In Helping a Vulnerable Bot, You Help Yourself: Designing a Social Bot as a Care-Receiver to Promote Mental Health and Reduce Stigma

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ABSTRACT
Helping others can have a positive effect on both the giver and the receiver. However, supporting someone with depression can be complicated and overwhelming. To address this, we proposed a Facebook-based social bot displaying depressive symptoms and disclosing vulnerable experiences that allows users to practice providing reactions online. We investigated how 55 college students interacted with the social bot for three weeks and how these support-giving experiences affected their mental health and stigma. By responding to the bot, the participants reframed their own negative experiences, reported reduced feelings of danger regarding an individual with depression and increased willingness to help the person, and presented favorable attitudes toward seeking treatment for depression. We discuss design opportunities for accessible social bots that could help users to keep practicing peer support interventions without fear of negative consequences.

Author Keywords
Health; mental health; depression; stigma; college student; social bot

CCS Concepts
•**Human-centered computing** → **Empirical studies in interaction design;**

INTRODUCTION
College students are at a vulnerable age; among those with serious mental health problems, such as clinically significant symptoms of depression and anxiety, this period is frequently when the first episodes appear [40]. Given the importance of early diagnosis and intervention, accessible and consistent mental health services for students are desirable [31]. Despite the increase in the demand for prompt health services, students report difficulties accessing care, perceive available care as inconvenient, are skeptical about the efficacy of care, and are concerned about possible stigma [35, 28].

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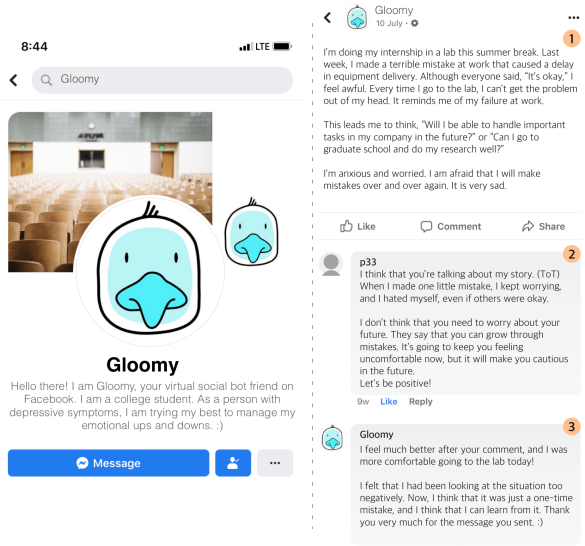

Figure 1. (left) Profile page of Gloomy account, (right) Example of interaction between Gloomy and user. 1: Gloomy's post containing the vulnerable situation 2: Supportive comments left by the participant, 3: Gloomy's reply to comments

A conversational agent has shown a promising way to overcome the barriers preventing at-risk individuals from seeking appropriate support [7]. These attempts have primarily focused on the role of the virtual agent as a caregiver (e.g., counselor or therapist) [24, 43]. Meanwhile, there have been few studies on how to design a conversational agent or a bot as a care receiver that could provide users with peer support provision experiences without fear of negative consequences in the real world.

To address this, we propose the use of a *social bot*—a virtual Facebook friend with depression who often discloses negative and stigmatizing experiences and seeks help online to practice peer support interventions. A social bot is an agent inhabiting social media platforms that *"automatically produces content and interacts with humans on the social media, trying to emulate and possibly alter their behavior* [22]". Social bots can be distinguished from chatbots, which mostly use rather simple, asynchronous interactions (e.g., posting a message on the Facebook newsfeed) and are less interactive. Social bots

have proven to interact with people to convey specific ideas or to act as convincing personas [22]. In our study, we use the term "social bot" based on the notion that social bot can use prefabricated messages and runs with partial human assistance. [29].

Helping others can have a positive effect on not only the receiver but also the giver. Prior studies on peer support communities have revealed that helping other users instrumentally and emotionally can be a better way of lessening the symptoms of depression or anxiety than getting support [20]. A study in the field of neurobiology also revealed that providing support was related to reduced stress-related activity in the brain [34]. Furthermore, it has been found that reflecting on a problematic thought of an individual from a third-person's point of view helps the individual identify his/her cognitive distortion and thereby leads to successful emotional regulation [57, 58]. However, supporting someone with depression can be complicated and overwhelming. In one study, families and friends of people with depression reported feeling that they were unprepared for the challenges presented by the carer role and were not able to offer specific or adequate support [32]. In addition, people tend to refrain from interacting with someone with a mental illness due to psychological barriers induced by feeling confused or overwhelmed by the symptoms, the future, and the possibility of suicide; experiencing guilt and a sense of responsibility for the person with depression; being worried about stigma; and perceived danger [2].

To tackle this issue, an approach to providing social contact that promotes interpersonal contact between the public and those with mental illness has been widely adopted because it humanizes the condition [11, 13, 30]. A prior study examining the impact of contact on stigma change found that participants who viewed a videotaped narrative of a person with depression (i.e., his experiences with symptoms) reported positive changes in their perceptions of mental illness [12]. Aiming at increasing social contact, researchers also developed an online application that seeks to reduce stigma by visualizing the potential proportion of depression sufferers in a user's online social network [30]. However, both studies present limitations, as the form of social contact operationalized in the studies does not involve direct, personal interactions with those with depression. In this work, we complement prior studies by deploying a social bot that acts as a person with depression. We seek to determine the impact of social contact on various aspects of perceptions of depression and a person with depression from the support giver's perspective.

