.

Previous empirical work in this space leaves several open questions. The first is the relationship between audience composition and the valence (positivity or negativity) of expressed emotions. Do people share different kinds of emotions online depending on whom they think is listening? The desire to make a good impression on others [22] and social norms emphasizing positivity [18] may cause people to withhold more negative feelings in the presence of weaker ties. Yet empirical research examining the relationship between emotional valence and network features like size and density (a proxy for how many close friends might be in the audience) has been mixed, with some research indicating negative emotions are expressed when the audience is larger and sparser [29] and other studies indicating the opposite [15,35].

The second open question relates to how audiences respond to emotional expression on Facebook. Research on offline communication indicates that social sharing induces strong feelings in the recipient, as well, and recipients often respond with empathy and hugs [13]. Does social sharing of

emotion online elicit emotion in viewers, and what form do their responses take? When someone posts a status update on Facebook, any number of friends may see it, but because the site does not reveal who has seen a post, no particular person is obligated to reply. Audiences may not respond at all: If people perceive social media as venues only appropriate for happy news, they might ignore negative posts in an attempt to discourage negativity, especially more extreme expressions such as low self-worth. This has occurred on Twitter; tweets expressing enduring loneliness receive fewer responses [30]. Furthermore, responses may come in a variety of formats: lightweight likes, comments that are visible to other friends, and private messages. What formats do friends choose when responding to emotional posts, what is the substance of their response, and how does it vary with post valence?

The present research is the first very large-scale quantitative study of social sharing of feelings in Facebook status updates, examining (1) how network properties (size and density) are associated with the valence of emotions shared, and (2) how characteristics of the emotions shared (valence and self-relevance) relate to how the audience responds (quantity of responses, emotional and supportive content in comments, and whether the responses come in network-visible or private channels). Facebook recently launched a feature allowing posters to annotate their status updates with feelings, like *feeling blessed* or *feeling embarrassed* (see Figure 1), so we use these annotations as gold standard labels for the poster’s emotion. (As such, we use the terms “feeling” and “emotion” interchangeably throughout.) Though there is adoption bias in the annotation tool (far more women than men use it, consistent with previous research on online emotional expression [47], and users are slightly older than average), the scale of the dataset is much greater than previous studies. This observational analysis covers millions of episodes of emotional expression (all de-identified and analyzed in aggregate, with no changes to any Facebook user’s experience).

This paper complements and expands upon previous smaller-scale studies in several ways. We show that people with larger and more diverse friend networks—and thus larger potential audiences for status updates—share fewer emotions. More than one third of emotions shared in status updates with the feeling annotation widget in Figure 1 are negative (e.g., *feeling upset* or *feeling embarrassed*), indicating that when people share emotions via network-visible updates, they don’t just limit themselves to happy news, at least among this large sample of Facebook users. We document properties of the responses to these positive and negative status updates, finding that posts with positive feelings (e.g., *feeling excited* or *feeling optimistic*) elicit more likes and comments than posts without feeling annotations, and posts with negative feelings (e.g., *feeling horrible* or *feeling disgusted*) receive even more comments than positive posts. Consistent with offline research, viewers of negative emotional posts respond with increased emotion

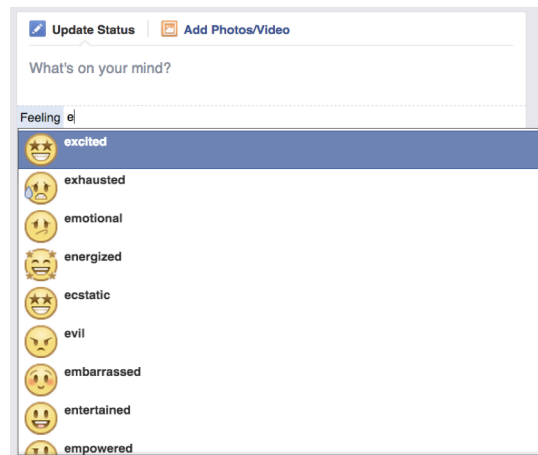


Figure 1. Adding feelings to a status update.

and supportive language. Finally, we demonstrate that when people express negative self-worth (e.g., *feeling worthless*), their friends also respond via private channels.

BACKGROUND

We begin by reviewing literature on social sharing and how properties of one’s audience may influence the valence of emotions shared. We then identify open questions about how listeners should respond.

Social Sharing and Emotional Valence

Social sharing theory asserts that we need to communicate with others in response to emotional events [44]. These events elicit ambiguity and challenge our beliefs about ourselves and the world, and so articulating our feelings helps us clarify and resolve those emotions. Beyond the psychological effects attributed to simply expressing emotions, there is a social component: Sharing emotions with others increases intimacy and allows others to provide empathy, validation, and support [34,44]. The support we receive, including commiseration, companionship, and affirmation helps us cope and produces positive psychological states that improve the immune system and buffer stress [14].

While a variety of ties may provide other forms of social support (such as information or advice), emotional support in times of psychological distress typically comes from one’s closest friends and family [49]. People may also expect their close friends not to judge them for sharing bad news, while a stranger might [4]. Empirical studies of Facebook have borne this out: Participants in online weight-loss communities reported seeing Facebook as a place only for sharing victories, because they wanted to “communicate the impression of being . . . in control, positive, and not struggling” and would save their challenges and requests for help for more private support groups [39]. College students on Facebook were more likely to turn to private messages than status updates to share more intense, negative emotions [1]. Both online and offline, people tend to reserve

disclosing negative emotions with trusted, close friends who are most able to provide meaningful support [1,12,44].

Beyond expectations about the kinds of ties that provide emotional support, social media users may also perceive a proscriptive norm against sharing negative emotions. Humans are generally hesitant to share bad news [4], a phenomenon that causes us to overestimate others' happiness and success [27]. These norms occur online, as well; many empirical studies of Facebook and Twitter reveal positive emotions are more prevalently shared than negative ones [1,36], especially among people with higher levels of presentational concerns [2].

On the other hand, people may share positive emotions widely in order to amplify the joy; they seek out others to help them "capitalize" on good news [33], even turning to strangers when the news is especially good [43]. Survey and diary studies of social media users show that people more often turn to channels with greater visibility, such as public tweets or status updates (as opposed to private messages) to share positive news, and that visible sharing is linked to positive affect and satisfaction [1,12].

