

Perception Differences between the Depressed and Non-Depressed Users in Twitter

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Abstract

One's state of mind will influence her perception of the world and people within it. In this paper, we explore attitudes and behaviors toward online social media based on whether one is depressed or not. We conducted semi-structured face-to-face interviews with 14 active Twitter users, half of whom were depressed and the other half non-depressed. Our results highlight key differences between the two groups in terms of perception towards online social media and behaviors within such systems. Non-depressed individuals perceived Twitter as an information consuming and sharing tool, while depressed individuals perceived it as a tool for social awareness and emotional interaction. We discuss several design implications for future social networks that could better accommodate users with depression and provide insights towards helping depressed users meet their needs through online social media.

Introduction

In developed countries, the cost associated with depression has grown rapidly and depression is a leading cause of disability (WHO 2012). Without treatment, depression has the tendency to assume a chronic course, to recur, and to be associated with increasing disability over time. The National Institute of Mental Health estimates the global cost of mental illness in 2010 at nearly 2.5 trillion dollars, and depression alone accounts for one third of this disability (NIMH 2011). Given the scale of the problem, much effort has been made towards the early diagnosis, treatment, and prevention of depression.

Online social media have tremendous potential to reach depressed individuals, and hence have received significant attention in relation to understanding the moods of users (Vazire and Gosling 2004; Back et al. 2010; De Choudhury, Counts, and Gamon 2012) as well as their depressive states (Moreno et al. 2011; Kotikalapudi and Lutzen 2012; Berger and Buechel 2012). In light of these studies, researchers and healthcare providers have begun to use social media for screening undiagnosed patients (Moreno et al. 2011; Park, Cha, and Cha 2012; Kotikalapudi and Lutzen

2012), for promoting discussions with patients and for providing treatment information.

While most on-going efforts have focused on rapid detection of depressed individuals, current research has not yet investigated how depressed people perceive information and how they communicate differently in online social media. That is, the prior work neither explains how depression changes the way that depressed individuals understand and interpret social information nor how depression changes interaction when participating online. If a social media system is to help depressed individuals, it may need to change how it presents information and the range of possible social relations. Understanding the differences between social media users who have depression and those who do not with the practical goal of developing interventions is the main focus of this study.

Our goal is to understand the perception and behavior differences toward online social media across people suffering from depression and those who are not. Through interviews with 7 depressed and 7 non-depressed participants in South Korea, a country that has the highest suicide rate among the OECD countries (OECD 2011), we explore participants' attitudes toward the uses of online social media. We are interested in (1) verifying whether depressed people perceive and interact differently compared to non-depressed people on Twitter, (2) exploring whether perceptual and behavioral differences provide insights that complement the existing content-centered research results, and (3) identifying design challenges for future Social Media based Healthcare Communities (SMHC).

The contributions of this work lie in our qualitative analysis of interview data collected from the participants who are active users of Twitter. We discussed emergent themes such as how the depressed and non-depressed users formed and maintained their relations, what were the key motivations of messaging activities, what was the impact of reading activities, and how the users think about online social media. We observed that the depressed participants preferred to consume emotional content over informational content, while the non-depressed participants mainly focused on informational value. The depressed participants were reluctant to build new relationships because they were sensitive about the responses as well as contents others produced. Furthermore, the depressed participants considered their tweet time-

line based on loosely connected network as a social awareness stream, while the non-depressed participants perceived the same loosely connected nature as a platform that facilitates information consumption through long-distance ties.

In the following sections we outline prior work closely related to the intersection of online social media and depression. Given the wealth of related work on depression, our review focuses on what could best inform the design of systems. We then outline the methods of the study and describe the data that were collected. While our main focus is on qualitative interviews, the analysis relies on some triangulating quantitative data. We discuss the findings and implications that open design opportunities for online social media systems for individuals with depression, and conclude.

Related Literature

Detecting Depression: User Content and Activity

Social media are commonly used for information exchange among users as well as status updates. Prior work illustrates that personal information—particularly status updates describing users' current experience or emotion—reveal critical information such as health-risk behaviors (Hanson et al. 2012; Thackeray et al. 2012). In particular, a recent study showed that users' Facebook status updates can disclose symptoms of depression called Major Depressive Episodes (MDE) (Moreno et al. 2011). This study explored such disclosures and provided insights into the prevalence of MDE and online content related to MDE.

A number of research illustrated how language usage can reveal depressive status with LIWC (Linguistic Inquiry and Word Count), a text analysis program that counts words in psychologically meaningful categories (Pennebaker, Mehl, and Niederhoffer 2003; Tausczik and Pennebaker 2010). The work showed significant differences in language usage between groups divided by depressive status (Rude, Gortner, and Pennebaker 2004; Ramirez-Esparza et al. 2008). Subsequently, linguistic analysis of short messages, tweets collected from Twitter, demonstrated that such short messages could reliably characterize depressive status of users and that tweets contain detailed information about depressed feelings, status, as well as treatment history (Park, Cha, and Cha 2012).

More recently, one study identified patterns of Internet usage that may indicate depression by analyzing the online logs of undergraduate students (Kotikalapudi and Lutzen 2012). This study indicated that students who exhibited signs of depression were more likely to use file-sharing services, send emails, and chat online than the non-depressed students. Depressed students were more likely to use high-bandwidth applications (such as online videos and games) and showed random behaviors like erratically switching between applications. This study illustrated the value of application logs, as opposed to the interaction data that have typically been used in other studies, in investigating the associations between depression and online user behaviors.

