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FRAMED TEXT MESSAGES AS A NUTRITION EDUCATION INTERVENTION

MICHAEL J. O'HALLORAN

50 Pages

A youth's college years is a critical period in health behavior formation, during which body mass index (BMI) and other health behaviors such as diet and physical activity are strong predictors of adult health status. Text messaging is prominent in the lives of most college-age adults. Despite this, relatively few studies have investigated the potential of utilizing a text message-based intervention to target fruit and vegetable consumption, a measure for weight management behaviors. Additionally, few studies utilizing a text message-based intervention have utilized a theory specific to the creation of behavior-motivating text messages. The gain-framed health behavior messages of Prospect Theory, in which the positive outcomes of an action are emphasized, have been shown in print media to significantly impact various health behaviors. This study investigates whether gain-framed text messages influence the fruit and vegetable consumption of college-aged adults compared to non-framed behavior motivating text messages. Midwestern college students (n=33) completed an online survey that assessed fruit and vegetable consumption. Participants were randomly divided into intervention (n=17) and control (n=16) groups. Both the intervention and control groups received three text messages for seven weeks, with the intervention group receiving gain-framed behavior motivating messages and the control group receiving an identical message without gain-framing. Descriptive statistics were analyzed to identify the sample's demographic characteristics. The pre- and post-

intervention food questionnaire scores for the intervention and control groups were compared using independent t-tests to determine differences in fruit and vegetable consumption. Paired t-tests were used to compare the intervention and control groups' within-group fruit and vegetable consumption scores before and after the intervention. Thirty-three participants fully completed the survey. The majority of the participants were 21 years of age (60.6%), white (78.8%), female (72.7%), and senior level in college (69.7%). The results of this study showed that gain-framed text messages non-significantly improved fruit and vegetable consumption; however, the text messaging intervention failed to increase fruit and vegetable consumption independent of the message frame. The results of this study show that health educators may be able to maintain or promote small changes in the fruit and vegetable consumption among college-age young adults.

KEYWORDS: Fruit and Vegetable Consumption, Message Framing, Prospect Theory, Text Messaging

FRAMED TEXT MESSAGES AS A NUTRITION EDUCATION INTERVENTION

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Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE

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FRAMED TEXT MESSAGES AS A NUTRITION EDUCATION INTERVENTION

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CHAPTER I
FRAMED TEXT MESSAGES AS A NUTRITION EDUCATION INTERVENTION

Introduction

As of 2014, an estimated 12.7 million children and adolescents are affected by obesity (Centers for Disease Control and Prevention, 2017). In an effort to curb the rising costs of overweight and obesity-related healthcare spending, much research has been invested into the prevention of overweight and obesity (Bech-Larsen & Grønhøj, 2013; Brown, O'Connor, & Saviano, 2014; Kerr, Harray, Pollard, Dhaliwal, Delp, Howart, & Boushey, 2016).

Research has shown that a young adult's new-found independence, often seen in their transition into college, is a critical time in the development of physical activity and dietary behaviors (Leone, Morgan, & Ludy, 2015). For example, health-related behaviors established during this time often follow young adults throughout adulthood. If continued over time, these established behaviors may significantly increase an adult's risk of developing diet-related chronic diseases such as cardiovascular disorders, obesity, and some cancers (Kerr, Harray, Pollard, Dhaliwal, Delp, Howart, & Boushey, 2016). Such conditions, in turn, can contribute to rising healthcare costs (Brown et al., 2014). Thus, there is great interest in developing dietary programs tailored towards college-age young adults.

