THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

COLLEGE OF INFORMATION SCIENCES AND TECHNOLOGY

INCORPORATION OF TEXTING BOTS INTO SOCIAL-INFLUENCE BASED FITNESS INTERVENTIONS

REBECCA MARJOLEIN JONAS
SPRING 2018

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Information Sciences and Technology
with honors in Information Sciences and Technology

Reviewed and approved* by the following:

Benjamin V. Hanrahan
Assistant Professor of Information Sciences and Technology
Thesis Supervisor

Edward J. Glantz
Associate Teaching Professor of Information Sciences and Technology
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

ABSTRACT

Obesity and overweight are significant health and mortality problems in America. Social support has been established as a helpful tool in causing people to be more physically active but is not always available to people who could benefit from it. Technology has been used to connect people to social support groups through online health communities and texting-based interventions but there are still limitations in any type of human-to-human social support, particularly for people who are focused on weight maintenance instead of weight loss.

In this study, I have evaluated four types of social support when provided by a texting bot instead of a person. Participants had texting conversations, based on prompts and background information, with four Wizard-of-Oz bots that I controlled and that each portrayed one type of social support. After each interaction, participants completed a survey about their perceived reasons and excuses for being inactive. After all four interactions, participants completed a survey about their current fitness habits and participated in a semi-structured interview about their experience in the study.

When all participants were evaluated as a group, there were no significant findings. When participants were separated into active or inactive participants, there were significant trends in the data. I found that participants who were physically active preferred to receive emotional support, while participants who were not physically active preferred to receive instrumental support. After interacting with the appraisal bot, physically active participants were seemingly more thoughtful in self-evaluation of their fitness, particularly reasons why they are inactive, than after interacting with the other bots ($p < .001$).

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to thank the following people for their time, support, and expertise, without which I could not have completed this thesis:

- Dr. Benjamin V. Hanrahan, my thesis supervisor, for his knowledge and reassurance through every step of this thesis
- Dr. Edward J. Glantz, my honors advisor, for his consistent encouragement and guidance
- Dr. Eun Kyoung Choe for guiding me into the field of mHealth
- My parents, Bruce and Astrid Jonas, and my sisters, Jessica and Elisabeth, for their advice, support and motivation throughout the years
- Robert Finn, for supporting and believing in me

Chapter 1

Introduction

Health, Weight, and Physical Activity in the US

Maintaining healthy weight and physical activity has been a growing problem across the US population for decades (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016). In 2008, 36.2% of adults engaged in no leisure-time physical activity at all and 81.8% of adults did not meet the current federal guidelines for aerobic physical activity and muscle-strengthening activity (Healthy People 2020). Additionally, an alarming statistic from the National Center for Health Statistics (2016) showed that over 70% of US adults are overweight or obese. With overweight and obesity negatively contributing to a large number of health factors, measures should be taken to reduce the rates in the US.

Social Support

Social support has been established as an effective means of increasing physical activity. Since the introduction of online forums, digital tools have been created to provide social health support (Heaney & Israel, 2008). With the current ubiquity of mobile phones, texting has also been leveraged as a vehicle for remote social support and intervention communication. Results so far have shown that texting is an effective delivery method for social support and that recipients of social support via texting increase physical activity and weight loss. (Donaldson, Fallows, &

Morris, 2014; Fukuoka, Vittinghoff, Jong, & Haskell, 2010; Patrick et al., 2009). In any form of peer-to-peer social support, however, limitations are present. In one study, researchers found that in an online health community, users had difficulty continuing to receive social support once they had achieved their weight goal and were in a maintenance phase (Wang, Shih, & Carroll, 2015). To my knowledge, texting bots have yet to be evaluated for effectiveness as a delivery system for social support.

Motivation

Prior mHealth research supports that texting is an effective vehicle for social support (Donaldson, Fallows, & Morris, 2014; Fanning, Mullen, & McAuley, 2012; Patrick et al., 2009;). However, I have found that it has yet to be studied how the receiver's perception of the sender (human or bot) impacts the effectiveness of the support. Texting is an extremely common means of communication in contemporary society (Statistic Brain, 2017). Texting is not only used for interpersonal relationships, but has been leveraged as a means of mass communication from companies through the use of automated texting and texting bots (De Kerckhove, 2002). This usage of texting and texting bots extends throughout multiple industries and has recently become an area of interest in the health industry as a means of enhancing doctor/patient relationships and making health professionals more accessible to patients (Papa & Lefton, 2015). Prior studies have leveraged texting, particularly texting via a bot, to instigate health intervention tools (Donaldson, Fallows, & Morris, 2014; Fanning, Mullen, & McAuley, 2012; Patrick et al., 2009;). In one study, for example, participants received daily food challenges which caused them to eat more healthily, be more mindful of their eating habits and nutrition, and help them to develop a

positive relationship with food by making mindful eating a fun experience (Epstein, Cordeiro, Fogarty, Hsieh, & Munson, 2016).

Much of the prior research involving texting as a means of providing and receiving social support used the medium to connect people with other people, either their peers or health experts, in order to receive social support (Fanning, Mullen, & McAuley, 2012). Due to the limitations of human-to-human social support (see p. 7 “Limitations to Peer-to-Peer Social Support) and the ubiquity of cell phones and texting, it may be appropriate to evaluate the potential of a non-human support provider via text messaging.

Research Questions

My research seeks to explore which of the four categories of social support, defined by Heaney and Israel (2008) as emotional, appraisal, informational, instrumental, if any, has the strongest impact on the recipient of the support when a non-human agent delivers the support. Answering this early question about non-human to human support exchanges will open the door for future studies to continue evaluation of these types of support relationships by laying the groundwork for the types of support that are most influential when communicated in this way. With this goal in mind, the research questions for my study are as follows:

RQ1: Which bots do participants enjoy interacting with the most?

RQ2: Which bots are most effective in inducing self-reflection about physical activity and health?

Existing research has documented the effects of different categories of social support on recipients (Heaney & Israel, 2008; Kirman, Linehan, Lawson, Foster, & Doughty, 2010.) This study seeks to explore how these effects differ when the provider of support is a non-human agent. For example, do people generally prefer one type of support over another when it is instigated by a bot? Are people more likely to self-reflect on their fitness and physical activity when provided one type of social support? Does this self-reflection induce a desire to be more active?

One hypothesis is that instrumental and informational support may elicit similar reactions from participants due to their similarities when utilized via a texting bot. The same is believed for emotional and appraisal support. Another hypothesis is that emotional support, the more affectual form of support, may be the least well received by participants due to the potential discomfort of receiving emotional responses from an inanimate support partner. Bots can commonly be perceived as intelligent, but unemotional, so participants may feel more comfortable interacting with the informative bots (instrumental, informational) than the emotional bots (emotional, appraisal).

Chapter 2

Literature Review

Self-Monitoring

Self-monitoring is the act of observing and keeping track of one's own personal weight, physical activity, and/or nutrition through methods such as weighing, food logging, and step counting, among others. Self-monitoring is not only an effective means of weight loss but also of weight maintenance (Elfhag & Rossner, 2005; Wing & Hill, 2001). In 1999, researchers (McGuire, Wing, Klem, Land, & Hill) tracked the continued weight maintenance of participants who had already successfully lost at least 30 pounds and had maintained their weight loss for at least one year. After one year in the study, one finding was that participants who regained weight were more likely to have fallen out of self-monitoring habits while participants who continued to maintain their weight loss were more likely to have continued self-monitoring. This study is one of many that have found that self-monitoring has resulted in greater weight-loss or more successful weight maintenance (Guare, Wing, & Grant, 1995; Baker & Kirschenbaum, 1993).

Social Support

It has been widely accepted that social relationships have a positive influence on health. Social support is defined as "the functional content of relationships that can be categorized into four broad types of supportive behaviors or acts" (Heaney & Israel, 2008, p. 190). Those four

categories are as follows: emotional support, instrumental support, informational support, and appraisal support. These types of support are characterized by the attributes in the Table 1.

Emotional support	Provision of empathy, love, trust, and caring
Instrumental support	Provision of tangible aid and services that directly assist a person in need
Informational support	Provision of advice, suggestions, and information that a person can use to address problems
Appraisal support	Provision of information that is useful for *self-evaluation* purposes—in other words, constructive feedback and affirmation.