These studies highlight the potential for social media to help individuals suffering from depression. In particular, they consider social media as an innovative avenue for com-

bating the stigma surrounding mental health conditions and for providing potential interventions (Berger and Buechel 2012). Future tools that help depressed people would benefit from methods for identifying users suffering from depression. But as well, social media systems should not simply stop at detection. These systems can be adjusted to better suit users with depression. For instance, they can align information and provide the right type of social interactions for depressed individuals. Addressing the needs of depressed individuals will require understanding how differently they perceive and use online social media.

Perceptual Differences through Depression

Much research over several decades have investigated the general perceptual difference of depressed individuals (Gotlib and Joormann 2010). For instance, depression has been shown to influence individuals' perceptions and depressed individuals see the world with a systematic, negative attentional bias (Punkanen, Eerola, and Erkkilä 2011). Also, individuals with depression show prolonged involuntary processing of negative information—shown by sustained bilateral amygdala activation for negative rather than positive words—when compared with non-depressed individuals as controls (Siegle et al. 2002). According to another research, patients with depression tend to recall a higher proportion of negative words than positive ones when compared to non-depressed controls (Joormann 2004). Also, depressed individuals exhibit enhanced self-referent recall for depressed and non-depressed content, whereas the non-depressed individuals display superior recall for self-referenced non-depressed content (Kuiper and Derry 1982).

Prior work has also shown differences in social interaction patterns caused by perceptual differences between depressed and non-depressed individuals. For example, depressed patients who had phone conversations with other depressed patients became significantly more depressed, anxious, hostile, and rejecting (Kuiper and MacDonald 1982), and discussion of negative subjects during dyadic interaction makes depressed individuals rate themselves as having lower social skills (Forgas, Bower, and Krantz 1984; Gotlib and Meltzer 1987; Slavich et al. 2010). Also, a research investigated how depressed individuals perceive positive (involving praise) and negative (involving criticism) social interaction (Hoehn-Hyde, Schlotzmann, and Rush 1982). The findings of this study indicate that depressed individuals rated negative interactions lower (i.e., in a more socially undesirable way) than non-depressed individuals. Other studies have revealed that depression often affects 'normal' social and psychological development, for example difficulty in establishing and maintaining relationships (Salovey 1997; Mayers 2000; Nasser and Overholser 2005).

The associations between depressed individuals' perceptions and their social media activities have not been studied. Further, much of the research on perceptual characteristics of depressed patients relied on self-reported ratings which can be inconsistent. We believe that using social media both as the focus of the study and as a data collection mechanism would provide another means of understanding perceptual differences.

Study Design

We recruited and interviewed 14 participants; 7 without any prior diagnosis of depression and 7 with existing symptoms of unipolar depression. Unlike prior studies that focused on detecting depression or major depressive episodes based on user-generated text, our goal is to understand how participants adopt online social media and how they perceive activities that are publicly logged (i.e., posting messages) and invisible (i.e., reading messages without any comments). From inductive analysis of 14 interview transcripts and using content analysis of the collected tweets, we identified differences between the depressed and non-depressed participants in their attitudes and behaviors. The remainder of this section describes how the interviewees were recruited and what methods were used.

Recruiting Participants

We recruited participants by sending invitations to participate in a short screening survey. The invitations were first sent to the personal networks of the authors in Facebook and Twitter, then those were consecutively shared by the friends of the authors. The survey collected the following information: (i) demographics (age, gender, education, and job title), (ii) Twitter ID and the permission to gather public tweets of the user¹, (iii) whether the respondent has been diagnosed with depression, and (iv) the depression quotient by the Center for Epidemiologic Studies Depression Scale (CES-D), for which we also provided the Web link for online assessment.

The CES-D is a 20-item self-report scale that is designed to measure depressive symptoms in the general population (Radloff 1977). Its scores range from 0 to 60, with higher scores indicating more severe depressive symptoms. Our participants were characterized with continuous CES-D score as well as a dichotomous indicator for clinically relevant depressive symptoms ($CES-D \geq 23$) with proven criterion validity for major depression (Haringsma et al. 2004). While studies adopt different cutoffs (such as 20, 22, 25, or 27), we chose 22 because it is the most widely used threshold with great improvements in false-positive rates and specificity (Houston et al. 2001).

A total of 253 users completed our screening survey. However, not all participants shared their Twitter IDs with us and only 165 participants gave us permission to use their public tweets for this study. Not all of the respondents were active on Twitter. We screened out users who posted fewer than 50 words during the week in which the survey was conducted. This resulted in 69 participants; 23 participants with depression and 46 who were not depressed. We sent direct messages on Twitter to these 69 participants and asked for an in-depth interview, of which 24 agreed (depressed=16, non-depressed=8). We set up interviews with 15 participants

¹We focused on Twitter as a characteristic social media platform because it exemplifies the minimal type of social interaction as well as content production and consumption necessary for the study. Further, the API allowed us to collect the publicly available content contributed and most likely read and consumed by our participants while respecting user privacy boundaries.

Participant	Group	Gender	Primary Network
D01	Depressed	F	Twitter
D02		F	Twitter
D03		M	Twitter
D04		M	Twitter
D05		F	Twitter
D06		F	Twitter
D07		F	Twitter
ND01	Non-Depressed	M	Twitter, Facebook
ND02		M	Twitter
ND03		F	Twitter, Facebook
ND04		M	Twitter, Facebook
ND05		M	Twitter, Facebook
ND06		M	Twitter
ND07		F	Twitter

Table 1: Interview participants information

among them. One interviewee with depression did not appear at the arranged place. This resulted in 14 interviews, half with participants who were ‘clinically diagnosed’ with unipolar depression and the other half without depression.