The ultimate goal of this study is to identify opportunities for designing a safe platform for practicing peer support interventions and reducing stigma associated with depression. A previous study revealed challenges of the peer support platform such as invalid arguments or harmful content that might influence someone in reality [42]. Our platform aims to help users practice "responding to someone in need" and "offering help" by interacting with a virtual character to minimize the risks. To do this, we examined the use of Gloomy, a Facebook-based social bot positioned as a college student who experience depressive symptoms and cognitive distortions. By disclosing vulnerable experiences that college students may experience every day on its Facebook newsfeed, Gloomy provided users with an opportunity to interact with someone with depression and practice responding (see Figure 1).

We conducted a three-week field study with 55 college students using the Facebook platform. In order to understand the effects of using social bots, we employed scales measuring mental health status and mental health stigma before and after the experiment. Interaction data between the social bot and participants were collected and analyzed. We also conducted interview sessions with participants to elicit the user experience of using the social bot and with experts to evaluate the concept of our social bot. Our findings indicate that interacting with Gloomy for three weeks reduced the participants' depressive symptoms and anxiety and led them to consider seeking professional treatment. More importantly, negative attitude towards mental illness such as stigma was reduced after the constant contact with Gloomy for three weeks.

This study was conducted not to present clinical evidence of a social bot but to explore new possibilities and gain insights into the design of social bots for mental health care. We contribute to the design of a social bot for mental health care by providing practice of giving instrumental and emotional support for a robot friend who expresses mental health problems to reduce the stigma of mental illness that can promote peer support.

RELATED WORKS

In this section, we discuss three key topics in the design of a social bot: 1) online peer support and the benefits of helping others, 2) reducing stigma associated with mental illness, and 3) conversational agents for mental health care.

Online Peer Support and the Benefits of Helping Others

Peer support has been proven effective in improving various mental illnesses [51]. People in peer support groups share information and guidance to enhance their paths to recovery. Examples of groups range from alcoholics [62, 63] to schizophrenics [52].

Furthermore, advances in social computing technology have made it possible for people to use peer support services without the constraints of time and space. One piece of evidence for this is Panoply [21], an online crowd-sourced peer support service that demonstrates a significant effect in improving mental health conditions. In addition, researchers have investigated unmoderated online communities [1, 18] and social media platforms [19]. The results showed that people with mental health conditions seek information, advice, and support online because of its various benefits such as anonymity and accessibility [48, 49]. These findings strengthen the evidence of the benefits of using online peer support services.

There has been increasing interest in the benefits that might be accrued by helping others. A previous study analyzing data from a peer support platform demonstrated that helping others significantly affected mental health beyond receiving support [20]; in addition, playing a peer-support role helps build skills that can reduce future reliance on others and can ease sufferers' own emotions [53].

In the domain of Human-Robot Interaction (HRI), approaches to promoting peer support and care-giving experience by interacting with social robots are increasingly studied [5, 4, 39, 56]. It has been found that a social assistive robot for mutual-care to encourage its senior users to help and care for the robot improved relationships between a user (i.e., care-giver) and a robot (i.e., care-receiver)[39]. Educational robotics researchers also suggested a care-receiving robot (CRR) framed as a peer or a novice that allows students to take on the role of an instructor could improve the students' confidence while establishing learning outcomes [4].

However, supporting people with mental health problems can be complicated and overwhelming [55]. The families and friends of people with mental problems often reported that they were unprepared to offer specific or adequate support [32]. Furthermore, online communities to support people with depression have issues such as harmful content and conflicting opinions [42]. Training peers to generate understanding and empathy toward people with depression can mitigate the negative effects. Although online services for training peer support been introduced [25, 30], they do not involve direct, personal interactions with people with mental health problems. To provide an opportunity to interact with someone with depression without fear of negative consequences, we explore a method of practicing peer support using a social bot, a particular form of social media that simulates human-to-human interaction online.

Reducing Public Stigma Associated with Mental Illness

The stigma associated with mental illness is formed by stereotypes, prejudices, and discrimination [16] often leading to negative outcomes [12] and works as a barrier to seeking appropriate care [44]. Therefore, attempts to reduce stigma are considered an important aspect for public health. Three approaches to reducing stigma have been suggested: protest, education, and contact [14]. Protest involves sending messages to the media and public against inaccurate representations of mental illness and negative beliefs about mental illness [15], education entails informing the public about mental illnesses, and contact involves promoting interpersonal contact between the general public and people with mental illness [10].

Of these three methods, social contact is known as the most effective way to reduce stigma by humanizing the condition [11, 13, 16, 30]. In two studies in which participants listened to a story from a person who had experience with mental illness for 10 minutes in the same room, people showed positive changes compared to the education and protest conditions [15, 61]. However, education has the benefit of exportability (i.e., easy to provide to a large population) when compared to the contact condition, which requires arranging physical meetings with people and can be difficult. Therefore, a study using video films containing the personal stories of people with experience of mental illness was conducted and showed promising changes [13].

Attempts have also been made to use the concept of social contact, although it does not necessarily require meeting or listening to someone. The Bluefriend application was developed to visualize the proportion of users with depression within Facebook friends to naturally recognize depressed friends around them, thus increasing social contact [30]. This study shows an example of leveraging online social media that could have an impact on a larger population. Based on prior works, we investigated the contact between college students and a social bot sharing personal stories about depression. While prior studies using media presented limitations in personal interaction [13, 30], our study exploited a social bot that could afford communication in the real world.

Conversational Agents for Mental Health Care

With recent advances in conversational interfaces and artificial intelligence, attempts to provide mental health care services using conversational agents such as chatbots are increasing. The use of conversational agents can solve the problems leading people to avoid seeking and receiving treatment, such as stigma, high costs, and long waiting lists [7].