Table 1 - Types of Social Support (adapted from Heaney & Israel, 2008, pp. 190-191)

According to Heaney and Israel (2008), one characteristic of social support that makes it beneficial to the health of the recipient is that it is inherently good intentioned. They also note that if social support becomes purposefully negative with the intention of impeding the recipients' progress towards their goals, it is characterized instead as *social undermining*. Social support and its effect on health has been studied extensively in regard to general health by looking at the link between active social networks and mortality rates or in regard to medical results (such as disease management) due to social networks (Rutledge et al., 2004). Positive effects of social support have been studied and shown to extend to individuals attempting to improve their health by increasing their physical activity and/or nutrition. Much of the existing research relating to social support and weight primarily focuses on quantitative measures (Maitland & Chalmers, 2011).

Technological Approaches to Social Support

Technology has been harnessed in many studies as a means of weight-management social support (Pellegrini et al., 2012; Kirman, Linehan, Lawson, Foster, & Doughty, 2010; Poole, 2013). Most of these studies use technology facilitate a connection between the individual and their existing social network (Fanning, Mullen, & McAuley, 2012). These studies have shown that social accountability is an effective influencer on weight management (Consolvo, Everitt, Smith, & Landay, 2006; Vandelanotte et al., 2016; Eisenhauer et al., 2017). Relatively few studies have utilized technology itself as the provider of social support.

One method in which technology is used to influence an increase in physical activity is the use of pedometers, digital food diaries, and other self-monitoring applications. Many studies have suggested that these types of services are an effective means of encouraging higher physical activity levels and weight loss in participants (Donaldson et al., 2014; Elfhag & Rossner, 2005; Fukuoka et al. 2010). The effects of these technologies could be seen as a form of appraisal support due to their encouragement of self-reflection but, arguably, do not qualify because of their lack of external social influence encouraging the self-reflection. When these applications include options for social activity, such as sharing progress and results with a social network, they are additionally effective in inducing higher physical activity and weight loss (Consolvo et al., 2006).

Limitations with Peer-to-Peer Social Support

Somewhat conflictingly, weight loss and weight management have been designated as intensely private while also being inherently social (Newman, Lauterbach, Munson, Resnick, & Morris,

2011; Wang, Shih, & Carroll, 2015). One study by Newman et al. (2011) delved into the variety of purposes for which Facebook is used, and not used, as a means of reaching a community for fitness social support. Participants in this study remarked on their desire to reflect a positive self-image to their Facebook networks. This desire caused some participants to shy away from requesting help and motivation, even though receiving emotional support was the most common goal from participants. This was because they were afraid of receiving negative judgment from their peers and tarnishing the positive image they constructed online. Participants also noted their preference for using online health communities (websites and forums geared specifically towards individuals with goals of improving fitness/health) because the people in those communities could relate to each other and shared common goals and struggles.

A study by Wang et al. (2015) suggested that online health communities have limitations in their ability to provide good social support networks. In that study, people using the LiveStrong online health community noted the sharp decline in received social support when their goals shifted from weight loss to weight maintenance. Users in the weight maintenance phase still desired social support but other members of the community were much less willing to provide support to them. A technology-based support agent could offer support on command and eliminate emotion-based limitations to social support relationships.

Accountability in Health Based Social Support

Accountability, a factor in appraisal support, has been cited as a key factor in supporting weight loss and increased fitness (Epstein et al., 2016; Newman et al., 2011). Newman et al. (2011) found that some reasons participants stated for choosing certain people and relationships over

others to support them in accountability have been availability, consistency, and privacy. A technology-based support agent, such as the ones modeled in my study, operate on a schedule and solely focus on the recipient of support, easily implementing the factors described. It is important to note that there are limitations with technology-based accountability agents. For example, some participants in the study by Newman et al. (2011) valued a personal connection with their accountability partner and felt that even an online connection with another person would not be enough for them to engage successfully in accountability support.

Texting Interventions and Characteristics of Effective Text Messages

Text messaging as a form of intervention, self-monitoring, and social support has been explored more in recent years (Buchholz, Wilbur, Ingram & Fogg, 2013). Eisenhauer et al. (2017) evaluated a variety of mHealth technology usage with rural men. One finding was that SMS messaging was one of the most effective measures in reminding the participants of their goals. They also found that the participants appreciated humor in the messages and messages that they found relatable. Patrick et al. (2009) conducted a text-message based intervention in which they sent daily text messages (from a bank of 3000 potential SMS and MMS messages), roughly half of which requested a reply from participants. Participants in the intervention lost more weight on average than those in the control group and 92% of participants stated they would recommend the intervention to friends and family. These studies support the idea that text-messaging based interventions are not only effective but are also enjoyable for participants. Because perception of support and intrinsic motivation have been found as key factors to weight-loss and maintenance (Fukuoka et al., 2010; Verheijden, Bakx, van Weel, Koelen, & van Staveren, 2005), an enjoyable

method of intervention is likely to be most effective in producing results (Eisenhauer et al., 2017).

Human Involvement vs. Purely Technological Approach

Relatively few studies have evaluated differences in results of fitness interventions with varying levels of human involvement vs. a purely technological approach. Ross & Wing (2016) conducted a study in which participants were put into groups with varied intervention tools. This study suggests that, while utilizing technology is more effective than self-monitoring alone, added human contact can roughly double weight loss results versus an exclusively technology-based intervention. All participants attended the pre-intervention information session, which means a level of human involvement was included in all groups.

Khaylis, Yiaslas, Bergstrom, & Gore-Felton (2010) reviewed 21 studies to identify five key components in successful technology-based weight-loss interventions. These components were identified as "(1) self monitoring; (2) counselor feedback and communication; (3) social support; (4) structured program; and (5) individually tailored program" (p. 932). Self-monitoring, structured program, and individually tailored program are all intervention features that do not require human involvement. This review found that the addition of human involvement in the form of counselor feedback and communication and social support added effectiveness. Some of their findings also suggest that, as long as technology can mimic or duplicate the support, it can still be effective. They note that, regarding counselor feedback and communication, "fully automated feedback via SMS text messaging was also effective in increasing physical activity and decreasing percentage of body fat" (Khaylis et al., 2010, p. 935). None of the studies they

evaluated tested a non-human approach to social support but they do note that online social support chat rooms were just as effective as in-person social support meetings. A study with the goal of evaluating the effectiveness of varying levels of human involvement could be useful for informing future research on technology-based fitness interventions because results could indicate more precisely how the effectiveness of social support changes with, or without, human interaction.

Chapter 3

Method

Participants and Recruitment

Participants were recruited from the State College downtown area and Penn State University Park campus. I posted flyers in libraries and other academic and community buildings which briefly described participant criteria (over 18 years of age), study procedures (interaction with texting bots regarding physical activity), and informed participants of the $10 incentive payment for their participation. Eleven participants were recruited. This sample size allowed me to reach saturation of qualitative data from participants in the semi-structured interview portion of the study.

Study Design

The study design consists of participants completing surveys after interacting with four Wizard-of-Oz texting bots that demonstrate the four forms of social support. The purpose of these surveys is to gain quantitative data about participants' perception of their physical activity and how their interaction with the different bots affects that perception. Gaining this data helps to answer my research question on how different types of social support cause people to self-reflect when administered by bots. Upon interacting with all four bots, I ask participants a series of questions in a semi-structured interview regarding their opinions about the bots and their

interactions with them. The interview contributes towards answering my research question on which types of social support people like, or dislike, receiving from bots.

Participants interact with each of the four texting bots, with the order of interaction being different for each participant, and take the CDC's Barriers to Being Active quiz (Appendix A) after each interaction. Fukuoka et al. (2010) used the Barriers to Being Active quiz in a study on the efficacy of mobile phone intervention in increasing physical activity. After all four interactions have been completed (along with the additional completions of the survey), participants complete the short-form International Physical Activity Questionnaire (Appendix B) to gain more definitive data on participants' physical activity. I then conduct a semi-structured interview (Appendix C) with participants regarding their broader thoughts about their interaction with the bots during the study.

Wizard-of-Oz Bots

A Wizard-of-Oz bot is not actually a bot but is a person texting under the façade of being a bot (Schlögl, Doherty, Karamanis, & Luz, 2010). For this study, I used Google Voice to text participants from my computer to their phone. Participants in this study were not aware that they were not actually communicating with a bot but, actually, were communicating with me. Before each of the participants' four interactions with the bots, the participants were given a scenario to use to inform their interaction. The texting interactions were based on that scenario and, therefore, actually followed scripts (Appendix D). Participants visualized themselves in the position of the person in the scenario and tended to follow the script. I copied and pasted the bot's side of the script into the texting conversation in response to participants. If a participant

went off script to a degree that the following bot response is incoherent, I instead copied and pasted an error message into the conversation. At this point, the participant would alert me to the issue and I helped them to enter the correct response to continue the conversation. I also informed participants that the conversation was over when the bot sends a message containing the word "goodbye." When participants received that message, they knew to let me know so they could move on to the survey.