The interview participants (male=7, female=7) were aged between 20-40 (mean=29.4, sd=5.9), and had a diverse mix of job. Job titles included student, college lecturer, IT developer, furniture designer, UX designer, rock musician, novelist, fashion trends analyst, and unemployed. Nine participants were undergraduates or had received a bachelor’s degree and the remainder had earned master’s degree. Despite this heterogeneity, interview results were surprisingly similar given the same depression status. Summary of study participants is presented in Table 1.

Interviews

We conducted semi-structured interviews during March 2012, in locations where participants had agreed to meet (e.g., cafes). Each interview lasted approximately 90 minutes. All interviewees had the same ethnic background of being native Koreans and lived in the same city, Seoul. The interviews were conducted face-to-face and audio recorded with the consent of the participant. The interviewer kept field notes to document any non-verbal signs observed during the interview. After completing all interviews, a number of follow-up interviews were requested to some of interviewees to clarify answers and to ask questions resulting from the other interviews via face-to-face or email. Participants were compensated with approximately 20 USD (20,000 KRW) upon completion of the interview.

The semi-structured interviews centered around participants’ experiences with their primary online social media and their experience with depression. Each interview began with general questions such as how long participants stayed online each day and which applications and content

they used the most. We then asked participants to explain why they chose each application or content. Following these questions, we asked participants about their online social media usage. We asked which online social media sites they frequently used and how they felt about using specific features of these sites. In the case of Twitter we asked about their use of following, unfollowing, direct messaging, status updating, replying, mentioning, retweeting, and reading streams.

Then we shifted our focus to inquiring about depression. We asked them to describe how they handle gloomy feelings and day-to-day stress. We also asked them to share experiences where an online community or social media helped resolve emotional problems. Following these questions we asked participants to share experiences with gloomy postings they had seen on online social media, to describe how they felt about them and what they did afterward. For participants with depression, we asked them to share their life stories before and after being diagnosed with depression. Non-depressed individuals were asked questions about their experiences with depressed individuals (e.g., whether the participants have any friends who are depressed and if so how the participants interact with them). These personal statements helped us gain a better understanding of the different participant groups' attitudes toward social media as well as how they use it.

Interview Coding Procedure

All interviews were transcribed and pseudo-anonymized. Emails exchanged during follow-up interviews were combined into the transcripts. An iterative process of analysis inspired in grounded theory was used to elicit emerging themes. We started with individual coding of the transcripts. Through discussion, we combined the coding schema identified by each member. Emergent themes were examined and related ideas were grouped together as possible subthemes of a common theme. The transcripts were re-reviewed to identify possible instances of any newer themes or principles. Iterative generation and refinement of themes continued until a sense of closure was achieved. The process resulted in four main themes and some associated subthemes.

The main themes include: (1) forming and maintaining social relations such as how users choose who to follow and their reasons for unfollowing; (2) messaging activities such as the motivations for tweeting, mentioning, replying, and retweeting; (3) considering Twitter as a social-awareness stream and its impact on reading the tweet-stream; and (4) thoughts about Twitter including its pros and cons compared to other social media. These qualitative categories are not mutually exclusive and in many cases participants' comments must be carefully unpacked before they can be effectively interpreted.

We asked two independent coders to validate our codes. We provided them our full transcripts and codebook to test high level codes across all of the data. We asked them to carefully read a selection of transcript segments and apply a 3-point confidence scale, where a '3' meant high confidence in coding and '1' meant low confidence. After the first round of evaluation, there was a discussion between the coders and

authors to clarify details of the coding scheme. In a second round of coding, the independent coders rated their coding of all themes as highly confident. Cohen's Kappa was used to assess the inter-rater reliability for the second round of evaluation, and the score was 0.759 ($p < 0.01$) indicating a substantial agreement.

Tweet Content Analysis

In addition to the analysis of the interviews, we conducted content analysis of tweets of our participants' friends² to characterize the preference of tweet consumption of the participants. For this, we downloaded all tweets of the participants' friends. A total of 1,523,377 tweets were collected from 1,363 friends of participants in the depressed group and 1,649,761 tweets were collected from 1,756 friends of participants in the non-depressed group. We generated a sample of 10,000 tweets; 5,000 randomly selected tweets from each group. These tweets were analyzed for quantifying the emotional significance.

We used Linguistic Inquiry and Word Count (LIWC) to analyze the tweet content. LIWC contains a dictionary of several thousand words, with each word scaled across the following six criteria: social, affective, cognitive, perceptual, biological processes, and relativity (Pennebaker, Mehl, and Niederhoffer 2003). Each criterion comprises several categories and sub-categories. For example, the word 'cry' is associated with sadness, negative emotion, overall effect, and verb. We focused on words that have scales in the affective criterion as this is where LIWC is most likely to detect emotional content and sentiment.

Results

The interviews revealed consistent tendencies within groups and significant differences across groups on the same activities in Twitter. In this section, we describe these key differences, framed around the four analytical themes: (1) forming and maintaining of social relations, (2) messaging activities, (3) considering Twitter as a social awareness stream, and (4) thoughts about Twitter.

Forming and Maintaining of Social Relations

The participants used Twitter to seek information, interact with others, and share interesting things about their lives (e.g., whereabouts, interesting articles read, and thoughts). These activities were not any different for the depressed and non-depressed groups. However, there was a significant difference when it came to whom the participants wanted to follow and why they unfollowed someone. Following and unfollowing activities reflected how one manages the content presented in the timeline.

Mechanism of Following Participants in both groups described their following mechanism in a similar fashion. At first, they followed users who are offline friends. They then navigated the social network of these newly added friends

²The term 'friends' indicates the people who a Twitter user follows and are the most likely source of the content which a Twitter user reads.

and read the timeline of other users looking for a potential person to follow. They explored user profiles through profile links on tweets and their friends' lists of friends and followers. Arriving upon a profile page of a user, they reviewed the profile information and judged whether tweets are something they would want to read in the future, in which case they followed the user.

