

Understanding Loneliness in Social Awareness Streams: Expressions and Responses

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Abstract

We studied the experience of loneliness as communicated by thousands of people on Twitter. Using a data set of public Twitter posts containing explicit expressions of loneliness, we qualitatively developed a categorization scheme for these expressions, showing how the context of loneliness expressed on Twitter relates to existing theories about loneliness. A quantitative analysis of the data exposed categories and patterns in communication practices around loneliness. For example, users expressing more severe, enduring loneliness are more likely to be female, and less likely to include requests for social interaction in their tweets. Further, we studied the *responses* to expressions of loneliness in Twitter’s social settings. Deriving from the same dataset, we examined factors that correlate with the existence and type of response, showing, for example, that men were more likely to receive responses to lonely tweets, and expressions of enduring loneliness are critically less likely to receive responses.

Introduction

This paper examines online expressions of loneliness through the study of declarations of loneliness on Twitter, and the responses to these messages. Loneliness, also known as “perceived social isolation” (de Jong Gierveld, Van Tilburg, and Dykstra 2006), threatens the physical and mental health of millions of people in the United States alone (Anderson 2010). Although everybody feels lonely at some point in their lives, prolonged experiences of loneliness can lead to severe problems including poor antibody response, low sleep efficiency and quality, depression, suicidal ideation, and social anxiety (Joiner and Rudd 1996; Wei, Russell, and Zakalik 2005; Brage 1995). Moreover, loneliness is disproportionately experienced by already vulnerable segments of the population such as the elderly, teenagers, minorities, and those who have recently overcome severe and stressful life events (Cacioppo, Hawkley, and Berntson 2003).

With the growing use of social awareness streams (SAS) – one-to-many communication channels available through popular social network sites like Facebook and Twitter (Naaman, Boase, and Lai 2010) – people increasingly express loneliness online. These expressions of loneliness and the responses they garner can provide a lens through which to examine contemporary loneliness as experienced and communicated by a growing number of people. More than two decades after the fundamental research on the nature of loneliness (Rubinstein, Shaver, and Peplau 1979), we now have the opportunity to investigate the communication practices around loneliness in their natural social environments, absent of research intervention. Moreover, by looking at the factors surrounding the expressions of loneliness in SAS, we can get a richer understanding of perceived social isolation in relation to, but also independent of, technology. How do people communicate about loneliness when they are addressing hundreds of friends and acquaintances through SAS? What kind of responses do the expressions of loneliness evoke?

We collected and analyzed thousands of “lonely” tweets posted on Twitter. We developed a qualitative coding scheme for the tweets and any responses to them, coded the tweets, and performed quantitative analysis of the data to address the following research questions:

- What are the prevalent communication practices around loneliness on Twitter?
- What are the evident circumstances that surround explicit expressions of loneliness on Twitter?
- What types of responses do individuals expressing loneliness receive?
- What are the relationships between expressions of loneliness and the responses they receive?

Background

Cacioppo and Patrick (2008) describe loneliness as *social pain*, a stimulus that motivates people to stay socially

connected. People crave to be socially connected - in fact belonging theory suggests that the need to belong is likely an evolutionary trait (Baumeister and Leary 1995). When people feel they are deprived of satisfactory social bonds, they experience loneliness (Perlman and Peplau 1981). Loneliness ensues from interplay of personal attributes (e.g., attributional styles, gender, age), situational factors (e.g., exposure to stressful life events), and cultural circumstances (Weiss 1982). Not only do people differ in ways they perceive and evaluate their relationships, but also their standards for what their relationships should be like, can be shaped by the cultural settings they live in.

The experience of loneliness is idiosyncratic. People's individual descriptions of how they feel when they experience loneliness, as well as their reactions to loneliness, differ greatly. Rubenstein and Shaver (1979) cluster experiences of loneliness into four categories: impatient boredom, desperation, depression, and self-deprecation. *Impatient boredom* describes a mild experience of loneliness manifested by feelings of unease, anger, and the inability to concentrate. *Desperation*, the most common, is a moderate level of loneliness that can include feelings of panic, helplessness, and abandonment. Finally, prolonged and severe experiences of loneliness are described as either *depression* (e.g., feelings of melancholy, isolation, emptiness) or *self-deprecation* (e.g., feeling unattractive, down on self, stupid, ashamed). People experiencing mild forms of loneliness often resort to active solitude (e.g., self-fulfilling activities like studying, working, engaging in hobbies) or social contact (i.e., communication in face-to-face or mediated settings) (Rubenstein, Shaver, and Peplau 1979). When the experience of loneliness is severe, people tend to fall into sad passivity, a group of activities detrimental to one's health such as overeating, crying, or taking tranquilizers.

As put forth by several existing studies, lonely people typically exhibit low self-disclosure in interpersonal settings (Schwab et al. 1998; Bell 1985; Gerson and Perlman 1979) and are less likely to self-disclose to both strangers and friends (Schwab et al. 1998). Emotional self-disclosure, a strong predictor for perception of intimacy in interpersonal relationships (Laurenceau, Barrett, and Pietromonaco 1998) is negatively correlated with loneliness (Solano, Batten, and Parish 1982).

The low self-disclosure of lonely people extends beyond traditional communication settings and has been observed in computer-mediated environments as well. Burke et al. found that on Facebook, there was a significant negative relationship between high levels of loneliness and people's tendency to participate in directed communication (e.g. messages, Wall posts) (Burke, Marlow, and Lento 2010). A more recent study by Jin found that lonely people reportedly engaged in positive self-disclosure on Facebook less than non-lonely people, and also reported to self-

disclose negative events and thoughts more than non-lonely people (Jin 2013).