Limitations

There is overlap between the characteristics and defining qualities of social support and, therefore, it is difficult to study each type as a completely separate entity from any or all of the others (Heaney & Israel, 2008). Testing a larger group of participants as well as people from a more diverse range of areas and backgrounds may yield results beyond those in this study. For this study, I did not take demographic information from participants which may be a confounding factor to my results.

Chapter 4

Results

Survey Results

The Barriers to Being Active quiz scoring sorts responses into seven categories which reflect specific reasons for potential inactivity. These categories are as follows: lack of time, social influence, lack of energy, lack of willpower, fear of injury, lack of skill, and lack of resources. This quiz allows for the evaluation of participants' self-reflection and perception of their fitness between interactions with bots. Because the quiz evaluates these factors, it is helpful in answering my second research question on which types of social support encourage participants to be more self-reflective regarding their fitness.

I conducted a repeated measures ANOVA to compare the effect of the different types of social support on participants' test scores for the seven factors in the Barriers to Being Active quiz after the appraisal, emotional, informational, and instrumental bot interactions. The results of the repeated measures ANOVA for each factor are shown in Table 2.

All participants			
Factor	SS	F	p-value
Factor 1: Lack of time	1.18	0.53	0.67
Factor 2: Social influence	0.27	0.14	0.93
Factor 3: Lack of energy	0.80	0.26	0.86
Factor 4: Lack of willpower	1.18	0.34	0.80
Factor 5: Fear of injury	0.55	0.39	0.76
Factor 6: Lack of skill	0.07	0.04	0.99

Factor 7: Lack of resources	1	0.91	0.45

Table 2 - Repeated Measures ANOVA for all participants (*df* of 3)

These results proved inconclusive, in part, because participants had too much variance to find meaningful results when all were evaluated in one pool. I sorted participants into categories of "active" or "inactive" based on information recorded on the short form International Physical Activity Questionnaire. Participants with similar levels of physical activity were likely to have less variance from participant to participant and, thus, reduce the noise outside of the treatment comparison. If participants reported that they did at least two days of moderate or vigorous exercise in the last week, they were marked as active. Otherwise, they were marked inactive. One participant said in the interview that he is not regularly active and has not exercised recently but his survey results fell into the active category. Because of this discrepancy, when I conducted the repeated measures ANOVA, again for each of the seven factors, across each group separately, I ran them once with him in the active group and once in the inactive group. Table 3 shows results for the first active/inactive grouping.

Active participants – 1st grouping (7 participants)			
Factor	SS	F	p-value
Factor 1: Lack of time	4.68	3.28	0.05*
Factor 2: Social influence	0.68	0.73	0.55
Factor 3: Lack of energy	2.57	0.76	0.53
Factor 4: Lack of willpower	4.68	1.30	0.30
Factor 5: Fear of injury	0.11	1	0.42
Factor 6: Lack of skill	1.29	3.48	0.04*
Factor 7: Lack of resources	2.43	2.4	0.10
Inactive participants – 1st grouping (4 participants)			

Factor	SS	F	p-value
Factor 1: Lack of time	6.69	5.63	0.02*
Factor 2: Social influence	3.19	0.95	0.46
Factor 3: Lack of energy	0.69	0.26	0.86
Factor 4: Lack of willpower	3.19	1.46	0.29
Factor 5: Fear of injury	1.69	0.42	0.74
Factor 6: Lack of skill	2.69	0.73	0.56
Factor 7: Lack of resources	1.5	2.25	0.15

Table 3 - Repeated Measures ANOVA for 1st grouping of active and inactive participants (*df* of 3)

The first set of repeated measures ANOVAs comparing active and inactive participants' responses to the seven factors had seven active participants and four inactive participants. Active participants evaluated against factor 1 (lack of time) were most likely to state lack of time as a reason for inactivity after the appraisal bot and least likely to after the informational bot ($p < .05$) as shown in Table 4. In the participant summaries, each type of social support is assigned a letter as follows: A = appraisal, B = emotional, C = informational, D = instrumental. Each factor is abbreviated as F and then the number of the factor. So AF1 is appraisal, factor 1, BF1 is emotional, factor 1, etc

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
AF1	7	30	4.29	5.24
BF1	7	24	3.43	4.95
CF1	7	23	3.29	5.24
DF1	7	28	4	6.67

Table 4 - Factor 1 participant summary for 1st grouping of active participants

Active participants were most likely to state factor 6 (lack of skill) as a reason for inactivity after the informational bot ($p < .04$) as shown in Table 5.

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
AF6	7	1	0.14	0.14
BF6	7	1	0.14	0.14
CF6	7	4	0.57	0.62
DF6	7	0	0	0

Table 5 - Factor 6 participant summary for 1st grouping of active participants

When evaluating inactive participants against factor 1 (lack of time), participants were least likely to use lack of time as a reason for inactivity after the appraisal bot ($p < .02$) as shown in Table 6.

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
AF1	4	11	2.75	7.583333
BF1	4	18	4.5	3.666667
CF1	4	16	4	6
DF1	4	16	4	6.666667

Table 6 - Factor 1 participant summary for 1st grouping of inactive participants

The second set of repeated measures ANOVAs dividing active and inactive participants and evaluating the seven factors had six active participants and five inactive. Table 7 shows results for the second active/inactive grouping.

Active participants – 2nd grouping (6 participants)			
Factor	SS	F	p-value
Factor 1: Lack of time	3	10	.0007***
Factor 2: Social influence	0.33	0.32	0.81
Factor 3: Lack of energy	2.17	0.61	0.62
Factor 4: Lack of willpower	3.46	1.03	0.41

Factor 5: Fear of injury	0.13	1	0.42
Factor 6: Lack of skill	1.5	3.75	0.03*
Factor 7: Lack of resources	2.83	2.5	0.10
Inactive participants – 2nd grouping (5 participants)			
Factor	SS	F	p-value
Factor 1: Lack of time	3.8	1	0.43
Factor 2: Social influence	1.8	0.60	0.63
Factor 3: Lack of energy	0.95	0.35	0.79
Factor 4: Lack of willpower	2.95	0.92	0.46
Factor 5: Fear of injury	1.35	0.44	0.73
Factor 6: Lack of skill	2.15	0.74	0.55
Factor 7: Lack of resources	1.2	2.09	0.15

Table 7 - Repeated Measures ANOVA for 2nd grouping of active and inactive participants (*df* of 3)

For active participants and factor 1 (lack of time) statistical significance rose ($p < .001$), indicating more strongly that active participants were most likely to state lack of time as an excuse after the appraisal bot and least likely after the informational bot as shown in Table 8.

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
AF1	6	24	4	5.6
BF1	6	21	3.5	5.9
CF1	6	18	3	5.6
DF1	6	21	3.5	5.9

Table 8 - Factor 1 participant summary for 2nd grouping of active participants

Significance also rose for active participants and factor 6 (lack of skill) ($p < .04$), supporting that participants were most likely to use lack of skill as an excuse after the informational bot and least likely after the instrumental bot as shown in Table 9.

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
AF6	6	1	0.166667	0.166667
BF6	6	1	0.166667	0.166667
CF6	6	4	0.666667	0.666667
DF6	6	0	0	0

Table 9 - Factor 6 participant summary for 2nd grouping of active participants

For the participant summaries for all factors and participant groupings, see Appendix E.

Interview Results

Favorite and Least Favorite Bots

In the interview portion of the study, two questions were, “Which bot was your favorite to interact with?” and “Which bot was your least favorite to interact with?” Participants could state multiple bots as being their favorite or least favorite. Another question was asked about which bots, if any, they would use outside of the study in their day-to-day lives. I included those bots as their favorite ones, even if they did not explicitly say so. By wanting to use a bot outside of the study, participants indicated that they found a special usefulness in it that equates (for these purposes) to it being one of their favorites to interact with. This information contributes to answering my first research question regarding which types of social support bots participants enjoyed interacting with. Table 10 and Figure 1 show how many participants selected each bot as their favorite or least favorite.