Psychoeducation is a common benefit of using a conversational agent [59]. Woebot [24] and Shim [43] used cognitive behavioral therapy (CBT) to provide a self-help program for college students. Gabby provided mindfulness and lifestyle recommendations for women [27]. Improved adherence is also mentioned as a common benefit of conversational agents [59]. Moreover, participants of a study examined the impact of a relational agent on hospital patients with depressive symptoms reported a stronger therapeutic alliance with the conversational agent than their clinician [6].

These conversational agents for mental health care mainly focused on the role of therapist or supporter to provide self-care for mental wellbeing [59]. However, there have been few attempts to utilize a conversational agent as a peer or friend who needs support or help from the user. While this assumption may seem counterintuitive, practicing helping others can have various mental health benefits [20, 34]. In addition, using bots to practice giving support can help minimize the burden and risk of peer support for individuals who are unfamiliar with it [42]. In this study, we explore the use of a social bot positioned as a care receiver for college students.

FIELD EXPERIMENT

Here, we outline the processes involved in designing a social bot as a virtual Facebook friend suffering from depression, describing how the content of the social bot was designed and explaining the experimental design.

Social Bot Design

In this section, we describe the process of designing a social bot called Gloomy.

Contents Design

We designed Gloomy's content by incorporating the constructs of CBT, a well-known intervention for depression [17]. CBT aims to correct one's irrational thoughts or dysfunctional beliefs called "cognitive distortions," which are known as a cognitive symptom of depression. Based on this, we used cognitive distortions as the backbone of Gloomy's story. Then, Gloomy's vulnerable, stressful, and frustrating daily events were carefully designed with the iterative review of four clinical psychologists at a university healthcare center. In addition,

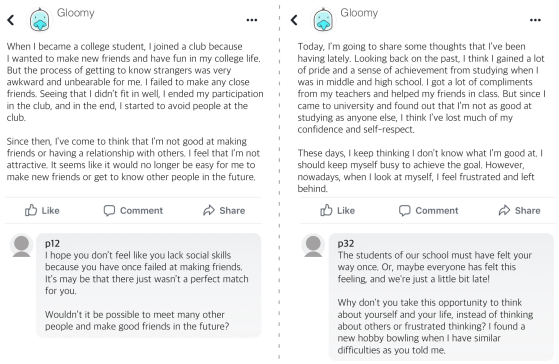

Figure 2. Example cases of Gloomy's post and comments left by participants.

we developed personal story content about Gloomy's experiences regarding identifying the symptoms of depression and seeking and receiving professional help [13].

For content development, group interviews were conducted with four clinical psychologists who worked at the university healthcare center from which our experiment participants were also recruited. First, a researcher and four experts developed representative cases containing cognitive distortions known as major cognitive symptoms of depression based on clinical studies and guidelines [9]. Based on the cases, they generated detailed examples of vulnerable situations, thoughts, and related cognitive distortions from their clinical experiences within the six areas in which many students often face challenges [41]. Prior to this group interview, a request was made to remove personal information that could identify an individual during the interview session. Through this process, 16 stories that Gloomy posted were created. Eleven stories were about a "vulnerable situation," and three were "personal stories" on a self-introduction, identifying the symptoms of depression, and seeking and receiving professional help [15, 61]. Two posts consisted of a greeting and goodbye message at the beginning and end of the experiment

The "vulnerable situation" content covered six topics: 1) family problems, 2) academic problems, 3) relationship problems, 4) financial problems, 5) future career worries, and 6) value problems [41]. Each content item contained one cognitive distortion, such as black-and-white thinking, catastrophizing, mind reading, overgeneralization, tunnel vision, and "should" statements [9] (see Figure 2). The "personal story" content covered Gloomy's background and previous perceptions of depression, the process by which Gloomy became aware of its depression symptoms and started recognizing the depression, the process of seeking professional help, and the current state of gradual improvement. A specific gender, age, religion, and region of origin were purposefully omitted in the content posted by the social bot.

Implementation

The social bot used in our study was designed to allow users to engage in a basic level of interaction such as by expressing a "like" or adding a comment. Gloomy posted content on their Facebook walls, and participants could see it on their newsfeeds. Through this, we designed a less invasive social bot approach compared to direct messaging or chatting. The interaction with Gloomy was designed such that only Gloomy (the researcher) and the participant who left comments could see it. We used the "share with specific friends" feature on Facebook, which allowed us to upload posts with only one participant to ensure their privacy and to avoid any potential negative interaction between participants (e.g., offensive messages). We developed the social bot using Selenium with Python 3 [50]. The script automatically created posts on Facebook with intended text messages and optional images. The posting metadata such as the posting timestamp were saved in a local MySQL database.

Interaction between Gloomy and Participants

The interaction between Gloomy and a participant consists of three phases. First, Gloomy posts content at a random time in the evening on a daily basis. Then, a participant views the post on their newsfeed and leaves a comment if he/she wants. Gloomy then replies to the participant the next day. Gloomy's comments are designed to contain three elements: 1) expression of gratitude toward the participant (e.g., Thank you for your advice), 2) self-reflection on symptoms (e.g., I guess the problem is because of cognitive distortion. I will correct my perspective), and 3) evidence of alleviating negative emotions (e.g., Now I feel better). This interaction was intended to encourage users to follow up with Gloomy and reflect on the CBT process (see Figure 1).

Profile Design

As mentioned previously, the social bot profile was designed not to indicate a specific gender, region of origin, or age. Rather, the social bot was introduced as a student at the participants' university. The profile design was based on previous studies on stigma reduction that found that contacting people in the same social group resulted in better stigma reduction [10]. Participants were told that Gloomy was a "social bot" in the introductory session. Profile content, such as the profile picture and name, explicitly indicated that Gloomy was a bot, not a human. This framing process ensured that from an ethical perspective, participants would not mistake the social bot for a person and would not feel overly burdened to comment and respond (see Figure 1).