Is social media making us lonely? On one side of the debate, Turkle argues that with connectedness, made easier by today's technology, people are sacrificing quality in their interactions for quantity. People are always connected, but their relationships lack intimacy and people subsequently experience loneliness. Moreover, as people become accustomed to constant connection, they struggle with solitude and desperately look for signals of communication (Turkle 2012). On the other hand, quantitative research on the field is inconclusive about the relationship between loneliness and Internet use. Amichai-Hamburger Ben-Artzi (2003) suggest that people who are lonely spend more time on the Internet, but the direction of the relationship is the opposite of what is hinted to, at Turkle's work, increased loneliness leading to more time spent on the Internet. The results of the study by Moody reveal that the more frequently people use the Internet, the more satisfied they are with the broader social network they have. However, at the same time, they may also feel lonelier due to lack of an intimate relationship, possibly with a romantic partner (Moody 2001). In short, the relationship between loneliness and quantity of Internet use, when found, is complicated. Frequency of Internet use may correlate with loneliness, but loneliness causes increased Internet use, not visa versa.

People self-disclose about their emotional experiences in social media (Kamvar and Harris 2009), and particularly in SAS (Brubaker et al. 2012). There has been recent interest in tying the use of emotion-laden language, an indicator of emotional self-disclosure to characteristics of individuals (Kamvar and Harris 2009), to their psychosocial circumstances (Brubaker et al. 2012) and well-being (De Choudhury et al. 2013; De Choudhury, Counts, and Horvitz 2013). To our knowledge, the only work that has investigated the linguistic correlates correlation of online expressions of loneliness, is from Kamvar and Harris (2009), which highlights that loneliness was most commonly expressed in conjunction with being unloved, depressed, bored, and friendless and was also more readily expressed by women than men, in blog posts.

Methodology and Dataset

Our study is based on large-scale analysis of public status posts expressing loneliness collected from Twitter (hereafter "lonely tweets"), and the public responses to those tweets, on Twitter. We developed a qualitative coding scheme for the tweets and the replies, coded tweets according to that scheme, and used Mechanical Turk to label the users posting the tweet as female or male. In this section, we provide more details on the basic dataset

construction and then expand on the qualitative coding process and resulting coding scheme.

Dataset

We collected two samples from Twitter, a *coding dataset* in March 2013, and a *final dataset* in November 2013.

The coding dataset was used to develop the qualitative coding scheme for lonely tweets. For this dataset, we crawled Twitter for posts containing the phrase "I'm so lonely" using the Twitter streaming API and collected 2000 tweets that were used for the construction of the coding scheme described in the next section.

For the final dataset, we collected a sample of 12,975 English Twitter posts (tweets) that *explicitly* expressed loneliness using the Twitter Streaming API between November 15 and November 29 of 2013. The lonely tweets we collected contained one or more phrases that expressed feelings of perceived social isolation as described by (Russell, Peplau, and Ferguson 1978). The phrases included: "I'm so lonely," "I feel left out," and "I feel isolated." Retweets were excluded.

Next, we used the Twitter API to get additional information for each of the 12,622 lonely tweet authors. This data included publicly available profile information, usage metrics, and the Twitter activity surrounding each person's lonely tweet. Profile information was collected from their Twitter profile. Usage metrics included the user's total number of the tweets, number of followers and followees, as well as the average number of replies they receive per tweet. We also collected the user's tweets before and after the lonely tweet was posted, as well as any public replies to the lonely tweet.

Finally, we labeled the gender of each person in our dataset using Amazon Mechanical Turk (AMT). The AMT task provided AMT workers with information about each user, including their profile picture, name, and Twitter username. The workers were asked to label the gender for each user. Represented gender of each user was labeled by an AMT worker, as either "male", "female", or "unknown". To verify the accuracy of gender coding by AMT workers, one author coded the gender for 200 randomly selected users, showing 85.5% accuracy.

However, preliminary examination of the final dataset showed that a noticeable amount of the tweets gathered were *not* authentic expressions of loneliness. Instead, they were direct quotes of creative work such as song lyrics, poems, proverbs, etc. With song lyrics being the largest portion of the quoted speech, we devised a simple, automatic "lyric detection" method using the Google Search API. Using the exact text of each tweet as the query for a search, our program examined the top 10 results returned by Google search engine. If the query for a tweet returned a domain that belonged to one of the top lyric

websites (e.g. rapgenius.com, lyrics007.com, songlyrics.com), or to a YouTube video, we classified the tweet as a lyric. After the development of the detector, authors took a random sample of 200 classified tweets, extensively searched if whether it contained a lyric, and compared their results with the classifier. The accuracy of the lyric detection is estimated at 87%, with 9% false positives, and 4% false negatives. After this step for lyric detection, our final dataset consisted of 10,380 posts, with 10,378 unique users, 70% of whom were female.

Understanding Expressions of and Responses to Loneliness

In this section, we describe the development of a qualitative coding scheme for the experiences and communications around loneliness in two phases. First, we describe the building of the coding scheme for expressions of loneliness. We then elaborate on the scheme we built to categorize the *responses* to expressions of loneliness.

Understanding Expressions of Loneliness

Development of the coding scheme for expressions of loneliness began with a qualitative content analysis by open coding of tweets. Two of the authors independently analyzed 125 randomly selected tweets from the coding dataset described above, in order to generate codes describing the content and context provided in the tweet. Across a series of discussions, the authors iteratively compared notes, refined and merged codes, and revisited the reference dataset. Finally, codes were organized into three categories described below. An initial codebook describing the categories and their codes was developed, after which the authors applied the codebook to the 125 tweets they had previously coded in order to assure all apparent concepts were covered. In a second phase of coding, the same two authors coded a second set of 125 tweets using the final codebook. Agreement scores for each code were calculated separately, as the categories do not compose of mutually exclusive categories. Agreement scores ranged from substantial agreement to excellent. Over the eight categories that were coded by two reviewers, the average agreement Kappa score was 0.83.