	Favorite	Least Favorite
Appraisal	2	8
Emotional	6	1

Informational	2	2
Instrumental	6	2

Table 10 - Participants' Favorite and Least Favorite Bot Interactions

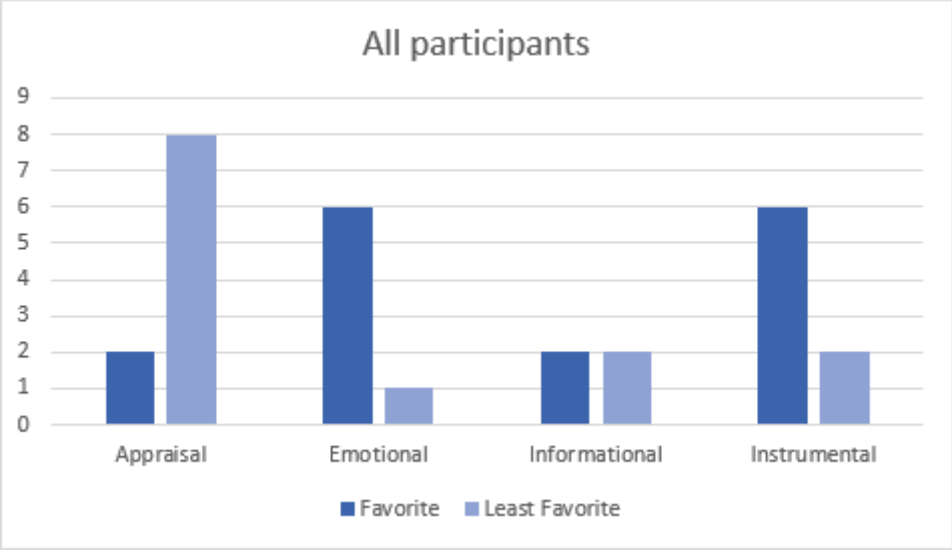

Figure 1 - Participants' Favorite and Least Favorite Bot Interactions

These results show that participants generally liked the appraisal bot interaction the least, with eight participants stating it as their least favorite. One participant said "(The appraisal) bot didn't try to understand my limitations." Another said "I already knew what my schedule was…I'm not a morning person, if you tell me to exercise like that, I won't do it." Another reason a participant gave for disliking the appraisal bot was that it gave "too basic of a response."

Participants liked the emotional and instrumental interactions the most, with six participants each listing either (or both) as their favorite. Splitting up these results by active and inactive participants provides additional insight into participants' propensity for the emotional and instrumental bots, however, the appraisal bot consistently ranked lowest and participants stated it as their least favorite most commonly across all groupings. As shown in Tables 11 & 12 and Figures 2 & 3, in both active participant groupings, more participants favored the emotional bot

to the instrumental bot, making the emotional bot the highest-ranking bot among active participants

	Favorite	Least Favorite
Appraisal	1	6
Emotional	5	1
Informational	2	1
Instrumental	3	1

Table 11 - Active Participants (1st Grouping: 7 Active)

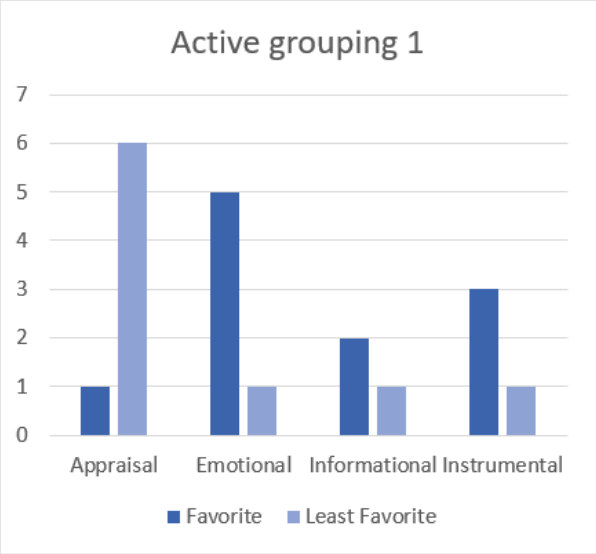

Figure 2 - Active Participants (1st Grouping: 7 Active)

	Favorite	Least Favorite
Appraisal	1	5
Emotional	4	1
Informational	1	1
Instrumental	3	0

Table 12 - Active Participants (2nd Grouping: 6 Active)

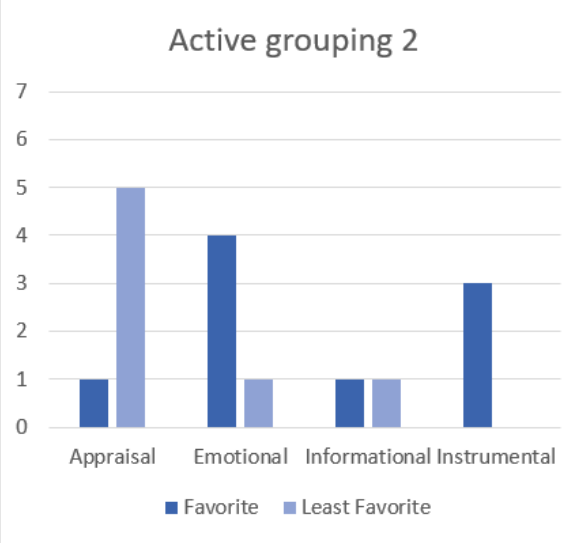

Figure 3 - Active Participants (2nd Grouping: 6 Active)

One participant who stated the emotional bot was his favorite said that he liked "emotional feedback rather than just numbers." Another participant stated that it was his favorite because it was "pretty positive and very congratulatory" which he liked. Seven participants stated that the emotional bot was motivational or encouraging with one participant saying, "It pepped me up. The emotional one is like 'yeah, good job!' and I was like okay, that's cool whether it's a computer or not."

	Favorite	Least Favorite
Appraisal	1	2
Emotional	1	0
Informational	0	1
Instrumental	3	1

Table 13 - Inactive Participants (1st Grouping: 4 Inactive)

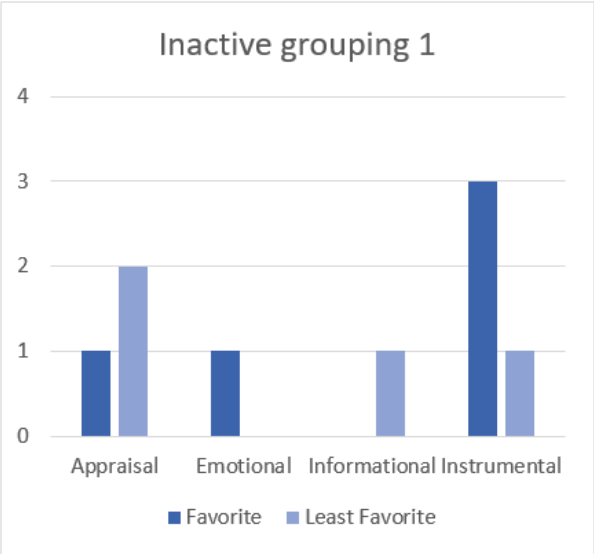

Figure 4 - Inactive Participants (1st Grouping: 4 Inactive)

	Favorite	Least Favorite
Appraisal	1	3
Emotional	2	0
Informational	1	1
Instrumental	3	2

Table 14 - Inactive Participants (2nd Grouping: 5 Inactive)

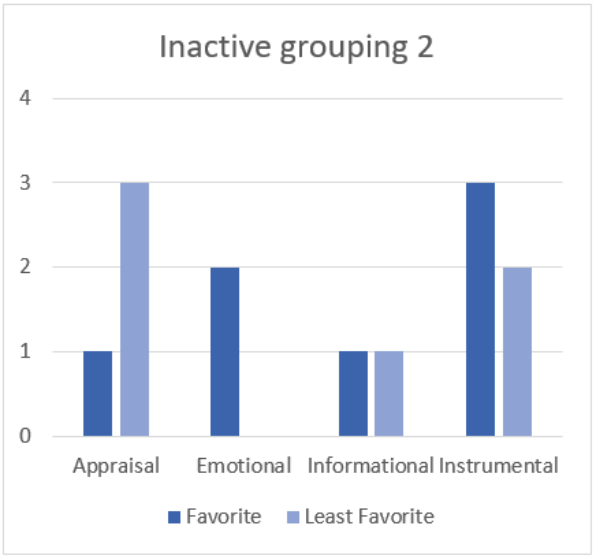

Figure 5 - Inactive Participants (2nd Grouping: 5 Inactive)

In contrast to the active group, within both inactive groupings more participants favored the instrumental bot than the emotional bot, making the instrumental bot overall the highest-ranking by inactive participants. One participant said “something more informative is more helpful” and mentioned that her interaction with the instrumental bot made her reevaluate the effectiveness of her current workout routine. Other participants stated that the instrumental bot was “helpful” and “fun.” Four participants said that they would use the instrumental bot beyond the study but would prefer it to have options to alter the workout given based on user feedback.