Taken together, this research suggests that on social media, people may share positive emotions regardless of their audience composition, but share negative news in contexts when they have a smaller audience with a greater proportion of close friends. However, as discussed below, empirical results on this front are mixed.

Network Properties Influencing Emotional Valence

Social media audiences vary along several dimensions; two commonly studied properties are network size and density [37]. Evolutionary psychology suggests that humans can only maintain a small number of close confidants, and so as network sizes grow, they necessarily are comprised of a greater number of weak ties [17]. Empirical studies of Facebook demonstrate that most ties are weak [16], so it's conceivable that people with large networks might only share positive emotions appropriate for the "lowest common denominator" in their audience [26].

Network density measures the proportion of a person's friends who are also friends with each other, and is commonly used as a representation of how "tightly-knit" or close a person's network is [37]. Dense networks have a greater proportion of ties within triads (a relationship between person A and B in which both are also friends with person C); these ties are thought to be stronger than ties without a mutual friend [45]. Presumably, the denser a person's network, the more comfortable he or she would be sharing negative emotions, because there would be relatively more strong ties available to provide emotional support [48], and fewer weak ties to elicit self-presentation concerns.

Analyses of the relationship between network size, density, and emotional expression in social media have been mixed. One study of Twitter [29] found a positive relationship between network size and the number of both positive and

negative emotional tweets, and surprisingly, found that negative tweets were greater in sparser, rather than denser, networks. Conversely, more recent studies suggest that negative emotions and personally relevant content are shared more in smaller networks [15,38], positive emotions in large networks [35], and emotions of all kinds are more likely to be shared in denser networks [35]. The Twitter studies [15,29] are somewhat limited by a lack of demographic information such as age and gender which may influence emotional expression [32]. The one Facebook study using network data [35] is based on a small sample of undergraduates; their similarity in age and life stage may cause them to have similar network structures and thus limit the generalizability of results. Based on the literature and some of the previous empirical work, we expect that people will be more comfortable sharing negative emotions among closer friends and positive emotions among wider audiences. Therefore, in Study 1, we test the following hypotheses:

H1a: People with smaller, denser social networks will share a greater proportion of negative emotions.

H1b: People with larger, more sparse networks will share a greater proportion of positive emotions.

How Audiences Respond to Emotional Posts

Rimé and colleagues [13] have demonstrated that hearing a friend share a negative experience elicits negative emotions in the listener, as well, and that listeners often engage in "secondary sharing" of emotions to trusted third parties. Listeners engage in supportive behaviors, such as expressing empathy and offering physical gestures (hugs). How do these responses by the listener manifest on social media?

One possibility is that viewers don't respond at all. By design, many social media systems do not reveal which people have viewed a post, so no single audience member is obligated to respond. If people perceive social media as venues only appropriate for happy news, they might only respond to happy posts, ignoring negative ones in an attempt to discourage negativity (e.g. [30]).

On the other hand, Facebook networks include strong-tie relationships [7,24], and strong ties often provide emotional support [49]. Close friends may still want to offer support, and previous research suggests they may feel compelled to do so, in order to process their own feelings [13]. We expect that friends are more likely to reply to than ignore emotional posts, given empirical evidence that Facebook users respond to requests for advice and favors [19] and feel increases in perceived social support through site use [8]. While existing research on the recipient's response to social sharing focuses on negative emotions, we also expect that positive emotions will elicit feedback, in part because responding to good news can be as simple as a congratulations, and results in bonding and trust [43]. Taken together, we expect that:

H2. Emotional status updates will receive more feedback than posts without emotion.

Furthermore, responses to posts can take many forms, including likes, comments, private messages, phone calls, and visits. Empirical studies of Facebook show that the post topic influences how people respond: posts about medical issues and those asking explicitly for support (e.g., with terms like *worry about*, *help me*, *pray for*) receive far more comments than posts about more mundane topics like *sleep* [47]. However, medical posts and other bad news receive fewer likes, since likes may be interpreted as endorsement or congratulations, rather than signs of support.

From a psychological perspective, there are two arguments why “composed” communication such as comments and messages might be perceived as more appropriate responses to negative emotion. Research applying signaling theory to Facebook communication (e.g., [7,20]) argues that likes require less effort to produce and thus may signal that a relationship is less valuable. This signal may degrade perceptions of social support. Furthermore, by virtue of being textless, likes necessarily cannot contain supportive language. Following this argument, Burke and Kraut [7] demonstrate people feel greater interpersonal benefits after receiving Facebook comments rather than likes. Therefore, negative emotions should elicit more “composed” communication—comments and private messages—in which friends commiserate or attempt to cheer up the poster [47]. Taken together, we propose:

H3a: Posts with positive emotion will receive more likes than posts with negative emotion.

H3b: Posts with negative emotion will receive more comments and private messages than posts with positive emotion.

Since recipients of social sharing experience emotions themselves and offer social support, we expect that:

H4: Responses to posts with negative emotion will contain more emotional and supportive content than responses to posts without emotion.

Beyond valence, the nature of the emotion may also affect how viewers respond [13]. In particular, people may respond differently based on the degree to which it reflects how the poster feels about herself. Feeling upset is very different from feeling unloved. The former is a diffuse emotion that does not have the self as a point of reference (you could be upset because it’s raining), while the latter expresses self-worth. Self-relevant emotions (as described in [6]) are closely linked to self-esteem and how we deal with failure. And our friends may respond differently to self-relevant and non-self-relevant emotions. On Twitter, people who express feelings of enduring loneliness are less likely to receive a response [30]. Other empirical work finds that viewing past interactions on Facebook may boost self-esteem and self-affirmation [46]; it’s therefore conceivable that when people post about feeling low they receive empathetic and self-affirming responses. Therefore, we also ask:

RQ1. How do friends respond to positive and negative self-relevant posts?

We address these research questions and hypotheses with a pair of studies. In Study 1, we examine the relationship between network properties (size and density) and the valence of emotions shared in status updates. In Study 2, we examine how audiences respond, identifying how characteristics of posts (emotional valence and whether the emotion is self-relevant) are associated with characteristics of the responses (quantity, the amount of emotion and supportive language in comments, and the channel that replies take: likes, comments, or private messages).