At the end, the coding process resulted in a three-dimensional categorization for the lonely tweets. These categories reflect the contents of the lonely tweets according to themes that were expressed in the data. These categories are: (a) the *temporal bounding* of loneliness as expressed (*enduring* vs. *transient*); (b) the inclusion of *context* (*social*, *physical*, *romantic*, and/or *somatic*); and (c) explicit *interactivity* within the expression (e.g., requesting someone message or call them). We describe

each in category more detail next. Please refer to figure 1 for an overview of the coding scheme.

Temporal Bounding of Loneliness

In their lonely tweets, people often referenced the duration of their experiences of loneliness, providing a temporal bounding of loneliness that we categorized as *transient* or *enduring* in our coding. If the tweet did not include a reference to any kind of temporal bounding, we marked it as *ambiguous*. A tweet was marked as *transient* if the expression of loneliness within the tweet included references to the experience being momentary, at present, or potentially short-lived, such as “OMG, I’m so lonely right now.”. Tweets were marked as *enduring* if the expression of loneliness was temporally framed in a way that suggested a long-lasting state: “I hate feeling like this. I’m so lonely and depressed all the time.”

Note that this temporal category, while developed directly through our analysis of Twitter data, aligns with prior re- search on loneliness. Young (Young 1982) categorized loneliness as transient, chronic, and situational. Transient loneliness refers to experiences of loneliness that emerge and die out quickly, while chronic loneliness describes experiences that last a long time even in absence of triggering stressful events.

Context of Loneliness

Emotional experiences are rarely isolated from the physical and social world, and tweets about loneliness in our data often included a reference to the context in which loneliness was experienced. Our coding identified four distinct but *not mutually exclusive* contexts.

Social Context. We define the social context as an indication of an *online* or *offline* social environment in the content of the lonely tweet. Social context included references to past, present, or aspired relationships (e.g. satisfaction with relationships, expectations of relationships), interactions (e.g. face-to- face, in CMC platforms), or social functions (e.g. parties, weddings, school functions). For example: “I wish I had friends to hang out with and do something with on my birthday I’m so lonely. #loser” or “i stayed up last night till 2:30 playing minecraft with matt, how sad is that? i’m so lonely...”

Tweets coded as including social context could include references to social interactions in CMC environments (e.g. Twitter, e-mail, Snapchat), and/or the physical world (e.g. parties, concerts, weddings). While labeling experiences as either online or offline is problematic, we coded these expressions of loneliness as online or offline in order to identify where the author situated the social context. For instance, in the following example tweet, the social context accompanying loneliness relates to the quantity of *online* relationships: “I have 9 followers... I’m so lonely on Twitter” Whereas, the next tweet references expectations of an *offline* social interaction that take place

in the physical world: “I’m so lonely in this class because Jesse left for basketball :(”

Physical context. This category refers to tangible, physical circumstances accompanying expressions of loneliness. These references can be indications of actual or aspired physical circumstances, as well as the specific conditions of these spaces (e.g., “I’m so lonely! Being in this big house by myself”). These tweets contained mentions of geographical locations at micro and macro-levels (e.g. room, house, city, country). Tweets describing the qualities of the environments the person was in (including temperature, noise, logistic properties, and perceived mood of the location) were also coded as including physical context: “I’m so lonely over here listening to my neighbors :(they play fighting and singing to Each other lemme get up and go somewhere!”

Romantic Context. We defined romantic context as past, present, or aspired romantic or sexual relationships, referenced together with the expression of loneliness. For example, in the following tweet, the person defines actions that he/she frames as stemming from an the absence of a romantic relationship (note that this tweet also defines a physical context): “I’m so lonely that I sprayed cologne all over my room so it smells like I have a boyfriend and now I keep smelling my pillows ha help”

Somatic Context. Lastly, the somatic context category was used to annotate tweets that referred to users’ physical or bodily state. It included references to the past, present, or aspired state of the users’ physical being (e.g. feeling nauseated, wishing to feel healthier, having a headache, losing sleep) and/or actions one takes towards one’s own body (e.g. taking medication). For example: “I’m so lonely right now lol nowhere near sleepy I been sleep all day finna take some medicine”.

Interaction

While the previous two categories directly referred to the experience of loneliness, our last category marked tweets based on whether or not the user communicated an explicit desire for interaction. Indeed, tweets often included a direct call to action to others, and were coded to as *other-directed* (interactive). For example, “I’m so lonely, somebody DM me!” and “Where are you, @anonymizeduser? I’m so lonely in this class!” were both coded as other-directed tweets, with the latter one making an explicit reference to another user (@anonymizeduser).

3 Categorical Dimensions for Expressions of Loneliness

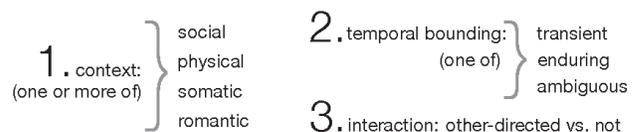


Figure 1: Coding Scheme for Expressions of Loneliness

Understanding Responses to Loneliness

In addition to the opportunity Twitter provides for understanding expressions of loneliness, it also allows us to investigate responses to these expressions. Our dataset included the Twitter replies to the lonely tweets. We developed a separate coding scheme for these responses.