Common Themes

Throughout the post-study interviews with participants, some common themes came up in participant comments regarding the things they liked and disliked about their interactions with the bots. I have categorized the most commonly occurring themes into five categories:

1. Bot content was encouraging
2. Informative content from a bot was credible and/or valuable
3. Liked bots better with relatable background scenarios
4. Bot did not understand a person’s limitations and/or gave advice a person would already think of
5. Preference of texting with structured vs. free form responses

Some of these themes conflict, for example, the value of encouraging bot content versus informative content, but were brought up commonly enough (sometimes both by one participant) that it is important to note the frequency of both.

7 of 11 participants made positive comments about the bot being encouraging. 6 of 7 of the participants who commented were referring specifically to the emotional bot when making these comments. 6 of 11 participants made positive comments about the bots being informative. 2 of these participants mentioned in their comments that information regarding fitness from a bot was better than from a human because a bot lacks emotional factors. 1 participant talked about preferring informative bot content to emotional bot content, stating that emotional encouragement was not meaningful coming from a bot. 3 of these participants (and 1 additional participant) also made negative comments about certain information-based bot content being unhelpful and/or not credible. 3 out of 4 of these participants' negative comments were directly referring to the appraisal bot.

4 of 11 participants said that their ability to relate to the person in the background scenario of a certain bot conversation positively influenced their feelings toward that bot and interaction. 8 of 11 participants made comments about how they would prefer to interact with the bot, indicating their preference for either free-form responses or structured responses. Because the bot was a Wizard-of-Oz bot, participants could use free-form responses and I could evaluate them and send the bot response if it was fitting. Some parts of the conversations still did use structured responses (e.g. "Enter Y for yes or N for no") so participants had experience in the study communicating in both ways. 6 of 8 participants who made comments would have preferred the

texting to be more free form than it was and the other 2 preferred texting with structured responses.

Chapter 5

Discussion

Survey Results

In grouping one of active participants and inactive participants (seven active, four inactive), after the appraisal bot, active participants were most likely to state lack of time as a reason for inactivity while inactive participants were least likely to do so. Lack of time is a factor for the person in the appraisal background scenario so it is not entirely surprising that this factor would correlate to this conversation. However, it is not clear what would cause active and inactive participants to have opposite responses to it. It is also possible that the significance found between inactive participants and lack of time was inaccurate, as it did not maintain significance in grouping two of active and inactive participants. Active participants were also least likely to state lack of time as a reason for inactivity after the informational bot.

The other factor that had statistical significance in active participants across both groupings was lack of skill. Active participants were most likely to state lack of skill as a reason for inactivity after the informational bot and least likely after the instrumental bot. A potential reason for this is the knowledge that active participants have in relation to the information the bot was providing. The instrumental bot provided a workout routine, which may have been unhelpful to active participants because they already are active, and, therefore, know what to do during a workout. The informational bot stated information about body mass index (BMI) and calorie intake, which active participants may not necessarily have known about already. This may have caused active participants to reevaluate what they knew, and did not know, to differently perceive and report their ability to be healthy and active.

Despite showing the most significance in the surveys, the appraisal and informational bots were the lowest rated by active participants in the interview portion of the study. It is possible that the reason those two bots were so poorly rated is because they made participants reevaluate themselves and put participants out of their comfort zone.

Based on the results found, the answer to my first research question is that, depending on their fitness level, participants like receiving emotional and instrumental support most when it comes from a bot. The answer to my second research question is that participants seem to be most likely to engage in self-reflection after receiving appraisal and informational support from a bot. If developing a texting bot for social support geared towards already active individuals, I would recommend incorporating emotional support, active participants' favorite, alongside appraisal and informational support. This way, the appraisal and informational support will motivate participants by causing them to think more critically about their fitness while the emotional support may encourage participants and make them more receptive to self-evaluation.

Interview Results

Social Support Preferences

One of the strongest results I found was the correlation between active participants and the emotional bot and inactive participants and the instrumental bot. When viewing the results for all participants grouped together (Figure 1), the emotional and instrumental bots were equally chosen as the favorite bots. When dividing participants into active and inactive, in both groupings, it became clear that the numbers for the emotional bot came largely from the active

group and the numbers for the instrumental bot came largely from the inactive group. This has strong implications about the support needs for both active and inactive people.

These results suggest that a reason for inactivity in people who do not exercise regularly is a lack of knowledge and guidance about what to do during a workout. Inactive participants reported that they would be likely to use a bot similar to the one in the study that provided a workout routine based on user input such as target muscle area, body composition, and length of workout. Comparatively, people who had a regular exercise schedule did not need guidance on what to do anymore but did still wanted emotional support to stay motivated to maintain their workout habits.

Bot Design Preferences

During the semi-structured interview in the study, participants provided insight on how they would want a bot to function if they were to use one beyond the study. Several participants noted that a bot would not be as helpful and convincing as a person but was better than not having anything or using currently available workout reminder options. One participant noted that the bot would help him with accountability, saying it would work "better than a calendar reminder."

Different participants had conflicting opinions of the value of emotional versus informational support. Seven participants gave positive feedback about the emotional bot. One participant said that he was embarrassed that he liked it because it felt superficial to get positive reinforcement from a bot but noted that it was "peppy…it makes me feel good." Another participant specifically mentioned liking "emotional feedback rather than just numbers." Other participants made more general comments about it being motivating, positive, and encouraging, with one

participant saying it was “super nice.” One participant preferred the information-based bots, specifically noting that she did not like the emotional bot and felt it was insincere, saying, “If I’m trying to get motivation, I’m not going to go to a bot.”

Other participants who preferred information-based bots did not specifically mention disliking the emotional bot but made general comments about the information being helpful and finding it motivational to gain a clearer understanding of what to do to exercise and be in shape. Several participants noted that, when talking about their fitness, they would prefer to use a bot over a person. One person said he would prefer to talk to a bot about fitness because it is “straight and to the point.” Another said that he liked that it is just information without having to worry about “what (the other) person is thinking.”

The most common feedback was regarding the bot conversation being structured or free form. The majority of participants preferred the conversations where they had more options for how they could respond. For example, in some conversations, it was not specified how to respond so some participants responded with full sentences. Participants said that being able to answer with full sentences made the bot feel more natural and realistic. The emotional bot was a more structured conversation but in future studies, it would be beneficial to give it the capability of accepting longer, free form responses from users. If the emotional bot felt more realistic, it may be more human-like and be more effective at motivating participants.

Future Research

Future research could evaluate a larger group of participants. Having less variation in the fitness habits of participants would account for less noise in the data and could lead to results that are

more conclusive. Additionally, taking demographic data and evaluating results based on demographics may also provide insightful results. Another recommendation for future studies would be to allow bots to intake actual user data rather than data from hypothetical people like those in the background scenarios in this study as well as moving on from a Wizard-of-Oz bot to an actual bot. If replicating this study, exploring different evaluative tools and surveys that have more direct questions about participants' self-perception of fitness may provide additional insights. A future study could also divide participant groups into those in communication with a bot and those receiving identical feedback from a person to gauge the impact of support when a bot, as compared to a person, administers it.

Appendix A

Modified Barriers to Being Active Quiz

Barriers to Being Active Quiz
What keeps you from being more active?

Directions: Listed below are reasons that people give to describe why they do not get as much physical activity as they think they should. Please read each statement and indicate how likely you are to say each of the following statements:

How likely are you to say?	**Very likely**	**Somewhat likely**	**Somewhat unlikely**	**Very unlikely**
1. My day is so busy now, I just don't think I can make the time to include physical activity in my regular schedule.	**3**	**2**	**1**	**0**
2. None of my family members or friends like to do anything active, so I don't have a chance to exercise.	**3**	**2**	**1**	**0**
3. I'm just too tired after work to get any exercise.	**3**	**2**	**1**	**0**
4. I've been thinking about getting more exercise, but I just can't seem to get started	**3**	**2**	**1**	**0**
5. Exercise could put me at risk of injury.	**3**	**2**	**1**	**0**
6. I don't get enough exercise because I have never learned the skills for any sport.	**3**	**2**	**1**	**0**
7. I don't have access to jogging trails, swimming pools, bike paths, etc.	**3**	**2**	**1**	**0**
8. Physical activity takes too much time away from other commitments—time, work, family, etc.	**3**	**2**	**1**	**0**
9. I'm embarrassed about how I will look when I exercise with others.	**3**	**2**	**1**	**0**
10. I don't get enough sleep as it is. I just couldn't get up early or stay up late to get some exercise.	**3**	**2**	**1**	**0**

