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Promoting Wellbeing with Sunny, a Chatbot that Facilitates Positive Messages within Social Groups

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Abstract

A Facebook Messenger chatbot, Sunny, was designed and deployed to promote positive social connections and enhance psychological wellbeing. A 10-day study was conducted with three pre-existing social groups of four members each in control (n=12) and experimental groups (n=12). Both groups completed initial assessments and daily reports, and the experimental groups interacted with Sunny. Exit interviews indicated three key themes: 1) Sunny prompted self-reflection, boosting participants' senses of self-worth and the depth of their relationships, 2) using Sunny encouraged participants to send heartfelt messages they would not have shared otherwise, 3) participants enjoyed accessing positive messages "on-demand". Experimental groups showed an average increase in psychological wellbeing of 1.73 (std = 6.08), compared to 0.5 (std = 5.94) in control. Our results suggest that an AI-based chatbot like Sunny could provide preventative care, promoting strong social connections and psychological wellbeing.

Author Keywords

chatbots; wellbeing; social networks; social support; agent-based interfaces; friendsourcing; dialog systems

CCS Concepts

•Information systems → Chat; •Human-centered computing → Social networks;

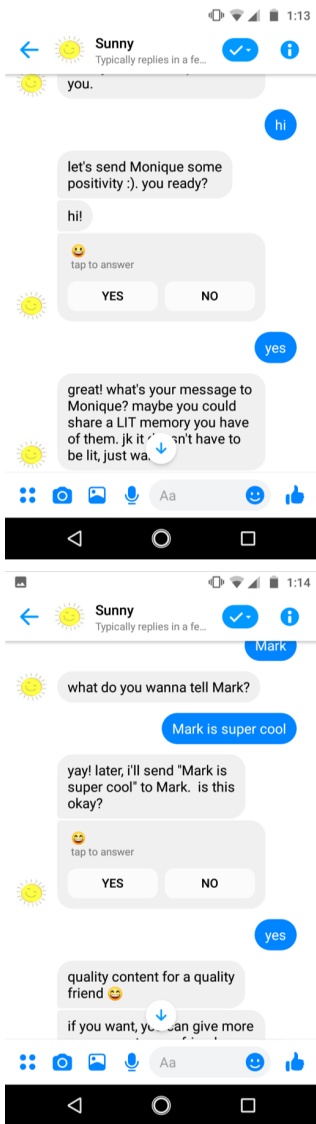


Figure 1: Sample chat interactions using Sunny chatbot

Introduction

Mental illness poses a significant challenge to psychological wellbeing in the United States. Approximately one in five American adults (46.6 million) are affected by a mental health condition each year [19]. While many computer applications have been developed to support people with mental illness [5, 1, 3, 4, 10], most focus on treating people with severe conditions (e.g., major depressive disorder), not preventing mental illness and maintaining wellbeing.

Positive social interactions have been shown to be one of the key contributing factors to psychological wellbeing [20, 2]. Many existing computer applications designed to treat mental illness focus on the individual in isolation, for example, delivering psychotherapy techniques like Cognitive Behavioral Therapy (CBT) and encouraging individual reflection on behaviors and feelings [9, 17, 8].

In this paper, we explore how artificial intelligence (AI) can be used to enhance social connections and, in doing so, improve psychological wellbeing. We conducted a 10-day study to assess the efficacy of a chatbot that facilitates positive messages within existing social networks, making it easier for members of the network to stay connected and show appreciation for each other. We present usage practices, feedback from participants, and preliminary results on the effect of using the chatbot on psychological wellbeing and social interactions.

Background

Positive affect has been shown to correlate to positive social interactions in a number of psychological studies [20, 14, 2]. MacGeorge et. al. (2005) found a direct, positive link between emotional support received from close friends and family and low depression levels [12]. Studies have also shown the significant influence social networks can have

on behavior and efficacy of technology-based interventions [15, 13]. For example, Santesteban-Echarri et al. (2017) studied an online, social media-based relapse prevention platform for youth depression and found that peer moderation and social networking enhanced the intervention engagement for some young people [16].