Two of the authors developed a coding scheme for the set of responses in reply to the original expressions of loneliness. To this end, the authors independently coded the same set of replies to 30 lonely tweets. Each coder independently came up with categories that capture the nature of the responses. Next, the categories were consolidated and refined to reflect major categorical dimensions. The authors then coded another set of 30 tweets to test the reliability of the refined coding scheme, resulting in strong inter-coder reliability (80%).

Next, we describe the three different, but *not mutually exclusive* categorical dimensions that emerged from the analysis of responses: (1) explicit acknowledgement, (2) explicit social support, and (3) un-engaging responses.

Explicit Acknowledgement

The first category describes responses that directly acknowledge the original user's experience. These responses include a direct acknowledgement of the expressions of loneliness. These responses tend to mirror the loneliness (e.g., "I'm lonely too"), simply acknowledge the lonely tweet (e.g., "awww"), or reflect on responders' own experiences of loneliness (e.g., "sorry, I know how that is").

Explicit Social Support

This category includes responses that offer some type of help in consideration of the targets' well-being and perceived needs. Although one could argue that any response to a lonely tweet (such as a simple "awww") is an instance of social support, our analysis distinguishes explicit social support as offering some type of comfort to the person experiencing loneliness. Social support often emerges as informational (e.g. advice, guidance), emotional (e.g. affection, concern, love), tangible (e.g., goods, solution), and esteem support (e.g. enhancing feelings of one's attributes, abilities, and accomplishments) (Albrecht and Adelman 1987; Holmstrom and Burlison 2011; Wills 1985). Some examples of explicit social support responses are: "wait for me, I'll be right there," and "you're not alone anymore."

Un-engaging Responses

This category describes responses that move away from loneliness as the main topic of the interaction or dismiss the experience, the potential seriousness or gravity of loneliness. These responses do not explicitly address or acknowledge the person's experience of loneliness. These responses do not offer solutions to loneliness but

frequently emerge as small talk (e.g. "how was your day?"), jokes (e.g., "that's yo fault lmaoo"), or irrelevant topics (e.g., "happy Thanksgiving").

Studying Expressions of Loneliness at Scale

With the coding schemes for expressions of loneliness on Twitter, and reactions to these expressions, we are now able for the first time to quantify context and communication practices around expressions of loneliness in a natural environment where they occur. In this section, we provide a descriptive analysis of the lonely tweets in our dataset using a large-scale coding effort.

Our final sample, after accounting for tweets that had foreign language components or memes incorporated (and not caught by our initial filtering) included 4454 unique individual expressions of loneliness. The AMT coding labeled 70% of the users in our sample as women. On average, a user had 938 (SD=4300) followers, and was followed by 636 (SD=2920) others. Using the categories listed above for expressions of loneliness and responses to it, we qualitatively coded these tweets. We further marked whether the tweet included quoted speech (for those that the automatic detector missed).

Most of the people that posted lonely tweets in our dataset also actively posted other content on Twitter around the same time. About 97% of the users in our sample had posted a status update at least once within the 24 hours immediately before the expression of loneliness. On average, the time between the last twitter post and the lonely tweet was 6.8 hours. 78% of the users post an update within the hour, and 61% within the 10 minutes preceding the lonely tweet. The majority of the users (82%) also posted a Twitter update within the day after the lonely tweet.

We also performed an analysis of how the different coding dimensions were represented in the dataset. The majority (62.7%) of the expressions of loneliness were ambiguous about the duration of the experience of loneliness. 22.5% of the coded tweets indicated a transient experience, and 14.8% referred to an enduring, prolonged experience. More than half the expressions (55.8%) explicitly described a social context for the loneliness; perhaps unsurprisingly, about 25.2% of the tweets referred to an online social context, where 17.8% described an offline social context. 11.6% of the expressions have defined a physical factor in conjunction with the experience of loneliness. Romantic context was exposed in 8.7% of the tweets, where only 3.3% of all expressions had a reference to a somatic context. The analysis also showed that 42.9% of the tweets were other-directed, i.e. included an explicit call for interaction whether online or offline.

Next, we examine in more depth the factors related to the duration of the loneliness experience, perhaps the most critical variable captured in our coding.

Enduring Experiences of Loneliness

Both in the literature and in our dataset, the temporal dimension of the loneliness experience emerges as a critical dimension. In this section we focus on temporality of expressed loneliness, and use our data to test several hypotheses based on existing theories of loneliness.

Young (1982) emphasizes that transient experiences of loneliness emerge and die out quickly, unlike chronic loneliness, which lasts a long time even in absence of triggering stressful events. In Rubenstein and Shaver's early work (1979) on experiences of loneliness, a category of "Impatient Boredom", defined a mild and momentary form of loneliness, similar to transient loneliness. The responses to mild loneliness, according to this work, often include initiating social contact, or pursuing a solitary, yet-fulfilling activity. On the other hand, Rubenstein and Shaver suggest that the more severe (or enduring) experiences (e.g. desperation, self-deprecation) lead to sad passivity, state of longing to be in social contact, yet not actively acting on it. These correlations can be captured by our categorical dimensions of interaction (action taken towards social contact) and temporal bounding (transient or enduring). Thus, we hypothesize that:

- H1.1: Expressions of transient loneliness are more likely to be other-directed compared to expressions of enduring loneliness.

One of the more severe manifestations of loneliness is *emotional loneliness*, which is a result of a person lacking an intimate / romantic relationship (de Jong Gierveld, Van Tilburg, and Dykstra 2006). In our coding scheme, the romantic context signified a tweet that referenced current, past, or aspired romantic relationships. We hypothesize:

- H1.2: Expressions of loneliness with a romantic context are more likely to be enduring than transient.