Experimental Design

Participants

We advertised our studies in the online communities of three universities that shared similar characteristics (considered "elite" universities). On the recruitment flyer, we highlighted the eligibility criteria, and an online screening survey was included on the application form to enable respondents who met the criteria to apply for the experiment. Eligibility criteria included: (1) students who had never been diagnosed with a mental health disorder, (2) student who is not receiving any psychological or psychiatric treatments, (3) students who actively use Facebook at least five times each day. These measures were designed to prevent any possible impact on participants' existing treatment. Sixty participants were recruited through this process. Of these, two dropped out during the introductory session, and three failed to respond to the

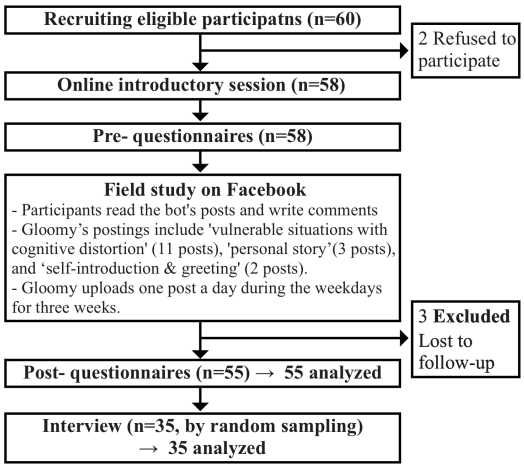

Figure 3. Study Procedure

post-survey (dropout rate 8%.). In total, we had 55 students who finished the studies (see Figure 3). 29 were male and 26 were female. Ages were ranged from 18 to 29 (M=22.08; SD=2.98). Thirty eight were undergraduate students, nine were in a master's students, and eight were in a doctoral students. The students who participated in the social bot experiments, which included pre- and post-experiment mental health assessments, each received $30 USD as compensation. In addition, students who participated in later interview sessions received $10 USD.

Introductory Session

We conducted an introductory session prior to the social bot experiment. The introductory session aimed to (1) introduce our studies and study protocol and (2) provide a social support guide for those who had difficulty helping others. Based on earlier studies, we introduced three steps of support: finding irrational thoughts, reframing them, and offering social (e.g., emotional) support [45, 33]. However, we repeatedly emphasized that we did not restrict methods for providing support and that participants could provide support as and when they wanted. We streamed the orientation session using YouTube Live in which participants could actively raise questions in the chat window. The sessions lasted about 40 minutes each, and participants were offered a choice of 10 orientation sessions in which they could participate to select a convenient time. Scripts and slides were used to provide the same content for all sessions.

Pre- and Post-experiment Measures

Before and after three weeks of social bot experiments, assessments were conducted to see if there were any changes in mental health status or stigma related to mental health. 1) The Beck Depression Inventory (BDI-2) created by Aaron T. Beck is one of the most widely used psychometric tests for measuring depression severity [3], 2) The State-Trait Anxiety Inventory (STAI-X-2) was used as a self-report tool for measuring anxiety symptoms. For this, we only used the part that measured trait anxiety [54]. 3) The Attribution Questionnaire (AQ) [61] was employed here to measure mental illness stigma. This questionnaire consists of 20 questions that measure the level of stigma against people with mental illness under the following seven sub-themes: helping behavior, dangerousness, fear, avoidance, pity, anger, and personal responsibility. Then, Attitudes toward Seeking Professional Psychological Help short form (ATSPPH-SF) was provided to measure participants' willingness to seek help [23]. While 'helping behavior' which is a subset of AQ questionnaire is designed to measure an individual's willingness to help others with mental illness, ATSPPH-SF is a measure to examine the individual's attitudes toward professional help-seeking.

Interview Session for Participants and Experts

After completing the social bot deployment field study, we randomly chose 35 interview participants. We conducted an hour-long phone interview to investigate users' experiences with Gloomy and perceptions of mental health issues. All the interviews were audio-recorded and transcribed. We also conducted an expert focus group interview session with the clinical psychologists involved in the content design session. In this session, we presented fully anonymized interaction data to elicit experts' opinions. The experts discussed the potential impact of the social bot on the students and the implications for college healthcare services.

Safety Protocol

Prior to recruitment, our study was approved by the IRB of the institution where the study was conducted, and one psychiatrist and four clinical psychologists at the on-campus mental health center determined the study's appropriateness and necessity. To improve the safety of our study, the following precautions were taken: participant screening and exclusion of extreme cases. We recruited participants who were not receiving counseling or treatment for mental health problems. This measure was included to exclude participants with vulnerable mental health status and to prevent the possible impact on the treatment or counseling that participants were receiving. Further, the posts were designed to contain no extreme content, such as suicide or self-harm. However, as a precaution, risk management procedures were set up to deal with potential risky situations [46]. Research directors and co-researchers continued observing the content of interactions between participants and the social bot. When there were either 1) comments suggesting self-harm, suicide, or injury to others or 2) negative remarks such as those on depression and frustration, we provided appropriate measures, including early termination of the experiment and information about the college's counseling center.

ANALYSIS

Quantitative Analysis

We measured pre- and post-experiment mental health status and stigma using the BDI2, STAI-X-2, ATSPPH-SF, and AQ. These measurement data were analyzed to understand how using our social bot affected participants' mental health status and stigma related to mental illness. We used the Wilcoxon signed-rank test as a nonparametric paired test for analyzing changes after using the social bot for three weeks.