STUDY 1

To understand the relationship between network properties and the valence of emotions expressed, we analyzed network properties and status updates by a random sample of people who used the feeling annotation tool.

Sample

A sample of $N=1,399,921$ English speakers in the U.S. (Mean age = 32.2, $SD=10.9$, 79% female) who posted at least one status update in June 2015 that included an emotion (using the annotation widget in Figure 1), had been Facebook users for at least six months, and had at least 20 friends, were randomly selected. Their status updates for one month (approximately 30 million) and friend networks were included in the analysis. Significant steps were taken to ensure user privacy: All data were de-identified and analyzed in aggregate such that no individual’s text was viewed by researchers. All data were observational—no experiment was performed and no one’s experience on the site was any different than usual.

We sample among people who used the emotion annotation tool rather than classifying emotion in all users’ post text (e.g., using LIWC [41]) because the annotation gives us an explicit signal of how the poster was feeling, rather than a potentially noisier signal based on keywords in the text. However, people who use the annotation may differ from those who don’t; they may be more savvy simply for knowing of the tool’s existence, or may believe their friends will be supportive to expressions of emotion. Posters who used the feeling annotation tool were approximately four years younger, 20% more likely to be women, had approximately 50 more friends, logged in an average of 0.6 more days in the past month, and had been using Facebook for approximately four fewer months than posters who did not use the annotation tool (all $ps < 0.001$). The gender bias in the data reflects the underlying population using the feeling annotation tool; as in other research [47], women were more likely to express emotion here. Therefore we control for age, gender, friend count (where applicable), number of login days, and tenure in all subsequent regressions, and discuss any limitations due to these differences in population in the discussion section.

Feeling Valence and Self-Relevancy

Approximately 15% of their posts included a feeling annotation. Two judges independently coded the top 200 feelings (which comprised 90% of feelings usage) on a 3-point valence scale (positive, ambiguous, or negative). Interrater reliability was good (Cohen's kappa = 0.77), and disagreements were resolved by consensus. Positive terms included *refreshed*, *optimistic*, *ecstatic*; ambiguous included *normal*, *drunk*, *curious*, *ready*; negative included *grumpy*, *disappointed*, *furious*. (See Appendix for complete list). Among posts with any feeling, 51% were positive, 38% were negative, and 11% were ambiguous. Ambiguous feelings were omitted from analysis.

The two judges also rated each feeling with a binary variable indicating whether the feeling was self-relevant using the general description in [6] (kappa = 0.74). Feelings that were self-relevant included *special*, *accomplished*, *strong*, *unwanted*, *worthless*, *alone* (see Appendix).

Network properties

For each participant, we calculated the number of Facebook friends (*network size*) at the beginning of the data collection window. The median participant had 372 friends (Mean = 594, SD = 714.9). We also calculated *network density* using the standard formula, the ratio of the existing connections to the total number of possible connections in the one-step egocentric network for the user. The median density was 0.07 (Mean = 0.08, SD=0.05). Network size and density were negatively correlated ($r = -0.19$).

Model

To understand the relationship between emotional valence and network properties, we performed two linear regressions; one estimating the percentage of total posts with a negative emotion, and one estimating the percentage of posts with a positive emotion. (Self-relevant emotions were included in their respective valence category.) In both cases we control for the poster's age, gender, number of login days in the past month, tenure, and number of posts in the past month. Age and login days were centered; tenure, number of posts, network size, and density were standardized; network size was logged (base 2) to account for skew before standardization. All variance inflation factors were less than 2 indicating multicollinearity was not an issue.

Results

Before examining the relationship between network properties and emotional valence, we begin with some basic descriptive statistics. Overall, 8.1% of posts on Facebook include a feeling annotation (calculated across all English posts in the U.S., not just those in our sample). Of the posts that included a positive or negative feeling annotation, 57% were positive and 43% were negative. Figure 2 shows the ratio of positive to negative feeling annotations used, grouped by poster age. Teens and young adults exhibited a greater proportion of negativity and self-relevance than older posters (Figure 2, top), consistent with previous research [11,47]. These numbers are conservative, since they

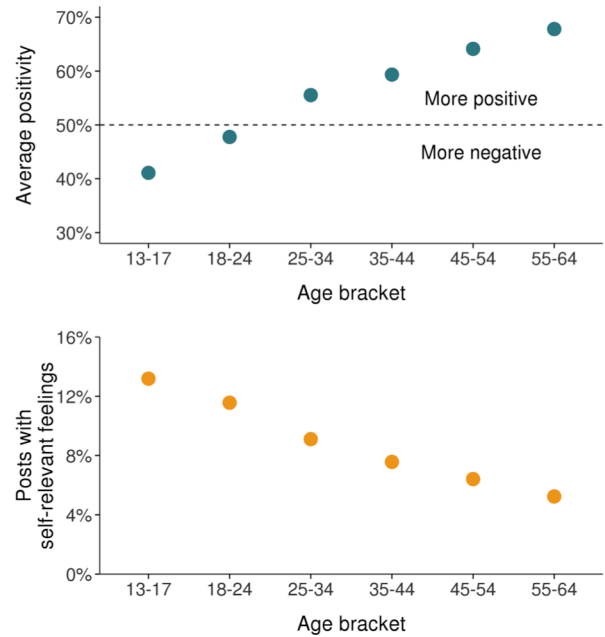


Figure 2. Expressions of feelings by age bracket. Top: Teens and young adults use relatively more negative feelings on Facebook, while older adults share a greater proportion of positive feelings. Bottom: Teens and young adults share a greater proportion of self-relevant feelings than older adults. Plot points are larger than error bars (bootstrapped 95% confidence intervals).

only include posts with explicit feeling annotations, and many posts may include emotion in the text itself, which we do not detect here. We address potential differences between posts with annotated feelings and those that include emotional text in the Discussion section.