Previously, women have been shown to self-disclose loneliness more than men do (Borys and Perlman 1985), though this does not indicate women actually experience emotions in higher rates. Especially as communication in Twitter takes place in a public setting, we expect that:

- H1.3: Women are more likely to express enduring loneliness than men.

People who are lonely are less likely to disclose to others, regardless of the closeness of the relationships they have with them (Schwab et al. 1998). They are also found to be less involved in conversations, making them undesirable conversation partners (Bell 1985). We expect that those who have expressed enduring loneliness to exhibit lower self-disclosure and interaction characteristics

compared to those who express a transient experience. Operationalized on Twitter, we examined the users' rate of interactions. On Twitter, users can post public content that targets specific others by "mentioning" them (including their username in a tweet). For each user, we calculated the interactivity of the user *preceding* and *following* the lonely tweet. *Interactivity* was calculated as the ratio of interactions (e.g. public tweets contain mentions of other Twitter users) to total number of tweets. We hypothesize:

- H1.4: People who express enduring loneliness are more likely to have low interaction ratios than those who express transient loneliness.
- H1.5: People who express enduring loneliness will have fewer Twitter posts than those who express transient loneliness.

Findings

Below we summarize our findings and explain hypotheses support. An overview of our hypotheses, including the variables tested for each, and information on found support for them can be seen in Table 1.

Expressions of transient loneliness were other-directed in significantly higher rates compared to expressions of enduring loneliness (42.1% vs. 30%) ($\chi^2 = 62.1, df = 2, p < .001$), providing support to H1.1. Also, as suspected, expressions that had defined a romantic context also described an enduring experience at significantly higher rates (20.9% of tweets) compared to expressions with no romantic context (14.3%; $\chi^2 = 26.08, df = 2, p < .001$), supporting H1.2. Lastly, we tested whether there were significant differences in rates of expressing enduring loneliness between men and women. Our findings support our hypothesis; while 16% of women in our data expressed enduring loneliness, for men this ratio was 11% ($\chi^2 = 19.61, df = 2, p < .001$), supporting H1.3.

An ANOVA test revealed that interaction rates preceding and following the expressions of loneliness varied between people who expressed enduring versus transient loneliness, or were ambiguous in their temporal framing (preceding - $F = 20.55, df = 2, p < .001$; following - $F = 21.95, df = 2, p < .001$). People who have expressed *transient* loneliness had the highest rates of interactivity before ($M=0.31, SD=0.21$) and after ($M=0.30, SD=0.21$) the expression of loneliness. They were followed by people whose expressions were without an explicit temporal frame of reference (pre-expression rate- $M=0.29, SD=0.21$; post-expression rate $M=0.28, SD=0.18$). Supporting H1.4, people who have expressed enduring experiences of loneliness demonstrated the lowest interaction rates before ($M=0.24, SD=0.19$) and following the expression of loneliness ($M=0.24, SD=0.17$). All pairwise differences were significant based on Tukey HSD post-hoc tests. Previous work suggests that people who are experiencing

high levels of loneliness disclose and interact less than non-lonely people (Schwab et al. 1998). It is plausible that the people expressing enduring loneliness are also those who are experiencing it in high levels, and hence are less interactive before and after their disclosures.

Looking at H1.5, the volume of activity from the day preceding the expression of loneliness had no significant relationship with the expressed temporality of loneliness. However, we did see a significant relationship between the temporality and the volume of activity during the day immediately following the expression of loneliness (ANOVA $F = 20.97$, $df = 2$, $p < .001$). People who have expressed transient loneliness on average posted 30.37 ($SD=35.75$), a rate significantly higher than people who expressed enduring loneliness ($M=25.32$, $SD=31.05$) or who did not have temporal framing ($M=23.01$, $SD=28.94$), based on the post-hoc test.

H1.1	Transient loneliness → Other-directed	✓
H1.2	Romantic context → Enduring loneliness	✓
H1.3	Gender (female) → Enduring loneliness	✓
H1.4	Enduring loneliness (-) → Interaction ratio	✓
H1.5	Enduring loneliness (-) → Tweet volume	✓
✓ - supported hypothesis, ✓ - partially supported hypothesis, → - positive relationship, (-) → - negative relationship		

Table 1 – Hypotheses for Enduring Experiences of Loneliness

Responding to Expressions of Loneliness

Expressions of loneliness on Twitter are, inherently, social acts, even as people express social shortcomings. But when do audiences receiving the expressions of loneliness respond to their authors' calls for interaction? Who is more likely to get a response? What kinds of responses do people get? In this section, we examine several hypotheses regarding the responses to lonely tweets.

In our dataset of 4,454 manually coded expressions of loneliness, 1,030 had at least one public response (23%). To compare, we examined the "usual" response rate to tweets posted by the people in our data set, using the 200 most recent tweets for each of person. The overall average tweet response rate was 3.4%. Initial tests have shown that the general response rate for each user was not dependent on their gender, nor did it relate to receiving a reply to their lonely tweet.

We used the qualitative categorization for responses, detailed above to code the replies to the 1030 tweets that received one or more responses. Out of the tweets that had a response, the average number of replies was 4.44. 12% of these expressions had responses that could not be coded as they included utterances that were not English. This left us with ($N=903$) tweets, responses to which were coded, according to our coding scheme, for containing (one or

more of): acknowledgement of loneliness; a proposed solution or support; or an un-engaging response. Out of the tweets that received one or more responses, 49.7% received a response that was acknowledging the experience of loneliness. 45.2% of these tweets received a response explicitly offering a solution for their loneliness, whereas 34% received a response that was un-engaging, or ignoring the reference to the experience of loneliness.