Preference for Following There is a clear distinction between the two groups on the types of Twitter users they preferred to follow. Participants in the depressed group told us they follow users who post life episodes with emotional content as well as those who produce information, but they preferred to read tweets with emotional life stories. Some of these participants even spent hours trying to find users who post such content as shown in the quote below³:

"Everyone talks about similar things like politics. Something light and comfy is what I want to read and write. So I want to follow people who talk a lot about ordinary stuff, but it's really hard to find someone like that. You really have to dig in." -D01

Participant D01 explained that she feels relieved when she reads other people's life episodes, because she no longer feels so different from others. She likes tweets that contain a sense of empathy toward someone or some issue as well as joyful emotions (e.g., *"I'm so happy that my first attempt to cook was wonderful!"*). For participants in the depressed group, the normalcy of 'everyday' affective content was such an important motivation that they consciously tried to follow users who frequently post such tweets. On the other hand, participants in the depressed group were unwilling to follow those who strongly criticized specific issues like politics and religion. Because such content made them feel uncomfortable, they tended to avoid reading such tweets. This preference for content was highly related to the depressed participants' unfollowing behavior as well.

In contrast, participants in the non-depressed group showed a different tendency. They wanted to follow users who produced unique or rapid information steadily. Hence, they often followed authoritative sources or institutions (e.g., public figures, journalists, entrepreneurs, news outlets, museums):

"I follow politicians, news outlets, publishers, designers, musicians—a wide range. But the list keeps changing because I unfollow anyone when that person starts posting unnecessary information, when I simply want to read someone else's tweets, or when I start getting too much information from that person. I sometimes follow someone whom I have previously unfollowed if I need information from that person again." -ND02

"I use Twitter only to gain information related to my job and politics. I often copy and paste some of the information to my personal note. I follow users like magazine editors who actively share information on specific domain. In this way, I don't need to spend time finding similar information by myself through many websites." -ND04

Participants in the non-depressed group concentrated on information consumption. As illustrated by ND02 and

ND04, participants in this group often judged users by the informativeness of the content produced. They liked to follow authoritative sources and popular figures in a specific field. ND02 also mentioned that he followed celebrities just for fun. Participants in the non-depressed group also followed multiple users who posted similar information, because they thought it provided a holistic view compared to relying on just one source. Such attitudes also influenced how these users post tweets. Some participants used retweet (RT) for archiving information, while others like ND04 archived relevant information manually. This will be discussed further in the 'Messaging Activities' subsection below.

The above qualitative difference can be triangulated by considering the actual tweets that the participants consumed. We examined the stated preference for emotional content by the depressed group through sentiment analysis comparing the friends' tweets of the depressed and non-depressed groups. We used LIWC to measure affectiveness of the sample and performed a two-sample t-test to determine the significance of mean difference between measured affectiveness of tweets. The average affectiveness of tweets of friends in the depressed group (mean=4.67, sd=0.68) was significantly higher than the average affectiveness of those tweets in the non-depressed group (mean=3.42, sd=0.45, $p < 0.01$, Cohen's $d = 2.35$). This result supports the statements of the participants in the depressed group. Given who they follow, they consumed more emotional content than participants in the non-depressed group.

Reasons for Unfollowing Participants in both groups told us they generally unfollowed someone when that user posted tweets too frequently. No participant wanted their timelines to be monopolized by a single individual regardless of the content. Participants also unfollowed someone when the posted content became uninteresting. These findings are similar to earlier studies that explored the unfollowing dynamics of Twitter (Pogue 2009; Kwak, Chun, and Moon 2011). While the general pattern aligns with findings from the literature, participants in the depressed group had one additional reason to unfollow someone. Complaining, whining, gloomy, and even depressing status updates caused these users to unfollow. They were afraid that reading such tweets might influence them to have a gloomy outlook, which they truly wanted to avoid. Two participants said:

"I unfollow downers, because I worry that I might also become gloomy by reading their tweets. I don't want to be carried away. I know I'm a sensitive person, so there is nothing else I can do besides unfollowing. I don't want to sink with them." -D03

"When I see a bad situation, I worry about that person. But at the same time, it strains me and I start to wonder 'does this person have anything else to say other than being depressed?' These tweets trigger negative emotions in my mind, and ultimately I unfollow the person." -D07

Everyone in the depressed group told us that they were easily influenced by gloomy and depressed emotions of others. Above, participant D03 mentioned that he does not want to be 'carried away' by the emotion of users who post

³All quotes were translated into English.

gloomy tweets. These participants did not unfollow users who posted one gloomy tweet. It was the regular and frequent gloomy tweets that resulted in unfollowing.

Participants in the non-depressed group, on the other hand, described their unfollow behavior similar to what previous study found (Kwak, Chun, and Moon 2011). These users unfollowed those who posted tweets about the mundane details of their lives. One interviewee said *“I’m not interested in how other people live.”* While participants in the depressed group rarely identified tweet volume as trouble, participants in the non-depressed group recognized tweet volume as an issue. Participants in the non-depressed group managed the number of people they follow with a finer level of control over the type and amount of information they received. This point is noted in the quote from ND02 in the previous subsection, above. Another participant also said:

“I unfollow accounts that post too many tweets. I regularly manage my following list by unfollowing a bunch and then re-following some of them if I need information from them again. I follow accounts that give me more information about the areas I’m interested in—like news outlets—and I unfollow any unnecessary accounts in order to control the total amount of information in my timeline.” -ND03

Messaging Activities

Messaging activities are important for understanding the motives of users. Tweeting, mentioning, replying, and retweeting are important activities that illustrate attitudes and behaviors of users. The interviews revealed eight different motives of messaging activities in Twitter: self-documentation, information archiving, information sharing, social interaction, entertainment, passing time, self-expression, and consoling oneself. These motives are similar those from a study of bloggers (Li 2005).