Table 1 shows the results of the two regressions with coefficients translated to percentages for readability. The intercept represents a woman with the mean value for all continuous variables (age 32, 594 friends, logged in 27 days and made 19 posts in the past month, and had been using Facebook for 5.3 years). On average 10.2% of her posts included a negative emotion annotation, and 17.4%, a positive emotion. Age and gender had modest effects: Older users and women were somewhat more positive. More engaged users (those who logged in more often and posted more) and those who had had Facebook accounts longer used fewer emotion annotations in their status updates. The final two rows confirm H1a and reject H1b: As network size increased, people shared a smaller proportion of emotions of either valence. One standard deviation in friend count (on a log scale) is associated with an 0.7% drop in negative and 0.8% drop in positive emotions (both $p < 0.001$). Controlling for network size, however, we see that in denser networks, people share more of each kind of emotion. One standard deviation increase in density is associated with an additional 0.3% negative and 1.0% positive posts (both $p < 0.001$). These results are discussed after Study 2.

	Negative		Positive	
	% posts	SE	% posts	SE
Intercept	10.2%	0.0%	17.4%	0.0%
Age	-0.2% ***	0.0%	0.1% ***	0.0%
Is male	-0.1% *	0.0%	0.1% **	0.0%
Login days	-0.1% ***	0.0%	-0.6% ***	0.0%
Tenure	-0.6% ***	0.0%	-0.1% ***	0.0%
Number of posts	-3.2% ***	0.0%	-7.0% ***	0.0%
Network size	-0.7% ***	0.0%	-0.8% ***	0.0%
Network density	0.3% ***	0.0%	1.0% ***	0.0%
N=1,399,921	R ² = 0.05		R ² = 0.12	

* p < 0.05 ** p < 0.01 *** p < 0.001

Table 1. Linear regressions estimating the percentages of a person’s posts in a month that include a negative (left) or positive (right) emotion annotation.

STUDY 2

Study 1 demonstrated that people share more emotions, both positive and negative, when they have smaller, denser networks. We next examine how characteristics of the emotions shared (valence and self-relevance) are associated with characteristics of the responses: quantity, supportive and emotional content, and channel (like, comment, private message).

Sample

A sample of N=31.7 million de-identified text-based status updates, comprised of a random sample of 14.2 million posts with attached feeling annotations and a random sample of 17.5 million without feeling annotations (to serve as a baseline), was analyzed on Facebook’s servers. As in Study 1, all data were analyzed in aggregate and no users’ experiences were affected. Posts were drawn from English speakers in the United States in early 2014, excluding one-week windows around holidays (e.g. Valentine’s Day, Mother’s Day) that might skew feelings and feedback. The sample represented 19.3 million unique posters aged 13-64 ($M=29.9$). The two populations (those who used feeling annotations and those who didn’t) are different, but we control for many of the demographic and engagement differences in the following regressions. As in Study 1, the 14.2 million posts with feeling annotations were categorized according to the valence and self-relevance of the emotion. The posts without an explicit feeling annotation form a baseline for comparison; since these posts may still express emotion in their text this is a conservative comparison point.

Feedback Counts and Support in Comments

For each post, three forms of feedback within a 24-hour period were counted: (a) likes, (b) comments (excluding those written by the original poster), and (c) number of incoming messages, defined as counts of private chat sessions initiated by someone other than the poster, taking place at least three hours after any previous chat session. No text from private messages was analyzed, only counts. The majority of feedback occurred during the first 24 hours, and

results are qualitatively the same when considering a 72-hour period (not shown).

In addition to studying counts of feedback, we analyzed the tone of comments received. Scripts automatically parsed all comments (but not private messages) into lowercase, punctuation-free unigrams and applied three dictionaries to the remaining bags of words: the “positive emotion” and “negative emotion” dictionaries from the Linguistic Inquiry and Word Count (LIWC) package [41], and a dictionary of support terms, described below. This dictionary method counts the percentage of terms from a given list that occur in a piece of text (e.g., positive emotions include *love*, *nice*, and *sweet* and negative emotions include *hurt*, *ugly*, and *nasty*). Terms were stemmed (e.g. *frustrat* represents both *frustrated* and *frustrating*). Though LIWC mischaracterizes negations (e.g., “That’s not good” would be coded as positive), these negations wash out in large samples and the tool has been shown to effectively surface many socio-psychological phenomena [41]. We created a dictionary of “support” terms by culling words from Hallmark cards and websites providing examples of sympathy or condolences, and extended LIWC with this “support” dictionary: *affection*, *awful*, *better*, *bless*, *care*, *caring*, *comfort*, *condolence*, *feel*, *frustrat*, *god*, *grief*, *hang*, *heart*, *help*, *hope*, *hopeful*, *hug*, *loss*, *lov*, *luck*, *pain*, *pray*, *sad*, *shock*, *sorry*, *sorrow*, *special*, *strength*, *strong*, *suck*, *support*, *sympathy*, *terrible*, *think*, *thought*, *warm*. This dictionary was created without any knowledge of the actual comment text. Average comment length, in words, was also included as a dependent measure.

In the end, we had seven dependent variables at the post level: separate counts of likes, comments, and messages received, average comment length, percent positive emotion in comments (averaged across pooled comment text for that post), percent negative emotion in comments, and percent support in comments.

Modeling Responses to Posts with Feelings

To understand the nature of responses to posts with feelings, we performed a series of regressions. Dummy variables were created to represent the four combinations of feeling valence (positive, negative) and self-relevance (yes, no). Control variables likely to affect both expression of emotion and feedback volume included poster gender and age [32], how long they had been on Facebook, and friend count bracket (potential audience size).

We performed separate regressions for each of the seven dependent variables (likes, comments, messages, average comment length, percentage of positive emotion in comments, percentage of negative emotion in comments, and percentage of supportive text in comments). Feedback counts—likes, comments, messages, and comment length—were log-transformed after adding 1. For outcomes related to comment text (positive emotion, negative emotion, and supportive text), we performed untransformed linear regressions on percentages. Because of the large volume of

data (31.7 million observations), regressions were performed on aggregated data with robust standard errors.

Results

First, we examine feedback received by posts with and without feeling annotations.