Variables and Hypotheses

We first address some general hypotheses regarding responses to lonely tweets. We then focus on responses to tweets depicting enduring experiences. Finally, we study the outcomes of the response in terms of activity by the user posting the lonely tweet.

People vary in their propensity of self-disclosures, specifically emotional self-disclosure. After controlling for external circumstances, men are less likely to disclose emotions than women do. Thus, when subjected to men communicating disclosing loneliness, people may be more compelled to respond. We hypothesize:

- H2.1: Men are more likely to receive responses to their expressions of loneliness, than women do.

While Twitter users can offer social support, it can be burdening to hear the emotional distress of loved ones, especially if the experiences are severe (Fiore, Becker, and Coppel 1983). Thus we expect transient expressions of loneliness to get responses more readily:

- H2.2: Expressions of enduring loneliness are less likely to get responses than expressions of transient loneliness.

One categorical dimension that has surfaced in our qualitative analysis was the call for interaction in the expressions of loneliness. We expect that expressions that were framed with a summon for social contact, in other words, tweets that were marked "other-directed", are more likely to get responses. We hypothesize:

- H2.3: Other-directed (interactive) expressions are more likely to get responses.

The following hypotheses focus on understanding the responses to expressions of an enduring experience of loneliness. Different responses can have different end results for the people who express loneliness; for those who are expressing enduring feelings of isolation, dismissing responses can be further detrimental, whereas an explicitly supportive response can be of substantial use.

Approach-avoidance theory suggests that people often make involved decisions prior to taking action, when they face a situation with both positive and negative valences. When people are at the receiving end of an expression of loneliness, they can find themselves in an approach-avoidance dilemma. On the one hand, by approaching, they show social support, can develop their relationships with the person further, and represent themselves in their online

social networks as one that helps. On the other hand, by “avoiding” they eliminate the risk of getting involved in an emotionally straining conversation (Lewin 1935). Expressions of enduring experiences of loneliness particularly can carry an enormous load of stress for their audiences. We expect these severe expressions to garner less dismissive responses than expressions of transient loneliness might.

- H2.4: Expressions of enduring loneliness are less likely to receive responses dismissing loneliness, than expressions of transient loneliness.

However, suggesting explicit solutions for profound problems like prolonged loneliness can be emotionally and socially difficult for people, especially those who may be weak ties with the person expressing loneliness. We expect that expressions of enduring loneliness to receive responses explicitly acknowledging loneliness at higher rates, and responses offering explicit solutions at lower rates, compared to expressions of transient loneliness.

- H2.5: Expressions of enduring loneliness are more likely to receive responses explicitly acknowledging the experience of loneliness than expressions of transient loneliness.

Findings

Below we summarize our analyses and findings on direct responses of lonely tweets, and explain hypotheses support. Table 2 summarizes our hypotheses and whether or not they were supported.

What factors contribute to getting a response? To examine hypotheses H2.1-H2.3, we constructed a logistic regression model with the binary dependent variable capturing whether or not at least one reply was received for a “lonely” tweet. The independent variables included: the gender of the user who tweeted the expression (H2.1), the temporal bounding of loneliness in the expression (i.e., whether the tweet expressed enduring, transient, or temporally ambiguous loneliness, (H2.2), and whether the tweet was other-directed (H2.3). The model revealed that the most significant predictor for a lonely tweet receiving a response was the directionality of the tweet – an expression without call for interaction had a reduced chance of being responded to by 63% ($p < .001$). The results from the model showed that men were more likely to receive responses – being a man increased the likelihood of receiving a response by 27% ($p < .01$). However, even after controlling for gender and direction, it was revealed that expressions of enduring loneliness are significantly less likely to receive a response. An expression communicating extended loneliness has a reduced likelihood of the expression receiving a response by 37% ($p < .01$). Thus, hypotheses H2.1-H2.3 are all supported.

Our findings back up H2.4. 43% of tweets that defined a transient experience have received an un-engaging response, compared to 33.6% for tweets with no explicit temporal framing, and 10% of tweets expressing an enduring experience ($\chi^2 = 27.22, df = 2, p < .001$).

What kind of response did tweets receive when they conveyed a more severe experience of loneliness? Expressions referencing enduring loneliness received higher rates of responses explicitly acknowledging the experience, supporting H2.5. For expressions of transient and temporally undefined loneliness, the rate of receiving a response explicitly acknowledging loneliness was 39.6% and 51.1% respectively. In contrast, 70% of expressions of enduring loneliness received a response explicitly acknowledging loneliness ($\chi^2 = 22.49, df = 2, p < .001$).

H2.1	Gender (male) → Response	✓
H2.2	Enduring loneliness (-)→ Response	✓
H2.3	Other-directed → Response	✓
H2.4	Enduring loneliness (-)→ Un-engaging response	✓
H2.5	Enduring loneliness → Acknowledging response	✓
✓- supported hypothesis, →- positive relationship, (-)→ - negative relationship		

Table 2 – Hypotheses on Responding to Expressions of Loneliness

Discussion

In our study, we show how people using Twitter disclose experiences of loneliness, including details of the context and severity of the experience. Explicit expressions of loneliness receive replies from others in higher rates than the baseline (other content posted by the same user), suggesting that these messages are evocative and online social networks are responsive to people in distress.