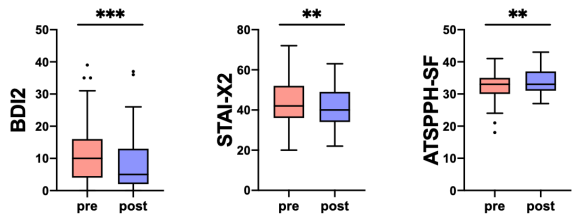

Figure 4. After three weeks of field study, symptoms of depression and anxiety reduced while help-seeking preference increased significantly. ns P > 0.05, * P ≤ 0.05; ** P ≤ 0.01; *** P ≤ 0.001; **** P ≤ 0.0001

Qualitative Analysis

We analyzed the data from the interviews and comments users added to Gloomy's posts using inductive thematic analysis [8]. In the Results section, we report the qualitative findings stemming from the data from both the interviews and the comments. Through an iterative inductive coding process, we identified themes related to perceptions of mental illness and emotional regulation. Generated codes were verified by experts working as clinical psychologists at a university healthcare center.

RESULTS

Below, we present the findings from our study. First, we show our descriptive summary of participants' reply data. Second, we present changes in mental health status and stigma based on the outcome measure. Third, we list the effects of the social bot on participants in three subcategories: supporting self-awareness and self-reflection, changes in perceptions of mental illness, and changes in attitudes on seeking professional help. Fourth, we present user experiences of using the social bot and expert evaluations.

Descriptive Summary of Social Bot Interaction

During the three-week deployment study, we collected 951 comments from 55 participants. However, some participants left multiple continuous comments on a single post, in which case they were considered one comment. Therefore, the social bot created 880 posts (16 posts * 55 participants), and 861 posts received comments from the participants. On average, participants wrote comments 22 hours 39 minutes after the posting time. However, this was spread over a wide range (*SD*=33 hours 8 minutes). The average comment length was 144.17 characters (*SD*=34.58).

Changes in Outcome Measures

Overall, our statistical analysis showed positive changes in mental health status and stigma associated with mental illness. The Wilcoxon test for analyzing differences between pre- and post-experiment depression (Z= -3.272 p<.001) and anxiety (Z=-2.798 p<.005) showed reduced outcomes, indicating that the symptoms of depression and anxiety experienced by participants decreased. The ATSPPH-SF showed increased scores (Z= -2.988 p<.003) indicating that the attitudes toward seeking help by participants positively changed (See figure 4). The AQ regarding stigma toward people with mental illness showed complex results. While dangerousness (Z=-3.782 p<.000), fear

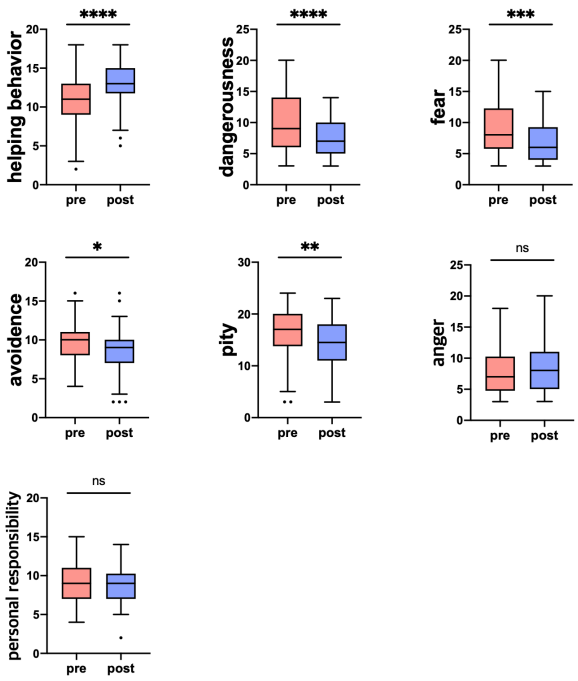

Figure 5. After three weeks of field study, participants showed changes in helping behavior, dangerousness, fear, and avoidance regarding the stigma toward a person with mental illness. ns P > 0.05, * P ≤ 0.05; ** P ≤ 0.01; *** P ≤ 0.001; **** P ≤ 0.0001

(Z=-3.619 p<.000), helping behavior (Z=-3.764 p<.000), pity (Z=-2.790 p<.005), and avoidance (Z=-2.411 p<.016) positively changed after the experiment, others (i.e., anger and personal responsibility) showed no significant differences. The analysis indicated that participants' fear, avoidance, and pity of people with mental illness were significantly reduced. In particular, decreases in pity could be explained as decreases in the pitiable stigma of mental illness (e.g., lowered self-esteem and loss of opportunity) [13]. The perception that a person with mental illness is dangerous was lessened, while the intention to help people with depression was increased (See figure 5).

Qualitative Analysis of User Interview and Comment Data

In this section, we present qualitative findings from the interaction data and interviews with our participants and clinical experts. After analyzing the qualitative data, we identified three main themes related to the effect of using the social bot: supporting self-awareness and self-reflection, changes in perceptions of mental illness, and changes in attitudes on seeking professional help.

Supporting Self-awareness and Self-reflection

Participants mentioned that reading Gloomy's posts and providing support led them to revisit and reframe their past, unsolved, and in-progress problems. These tendencies were identified through both interview data and comment data. Comments referencing personal stories and strategies were found in 152 of total comments (17.65%). From the interview data, participants mentioned the following themes: revisiting their

own problems, identifying their own negative feelings and distorted thinking, building their own strategies for emotional regulation, and preparing for future events. As shown below, several participants explicitly mentioned that the comments they wrote for Gloomy also worked for themselves.