Comments. Table 2 shows a regression estimating the number of comments received based on post characteristics. The omitted levels for categorical variables were set to the most common categories, so the intercept represents a post without a feeling annotation written by an 18-24 year-old woman with 201-500 friends and more than two years of Facebook experience. On average, her post received 0.77 comments ($e^{0.57}-1= 0.77$). A similar post with positive feelings would receive 5.2% more comments (Mean=0.81, all subsequent $p < 10^{-16}$). (For simplicity, we refer to non-

self-relevant feelings (e.g., *feeling excited*) as simply “feelings” and refer to self-relevant feelings (e.g., *feeling unloved*) as “self-relevant feelings.” These two categories are mutually exclusive, not nested.) Negative feelings elicit even more comments (36% more than a non-feeling post). A post-hoc comparison confirms that posts with negative emotion receive 29% more comments than posts with positive emotion ($Beta=0.12, SE=0.01, p<0.001$).

However, self-relevant posts, especially negative self-relevant ones, receive far more comments, even compared to posts with other feelings: positive self-relevancy elicits 14% more comments and negative self-relevancy garners 72% more comments. A post-hoc test confirms that the effect is greater for negative self-relevancy than other negative non-self-relevant emotions ($Beta=0.12, SE=0.01, p < 0.001$).

Figure 3 displays these response rates to posts with the four kinds of feelings, relative to a post without feelings. Each panel represents one of the seven dependent variables. Overall, with the exception of likes and positive comments, we see that friends respond more to posts with negative emotions, especially negative self-relevant emotions. We now discuss the other dependent variables in turn.

Comment length. Friends respond with much longer comments to posts with negative feelings, especially to negative self-relevant ones (see Figure 3d). While the average post without feelings elicits 5.4-word comments on average, negative feelings get 21% longer comments, and negative self-relevant posts get 51% longer comments. We’ll address the tone of these comments shortly.

Likes. Likes follow a different pattern than comments, consistent with the idea that people are uncomfortable clicking the “like” icon for negative posts, since likes suggest endorsement or congratulations, rather than support. Instead, we see that positive posts garner far more likes: positive feelings are associated with a 58% increase in likes, and positive self-relevancy garners 71% more likes, supporting Hypothesis 3a. On the other hand, negative feelings elicit 32% fewer likes, and negative self-relevant feelings, 34% fewer likes (see Figure 3a).

Number of private messages. Both likes and comments are visible to other friends, but we see support being enacted over private channels, as well. We included counts of private messages as a dependent variable (no text was analyzed) and found that negative self-relevant posts result in 24% more chat sessions initiated by other friends (see Figure 3c). These results suggest that friends reach out to privately check-in with the poster and offer support. Hypothesis 3b is partially supported (posts with negative feelings elicit more comments, but only negative self-relevant feelings elicit more private messages). In general, however, posting a feeling results in a very slight reduction in messaging, perhaps because viewers reply through comments and likes instead. One interpretation is that social chat sessions that would have occurred (had one friend not posted an

Ln(comments +1)	Comments		
	Coef.	SE	(Est.)
Intercept	0.57 ***	0.00	0.77
Feelings			
Positive (non self-relevant)	0.02 ***	0.00	0.81
Positive self-relevant	0.06 ***	0.00	0.88
Negative (non self-relevant)	0.15 ***	0.00	1.05
Negative self-relevant	0.27 ***	0.00	1.33
Controls			
Is male	-0.05 ***	0.00	0.69
Site tenure			
0-35 days	-0.06 ***	0.00	0.68
36-90 days	-0.07 ***	0.00	0.65
3-12 months	-0.07 ***	0.00	0.65
1-2 years	-0.07 ***	0.00	0.65
Friend count			
0-10	-0.59 ***	0.00	-0.02
11-20	-0.44 ***	0.00	0.14
21-30	-0.38 ***	0.00	0.22
31-40	-0.33 ***	0.00	0.28
41-50	-0.29 ***	0.00	0.33
51-100	-0.21 ***	0.00	0.44
101-200	-0.10 ***	0.00	0.61
501+	0.01 ***	0.00	0.79
Age			
13-17	-0.07 ***	0.00	0.65
25-34	0.19 ***	0.00	1.15
35-44	0.29 ***	0.00	1.37
45-54	0.32 ***	0.00	1.44
55-64	0.34 ***	0.00	1.50
*** $p < 10^{-16}$		N = 31.7 million posts	

Table 2. Model of comments received by posts with feelings. All standard errors are below 0.001. Posts with feelings elicit more comments than posts without feelings, and negative feelings elicit more comments than positive feelings. Feelings that are self-relevant amplify these effects.

emotional status update) were replaced by other social interactions (likes and comments).

Positive emotion in comments. In addition to feedback volume, we also analyzed the emotional content of post comments. As noted previously, all analyses were performed automatically with scripts; researchers did not read any comments. The average post without feelings elicited