Studies and products have also broadly explored the use of technology to provide support for people with mental illness and to promote wellbeing. Previous work has shown that technology-based journaling interventions can be effective in promoting wellbeing [9]. Fitzpatrick et. al. (2017) ran a randomized controlled trial to evaluate the efficacy of the AI chatbot Woebot in delivering CBT to college students with anxiety and depression. They found that the Woebot significantly reduced symptoms of depression. Many participants appreciated Woebot's regular check-ins and empathetic personality [6]. Lee et. al. (2019) tested (n=12) caregiving and care-receiving versions of Vincent, a chatbot that encourages users to practice in self-compassion by being cared for by the chatbot or caring for it [11]. Lee's results suggest that delivering care to another entity by writing messages may be particularly effective at promoting wellbeing. Sunny provides a hybrid of both care-delivering (message writing) and care receiving (message displaying), yet the people giving and receiving care are members of a person's existing social network, rather than a chatbot itself.

Online social networking platforms are not always positive for an individual's psychological wellbeing. A meta-analysis of 65 studies by Frost et. al. (2017) associated using Facebook with addiction, anxiety, depression, among other issues. However, the study also suggested that Facebook use correlated with lower depressive symptoms when used in a way that "enabled perceived social support and connection" [7]. Sunny enhances the functionalities of Face-

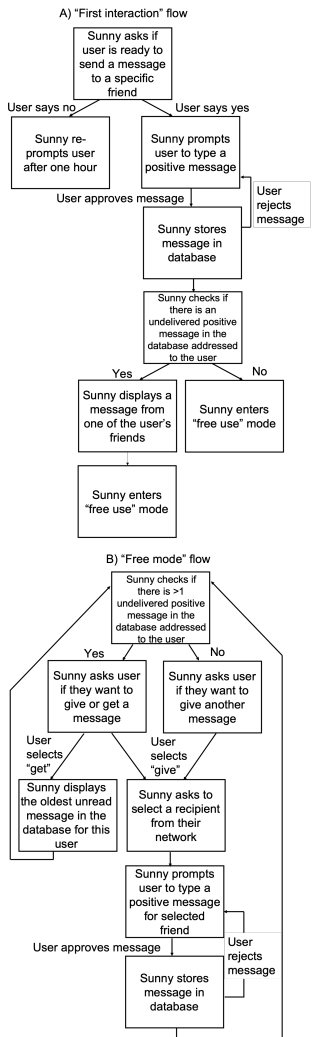


Figure 2: A) "First interaction" conversation flow that was completed in response to a user's first daily interaction with Sunny; B) "Free use" conversation flow that was executed whenever the user had completed their routine daily interactions with Sunny

book that were associated with lower depression: sending supportive messages and facilitating interactions between friends. Because Sunny functions as a Messenger chatbot, participants are not exposed to other aspects of Facebook that may be associated with negative mental health while they use the tool.

Sunny helps participants maintain positive mental health by facilitating an activity associated with psychological wellbeing, rather than by providing coaching or targeted wellbeing activities. Sunny is a preventative technology that strengthens connections within existing social groups by facilitating sharing of positive messages between members.

Sunny, the AI Chatbot

User Experience

A chatbot named Sunny was deployed on the Facebook Messenger platform to send and receive positive messages between pre-defined social groups. When a user initiates a conversation with Sunny, Sunny responds using the "first interaction" flow (Fig. 2A) – Sunny greets them, then prompts the user to record a message to a specific friend. Sunny provides positive reinforcement and a daily prompt: "great! what's your message to [friend name]? [prompt]". The available prompts were: "you could share your favorite things about them.", "you could tell them why you're grateful for them.", "maybe you could share a LIT memory you have of them. jk it doesn't have to be lit, just warm", "you could tell them what your friendship means to you." The prompts were designed to promote gratitude towards the friend, positive reflection on the friendship, and recognition of the friendship's meaning. Figure 1 shows sample interactions between a user and Sunny.

After the user provides a message, Sunny asks if the user accepts the message: "yay! later, i'll send [message] to

[friend name]. is this okay?". If the user rejects the message, Sunny says, "no prob! one more time. what do you wanna say to [friend name]?" and restarts the recording flow. If the user confirms, three things happen: (1) Sunny responds with either "that was really nice 😊" or "👍", (2) Sunny shares a message from a friend "[friend name] said this about you: [message]", or (3) Sunny offers options for additional interactions.