11. It's easier for me to find excuses not to exercise than to go out to do something.	**3**	**2**	**1**	**0**
12. I know of too many people who have hurt themselves by overdoing it with exercise.	**3**	**2**	**1**	**0**
13. I really can't see myself learning a new sport.	**3**	**2**	**1**	**0**
14. It's just too expensive. You have to take a class or join a club or buy the right equipment.	**3**	**2**	**1**	**0**
15. My free times during the day are too short to include exercise.	**3**	**2**	**1**	**0**
16. My usual social activities with family or friends do not include physical activity.	**3**	**2**	**1**	**0**
17. I'm too tired during the week and I need the weekend to catch up on my rest.	**3**	**2**	**1**	**0**
18. I want to get more exercise, but I just can't seem to make myself stick to anything.	**3**	**2**	**1**	**0**
19. I'm afraid I might injure myself or have a heart attack.	**3**	**2**	**1**	**0**
20. I'm not good enough at any physical activity to make it fun.	**3**	**2**	**1**	**0**
21. If we had exercise facilities and showers at work/school, then I would be more likely to exercise.	**3**	**2**	**1**	**0**

Scoring (researcher use only):

____ + ____ + ____ = _____
1 8 15 Lack of time

____ + ____ + ____ = _____
2 9 16 Social influence

____ + ____ + ____ = _____
3 10 17 Lack of energy

____ + ____ + ____ = _____
4 11 18 Lack of willpower

____ + ____ + ____ = _____
5 12 19 Fear of injury

____ + ____ + ____ = _____
6 13 20 Lack of skill

____ + ____ + ____ = _____
7 14 21 Lack of resources

Appendix B

Short-Form International Physical Activity Questionnaire

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

□ No vigorous physical activities ➔ ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ hours per day

_____ minutes per day

□ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

□ No moderate physical activities ➔ ***Skip to question 5***

4. How much time did you usually spend doing moderate physical activities on one of those days?

_____ hours per day

_____ minutes per day

□ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ days per week

□ No walking ➔ ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ hours per day

_____ minutes per day

□ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **weekday**?

_____ hours per day

_____ minutes per day

□ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

Appendix C

Semi-Structured Interview Questions

Interacting with bot

Did you like texting with the bots?

How did texting with the bots feel (i.e. natural or strange)?

Did you feel differently about your interactions with the different bots? How?

Which bot did you like texting with the most?

Which bot did you dislike texting with the most?

How did texting with the bots compare to texting with a person?

How did texting with the bots compare to other bots you may have texted with (e.g. store promotion bots, doctor's office reminder bots)?

How did texting with the bots make you think or feel about your current fitness?

Would you use the bots beyond this study? Which one(s)? Why?

Surveys

How did completing the surveys make you think or feel about your current fitness?

Personal fitness

How did you feel about your level of fitness prior to this study?

How do you feel about your level of fitness now that you have completed the study?

If there has been a change, what do you think influenced that change in your perception of your fitness?

Appendix D

Bot Scenarios and Scripts

Appraisal

Background:
You recently graduated from Penn State and have moved for work. You often feel too tired to exercise after work and you haven't exercised at all since moving. In college, you exercised 4 times a week and would like to get back to that frequency. You often find yourself saying that you will exercise tomorrow but, so far, have never followed through.

Texting script:
Bot: Hello! Let's start by talking about your fitness goals. Do you have an idea of how often you would like to exercise? Please answer Y for yes or N for no

Participant: Y

Bot: Okay. How many days per week would you like to exercise?

Participant: 4

Bot: How many days per week do you currently exercise?

Participant: 0

Bot: Okay. Now let's talk about your fitness today. Have you exercised today? Please answer Y for yes or N for no

Participant: N

Bot: Why not? A: I did not have time B: I felt tired C: I am sick D: Another reason E: I plan on exercising later. Please answer A, B, C, D, or E.

Participant: B

Bot: Did you plan to exercise early or late in the day? Please enter A for early or B for late

Participant: B

Bot: Try exercising earlier. Later, you may be too tired after a long day. Morning exercising may work better for your schedule. Keep in mind that exercising in the morning requires a good night's sleep. I will check in tomorrow. Thank you! Goodbye.

Emotional

Background:
You want to lose 50 pounds to get into a healthy weight range but have difficulty finding the motivation. To lose the weight, you want to start by exercising 2 days a week. This week was your first time trying your new workout plan and you only exercised once (running on the treadmill for 30 minutes and then doing 30 minutes of weight training). The workout you completed was the most physically active you have been in years and you are proud of yourself for exceeding your own expectations.

Texting script:
Bot: Hello! How many days did you exercise this week?

Participant: 1

Bot: Okay, how many days did you exercise last week?

Participant: 0

Bot: Great job! Congratulations on increasing your number of workouts! How long did you exercise for during your workout(s)?

Participant: 1 hour

Bot: Excellent! You should be proud of yourself. How many days would you like to exercise next week?

Participant: 2

Bot: Great! Keep up the good work. I will check in next week to see how you did. Thank you! Goodbye.

Informational

Background:
You are looking to improve your fitness but have never been very conscious of your physical activity. You are a 25 year old 5'4 woman and weigh 170 lbs. You don't currently exercise but are interested in losing weight and want to learn more about how to do so.

Texting script:
Bot: Hello! Let's start by assessing your current weight. What is your weight in pounds?

Participant: 170

Bot: Okay. What is your height?

Participant: 64 in.

Bot: Your Body Mass Index is 29.2 which is in the overweight range. Now we will assess your goals. Are you looking to A: lose weight, B: gain weight, or C: maintain your current weight? Please answer A, B, or C.

Participant: A

Bot: Okay. To lose weight, it is important to consume fewer calories than you burn every day. How old are you?

Participant: 25

Bot: Based on your height, weight, and age, you burn around 1500 calories per day not including calories burned from exercise. How many days per week do you currently exercise?

Participant: 0

Bot: Okay. If you are just starting out exercising, you should start slow and give yourself rest and recovery days to prevent injury. Start out by exercising 1 or 2 days a week and eating 1500 calories per day. Thank you! Goodbye.

Instrumental

Background:
You like weight lifting at your local gym but can't afford a personal trainer. You want to know what exercises to perform to target specific muscle areas. Particularly, you have difficulty deciding what to do for leg day. At the gym, you like starting with 45 minutes of cardio on the treadmill and then doing 15 minutes of weight training. You've just finished the cardio portion of your workout and are about to start your leg weight training.

Texting script:
Bot: Hello! Are you looking to do cardio or strength training right now? Please answer C for cardio or S for strength

Participant: S

Bot: Okay. How long would you like your workout to be?

Participant: 15

Bot: Okay. What muscle area do you want to work on? A: upper body B: core C: legs D: full body. Please answer A, B, C, or D.

Participant: C

Bot: Okay. Here is a routine for you: 30 squats, 40 mountain climbers, 20 lunges (each side), 10 burpees. Do this routine as many times as you can in 5 minutes then take a minute rest. Repeat twice more. Are you happy with this routine? Please answer Y for yes or N for no

Participant: Y

Bot: Thank you! Goodbye

Appendix E

Barriers to Being Active Quiz Participant Summaries

In these summaries, each type of social support is assigned a letter as follows: A = appraisal, B = emotional, C = informational, D = instrumental. Each factor is abbreviated as F and then the number of the factor. So AF1 is appraisal, factor 1, BF1 is emotional, factor 1, etc.

All participants				
SUMMARY	*Count*	*Sum*	*Average*	*Variance*
AF1	11	41	3.73	6.02
BF1	11	42	3.82	4.36
CF1	11	39	3.55	5.07
DF1	11	44	4	6
AF2	11	22	2	2.8
BF2	11	20	1.82	2.36
CF2	11	20	1.82	1.76
DF2	11	20	1.82	2.56
AF3	11	31	2.82	7.76
BF3	11	27	2.45	5.67
CF3	11	30	2.73	8.02
DF3	11	29	2.64	6.25
AF4	11	47	4.27	12.82
BF4	11	42	3.82	10.76
CF4	11	45	4.09	12.09
DF4	11	44	4	11.2

AF5	11	7	0.64	1.45
BF5	11	8	0.73	1.42
CF5	11	7	0.64	1.45
DF5	11	10	0.90	2.49
AF6	11	10	0.90	3.69
BF6	11	9	0.82	5.76
CF6	11	9	0.82	1.56
DF6	11	9	0.82	4.56
AF7	11	34	3.09	4.69
BF7	11	32	2.91	5.09
CF7	11	30	2.73	5.02
DF7	11	30	2.73	5.02
Active Participants 1st Grouping				
SUMMARY	*Count*	*Sum*	*Average*	*Variance*
AF1	7	30	4.29	5.24
BF1	7	24	3.43	4.95
CF1	7	23	3.29	5.24
DF1	7	28	4	6.67
AF2	7	9	1.29	0.57
BF2	7	10	1.43	0.62
CF2	7	10	1.43	0.95
DF2	7	12	1.71	1.24
AF3	7	19	2.71	8.57
BF3	7	14	2	3
CF3	7	19	2.71	9.57
DF3	7	16	2.29	4.90