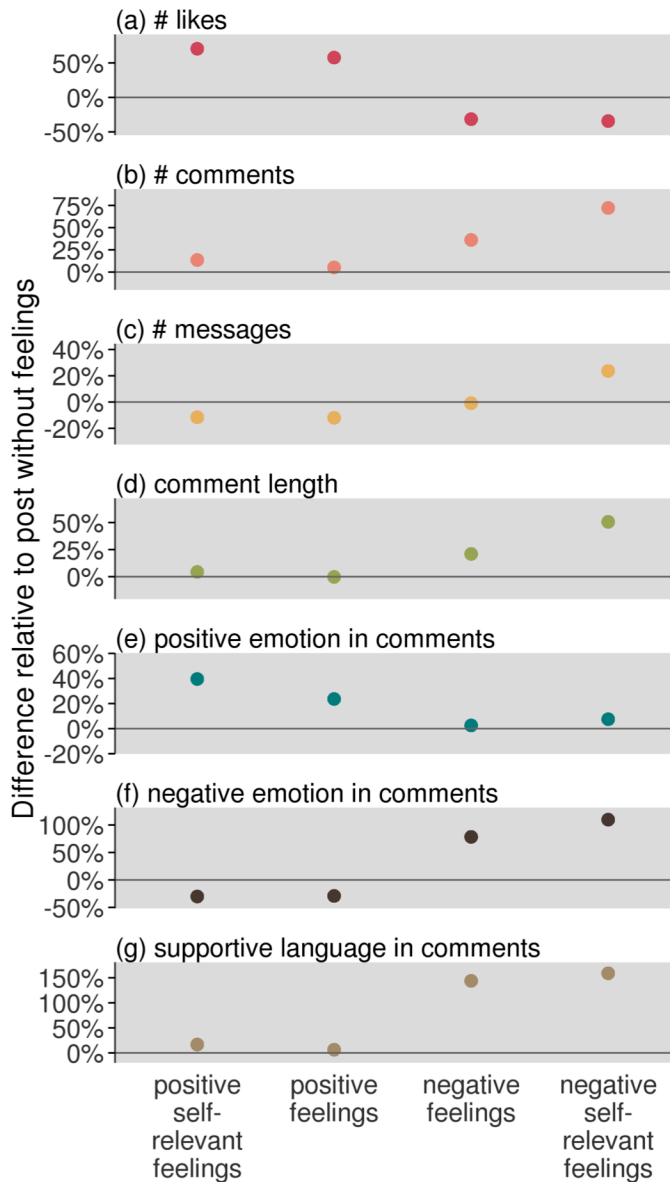


Figure 3. Relative difference in responses based on use of feeling annotations. Each row shows one outcome. Each point shows the percentage difference in that outcome for a post that includes a feeling, relative to a post without a feeling. Posts with positive feelings elicit more (a) likes and (e) positive comments, while negative feelings elicit (b) more comments, (d) longer comments, and (e,f) comments with more emotional and (g) supportive language. Posts about self-relevant feelings, especially negative ones, amplify these effects. Negative self-relevant posts also elicit more private messages (c). Plot points are larger than error bars (bootstrapped 95% confidence intervals).

comments that contained 3.1% positive emotion words, 0.7% negative emotion, and 0.9% supportive text. Not surprisingly, posts with positive feelings, such as *feeling awesome*, elicited far more positive emotion in comments (a 24% relative increase). Figure 3 (panels e-g) show the relative difference in positive emotion, negative emotion, and supportive text found in comments to posts with various levels of feelings. In general, however, even posts with negative feelings elicited more positive comment text; given the context we might infer commenters are saying things like *hope you're feeling better* or *sending happiness your way*.

Negative emotion in comments. We see a big increase in the use of negative emotion words (Fig 3f) in response to posts containing negative feelings, while the use of these words is significantly reduced in responses to positive feelings. Comments on posts with negative feelings contain 78% more negative-emotion words than comments on ordinary posts, as the responder commiserates with the poster (presumably phrases like *that sucks* or *i feel your pain*). Negative self-relevant feelings show an even stronger effect, as these contain more than double the negative emotion compared to a typical comment (110% more). For positive feelings, we see an unsurprising significant drop-off in comment negativity (-29%).

Supportive language in comments. Recipients of social sharing often respond by offering support [13], and the data show that this occurs on Facebook, as well. Figure 3g shows a large effect in response to posts with negative feelings, which elicit 2.44 times as many support words as non-feeling posts. Self-relevancy again amplifies these effects; negative self-relevant posts elicit 2.6 times as many support words as a non-feeling post. These multipliers are per word, so given that there are more comments and the average comment is longer, the effect in terms of raw words is even larger. Hypothesis 4 is supported.

In summary, positive feelings elicit likes and positive comments, and negative feelings elicit more comments and messages, where friends have room to respond with emotion and support. RQ2 asked how friends respond to negative self-relevant feelings, and collectively, these results demonstrate that friends respond in greater volume and with more emotion to negative, self-relevant feelings.

Responses to Specific Feelings

In the previous analyses feeling terms were grouped by their valence and whether they were self-relevant, but the effect size may vary with individual feelings. Figure 4 (top panel) presents the ten feelings with the highest usage rates; response percentages are relative to a post with no feeling annotation. We can see that the most sympathetic, *sad*, produces a significant positive lift in comments, and those comments are longer, have more negative emotion, and are more supportive. *Sad* also elicits a bump in private messages, which few feelings do. Many of the feelings that could be followed with an “about what” question receive more comments: *sick*, *annoyed*, and *excited*. Meanwhile,