SAS are passive communication environments that provide a variety of cues and affordances for content production activity, but provide no indication of passive consumption: there are no signals that inform an individual that his or her social network has actively viewed the information the individual shared. Indeed, this feeling or sense of “social presence” from one’s network is critical to understanding one’s psychological, emotional, and intentional states (Biocca, Harms, and Burgoon 2003; Singer and Witmer 1999). Therefore, the lack of verification of authentic social presence creates a peculiar environment for observing how people or groups of people respond to evocative emotional disclosures such as expressions of loneliness. In the physical world, when a friend cries for help, we run to her aid. What happens when the friend does not know whether we heard her cry?

Although nobody is *obliged* to respond to an expression of loneliness, some people do choose to publicly

acknowledge and reply to such disclosures. Our analysis revealed that expressions referencing a transient loneliness experience are much more likely to receive a response than those expressing an enduring loneliness experience. This finding may suggest that responders practice a certain level of discretion when responding to expressions of loneliness. The discretion may be a consequence of expressions of enduring loneliness being too onerous for potential responders. Enduring expressions of loneliness likely require less casual responses and more conscious awareness of the overall impact of the problem. When faced by an emotionally burdensome social circumstance, given the lack of social presence, the potential replies may be more easily suppressed. Further complicating the situation is that users suffering from enduring loneliness are less likely to post a call for social interaction. As a result, these users are even less likely to elicit a helpful response to start with.

While many individuals may feel more comfortable and safe *disclosing* enduring loneliness within a mediated context (Morahan-Martin 1999), the quality and frequency of *responses* to these disclosures can suffer. For instance, compared to face-to-face conversations, online interactions can yield lesser degrees of closeness, self-disclosure, and overall satisfaction (Mallen, Day, and Green 2003). Potential responders are likely to consider several factors when deciding if and how to respond, such as whether norms dictate the lonely person receive, or what the costs and rewards are for interacting with the lonely person (Weiss 1973). Moreover, within the mediated context, people are likely to feel less responsible for providing acknowledgement or support towards those who are weakly tied or not well known to them (Garton, Haythornthwaite, and Wellman 1997). In some way, potential responders are subject to less risk and burden when addressing disclosures of transient versus enduring experiences of loneliness, and may ultimately refrain from addressing expressions of enduring loneliness.

For people expressing an enduring experience of loneliness, Twitter may be a place where they receive acceptance, but not help or counseling. When people do respond to enduring experiences, they are not dismissive of the fact that these people are feeling lonely. On the other hand, they do not seem to prefer offering explicit solutions to their problems. One may think acknowledgement alone suggests a level of empathy, and knowing someone understands may be all that is needed by the people experiencing enduring loneliness. Thus, perhaps, SAS are ideal places for catharsis, yet not direct routes towards emotional healing.

We do not have evidence in this study that pertain to recovery, or evidence that people's expressions of loneliness persists or decays over time. In future work, it would be interesting to see if certain kind of responses on Twitter are

actually helpful, and under what circumstances (e.g. the type of tweet posted, the user posting it, the relationship with the user replying, and the type of reply).

Conclusion

In this work, we presented the first large-scale study of online expressions of loneliness, and of the responses to these expressions. Many of our findings correspond to what we know about the experience of loneliness from prior work, for example, the existence of prolonged, sustained condition where the suffering people are less likely to be interactive. However, our study helps expand our understanding of both the experience of loneliness and the responses to it, from the types of contexts that evoke loneliness, to the type of responses that lonely tweets of different kinds get.

Our study, of course, has several limitations. First and foremost, we looked at *explicit* expressions of loneliness in one SAS. By the nature of our sampling, we did not include expressions of loneliness that were not as straightforward as the phrases we chose to query. Moreover, as our study at this point was limited to one SAS, we cannot suppose that the experience is communicated in the same way on other SAS (e.g., Facebook) where the affordances for social interaction and privacy are different. Moreover, we looked at disclosures, which may not always imply genuine experiences, especially in public and performative settings of Twitter. Therefore, while we described the experience of loneliness as *communicated* on Twitter, we cannot claim to have described the actual experience. Finally, as we sampled our data from English speaking U.S., we may be missing nuances in communication practices around loneliness that can be introduced by cultural variation.

Turkle (2012) famously claims that we forgot how to be alone. Indeed, our data provided some anecdotal evidence to support this claim. Large numbers of tweets in our dataset expressed loneliness in almost-trivial contexts (e.g., a friend stepping out for a minute to take a shower, posting something and not receiving a response yet). Did we forget how to be alone? Perhaps technology is not making us lonelier, but instead this phenomenon can be explained by the recently increased ease of communication – the barriers for people to reach for contact have dropped. Before SAS became prominently accessible, we would have to find ways to be content with “impatient boredom”. Nowadays, we may be too quick to attempt to relieve it, SAS being the perfect setting for relief. We may not be lonelier, but be gratified more quickly for disclosing it.