AF4	7	23	3.29	9.24
BF4	7	16	2.29	5.57
CF4	7	21	3	7.333333
DF4	7	23	3.29	9.90
AF5	7	6	0.86	2.14
BF5	7	5	0.71	1.24
CF5	7	6	0.86	2.14
DF5	7	6	0.86	2.14
AF6	7	1	0.14	0.14
BF6	7	1	0.14	0.14
CF6	7	4	0.57	0.62
DF6	7	0	0	0
AF7	7	19	2.71	5.24
BF7	7	20	2.86	6.14
CF7	7	16	2.29	5.57
DF7	7	15	2.14	5.14
Inactive Participants 1st Grouping				
SUMMARY	*Count*	*Sum*	*Average*	*Variance*
AF1	4	11	2.75	7.58
BF1	4	18	4.5	3.67
CF1	4	16	4	6
DF1	4	16	4	6.67
AF2	4	13	3.25	4.92
BF2	4	10	2.5	5.67
CF2	4	10	2.5	3
DF2	4	8	2	6

AF3	4	12	3	8.67
BF3	4	13	3.25	11.58
CF3	4	11	2.75	7.58
DF3	4	13	3.25	10.25
AF4	4	24	6	18
BF4	4	26	6.5	9.67
CF4	4	24	6	18
DF4	4	21	5.25	14.25
AF5	4	1	0.25	0.25
BF5	4	3	0.75	2.25
CF5	4	1	0.25	0.25
DF5	4	4	1	4
AF6	4	9	2.25	8.25
BF6	4	8	2	16
CF6	4	5	1.25	3.58
DF6	4	9	2.25	10.92
AF7	4	15	3.75	4.25
BF7	4	12	3	4.67
CF7	4	14	3.5	4.33
DF7	4	15	3.75	4.25
Active Participants 2nd Grouping				
SUMMARY	*Count*	*Sum*	*Average*	*Variance*
AF1	6	24	4	5.6
BF1	6	21	3.5	5.9
CF1	6	18	3	5.6
DF1	6	21	3.5	5.9

AF2	6	7	1.17	0.57
BF2	6	8	1.33	0.67
CF2	6	8	1.33	1.07
DF2	6	9	1.5	1.1
AF3	6	14	2.33	9.07
BF3	6	11	1.83	3.37
CF3	6	16	2.67	11.47
DF3	6	13	2.17	5.77
AF4	6	15	2.5	5.9
BF4	6	11	1.83	4.97
CF4	6	16	2.67	7.87
DF4	6	17	2.83	10.17
AF5	6	6	1	2.4
BF5	6	5	0.83	1.37
CF5	6	6	1	2.4
DF5	6	6	1	2.4
AF6	6	1	0.17	0.17
BF6	6	1	0.17	0.17
CF6	6	4	0.67	0.67
DF6	6	0	0	0
AF7	6	15	2.5	5.9
BF7	6	16	2.67	7.07
CF7	6	12	2	6
DF7	6	11	1.83	5.37
Inactive Participants 2nd Grouping				
SUMMARY	*Count*	*Sum*	*Average*	*Variance*

AF1	5	17	3.4	7.8
BF1	5	21	4.2	3.2
CF1	5	21	4.2	4.7
DF1	5	23	4.6	6.8
AF2	5	15	3	4
BF2	5	12	2.4	4.3
CF2	5	12	2.4	2.3
DF2	5	11	2.2	4.7
AF3	5	17	3.4	7.3
BF3	5	16	3.2	8.7
CF3	5	14	2.8	5.7
DF3	5	16	3.2	7.7
AF4	5	32	6.4	14.3
BF4	5	31	6.2	7.7
CF4	5	29	5.8	13.7
DF4	5	27	5.4	10.8
AF5	5	1	0.2	0.2
BF5	5	3	0.6	1.8
CF5	5	1	0.2	0.2
DF5	5	4	0.8	3.2
AF6	5	9	1.8	7.2
BF6	5	8	1.6	12.8
CF6	5	5	1	3
DF6	5	9	1.8	9.2
AF7	5	19	3.8	3.2
BF7	5	16	3.2	3.7

CF7	5	18	3.6	3.3
DF7	5	19	3.8	3.2

Table 15 - Participant Summaries (A: Appraisal, B: Emotional, C: Informational, D: Instrumental, F1: Factor 1, F2: Factor 2, etc.)

BIBLIOGRAPHY

Baker, R. C., & Kirschenbaum, D. S. (1993). Self-monitoring may be necessary for successful weight control. *Behavior Therapy, 24*(3), 377-394. https://doi.org/10.1016/S0005-7894(05)80212-6

Bass, B., Fink, N., Price, M., Sturre, L., Hentschel, E., & Pak, R. (2011). How does anthropomorphism affect user's trust, compliance, and performance on a decision making automation task? *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *55*(1), 1952-1956. https://doi.org/10.1177/1071181311551407

Berkman, L., Glass, T., Brissette, I., & Seeman, T. (2000). From social integration to health: Durkheim in the new millennium. *Social Science & Medicine*, *51*(6), 843-857. https://doi.org/10.1016/S0277-9536(00)00065-4

Buchholz, S. W., Wilbur, J., Ingram, D., & Fogg, L. (2013). Physical activity text messaging interventions in adults: A systematic review. *Worldviews on Evidence-Based Nursing*, *10*(3), 163-173. https://doi.org/10.1111/wvn.12002

Consolvo, S., Everitt, K., Smith, I., & Landay, J. A. (2006). Design requirements for technologies that encourage physical activity. Proceedings of the SIGCHI Conference on human factors in computing systems, 457-466. https://doi.org/10.1145/1124772.1124840

De Kerckhove, A. (2002) "Building brand dialogue with mobile marketing", *Young Consumers*, *3*(4), 37-42, https://doi.org/10.1108/17473610210813600

Donaldson, E. L., Fallows, S., & Morris, M. (2014). A text message based weight management intervention for overweight adults. *Journal of Human Nutrition and Dietetics*, *27*(s2), 90-97. https://doi.org/10.1111/jhn.12096

Eisenhauer, C. M., Hageman, P. A., Rowland, S., Becker, B. J., Barnason, S. A., & Pullen, C. H. (2017). Acceptability of mHealth technology for self-Monitoring eating and activity among rural men. *Public Health Nursing*, *34*(2), 138-146. https://doi.org/10.1111/phn.12297

Elfhag, K., & Rössner, S. (2005). Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obesity Reviews*, *6*(1), 67-85. https://doi.org/10.1111/j.1467-789X.2005.00170.x

Epstein, D. A., Cordeiro, F., Fogarty, J., Hsieh, G., & Munson, S. A. (2016). Crumbs: Lightweight daily food challenges to promote engagement and mindfulness. *Proceedings*

of the 2016 CHI Conference on Human Factors in Computing Systems, 5632-5644. https://doi.org/10.1145/2858036.2858044

Fanning, J., Mullen, S. P., & McAuley, E. (2012). Increasing physical activity with mobile devices: A meta-analysis. *Journal of Medical Internet Research*, *14*(6), 159-169. https://doi.org/10.2196/jmir.2171

Flegal, K. M., Kruszon-Moran, D., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2016). Trends in obesity among adults in the United States, 2005 to 2014. *Jama, 315*(21), 2284-2291. 10.1001/jama.2016.6458

Fukuoka, Y., Vittinghoff, E., Jong, S. S., & Haskell, W. (2010). Innovation to motivation—pilot study of a mobile phone intervention to increase physical activity among sedentary women. *Preventive Medicine*, *51*(3), 287-289. https://doi.org/10.1016/j.ypmed.2010.06.006

Goh, O. S., Fung, C. C., & Depickere, A. (2008). Domain knowledge query conversation bots in instant messaging (IM). *Knowledge-Based Systems*, *21*(7), 681-691. https://doi.org/10.1016/j.knosys.2008.03.055

Guare, J. C., Wing, R. R. and Grant, A. (1995), Comparison of obese NIDDM and nondiabetic women: short- and long-term weight loss. *Obesity Research, 3*(4), 329–335. https://doi.org/10.1002/j.1550-8528.1995.tb00158.x

Healthy People 2020 [Internet]. Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, cited 27 March, 2018. Available from: https://www.healthypeople.gov/2020/leading-health-indicators/2020-lhi-topics/Nutrition-Physical-Activity-and-Obesity/data.