If a user has missed a previous day's interaction, Sunny says "there are still more messages to give and get! let's keep going 🔥", and restarts the recording flow for a specific person. If the user has more than one message left to read, Sunny offers two options, "if you want, you can give or get more messages!"; users can type or select "give" or "get". If there are no extra messages, Sunny asks, "if you want, you can give more messages to your friends. wanna do another?" and provides one button to respond with "helllll yeah!". If a user accepts, Sunny prompts in one of three ways: "who do you want to give a boost to next?", "pick a friend!", "show a friend you're thinking of them". When in "free mode" (Fig 2B), users can select a specific friend in their group to whom they want to write a message. Sunny prompts users to send messages using a "give" button, which is intended to frame message writing as a gift and highlight the positive potential of the gesture.

Sunny's content is designed to make users feel comfortable writing messages to their network. The language Sunny uses aims to be persuasive and encouraging; the choice of diction and punctuation give a positive, up-beat tone. Sunny's language is also informal and friendly, as if it was written by a peer. By using emojis ("let's keep going 🔥", "quality content for a quality friend 😊"), avoiding sentence-casing, and using acronyms like "kk" (for "okay") and "jk"

Days 0-2	Pre-study Journaling	(for "just kidding"), Sunny reflects how friends may instant message each other on other platforms.
	Participants fill out a short daily survey about positive social interactions they have had, and rate their mood and energy levels	Interactions with Sunny are designed to be positive but unremarkable, to allow users to focus on their interactions with each other. Sunny does not attempt to develop a relationship with users, it only facilitates and supports existing in-person relationships.
Day 3	Study Begins	<i>System Architecture</i> The Facebook Messenger development platform uses webhooks to manage application behavior. The Sunny webhook was hosted on Heroku, a cloud-based application management platform. Sunny's backend managed the conversation flow using a state machine, a set of states and transitions between these states. The chatbot used a SQL database to store the groups, each user's current state and interaction history, and each recorded message along with its sender, recipient, and timestamp. .
	Orientation Session: How to use app, Pre-surveys (demographics, psychological well being, self-esteem)	
Days 4 - 10	Daily Journaling and AI interaction	Methodology
	All participants complete brief daily survey. Only participants in experimental groups interact with AI agent for ~5 minutes each day to send/receive messages;	<i>Study Design</i> A 10-day study was conducted: three days of daily surveys for all participants followed by seven days of study activities. Six groups of four participants were recruited and randomly assigned to either the control condition (three groups) or the experimental condition (three groups). For the seven-day study period, all participants completed daily surveys and participants in the experimental group also interacted with Sunny each day. Participants were paid 95 dollars.
Day 11	Study Ends	<i>Participants</i>
	Exit interview and post-surveys	Participants were five groups of university students and one group of young professionals. They were recruited on a university campus via email advertisements that called for groups of four people who were friends or family. The email included a general overview of the study: daily surveys,

Figure 3: A 10-day study was conducted to understand how social groups interacted with Sunny. The study included a control group to compare differences in changes in wellbeing and self-esteem

possibly interacting with a smart device, and a wrap-up session. The groups were randomly selected from those that completed a sign-up form.

Data Collection

For the first three days of the study (days 0-2, see Figure 3), all participants filled out a short survey to record their mood and energy baseline. On day two of the study, all participants attended an orientation session where they also completed the 18-question psychological wellbeing test [18] and the Rosenberg Self-Esteem scale [21].

For each day for the remainder of the study, all participants completed daily surveys about positive social interactions, compliments, and their mood and energy levels. Participants in the experimental groups were also asked to write and receive at least one message on the platform each day, but could elect to give or get additional messages. At the end of the study, all participants completed the psychological wellbeing and self-esteem tests again. Participants in the experimental group participated in a 20-minute exit interview with a member of the research team.