Text messaging has become a common form of communication among teenagers and young adults (Brown et al., 2014). Because of the interactive and instantaneous nature of text messaging, researchers have been increasingly focused on utilizing text messaging for health behavior interventions (Head, Noar, Iannarino, & Harrington, 2013). Text messaging has been underutilized for providing dietary interventions to college-aged students (Brown et al., 2014). Relatively few studies have addressed the potential of text messaging as a tool for improving

dietary behaviors. Of the few studies conducted in this context, text-messaging has shown promise as an effective and accessible intervention for young adults in college (Bech-Larsen & Grønhoj, 2013; Brown et al., 2014; Kerr et al., 2016). A meta-analysis of 19 randomized control trials of text messaging interventions found these interventions to significantly improve health outcomes in young adults (Head et al., 2013). Generally, the effect sizes of these studies range from small to moderate; however, such effect sizes are favorable when compared to the effect sizes of print and computer-based health behavior interventions (Head et al., 2013).

One notable study by Brown et al. (2014) incorporated the MyPlate icon coupled with a health behavior message into a dietary behavior intervention. MyPlate is a nutrition education icon showing the USDAs recommended distribution of food groups per meal (Brown et al., 2014). Brown et al. (2014) found that texting an image of the MyPlate icon coupled with a health behavior message biweekly significantly increased fruit consumption among college-aged students compared to those who received the same materials in print.

Several gaps exist in the text message-based nutrition education literature (Brown et al., 2014). First, more studies are needed to better substantiate the effectiveness of text message-based nutrition education programs. Most of the existing studies that incorporate text messaging as an intervention have focused more broadly on health promotion, which includes but not limited to dietary, physical activity, and smoking behaviors, rather than specifically dietary behaviors. For example, in Head et al.'s (2013) meta-analysis of the efficacy of text-message based health interventions, few of the interventions analyzed focused specifically on dietary behaviors. Instead, many of the interventions focused on behaviors such as smoking cessation, physical activity, and weight loss (Head et al., 2013). In contrast, recent studies that have

specifically targeted dietary behavior have focused on measuring changes in fruit and vegetable consumption (Bech-Larsen & Grønhøj, 2013; Brown et al., 2014).

Secondly, a significant gap concerns the use of health behavior messages incorporated into these studies. Head et al., (2013) noted that the current health promotion literature is deficient in theory-guided work and theory development as it pertains to text messaging. Most of the studies in this field that have incorporated a theory into their methodology used either the Transtheoretical Model or Social Cognitive Theory rather than a theory directly pertaining to text messaging. The authors called for more studies to examine how a text message's structure and characteristics influence a message's effectiveness in promoting behavior change (Head et al., 2013).

In light of Head et al.'s (2013) call for more studies, Prospect Theory has been used to inform message-framing in past interventions (Apanovitch, McCarthy, & Salovey, 2003; Churchill & Pavey, 2013; Mann et al., 2004). Prospect Theory is a health behavior promotion framework that differentiates between gain-framed and loss-framed behavioral messages in promoting screening and preventative health behaviors. Gain-framed messages emphasize that a positive health status will be gained by an action. For example, a gain-framed behavioral message from Mann et al (2004), "Flossing your teeth daily removes particles of food in the mouth, avoiding bacteria, which promotes great breath" (pg.332). Conversely, loss-framed messages emphasize the negative consequences of inaction (Rothman, Bartles, Wlaschin, & Salovey, 2006). An example of a loss-framed message from the same study, "If you do not floss your teeth daily, particles of food remain in the mouth, collecting bacteria, which causes bad breath" (pg. 332). This study sought to address both the lack of theory-based work and nutrition-

specific text messaging interventions by incorporating Prospect Theory into a text-message-based intervention to determine if gain-framed behavioral messages would increase fruit and vegetable consumption among college-aged adults.

A study of the impact of message-framing on the efficacy of health behavioral text messages was necessary for several reasons. First, this study better substantiated the effectiveness of text messaging as a means of influencing young adults' dietary behavior. Second, this study helped establish whether incorporating theory into text messages can influence health behavior. Lastly, this study opened the door for future studies to examine how the format and framing of text messages can influence dietary behaviors.