Heaney, C. A., & Israel, B. A. (2008). Social networks and social support. In K. Glanz, B. K. Rimer, K. Viswanath (Eds.), *Health behavior and health education: Theory, research, and practice* (4th ed.), (pp. 189-210). San Francisco, CA: Jossey-Bass.

Hebden, L., Cook, A., van der Ploeg, H. P., King, L., Bauman, A., & Allman-Farinelli, M. (2014). A mobile health intervention for weight management among young adults: A pilot randomised controlled trial. *Journal of Human Nutrition and Dietetics*, *27*(4), 322-332. https://doi.org/10.1111/jhn.12155

Hurling, R., Catt, M., Boni, M. D., Fairley, B. W., Hurst, T., Murray, P., & Sodhi, J. S. (2007). Using internet and mobile phone technology to deliver an automated physical activity program: Randomized controlled trial. *Journal of Medical Internet Research*, *9*(2), e7. https://doi.org/10.2196/jmir.9.2.e7

Khaylis, A., Yiaslas, T., Bergstrom, J., & Gore-Felton, C. (2010). A review of efficacious technology-based weight-loss interventions: Five key components. *Telemedicine and e-Health*, *16*(9), 931-938. https://doi.org/10.1089/tmj.2010.0065

Kiesler, S., Powers, A., Fussell, S. R., & Torrey, C. (2008). Anthropomorphic interactions with a robot and robot-like agent. *Social Cognition*, *26*(2), 169-181. https://doi.org/10.1521/soco.2008.26.2.169

Kirman, B., Linehan, C., Lawson, S., Foster, D., & Doughty, M. (2010). There's a monster in my kitchen: Using aversive feedback to motivate behaviour change. *CHI '10 Extended Abstracts on Human Factors in Computing Systems*, 2685-2694. https://doi.org/10.1145/1753846.1753852

Maitland, J., & Chalmers, M. (2011). Designing for peer involvement in weight management. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 315-324. https://doi.org/10.1145/1978942.1978988

McGuire, M. T., Wing, R. R., Klem, M. L., Lang, W., & Hill, J. O. (1999). What predicts weight regain in a group of successful weight losers? *Journal of Consulting and Clinical Psychology*, *67*(2), 177-185. https://doi.org/10.1037/0022-006X.67.2.177

Munson, S. A., Lauterbach, D., Newman, M. W., & Resnick, P. (2010). Happier together: Integrating a wellness application into a social network site. In T. Ploug, P. Hasle, & H. Oinas-Kukkonen (Eds.), *Persuasive Technology* (pp. 27-39). Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-13226-1_5

National Center for Health Statistics. Health, United States, 2016: With Chartbook on Long-term Trends in Health. Hyattsville, MD. 2017.

Newman, M. W., Lauterbach, D., Munson, S. A., Resnick, P., & Morris, M. E. (2011). It's not that I don't have problems, I'm just not putting them on Facebook: Challenges and opportunities in using online social networks for health. *Proceedings of the ACM 2011 Conference on Computer Supported Cooperative Work*, 341-350. https://doi.org/10.1145/1958824.1958876

Papa, A. & Lefton, C. (2015). Discharge texting: The evolution of ED callbacks. *Journal of Emergency Nursing*, *41*(4), 345-346. http://dx.doi.org.ezaccess.libraries.psu.edu/10.1016/j.jen.2015.04.002

Patrick, K., Raab, F., Adams, M. A., Dillon, L., Zabinski, M., Rock, C…Norman, G. J. (2009). A text message-based intervention for weight loss: Randomized controlled trial. *Journal of Medical Internet Research*, *11*(1), e1. https://doi.org/10.2196/jmir.1100

Pellegrini, C. A., Duncan, J. M., Moller, A. C., Buscemi, J., Sularz, A., DeMott, A.,…Spring, B. (2012). A smartphone-supported weight loss program: Design of the ENGAGED randomized controlled trial. *BMC Public Health*, *12*(1), 1041. https://doi.org/10.1186/1471-2458-12-1041

Ploderer, B., Smith, W., Howard, S., Pearce, J., & Borland, R. (2013). Patterns of support in an online community for smoking cessation. *Proceedings of the 6th International*

Conference on Communities and Technologies, 26-35. https://doi.org/10.1145/2482991.2482992

Poole, E. S. (2013). HCI and mobile health interventions: How human-computer interaction can contribute to successful mobile health interventions. *Translational Behavioral Medicine, 3*(4), 402-405. https://doi.org/10.1007/s13142-013-0214-3

Ross, K. M., & Wing, R. R. (2016). Impact of newer self-monitoring technology and brief phone-based intervention on weight loss: A randomized pilot study. *Obesity, 24*(8), 1653-1659. https://doi.org/10.1002/oby.21536

Rutledge, T., Reis, S. E., Olson, M., Owens, J., Kelsey, S. F., Pepine, C. J.,….Matthews, K. A. (2004). Social networks are associated with lower mortality rates among women with suspected coronary disease: The national heart, lung, and blood institute-sponsored women's ischemia syndrome evaluation study. *Psychosomatic Medicine, 66*(6), 882-888. 10.1097/01.psy.0000145819.94041.52

Schlögl, S., Doherty, G., Karamanis, N., & Luz, S. (2010). WebWOZ: A wizard of oz prototyping framework. *Proceedings of the 2nd ACM SIGCHI symposium on engineering interactive computing systems*, 109-114. https://doi.org/10.1145/1822018.1822035

Skeels, M., Unruh, K., Powell, C., & Pratt, W. (2010). Catalyzing social support for breast cancer patients. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 173-182. https://doi.org/10.1145/1753326.1753353

"Text Message Statistics – United States – Statistic Brain." 2017 Statistic Brain Research Institute, publishing as Statistic Brain. http://www.statisticbrain.com/text-message-statistics/

Vandelanotte, C., Müller, A. M., Short, C. E., Hingle, M., Nathan, N., Williams, S. L.,…Maher, C. A. (2016). Past, present, and future of eHealth and mHealth research to improve physical activity and dietary behaviors. *Journal of Nutrition Education and Behavior, 48*(3), 219-228.e1. https://doi.org/10.1016/j.jneb.2015.12.006

Verheijden, M. W., Bakx, J. C., van Weel, C., Koelen, M. A., & van Staveren, W. A. (2005). Role of social support in lifestyle-focused weight management interventions. *European Journal of Clinical Nutrition, 59*(S1), 179-186. https://doi.org/10.1038/sj.ejcn.1602194

Wang, J., Shih, P. C., & Carroll, J. M. (2015). Life after weight loss: Design implications for community-based long-term weight management. *Computer Supported Cooperative Work (CSCW), 24*(4), 353-384. https://doi.org/10.1007/s10606-015-9226-5

Wing, R.R., Hill, J.O. (2001). Successful weight loss maintenance. *Annual Review of Nutrition, 21*(1), 323-341. https://doi.org/10.1146/annurev.nutr.21.1.323

ACADEMIC VITA

Rebecca Jonas

EDUCATION

Bachelor of Science | The Pennsylvania State University, University Park | May 2018

- College of Information Sciences and Technology (IST)
    - Major/Option: IST/Integration & Application
    - Minor: English (18 credits)
- Honors in Information Sciences and Technology
- Dean's List (7 semesters)

RESEARCH AND PRESENTATIONS

- Honors thesis "Incorporation of texting bots into social-influence based fitness interventions." under advisement of Dr. Benjamin V. Hanrahan (August 2016 – May 2018)
- Member of Design Square Lab with Dr. Eun Kyoung Choe (September 2016 – May 2017)
- Independent study "How queer is queer enough? Exploring fan perception of Batwoman's sexual identity" under advisement of Dr. Cheryl L. Nicholas (August 2015 – May 2016)
    - Poster presentation at the 107th Annual Eastern Communication Association Convention (March 2016)
- Panel presentation "Rewriting Local Histories" at the 2016 Penn State Teaching and Learning with Technology Symposium with Dr. Laurie Grobman, Mary Ann Mengel, Heather Hughes (March 2016)
- Wrote report on the history of entrepreneurship workshops at Penn State Berks based on previous research (surveys) conducted by Dr. Sadan Kulturel (June 2015)

INTERNATIONAL EXPERIENCE

- Honduras. (January 2014, January 2016). Built water filtration systems for two disadvantaged villages
- Nicaragua. (November 2015). Presented entrepreneurship workshop to young adults in an underprivileged community
- Norway. (March 2015). Honors Spring Break trip to study castles and Norwegian culture