We found several key differences in attitudes toward messaging activities expressed by participants in both groups. Participants in the non-depressed group told us they commonly forwarded or retweeted other people’s tweets to facilitate information sharing (e.g., breaking news, public figure’s comments) and information archiving. In contrast, participants in the depressed group said that the act of retweeting meant expressing agreement or sympathy. Thus, retweeting for the depressed participants had important interpersonal implications. One participant said:

“Retweet (RT) usually means that you sympathize or agree with the content or the user, right? Perhaps, it might be an expression that I like these things.” -D01

Participants in the depressed group used the word ‘sympathy’ frequently during the interview. Participant D02 told us she has significant affection for tweets containing sympathy as well as joy. She sometimes ‘mentioned’ users who post a tweet that contains sympathetic content, but did not always get a response from them. Participants in this group noted that retweeting is an easy expression of what they like and agree with, without the expectation of a response. They also mentioned the information sharing value of retweeting, but the most important reason to retweet was to empathize with the content.

In contrast, participants in the non-depressed group mostly retweeted for archiving and information sharing purposes. Some participants in this group retweeted to create a personal archive of tweets to circumvent Twitter limits⁴ and retweeted with category tags by utilizing third party applications that automatically stored the RT messages with the associated tags.

When it came to making new friends, participants in the depressed group were sensitive about developing new, unexpected relationships online. These users preferred to simply post tweets than to engage in other interactions like mentioning or replying. For them, Twitter is a comfortable space to receive emotional comfort through tweeting; it is a place to post life episodes and gain emotional support without directly interrupting or bothering someone. They also emphasized that Twitter can be distinguished by “unconcernedness” and “indifference” that are characteristic of loosely connected relationships. D01 said, *“Everybody pays attention to different things even though they are in the same sphere.”* Participants in this group described how this indifference helped them disclose their feelings and thoughts:

“When I talk to my friends [face-to-face] about someone who hurt me, they seem to be super-supportive and get more upset than myself. As a result, I feel even more negative and the situation gets worse. But when I share the same story on Twitter, it seems that no one cares about what I say. While I didn’t really expect to gain emotional support from others by expressing negative feelings or disclosing my bad situations on Twitter, I get more objective feedback and feel more productive than talking to a close friend.” -D04

“Twitter makes me feel like I’m shouting in the void. I forget there are others who are reading my tweets. So I can write a lot about things that only I can understand. Then I feel consoled.” -D06

D04 and D06 thought that the indifferent atmosphere of Twitter lowered the barrier to express their feelings and disclose life stories. The networked, social characteristics lead them to expect meaningful feedbacks and sympathetic remarks from their followers and potentially others as well. They knew that feedback is not always guaranteed nor is always helpful. Nonetheless, posting tweets was more comfortable for them than any other types of interactions such as replying or mentioning. Posting about oneself on Twitter was far more comfortable than doing so in other social networks like Facebook.

Considering Twitter as a Social Awareness Stream

For all of our participants, navigating to others’ accounts and to external web sites, was a daily activity. Participants in both groups claimed to read 80-100% of tweets on their timeline every day and spent more time reading tweets and visiting others’ profile pages than posting. This revealed another important theme that illustrates differences between the two groups. Participants in the non-depressed group regarded such activities as information seeking and sharing. However, participants in the depressed group described their

⁴Twitter displays tweets chronologically and that older tweets cannot be accessed when a user posts more than 3,200 tweets.

experiences and feelings about reviewing their tweet stream with a unique significance: “I feel I’m connecting to the world” and “I feel like I’m a part of society.”

Previous study identified Twitter as a social awareness stream with three factors that distinguish it from other communication platforms (Naaman, Boase, and Lai 2010): (1) the public or personal-public nature of the communication and conversation, (2) the brevity of posted content, and (3) a highly connected social space where most of the information consumption is enabled and driven by articulated online contact networks. We believe that such characteristics allow users to have social awareness not only with public information but also with deeply personal content on various episodes and insights of individuals connected through short and long distances. One participant said:

“Twitter makes me think that I’m not alone in this world and that I can be myself. Looking at the timeline of Twitter flowing all the time reminds me that the world is constantly changing without my effort, yet still, also reminds me that I’m not alone in this world at the same time.” -D02

In the quote above, D02 explained two things based on her experience with Twitter: by seeing tweet dynamics (1) she realized that there are many things going on around her, and (2) she felt that she is a part of these things. She told us it is complicated and difficult to explain, but she illustrated her point with a simple example based on the sleep cycle. She told us she would become aware of the fact that it was time to sleep by seeing others post “Good night!” tweets and by seeing fewer tweets by others as it got later at night. Like many other depressed people, she struggled getting regular sleep, but she was trying to lead a more regular life schedule as regular sleep rhythm helped her feel better.

Another participant’s view about the social awareness in Twitter complements that of participant D02:

“Usually, people [like me] who suffer from depression do not easily talk about their problems openly, and this can make them think that the problem cannot be solved by themselves. They are burdened by the problem all the time because of lack of communication. But through Twitter, they can read others’ tweets like ‘I eat,’ ‘I got hurt,’ ‘I’m sad,’ ‘I broke up with my girlfriend.’ This experience makes them think their problem is just one of tons of problems in the world and realize that their problem may not be as immense as they had been thought. Such awareness and realization can help them fighting the problem. Twitter leaves them free of their own confinement, so they can see their problem more objectively and get the motivation and energy to overcome the problem.” -D05

For D05, an explicit reason for considering other individuals’ daily episodes on her timeline as social awareness was that it could reduce her self-focused tendency and encourage her to consider that the problem at hand may not be as immense as she had thought. She believed that social awareness provided critical perspective that helped her gain a sense of control. Other participants in the depressed group also said like “I get obsessed with my own thoughts when I do not communicate with others.” The depressed participants felt that they learned more about everyday life by seeing details from others’ lives and spent less time brooding

over their own situation than before they began using social media.