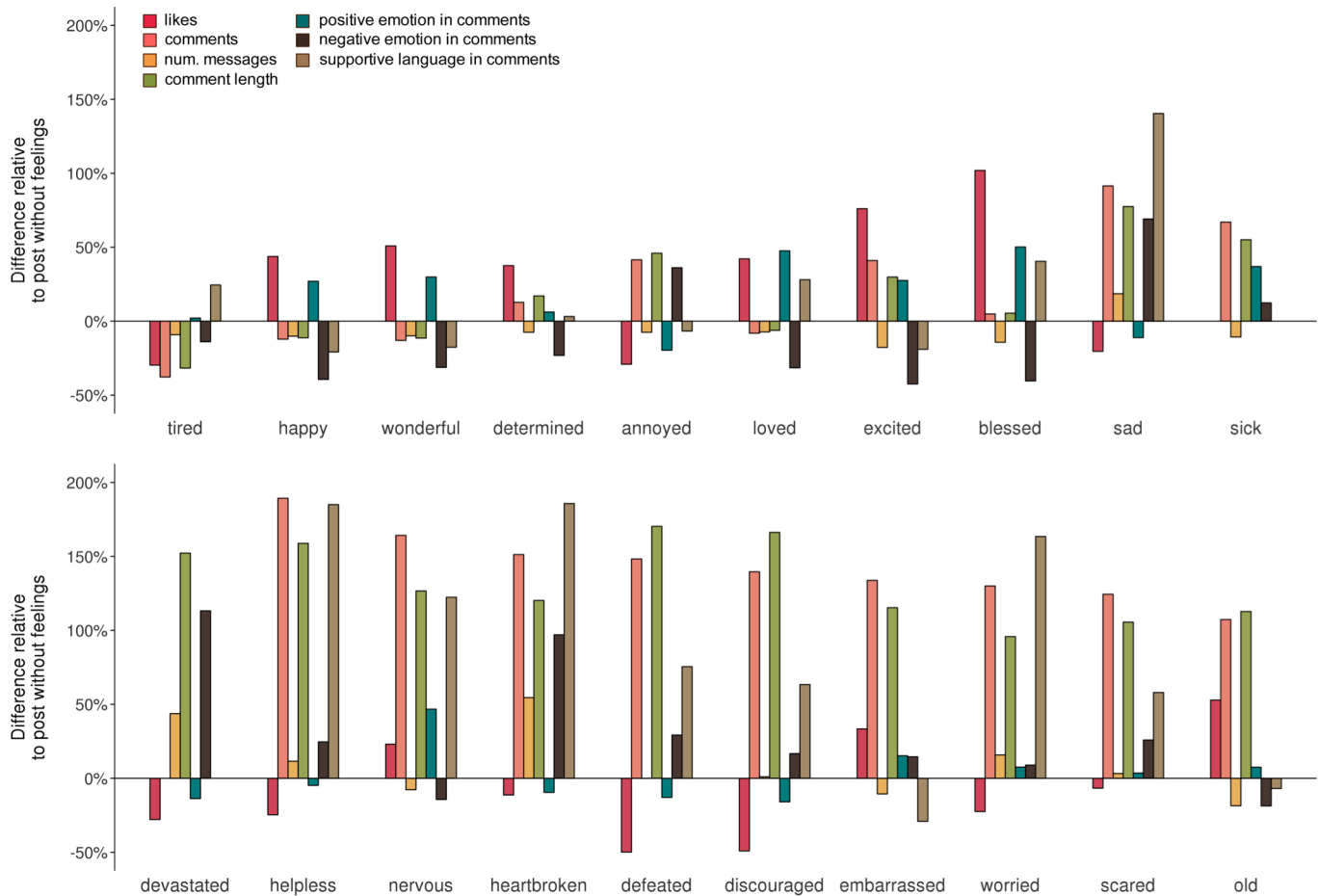


Figure 4. Relative difference in responses based on use of specific feelings. Top panel shows the most commonly used feelings; a post with *feeling tired* receives less feedback than a post without feelings, while *feeling sad* receives far more comments, longer comments, and comments with negative emotion and supportive language. The bottom panel shows the feelings that elicit the most comments. Note that the very personal feelings, *devastated* and *heartbroken*, elicit far more private messages, as well.

generic statuses like *happy*, *tired*, and *wonderful* induce fewer comments than the average post.

Figure 4 (bottom panel) shows the feelings that elicit the most comments. Consistent with the regression results, the theme is clear: other than *old* (which is ambiguous) all of these are negative, and several are self-relevant. The most personal ones, *devastated* and *heartbroken*, reveal a large bump in private messages in addition to comments, indicating that friends may be providing support over backchannels when needed.

DISCUSSION

The present study extends previous dyadic research on social sharing by examining contemporary practices of one-to-many broadcasts in social media. On the whole, the research demonstrates that when people have smaller, denser networks, they share more positive and negative emotions, and friends respond in greater volume to posts with emotion, especially negative emotion. Responses to posts with negative emotion are more emotional themselves and contain more supportive language; more extreme expressions of negative self-worth (e.g., *feeling unloved*) often elicit private responses from friends. Figure 5 (top)

shows the terms most disproportionately found in comments responding to negative feelings: phrases like *sorry*, *hugs* and references to *prayer* are common. The support shifts offline, as well (*talk*, *call*).

A key distinction between this research and previous analyses of social sharing is the focus on responses, rather than just the posters. Rimé and colleagues [13] note that hearing others share emotions elicits emotions in the listener, and those listeners often respond with empathy and support. Beyond demonstrating that this also occurs in Facebook comments, the present study may also shed light on how “secondary sharing” occurs in social media. Rimé’s research on dyads shows that when people hear about negative events, they often feel compelled to share the story again to a third party, in order to process their own emotions. This secondary sharing is more likely to occur the more intensely negative the original emotion. We see here that intensely negative emotions generally evoke longer, more emotional comment threads on Facebook. It’s possible that these comment threads are one way secondary sharing manifests on social media, with mutual friends of the original poster



Figure 5. Comment terms that occur disproportionately in response to negative feelings (top), and positive feelings (bottom).

collectively offering support to each other and trying to reappraise the situation.

Intensely negative emotions also evoked more private responses in the present study. This may explain why previous research found that intensely lonely tweets received fewer public Twitter replies [30]; friends may have responded through private channels unavailable to the researchers. Though we do not analyze the text of any private messages, the notion that people turn to more intimate, dyadic channels in times of sadness is consistent with previous research on social media [1,12].

A fundamental assertion of this and previous work is that audience composition matters when people are considering sharing their emotions online. Much previous research indicates that audience size and the proportion of closer ties is related to the disclosure of negative emotions [1,12,29,35], but results have varied. Our findings are partially consistent with previous quantitative Facebook research [35], in that people shared more emotions when their friend networks were denser. Whether this is for self-presentation concerns (e.g., expecting that weak ties will be more likely to judge) or an expectation of support from strong ties is left to future work. However, our results diverge from previous studies [29,35] that found a positive correlation between network size and the expression of positive emotions; we found that both positive and negative emotions were expressed less often in larger networks. Differences between Twitter and Facebook may account for some of the results: Tweets are typically public, so posting good news to Twitter in effect posts it to the world, so follower count may not matter as much there. Differences in adoption rates may also mean that Twitter audiences are less likely to contain the poster's closest confidants [24]. We

expect more of the differences to be explained by perceived audience: People have difficulty estimating how many people will see their Facebook posts [3] and thus may be more directly influenced by other factors that contribute to their mental image of audience, such as which ties are visible in their News Feeds or have responded in the past, rather than their actual network size. Future work should take the poster's expectations of audience size and supportiveness into account.