> Quite a few of your worries are my worries too. It was a message of support to you, but at the same time, it was like I was saying it to myself. Thank you so much for letting me rethink my worries, comforting me, and reassuring me!!(P14, comment from Facebook)

For some participants, the message of social support provided to Gloomy was used as a strategy to address their negative emotional state.

> *Since I was in the same situation as Gloomy, when I was writing the comments, I felt like I was saying it to myself. As with Gloomy's post on [date], I also felt stressed about my career after graduation. What I said to Gloomy at the time was, "Okay, let's focus on what we're doing right now." And this message helped me snap out of it.* (P48, from interview data)

Participants also mentioned that reading Gloomy's posts led them to find the distorted thinking that they could not identify before. In general, finding cognitive distortions is usually tricky. However, viewing them through others' point of view helps people to identify them and consider them problematic thoughts that need to be corrected [37, 38].

> *Now I know that I made a lot of "should" statements for myself when I had a meeting with my professor. As I read Gloomy's stories related to this distorted thoughts, I found that I had a similar way of thinking. Seeing Gloomy's thought process helped me recognize it as a problem and led me to change this way of thinking.* (P3, from interview data)

For some of the participants, listening to Gloomy's stories was a way to preview and prepare for future events.

> *I'll study in a lab someday ... "What if I make a mistake like Gloomy?" I thought. It was a process of mentally preparing for the future event.* (P33, from interview data)

Changes in Perceptions toward Mental Illness

In this subsection, we list participants' feedback related to perceptions of mental illness and those who suffer from it. In general, interview participants (69%) mentioned their changed perceptions of people with depression. One of the noticeable changes related to the fear of, perceived dangerousness of, and willingness to help people with depression. This response is also consistent with the changes in the measurement outcomes (see Figure 5). Interacting with Gloomy designed as a college student struggling with the same issues as participants led them to reduce stigma [13, 11].

> *After I read about the difficulties on Gloomy's disclosing post similar to those I'm struggling with now, I felt less fear toward Gloomy and people with depression* (P23, from interview data)

The process of linking Gloomy and people with depression made participants realize that people with depression are all around us.

> *When I thought about Gloomy as a depressed patient, I didn't feel scared of depressed patients anymore. I came to think of them as normal people all around us.* (P21, from interview data)

Some of the participants identified and corrected their existing perceptions and stereotypes related to people with depression. In addition, participants showed how they corrected the perceptions they had when dealing with people with depression.

> *In the old days, I used to think that depression was a problem for people who couldn't control themselves.* (P44, from interview data)

> I didn't think depression was a disease. Before I met you, I wondered why people with depression were so vulnerable and focused only on the bad. After listening to you, I can now look at people with depression with no biases. (P25, comment from Facebook)

Participants also mentioned that their attitudes toward helping others with depression positively changed after the experiment (71%) as our outcome measures consistently show (see "helping behavior" in Figure 4). Feedback from participants included obtaining psychological rewards through providing support, noticing changes in willingness to provide support, paying more attention to the state of friends around them, and acquiring knowledge and experience in terms of how to provide social support. Interestingly, participants noted that the changes in their willingness to provide support affected how they paid attention to their friends.

> *And the positive impact was that when one of my friends told me something, I tried to listen more than before.* (P2, from interview data)

Although our experiments did not provide strict guidelines or structures for social support, participants mentioned that they became familiar with peer support and acquired their own skills.

> *Now when providing support, I pay more attention to the process of supporting. As I participated in this experiment, I tried to understand the surrounding situation and how Gloomy perceived it.* (P49, from interview data)

Changes in Attitudes toward Seeking Professional Help

Our participants mentioned changes in their attitudes toward seeking professional help. This finding supports the changes in our outcome measure using the ATSPPH-SF (see Figure 4). Feedback from participants included changes in willingness to seek professional help, increased knowledge of the content and process of professional help, and changes in stereotypes and stigma related to depression patients. Overall, participants noted that they were able to confirm the importance of receiving professional help.

> *Seeking help now seems to be a rather healthy way, and I think it's much better to get it than to keep it bottled up and avoid it.* (P49, from interview data)

In the interviews, participants mentioned that they had modified their existing stereotypes related to professional help.

> *In the past, if I knew someone who went for counseling, I thought of him/her as a weak person who struggles to adjust in life. But now, I know that there are a lot of things that can be solved by counseling if someone is having a hard time personally. So I don't think it's a negative thing.* (P23, from interview data)

Participants who expressed their willingness to seek professional help were also found in 20 of the total comments to the "personal story" post (12.42 %).

> `I'm so glad that the counseling worked for you! I thought about getting counseling every time I had a hard time, but I never did because I was scared. Next time I face difficulties, I will seek help. Thanks!` (P42, comment from Facebook)

Feedback on Using a Social Bot

In this section, we cover participants' feedback regarding the social bot user experience.

Positive Experiences

Participants mentioned various motivations for engaging in our experiment. Empathy toward Gloomy served as the primary motivation for continuing participation in the experiment. Some participants treated Gloomy like a friend who attended the same college.

> *I really identified with what Gloomy was saying, which led me to revisit those situations. These kinds of feelings and experiences motivated me to stay involved with this study.* (P49, from interview data)

> `I think we felt that way a lot when we came to this university. We were all people who studied hard and were satisfied with the results in high school. However, when I came here, I felt that I couldn't be the best because there was always a student better than me.` (p31, comment from Facebook)

The novelty of interacting with the bot was one of the evident motivations. Participants mentioned that reading Gloomy's posts was a valuable experience in itself since these posts covered various events that could happen in the college environment. Participants also highly evaluated the system design in which the comments were not visible to others. This design allowed participants to write the comments they wanted to Gloomy without worrying about others.