Thoughts about Twitter

In addition to the messaging, awareness, and social aspects of Twitter, the participants discussed the system and interface characteristics that influenced their attitudes and behaviors. Participants in both groups underscored two attributes of Twitter—the loosely connected nature of relationships and the volatile characteristic of tweets. Like our other findings, participants in each group shared some similarities as well as certain differences.

Loose Connections As discussed earlier, participants in the depressed group identified the atmosphere of indifference resulting from loose social connections made them freer to post private thoughts and feelings compared to other face-to-face or online communications. In particular, all of the participants in the depressed group preferred Twitter over Facebook. One participant said:

“When I say ‘I’m not feeling good’ on my personal blog or Facebook, most friends will reply with some encouraging comment. When I say the same thing on Twitter, only a few will notice because tweets just flow away in the timeline. It’s hard to explain but I like this kind of indifference. Sometimes when I sit down and watch the tweets stream by, I feel like depression is nothing so serious, but part of ordinary life. And I feel like I’m connected with other people on Twitter by seeing their tweets about eating meals, taking a trip somewhere, or feeling blue.” -D02

For D02, Twitter was viewed as a medium where everyone talked about their own stories and paid attention to different things, but collectively gave a sense of community (similar to D01 above in ‘Messaging Activities’). The ‘loosely connected network’ was a principle way that she recognized details of other people’s lives. Such indifference let her post more freely about what is on her mind. In contrast, Facebook friends were mostly based on close offline connections, which made her self-conscious that her Facebook friends may misconstrue her posts and respond too sensitively. This is similar to the comment by D04 in the ‘Messaging Activities’ subsection above.

In contrast, participants in the non-depressed group perceived the loosely connected nature of Twitter differently. Some of them saw a value in the ability to read the thoughts of public figures, whom otherwise is hard to get access. In particular, ND06 mentioned that he was often impressed by the insights from high status individuals:

“I think the loose connection is the greatest merit of Twitter. In the real world, I would never get to meet someone like John Maeda in person. He would also never friend me on Facebook. But on Twitter, I can follow him and then I am able to see what he thinks about or what he writes. I feel lucky to read such content without hindrance.” -ND06

Participants in the non-depressed group saw another advantage in information consumption due to the loose connection. Participants in this group were happy to consume undistilled information from both authoritative and non-authoritative sources, because it was faster than traditional

media. They highlighted the value of unfiltered information. ND01 said that *“Issues with societal importance cannot be effectively discussed because of political divisions.”* Such information generated by non-authoritative users might be false but he said that *“That is exactly the beauty of social media as I can read ‘uncensored’ information.”* Participants in the non-depressed group valued the information delivered across long social distances in the network and recognized that the same information may not have been available in a more closely connected social media community such as Facebook or offline friendship.

Volatile or Instant Attributes Currently, Twitter only supports retrieval of the most recent 3,200 tweets for any user and that users cannot see their oldest tweets beyond this limit. Some participants in the non-depressed group complained about this limit. They mitigated possible information loss by archiving meaningful tweets either manually (i.e., copy and paste) and automatically (i.e., using a third party application that save user’s retweets or favorited tweets). Additionally, they told us that Twitter’s search function is insufficient when they need to find their own or their friends’ tweets. They added *“the timeline refreshes so quickly”* but there is sometimes a need to re-read old tweets.

On the other hand, participants in the depressed group considered the archiving problem and the fast timeline dynamics positively. Some participants in this group perceived the volatile nature of Twitter to encourage them to communicate with others. The loosely connected nature of Twitter had similar effect on these users. They know that other popular communication platforms such as blogs and Facebook do not remove (or timeout) a user’s message unless the user explicitly deletes it. In those cases messages remain for a long time compared to Twitter. The long-lived nature of messages in these other media raised the barrier when the depressed participants wanted to disclose their emotions and daily situations. As discussed in an earlier subsection, they were uncomfortable with expressing their situations to close friends and worried that a post may be seen by a close friend one day. One participant in the depressed group said:

“The reason why people post feelings on the Internet is that they want others to recognize and sympathize. I have mixed feelings about this because I feel uncomfortable knowing that the Internet will log things forever. It’s hard to write about my life in online communities like Facebook, because I know these messages will remain forever. That’s why I feel more comfortable writing about my feelings on Twitter since tweets flow away and disappear from people’s timelines quickly.” -D07

Discussion

Our participants showed differing attitudes and behaviors toward online social media, depending on their depression status. Participants in the depressed group tended to think about their activities as means of maintaining social awareness and consoling oneself, whereas those in the non-depressed group tended to regard the same activities as information sharing and consumption. This key perception difference leads to several implications for Social Media based Healthcare

Communities (SMHC) that can support depressed individuals. Below, we explore how some of our themes suggest possible design moves that differentially address the needs of users and discuss how our findings shed light on usages of current social media for depression patients.

Rethinking SMHC

Our observations show that a lightweight and somewhat less persistent communication tool may encourage depressed people to participate more actively. The fact that some web content lived long often was an emotional barrier for the depressed participants. This barrier could be addressed through tools that allow users to select the volatility of a message: messages marked as non-volatile would remain available, whereas volatile messages would be deleted from the server as well as from the screens of users after a specified time period (Maeng et al. 2011). Associations between the types of messages and the selected volatility could be examined through analyzing users’ actual messages, and these may address posting concerns, which will lower the barriers in posting difficult or uncomfortable posts.