Results

Themes in Message Content

First, the research team analyzed key features of messages written on the Sunny platform. Figure 4 presents the identified features and provides examples for each. Some messages contained multiple features. For example, "Hey [friend]! I hope you're [sic] interview went well! You're a very smart person, and I know that regardless of the result, you will succeed! You're awesome! Hope to see you soon so I can sass you!" expresses six features: thinking of their friend, calling out a particular event ("interview"), encouragement ("you will succeed!"), incorporating a generic positive message ("You're awesome"), affirming

Message Type	Examples
Integrating Symbols	"^ ^", "<3", "Movie night! :)"
Thinking of You	"hope you had a good day because you deserve it"
Referencing Event or Location	"I hope you're enjoying NY :)", "hope you're interview went well!.."
Encouragement	"Keep rocking those calls <3", "You're about to make it buddy! I know it"
Gratitude	"Hi friendo I appreciate you <3"
Referencing Memory	"I love every time I walk into the lounge at odd hours in the night and you are sitting there making everything so positive!.."
Neutral or Random	"Your cat is amazing!"
Attractiveness	"I like MOST of your sweaters. You've actually got a good sense of style", "youre super cute :)"
Highlighting Personal, Internal Qualities	"u huge nerd i appreciate u", "...I really enjoy hanging out with him because he can take a joke, and he puts me at ease..."
Sharing Media	"I watched this video and I thought you will like it and get you in the Saturday mood [link redacted]"
Acknowledging Skill, Talent, or Ability	"its cool that u know how to do things...", "Hi [friend]!!! You are super cool and smart. Always very reliable"
Social or Prompting Follow-up	"Yooo [friend] WYA? Havent heard your saaaa in a while", "Such an amazing night we had yesterday, We need to do it more often"
Reflecting on Meaning in the Relationship	"I love our powerful conversations. What I always take from you is your great powerful insights <3", "Our friendship means a lot to me"

Figure 4: Table listing the message categories and examples for each, pulled from messages sent by the participants

internal qualities ("very smart"), and prompting follow-up interaction ("Hope to see you soon..."). Figure 5A presents a sorted table of feature occurrences and highlights important components of positive messages, which may inform other platforms that share positive messages.

Number of Sent and Received Messages

Figures 5B and 5C show that on average across all three groups, participants sent more messages than they received - typically a user received one message and then sent messages to 2-3 participants in the group, though they were only required to send one message per day as part of the study activities. Throughout the study, participants interacted with Sunny even after they had completed the minimum requirement of one give/get interaction. This suggests that Sunny is persuasive and engaging, and that users may use the platform without the incentive of payment.

Exit Interviews

The research team conducted exit interviews with participants in the experimental group to gather feedback on the chatbot UI and on the chatbot's functionality. Qualitative coding was used to extract themes from the interview notes. Three researchers independently coded the interview transcripts, looking for pain points, delight points, suggested changes or workarounds used by participants, and other salient observations. Common comments were then extracted and grouped into themes. Major themes emerged from the analysis: (1) interacting with Sunny prompted self-reflection, which influenced users' views on themselves and their friendships, (2) Sunny encouraged interactions that were different than other social interactions and was effective and engaging as a result, (3) a smoother, more personalized UI would improve the overall experience.

Many participants mentioned that interacting with Sunny prompted them to reflect on their friendships. For some, this

led to benefits that extended off the platform, like enhanced perceived self-worth and relationship depth. Participants commented that they felt more valued by their friends after receiving genuine, heartfelt comments, which were often unexpected. These comments "solidified and bolstered" friendships. One participant commented, "I'm not that close to one person in the group, but things we said to each other [via the Sunny chatbot] really strengthened the connection", while another reflected on the group as a whole, "it made me more mindful of my interactions with others... I was thinking about my friends more."

Participants mentioned that Sunny facilitated social interactions that were different than typical interactions they had with group members. One participant said, "some of my friends would never have said what they said, in person". Interacting with Sunny appeared to inspire deeper consideration of message content. A participant commented, "when I used the bot, I more carefully designed what I wanted to say, with more purpose" and another shared, "in our ordinary life [sic], we don't stop and reflect and give compliments to people." The chatbot provided an outlet where the norm was to express gratitude and affection in a way that may feel out of place in day-to-day life.