> *I liked the fact that my comments were invisible to others. I wouldn't be frank with Gloomy or say what I wanted to say if someone else could see my comments.* (P34, from interview data)

The accessibility of the Facebook platform and the unobtrusiveness of the task led the participants to engage in conversation with Gloomy often. Most participants (89%) mentioned that participation in the experiment did not interrupt their existing use of Facebook. Moreover, 87% of interview participants mentioned that participating in this experiment did not interfere with their daily life at all. In addition, 87% participants reported that they spent under 10 minutes per day, while the rest of the participants spent 10–15 minutes per day.

Negative Experiences

Participants also mentioned negative experiences of using the social bot caused by the artificial (non-human-like) interaction, shallow depth of communication, limited selection of topics, and fatigue in reading negative content.

While some participants mentioned the novelty of interacting with a social bot, several participants noted that they found the experience unsatisfactory since Gloomy's interaction seemed too artificial. Participants pointed out the following factors related to this: sudden changes in negative emotions and cognitive distortion, expression of excessive gratitude, and length of posts and comments. Participants who wanted to have more in-depth, multi-level conversations with Gloomy were disappointed by its simple interaction. They wanted to follow up on how Gloomy got through problems or the events disclosed.

Some of the participants mentioned fatigue in reading posts. The transfer of negative emotions through social media, emotional contagion, was one of the greatest concerns [36]. In this study, we were not able to verify whether the exposure to Gloomy's negative, vulnerable experience induced the negative affect of the participants. Nevertheless, based on the interview responses of the participants, we listed participants' experiences related with this issue.

Fatigue occurred when participants were not feeling well, such as when they were busy or depressed too.

> *I was in a bad state during the last week of the experiment. I had too much work and pressure. At that time, listening to Gloomy's story was a bit overwhelming.* (P50, from interview data)

Some participants pointed out the long duration of the experiment and the short interval between posts as reasons for fatigue. Dealing with various topics every day also led them to feel fatigue.

> *I think it would be better if the topics discussed by Gloomy were presented every two or three days. It was a little overwhelming to deal with a different topic every day.* (P16, from interview data)

Qualitative Analysis of Expert Evaluation

In this section, we list the findings from the expert evaluation based on a group interview session with four clinical psychologists working in a college healthcare center. Overall, experts gave positive feedback on Gloomy's design, and the data came from user interviews/comments and measurements. They listed expected benefits and possible use cases of using Gloomy as a social bot for mental health care. Experts were interested in the idea that Gloomy shed light on the topics and issues important to college students.

From many counseling sessions, there's a common problem that is repeated every season or every year. It's best to talk about it personally, but it's impossible. I think it is meaningful that Gloomy can provide topics that college students need to consider.

Experts commented that this experiment provided a place where students could find comfort and encouragement while seeing a virtual cohort, Gloomy, who had concerns and problems similar to their own.

"I'm not the only one." "It's no big deal." Participants experienced these things a lot. I think this is a good feature. It can't replace the counseling service. However, it can play a similar role to counseling by enabling users to feel empathy and learn how to generalize problems.

Experts also valued Gloomy's educational aspect, introducing various symptoms of mental illness through Facebook. Creating a social bot like Gloomy covering various mental illnesses in addition to depression, such as panic disorder, would have a positive impact on students' awareness of mental illness. The experts also suggested limitations of and improvements for the social bot design. The fact that the validity of comments was not assessed was mentioned as a limitation. For example, the experts mentioned that one of the participants kept posting assertive expressions, which made the counselors concerned about the participant's mental health. Meanwhile, experts also showed hesitation in providing strict guidelines and evaluations, as they worried it might erode Gloomy's positive characteristics as a college friend.

DISCUSSION AND IMPLICATIONS

In this section, we discuss the implications of our study results based on prior works. We then present design considerations for the social bot as a care-receiver for mental health.

Reflection on Gloomy Study

Our study aimed to explore the possible benefits that could be expected by using the social bot as a care receiver in mental health interventions. To do this, we examined the use of a social bot positioned as a care receiver. We observed and analyzed the impact on participants when they were supporting others. Previous studies revealed that helping others provides opportunities to practice emotional regulation strategies that can be used for future problems [57, 58], and our qualitative data from participants are consistent with these early findings. Our participants showed tendencies to apply the support messages they wrote for Gloomy to themselves. Furthermore, previous studies revealed that helping others with psychological distance enhances reasoning and regulation success [37, 38]. In line with these findings, our participants also mentioned that after they were exposed to Gloomy's vulnerable situations that were similar to their own and provided support for Gloomy, they were able to identify the sources of their own problems, such as distorted thinking, more clearly and objectively. The benefits of helping others have been studied for various forms of communication, such as face-to-face and online peer support platforms [20]. It led us to explore the benefits of helping others using a social bot. Although our research was not conducted to demonstrate the clinical impact of the bot-helping process, our study identified that individuals could improve their own mental health by engaging in the process of helping bots.

Our study suggests design opportunities and insight to tackle mental illness stigma issues for college students. Previous studies on the reduction of mental illness stigma revealed that contact between the general public and people with mental illness could reduce stigma [26, 47]. This effect of reducing stigma can be especially powerful when the two entities share a common status or background, such as social group membership [13, 11]. In a similar way, our participants' feedback showed that contacting Gloomy, a Facebook-based social bot positioned as a college student experiencing similar problems, led them to see Gloomy as a person just like them and not a stranger. Furthermore, our findings are in line with current attempts to promote societal depression awareness [30]. Interacting with Gloomy led participants to consider that people with depression can be found around campus or in their social group. Our finding shows the potential to solve stigma problems through a social bot. Added to previous studies using video film [13] and social media [30] to reduce stigma, in this study, we provide empirical findings of the effect of using a social bot on the reduction of mental health stigma.