We saw several examples of why the depressed participants unfollow someone. One important reason was they tend to avoid gloomy or depressing tweets. An alternate approach would be to filter out gloomy messages, creating a social squelch that depressed users could control. Filtering messages allows the depressed person to keep in contact and control of their own exposure to content. Social media applications implementing the filtering feature can be designed to explicitly test this idea. A filtering approach would likely face a difficult text classification challenge. Prior work has illustrated the ability to detect depression from text (Moreno et al. 2011; Park, Cha, and Cha 2012), so there is some promise that filtering could be effective.

Finally, our results raise an interesting challenge for effective social matching (Terveen and McDonald 2005). Both our interviews and content analysis support the tendency of the depressed participants to follow users who post life episodes with emotional content. This suggests that there might be an opportunity to apply sentiment analysis in social recommendation. A friend suggestion feature based on content sentiment might be more useful for individuals with depression than a traditional egocentric-based friend-of-friend similarity. Given a large set of existing tweets, content based friend recommendations could be simulated and tested by replaying prior tweets.

Social Media for Depression Patients

Our findings suggest several ways to better assist depressed individuals in Twitter. Healthcare providers working with depression patients could consider recommending social media as a way to reduce the level of self-focusing thoughts. Social media may help depressed individuals see themselves more objectively which is positively related to overcoming depression (Von Korff et al. 2001; Papolos 1997). Moreover, our findings suggest that depression patients might gain comfort from disclosing life episodes and communicating with others through social media.

We also identified opportunities to incorporate social media streams in clinical treatment. Our depressed participants fully acknowledged that they needed doctor's advice and structured action plans to overcome the illness. However, their doctors mostly asked about how they felt at a given moment, focusing on prescribing new medicine or adjusting the dosage of current medicine. Day-to-day feelings and episodes can be hard to disclose in a short time allowed with the doctor. In this case, a social-media-based mental health dashboard could help doctors be more aware of the patients' daily lives and emotional states. The technical challenge here would be to distill a patient's Twitter stream into something similar to a medical chart that could be easily and quickly reviewed by medical practitioners. Doctors and other caregivers then can have a more fruitful discussion with patients given the limited consultation hours.

Limitations

Our study relied on individuals who were active users of online social media, and hence the findings can be limited to less active users. It is unclear whether depressed but non-active users would encounter the same types of barriers and supports as our participants. Furthermore, while we learned of several clear perception and behavioral differences between the depressed and non-depressed individuals, we did not control for other factors such as demographic and socioeconomic status (e.g., age, gender, education, and job). Also, we focused on only Korean sample, which is not diverse user set. Although overcoming these limitations is beyond the scope of our research, there might be meaningful differences that could be drawn from studies that explicitly focus on these dimensions.

Conclusion

Our mental state often influences our perception of the world and of the people around us. In order to understand the perceived differences in attitudes and behaviors of online social media users with and without depression, we conducted interviews with 14 active Twitter users and performed content analysis of their tweets. Based on the qualitative analysis, this paper presented several key findings.

Users with depression perceived Twitter as a tool for social awareness and consoling oneself. As a result, the simple act of tweeting life episodes gave them a way to express themselves and gain emotional support from their peers. These users preferred to follow other users who post about their daily lives with emotional content. These users were rather sensitive about the implications of social interactions such as 'mention' or 'reply' and tried to avoid unexpected relations resulting from this form of interaction. They were also careful in controlling the types of sentiments they received from peers; those who tweeted negative or depressive feelings were soon unfollowed.

In contrast, users without any sign of depression perceived Twitter as an information consumption and sharing tool. These users were keen to manage the type and amount of information they received. Prolific peers who tweeted too frequently were hence unfollowed, and sometimes followed

back later when their information were needed again. Non-depressed users were more willing to participate in active social interactions (i.e., mentions, replies) compared to the depressed users, and they interacted with peers of varying degrees of social strength, including those with weak social ties or even strangers. For these users, the act of retweeting provided a mechanism for curating or archiving tweets that have potential value in the future.

Much of recent social media research has focused on detecting mental health issues, such as finding markers of depression in conversation logs. However, detection alone does not imply an effective social support or treatment. Building upon the literature, our study focused on the key perceived differences between the depressed and non-depressed users, and our findings suggest several important design options that might improve the care, support, and treatment of depression. In that way, our study suggests important ways to move beyond simply detecting mental health problems and towards helping to solve some of the problems.

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References

- Back, M.; Stopfer, J.; Vazire, S.; Gaddis, S.; Schmukle, S.; Egloff, B.; and Gosling, S. 2010. Facebook profiles reflect actual personality, not self-idealization. *Psychological Science*.
- Berger, J., and Buechel, E. 2012. Facebook therapy? why do people share self-relevant content online. Available at <http://ssrn.com/abstract=2013148>.
- De Choudhury, M.; Counts, S.; and Gamon, M. 2012. Not all moods re created equal! a exploring human emotional states in social media. In *International Conference on Weblogs and Social Media*.
- Forgas, J.; Bower, G.; and Krantz, S. 1984. The influence of mood on perceptions of social interactions. *Journal of Experimental Social Psychology*.
- Gotlib, I., and Joormann, J. 2010. Cognition and depression: current status and future directions. *Annual review of clinical psychology*.
- Gotlib, I., and Meltzer, S. 1987. Depression and the perception of social skill in dyadic interaction. *Cognitive Therapy and Research*.
- Hanson, C.; Barrett, J.; West, J.; and Barnes, M. 2012. Protecting public health in a social media world: Policy responses to online threats. *The Internet Journal of Public Health*.
- Haringsma, R.; Engels, G.; Beekman, A.; and Spinhoven, P. 2004. The criterion validity of the center for epidemiological studies depression scale (ces-d) in a sample of self-referred elders with depressive symptomatology. *International journal of geriatric psychiatry*.