Participants enjoyed the 'on-demand' experience of being able to access compliments when they needed them most. One participant described saving all of their compliments up for several days and then listening to them all at once to get the 'boost' they needed to get through a stressful day. Another mentioned that they chose to get compliments at stressful times during the day, and that they felt a 'boost' after receiving a compliment.

Participants mentioned they would enjoy a more responsive and conversational chatbot. For most, Sunny's personality achieved its desired intention of being a friendly 'facilitator'

A)

Message Type	Count
Personal, Internal Qualities	64
Gratitude	41
Referencing Memory	29
Attractiveness	22
Integrating Symbols	21
Referencing Event/Location	20
Meaning of Relationship	20
Neutral/Random	17
Thinking of You	14
Skill, Talent, or Ability	11
Prompting Follow-up	11
Encouragement	3
Sharing Media	3

B)

Group	Avg. Given	Std.
1	14.25	6.18
2	15.50	4.27
3	13.75	2.86
All	14.50	4.70

C)

Group	Avg. Gotten	Std.
1	10.00	3.16
2	10.75	3.42
3	9.25	4.38
All	10.00	3.74

Figure 5: A) Table depicting the counts of messages in different categories. B and C) Tables depicting that average, people sent more messages than they received across all experimental groups.

of interactions, rather than dominating the experience. One participant said that while interacting with Sunny, they felt Sunny's personality "disappeared" and that "I didn't think I was interacting with it, I was interacting with my friends."

The frequency and similarity of prompts were common areas of reflection for participants. Many felt that being prompted to compliment their group members everyday was too often, particularly for a small group, and that at times their compliments felt forced. One participant commented that "I said a lot of the same things because the prompts were similar." In addition, participants suggested that to keep up this frequency they would benefit from more inspiration, such as a wider variety of prompts, or prompts based on the recipient's Facebook activity that day. This suggests that there are several levers to pull in future iterations - the frequency of messages, size of group, and amount of input given to a user to guide their message.

Psychological Wellbeing and Rosenberg Self Esteem

Participants in the experimental condition had larger average increases in both scores psychological wellbeing and self-esteem. The experimental groups showed an average increase in psychological wellbeing of 1.73 scale points (std = 6.08), as compared to 0.50 (std = 5.94) scale points in the control group and an increase in self-esteem of 0.64 scale points (std = 4.80), as compared to 0.083 scale points (std = 3.88) in the control group.

The calculated p values were 0.14 and 0.15 for a one-tail Fisher's exact test (suitable for small samples) assessing if the experimental group was more likely than the control to have an improvement in psychological wellbeing and in self-esteem, respectively. This indicates that the results are not statistically significant, but that there is relatively high (85-86%) confidence that the chatbot improved psychological wellbeing and self-esteem. Additional studies with more

participants are needed to further assess the significance and effects on wellbeing of using the Sunny chatbot.

Conclusion

The study's results suggest that a chatbot like Sunny enhances social connections by facilitating positive messages sent within existing social groups, improving psychological wellbeing and self-esteem. Feedback from exit interviews demonstrated that participants enjoyed interacting with the chatbot and that it offered positive messages 'on-demand', which prompted reflection on friendships and provided users with an avenue to say meaningful things that may feel awkward to share in day-to-day life. Generally, participants interacted with Sunny more than was required for the study, which indicates that the platform was persuasive and engaging. Most messages shared on the platform highlighted the receiver's internal qualities or expressed gratitude.

Future Work

Major directions for future work include: personalization and interactivity, studying group composition, and testing the chatbot with a larger population. Sunny's prompts and messages could be personalized based on information gathered from users' schedules, emotional states, or previous messaging history. Sunny could also offer users metrics about their engagement with the chatbot, such as number of messages waiting to be received, to encourage more frequent or sustained use. Future studies could investigate the use of participant-selected group sizes on group dynamics, quality of messages, and perception of the chatbot. The presented study did not have a large enough sample size to generate statistically significant results. A larger-scale study is required to analyze the impact of the Sunny platform on users' self-esteem and wellbeing according to quantitative clinical screening tools.

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