References

- Albrecht, T. L., and Adelman, M. B. 1987. *Communicating social support*. Sage Publications, Inc.
- Amichai-Hamburger, Y., and Ben-Artzi, E. 2003. Loneliness and Internet use. *Computers in Human Behavior* 19(1): 71–80.
- Anderson, G. 2010. Loneliness among older adults: A national survey of adults. http://www.aarp.org/personal-growth/transitions/info-09-2010/loneliness_2010.html
- Baumeister, R. F., and Leary, M. R. 1995. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin* 117(3): 497–529.
- Bell, R. A. 1985. Conversational involvement and loneliness. *Communication Monographs* 52(3): 218–235.
- Biocca, F.; Harms, C.; and Burgoon, J. K. 2003. Toward a More Robust Theory and Measure of Social Presence: Review and Suggested Criteria. *Presence: Teleoperators and Virtual Environments* 12(5): 456–480.
- Borys, S., and Perlman, D. 1985. Gender Differences in Loneliness. *Personality and Social Psychology Bulletin* 11(1): 63–74.
- Brage, D. G. 1995. Adolescent depression: A review of the literature. *Archives of Psychiatric Nursing* 9(1): 45–55.
- Brubaker, J. R.; Kivran-Swaine, F.; Taber, L.; and Hayes, G. R. 2012. Grief-Stricken in a Crowd: The Language of Bereavement and Distress in Social Media. In *Proceedings of ICWSM 2012*.
- Burke, M.; Marlow, C.; and Lento, T. 2010. *Social network activity and social well-being*. In *Proceedings of CHI 2010*.
- Cacioppo, J. T., and Patrick, W. 2008. *Loneliness: Human nature and the need for social connection*. WW Norton & Company.
- Cacioppo, J. T.; Hawley, L. C.; and Berntson, G. G. 2003. The anatomy of loneliness. *Current directions in psychological science* 12(3): 71–74.
- De Choudhury, M.; Gamon, M.; Counts, S.; and Horvitz, E. 2013. Predicting Depression via Social Media. In *Proceedings of ICWSM 2013*
- De Choudhury, M.; Counts, S.; and Horvitz, E. 2013. Predicting postpartum changes in emotion and behavior via social media. In *Proceedings of CHI 2013*.
- de Jong Gierveld, J.; Van Tilburg, T.; and Dykstra, P. A. 2006. Loneliness and social isolation. *Cambridge handbook of personal relationships* 485–500.
- Fiore, J.; Becker, J.; and Coppel, D. B. 1983. Social network interactions: A buffer or a stress. *American Journal of Community Psychology* 11(4): 423–439.
- Garton, L.; Haythornthwaite, C.; and Wellman, B. 1997. Studying Online Social Networks. *Journal of Computer-Mediated Communication* 3(1).
- Gerson, A. C., and Perlman, D. 1979. Loneliness and expressive communication. *Journal of Abnormal Psychology* 88(3): 258–261.
- Holmstrom, A. J., and Burleson, B. R. 2011. An Initial Test of a Cognitive-Emotional Theory of Esteem Support Messages. *Communication Research* 38(3): 326–355.
- Jin, B. 2013. How lonely people use and perceive Facebook. *Computers in Human Behavior* 29(6): 2463–2470.
- Joiner, T. E., and Rudd, M. D. 1996. Disentangling the interrelations between hopelessness, loneliness, and suicidal ideation. *Suicide and Life-Threatening Behavior* 26(1): 19–26.
- Kamvar, S., and Harris, J. 2009. *We feel fine: An almanac of human emotion*. Simon and Schuster.
- Laurenceau, J.-P.; Barrett, L. F.; and Pietromonaco, P. R. 1998. Intimacy as an interpersonal process: The importance of self-disclosure, partner disclosure, and perceived partner responsiveness in interpersonal exchanges. *Journal of Personality and Social Psychology* 74(5): 1238–1251.
- Lewin, K. 1935. *A dynamic theory of personality*. McGraw-Hill.
- Mallen, M. J.; Day, S. X.; and Green, M. A. 2003. Online versus face-to-face conversation: An examination of relational and discourse variables. *Psychotherapy: Theory, Research, Practice, Training* 40(1-2): 155–163.
- Moody, E. J. 2001. Internet Use and Its Relationship to Loneliness. *CyberPsychology Behavior* 4(3): 393–401.
- Morahan-Martin, J. 1999. The Relationship Between Loneliness and Internet Use and Abuse. *CyberPsychology Behavior* 2(5): 431–439.
- Naaman, M.; Boase, J.; and Lai, C.-H. 2010. Is it really about me? In *Proceedings of CSCW 2010*.
- Perlman, D., and Peplau, L. A. 1981. Toward a social psychology of loneliness. *Personal relationships* 3:31–56.
- Rubinstein, C.; Shaver, P.; and Peplau, L. A. 1979. Loneliness. *Human Nature* 2(2): 58–65.
- Russell, D.; Peplau, L. A.; and Ferguson, M. L. 1978. Developing a Measure of Loneliness. *Journal of Personality Assessment* 42(3): 290–294.
- Schwab, S. H.; Scalise, J. J.; Ginter, E. J.; and Whipple, G. 1998. Self-Disclosure, Loneliness And Four Interpersonal Targets: Friend, Group Of Friends, Stranger, And Group Of Strangers. *Psychological Reports* 82(3c): 1264–1266.
- Singer, M. J., and Witmer, B. G. 1999. On Selecting the Right Yardstick. *Presence: Teleoperators and Virtual Environments* 8(5): 566–573.
- Solano, C. H.; Batten, P. G.; and Parish, E. A. 1982. Loneliness and patterns of self-disclosure. *Journal of Personality and Social Psychology* 43(3): 524.
- Turkle, S. 2012. *Alone Together: Why We Expect More from Technology and Less from Each Other*. Basic Books.
- Wei, M.; Russell, D. W.; and Zakalik, R. A. 2005. Adult Attachment, Social Self-Efficacy, Self-Disclosure, Loneliness, and Subsequent Depression for Freshman College Students: A Longitudinal Study. *Journal of Counseling Psychology* 52(4): 602–614.
- Weiss, R. S. 1973. *Loneliness: The experience of emotional and social isolation*. Cambridge, MA, USA: MIT Press.
- Wills, T. A. 1985. Supportive functions of interpersonal relationships. In Cohen, S, and Syme, S.L. (Eds), *Social support and health*, San Diego, CA, US: Academic Press,
- Young, J. E. 1982. Loneliness, depression and cognitive therapy: Theory and application. *Loneliness: A sourcebook of current theory, research and therapy* 379–406.