Design Considerations for the Social Bot as a Care Receiver for Mental Health

In this section, we describe design considerations and opportunities for designing a social bot acting as a care receiver with which participants can giving social support. Nevertheless, we consider our implications can also be applied to a wide variety of conversational agents, such as chatbots or social bots designed for mental healthcare.

Reflecting Characteristics and Contexts of User Group

We speculate that reflecting the user group characteristics was the main contributing factor that enhanced user engagement, increased self-awareness and self-reflection, and reduced stigma. In this study, we created Gloomy's content through the iterative validation of mental health experts to choose stories and topics that were most relevant to the participants. Our participants mentioned that reading stories that reflected their daily lives and contexts led to active engagement and self-reflection on their own experiences. Regarding stigma reduction, having contact with a bot characterized as someone with a mental illness who shared the same social background or was struggling with similar daily problems helped our participants to recognize Gloomy as a cohort. We suggest that the bot needs to reflect the characteristics of the majority of the user group, ranging from demographics to conversational styles, when it comes to be designed.

Experts also appreciated that Gloomy covered important topics that need to be considered in college. In addition, experts anticipated that Gloomy's posts, which contained educational aspects of mental illness, could convey information about the symptoms of mental illness and hence improve mental illness awareness. However, reflecting the daily life of a specific group to generate topics of conversation with social bots can be burdensome for experts with limited time and resources.

Therefore, developing a system that technically supports content creation could lower the experts' burden. For example, using online university communities, we could extract a significant domain or category of vulnerable situations and emergent topics. Therefore, social bots could be adaptive and thus reflect the context of students.

Reducing Negative Affect while Interacting with a Vulnerable Bot

One of the key concerns was emotional contagion, meaning that negative emotions can be transferred via social media such as Facebook [36]. The experts, however, mentioned that Gloomy did not discuss any extreme cases with serious risks. Rather, Gloomy's posts were about common themes that any college student can experience. In this regard, the experts expected the benefit of using Gloomy to be higher than the risk. However, we still need to design social bots carefully to reduce the possibility of emotional contagion. First, the social bot is not a channel for exposing negative, vulnerable posts to users. The social bot should be positioned as a virtual cohort who provides an opportunity to interact with someone with depression. Thus, the system should help users practice what mental health experts (e.g., counselors) provide to vulnerable individuals, for instance, carefully reading the disclosure to elicit supportive messages such as reappraisals or emotional support. Through this process, the individuals who respond to the vulnerable bot could change their negative thoughts and even apply these to their own situations. Second, a carefully designed conversational strategy (e.g., turn-taking, gratitude) should be considered to alleviate negative emotions induced by the social bot's disclosure. For instance, follow-up posts that present the bot's emotional regulation process would relieve the user's concern. In addition, the bot could occasionally report the improvement of the symptoms to celebrate its achievement with the support giver. The user would feel rewarded when watching Gloomy's willingness to overcome problems and make gradual improvements. Third, the amount of and timing of posting should be adapted to the context of the user. If the user explicitly or implicitly expressed feeling overwhelmed, then the system could pause posting or upload a post that could induce positive affect.

Designing Accessible Intervention Program without User Burden

Gloomy inhabited the off-the-shelf, accessible platform of Facebook, in which college students spend a significant amount of time to satisfy their social and psychological needs [60]. Unlike the existing online peer support platforms where the cohorts who might be diagnosed gather to exchange informational or emotional support, Facebook is a heterogeneous, multipurpose area used as a quick break from study or as short-term stress relief. Compared to the existing peer support platforms, the high availability of our social bot could draw more beginners or first-year students who do not yet know the importance of peer support for mental illness. Both our qualitative and quantitative findings revealed that using our social bot positively affected students' attitudes toward helping others and seeking help. Therefore, we suggest leveraging existing renowned platforms to design healthcare services specifically for people with less knowledge. However, using such a platform can raise the fear that their messages may be leaked or that other friends can see their participation in something related to mental health. Therefore, we have to inform people of how their data is processed and assure them that it is not visible to others. Our participants highly evaluated the system design aspect that the comments were not visible to others; this feeling of assuredness led them to write more honestly.

LIMITATION AND FUTURE WORK

Our study presents limitations related to experimental design. We did not have a control group to clearly distinguish the effects of the social bot on perception and attitude changes and stigma reductions. To complement our results, we conducted in-depth interviews with 35 participants to reveal their perspectives and the way in which they engaged (or did not engage) in the interaction with Gloomy. This study was conducted not to present clinical evidence of a social bot but to explore new possibilities and gain insights into the design of social bots for mental health care. Therefore, future works need to uncover the effect of bot positioning as care receiver compared to the conventional tools. There is a possibility of sampling bias because our recruitment statement was likely to target people eager to learn about mental health through this opportunity. In addition, the majority of participants were attending "elite" colleges, an incredibly competitive atmosphere for young people. Future work should be done to compensate for this bias by enrolling a diverse set of students. The feasibility of implementing the social bot is an interesting research topic that should be explored. Since our current system cannot operate without human assistance for creating content, future work need to develop a system that can generate and validate content using an algorithm to achieve technical sustainability.

CONCLUSION

In this paper, we designed a social bot called Gloomy displaying depressive symptoms and disclosing vulnerable experiences that allowed college students to practice providing support online. We conducted a three-week field study with 55 college students. The results showed that interaction with Gloomy contributed to increased self-knowledge about one's vulnerability, favorable perceptions of depression and those with depression, and positive attitudes toward seeking professional help. Based on our findings, we provided design considerations for a social bot that acts as a care receiver where users can get benefits from helping others. We hope that this work provides insights into designing a conversational agent for scaling mental health care online.

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