The current study opens many avenues for future research, particularly for longer-term repercussions of expressions of emotion. After you vent to your friends online, do you feel better? Offline research suggests that the story is not simple: In some cases, putting upsetting feelings into words helps with recovery, but it depends on the nature of the emotional event, and may also reactivate negative feelings (see [23,42] for reviews). Do sociotechnical affordances of the Internet like reduced time pressure and lack of nonverbal cues make it easier to express and recover from negative experiences? Additional surveys of people who have recently expressed feelings and received varying kinds of responses would illuminate these answers. In particular, we do not yet understand what happens if friends don't respond. Previous research demonstrates that merely broadcasting status updates out to a circle of friends is not directly linked to improvements in well-being; in fact, it is linked to higher levels of loneliness [10]. Those broadcasts must be met with feedback for people to reap the benefits of their networks. Are people who receive supportive comments to negative feelings more likely to post positive feelings later, indicating that they are feeling better? The providers of support may also experience improvements in psychological well-being as a result of helping, or they might feel somewhat worse as a result of empathizing [25]. Finally, it would be valuable to investigate whether emotional transactions of this form increase tie strength between the poster and the responder.

How social network properties such as size and density affect the nature of responses is an additional avenue for future research. Do people receive more emotional comments when their networks are denser, or more backchannel messages when their audiences are larger? The current study demonstrates that people share more emotions when their networks are smaller and denser, but we do not know if smaller, denser networks provide more emotional support, or if larger networks are better in this regard, having more people to provide support. When audiences are larger, potential responders may have their own self-presentation concerns, so may turn to private messaging rather than network-visible channels like comments to offer support.

How does the identity of the responder matter? Does feedback on personal feelings come disproportionately from close friends and family? While one's closest confidants are typically the providers of emotional support [49], in times of psychological distress, strong ties may actually exacerbate feelings of stress or embarrassment [8]. The present study

treats all commenters as equal; future work should examine how tie strength and relationship type moderate the relationship between emotional support provided online and changes in the poster's mood, self-esteem, and perceived social support. Positive news might be more exciting and fulfilling when a variety of acquaintances share in the joy with likes and congratulatory comments. On the other hand, weak ties may be less comfortable expressing empathy in response to negative feelings, or the poster may interpret comments from weak ties as unhelpful platitudes.

We make no claims about the overall percentages of emotions expressed on Facebook; we merely treat the number of posts using the feeling annotation tool as a high-quality lower bound. In Study 2, when we compare posts with emotion annotations to those without, the posts "without" may still contain emotion. Therefore, it makes a relatively conservative baseline. And the present study is correlational; we cannot determine whether revealing feelings on Facebook causes friends to respond in a more supportive way, or if we are simply comparing differences in responsiveness by the friends of two kinds of people: the kind of people who post feelings, and the kind who do not. There are many unobserved variables that likely influence one's propensity to disclose personal thoughts online, and how supportive their social network is. Teens, in particular, may intentionally obscure their thoughts so that parents and other outsiders don't understand [5]. We control for many of the major factors, including age, gender, number of friends, and tenure on the site, but cannot directly control for factors like depression, cohesiveness among friends, or exogenous events. People who use the feeling annotation tool may be more technologically savvy or more emotionally open than people who do not. Sensitivity tests repeating the regressions on each age bucket separately revealed effects were qualitatively similar, but unmeasured confounds remain. While the results generalize well to women and the highly engaged users who chose to use the feeling annotation tool, caution should be used when applying the results to other populations.

We assume that when people share feelings on Facebook, especially negative ones, that those feelings are genuine. Studying feedback mitigates some of these concerns; friends would not respond so consistently if they interpreted the feelings as disingenuous. In some cases, a person might exaggerate the extent to which they feel blue to solicit more sympathy, but perhaps that is legitimately what he or she needs. Previous research also indicates that emotional language in Facebook posts correlates moderately with external measures of happiness [31].

CONCLUSION

Millions of feelings are shared on Facebook every day. The present study demonstrates that posts with explicit feeling annotations, such as "feeling wonderful" or "feeling heartbroken" receive far more responses than ordinary posts. Positive feelings elicit more feedback than text without

feelings, and negative feelings elicit even more responses than positive. The nature of those responses differs, as well, with positive feelings receiving more likes and emotionally positive comments, and negative feelings getting longer, more empathetic comments. Feelings related to low self-worth heighten these effects, and are also linked to an upturn in private messages, where friends can provide emotional support. The results mirror face-to-face support provision, with friends lifting each other up in times of sadness and joy.

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APPENDIX: FEELING TERMS

Positive feelings (not self-relevant): warm, blessed, amazing, wonderful, determined, hopeful, relaxed, excited, happy, great, inspired, refreshed, stoked, awesome, ecstatic, amused, relieved, grateful, pumped, lucky, rested, better, good, mischievous, safe, motivated, fantastic, in love, focused, free, silly, satisfied, fresh, stuffed, thankful, lovely, optimistic, comfortable, peaceful, funny, energized, chill, positive, super, nice, amazed, content, honored, fabulous, fortunate, joyful, calm, well, giddy

Positive self-relevant feelings: special, accomplished, confident, loved, pretty, creative, proud, sexy, appreciated, beautiful, whole, strong, smart, productive, healthy, complete, empowered

Neutral feelings (not self-relevant): nostalgic, meh, hungry, thirsty, ready, spoiled, human, confused, curious, crazy, surprised, restless, rough, emotional, busy, challenged, entertained, cool, shocked, hot, hyper, full, awake, drunk, unsure, blah, impatient, OK, alive, tipsy, thoughtful, undecided, goofy, evil, fine, adventurous, some, type, of, way, perplexed, puzzled

Neutral self-relevant feelings: weird, different, old, normal

Negative feelings (not self-relevant): overwhelmed, annoyed, disappointed, sad, exhausted, sick, tired, sleepy, lazy, angry, sore, frustrated, yucky, irritated, worried, heartbroken, crappy, down, uncomfortable, awful, bored, conflicted, pissed, off, uneasy, disgusted, stressed, anxious, pained, nervous, pissed, guilty, cold, ashamed, nauseous, upset, aggravated, hungover, low, bummed, scared, furious, lost, drained, stuck, miserable, terrible, fed, up, dumb, blue, hurt, jealous, mad, grumpy, sorry, horrible, bad, worse, betrayed, concerned, numb, in, pain, discouraged, embarrassed, sarcastic, trapped, homesick

Negative self-relevant feelings: weak, nerdy, helpless, depressed, lonely, broken, defeated, hopeless, alone, unappreciated, worthless, unloved, fat, insecure, stupid, devastated, unwanted, incomplete, awkward, unimportant