- Hoehn-Hyde, D.; Schlottmann, R.; and Rush, A. 1982. Perception of social interactions in depressed psychiatric patients. *Journal of Consulting and Clinical Psychology*.
- Houston, T.; Cooper, L.; Vu, H.; Kahn, J.; Toser, J.; and Ford, D. 2001. Screening the Public for Depression through the Internet. *Psychiatric Services*.
- Joormann, J. 2004. Attentional bias in dysphoria: The role of inhibitory processes. *Cognition and Emotion*.
- Kotikalapudi, R., C. S. M. F. W. D., and Lutzen, K. 2012. Associating depressive symptoms in college students with internet usage using real Internet data. In *IEEE Technology and Society Magazine*.
- Kuiper, N., and Derry, P. 1982. Depressed and nondepressed content self-reference in mild depressives. *Journal of Personality*.
- Kuiper, N., and MacDonald, M. 1982. Self and other perception in mild depressives. *Social Cognition*.
- Kwak, H.; Chun, H.; and Moon, S. 2011. Fragile online relationship: a first look at unfollow dynamics in Twitter. In *Proceedings of the ACM Conference on Human Factors in Computing Systems*.
- Li, D. 2005. *Why do you blog: A uses-and-gratifications inquiry into bloggers' motivations*. Marquette University.
- Maeng, S.; Yeom, J.; Cho, H.; and Jeon, B. 2011. Bunny burnit: the volatile message as a new social network system to overcome digital eternity. In *Proceedings of the ACM International Conference on Advances in Computer Entertainment Technology*.
- Mayers, C. 2000. Quality of life: priorities for people with enduring mental health problems. *The British Journal of Occupational Therapy*.
- Moreno, M.; Jelenchick, L.; Egan, K.; Cox, E.; Young, H.; Gannon, K.; and Becker, T. 2011. Feeling bad on Facebook: depression disclosures by college students on a social networking site. *Depression and Anxiety*.
- Naaman, M.; Boase, J.; and Lai, C.-H. 2010. Is it Really About Me? Message Content in Social Awareness Streams. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work*.
- Nasser, E., and Overholser, J. 2005. Recovery from major depression: the role of support from family, friends, and spiritual beliefs. *Acta Psychiatrica Scandinavica*.
2011. *NIMH (National Institute of Mental Health)*, Statistics (Accessed on Nov 1, 2012). <http://tinyurl.com/452x2rv>.
2011. *OECD (Organisation for Economic Co-operation and Development)*, Statistics (Accessed on Nov 1, 2012). <http://stats.oecd.org/Index.aspx>.
- Papoulos, J. 1997. *Overcoming depression*. Harper Paperbacks.
- Park, M.; Cha, C.; and Cha, M. 2012. Depressive moods of users portrayed in Twitter. In *Proceedings of the ACM SIGKDD Workshop on Health Informatics*.
- Pennebaker, J. W.; Mehl, M. R.; and Niederhoffer, K. G. 2003. Psychological Aspects of Natural Language Use: Our Words, Ourselves. *Annual Review of Psychology*.
- Pogue, D. 2009. Twitter? it's what you make it. *The New York Times*.
- Punkanen, M.; Eerola, T.; and Erkkilä, J. 2011. Biased emotional recognition in depression: Perception of emotions in music by depressed patients. *Journal of Affective Disorders*.
- Radloff, L. S. 1977. The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. *Applied Psychological Measurement*.
- Ramirez-Esparza, N.; Chung, C. K.; Kacewicz, E.; and Pennebaker, J. W. 2008. The psychology of word use in depression forums in english and in spanish: Testing two text analytic approaches. In *International Conference on Weblogs and Social Media*.
- Rude, S.; Gortner, E.; and Pennebaker, J. 2004. Language use of depressed and depression-vulnerable college students. *Cognition and Emotion*.
- Salovey, P. 1997. *Emotional development and emotional intelligence: Educational implications*. Basic Books.
- Siegle, G.; Steinhauer, S.; Thase, M.; Stenger, V.; and Carter, C. 2002. Can't shake that feeling: event-related fmri assessment of sustained amygdala activity in response to emotional information in depressed individuals. *Biological psychiatry*.
- Slavich, G.; O'Donovan, A.; Epel, E.; and Kemeny, M. 2010. Black sheep get the blues: A psychobiological model of social rejection and depression. *Neuroscience & Biobehavioral Reviews*.
- Tausczik, Y. R., and Pennebaker, J. W. 2010. The Psychological Meaning of Words: LIWC and Computerized Text Analysis Methods. *Journal of Language and Social Psychology*.
- Terveen, L., and McDonald, D. W. 2005. Social matching: A framework and research agenda. *ACM Transactions on Computer-Human Interaction*.
- Thackeray, R.; Neiger, B.; Smith, A.; and Van Wagenen, S. 2012. Adoption and use of social media among public health. *BMC Public Health*.
- Vazire, S., and Gosling, S. D. 2004. e-Perceptions: Personality Impressions Based on Personal Websites. *Journal of Personality and Social Psychology*.
- Von Korff, M.; Katon, W.; Unutzer, J.; Wells, K.; and Wagner, E. 2001. Improving depression care: barriers, solutions, and research needs. *Journal of Family Practice*.
2012. *WHO (World Health Organization)*, Report of Depression (Accessed on Nov 1, 2012). <http://tinyurl.com/d63b3jw>.