The purpose of this study was to determine if Prospect Theory, via gain-framed health behavior text messages, would impact the fruit and vegetable consumption of college-aged adults. The study was conducted at a Midwestern University and targeted college students aged 18-24. The independent variable was the message frame of health behavior text messages. In this study, gain-framed behavioral messages were compared to non-framed messages. Both the gain and non-framed text messages focused on dietary behaviors. The dependent variable was fruit and vegetable consumption assessed through a condensed version of the NHANES Food Questionnaire. Text messages were sent three times each week to participants in both the gain-frame and non-framed groups. The following hypotheses were generated: 1) The gain-framed text message group will have higher post-test fruit and vegetable consumption than the non-framed groups and 2) Both groups will have higher post-test fruit and vegetable consumption.

Methodology

Participants and Recruitment

Participants were college students 18-24 years of age identified through the university's listserv of students willing to receive emails pertaining to research study participation. 12,762 prospective students were sent a recruitment email outlining the study's purpose, methodology, incentive, and a link to the online initial survey. Before answering any of the survey questions, participants were shown and required to provide informed consent. A total of 33 participants completed the survey and were randomly divided into the intervention group (n=17) and control group (n=16). Inclusion criteria for this study included (1) university student age 18-24, and (2) access to Short-Message Service (SMS) text messaging. Exclusion criteria for the study included (1) having a nutrition or kinesiology major; (2) enrollment in a nutrition course at the time of the study, and (3) not having regular access to text messaging. Regular access to text messaging was considered the ability to consistently receive and read a text message twice per day for this study.

After the post-intervention survey was completed, participants were able to access a link that asked for their name and email address to be entered into a drawing for four \$25 gift cards. Winners were selected at random from participants who completed the post-intervention survey. Participants selected to win the gift cards were emailed notifications requesting their mailing address for the purposes of sending the gift cards.

Procedure

Qualtrics, an online survey platform, was used to obtain informed consent online upon approval by the university's Institutional Review Board (Approval Number: [1095486-3]).

Following consent, participants were asked to provide their phone number and complete a condensed version of the National Health and Nutrition Examination Survey (NHANES) food frequency questionnaire along with demographic questions (age, sex, race, year in school), height, and weight. Participants were given two weeks to volunteer to participate in the study and to complete the pre-intervention questionnaires. An additional recruitment email was sent to students on the listserv one week after the initial recruitment email as a reminder to complete the pre-intervention questionnaires. The questionnaire was estimated to take 15-20 minutes to complete. Upon completion of the pre-intervention questionnaires, participants were randomly divided into the intervention and control groups. The intervention group received three gain-framed text messages each week over the course of the intervention. Gain-framed messages were constructed from behavior promoting messages found on ChooseMyPlate.gov, a United States Department of Agriculture (USDA) website which serves to promote healthy dietary habits. Messages found on the website were modified to emphasize the benefits of a given action. Gain-framed messages were reviewed for content analysis by a health education expert. One example of a gain-framed message sent to participants was, “Frozen juice bars (100% juice) make healthy alternatives to high-fat snacks. Eating less high-fat snacks helps keep your heart healthy.” The control group received three unframed text messages of the same behavior promoting messages from ChooseMyPlate.gov without any modification, such as “Frozen juice bars (100% juice) make healthy alternatives to high-fat snacks.” For the full list of text messages sent to participants, see Appendix A.

Measures

Fruit and vegetable consumption was measured using a modified version of the NHANES Food Questionnaire created by the Center for Disease Control (CDC). NHANES is a series of studies organized by the CDC that assessed the health status of various populations within the U.S. The NHANES Food Questionnaire consisted of 139 questions that measure the frequency of a variety of dietary behaviors. These dietary behaviors include but are not limited to fruit and vegetable consumption, dairy and sugar-sweetened beverage consumption, alcohol use, meat consumption, and grain consumption. For this study, the NHANES Food Questionnaire was adapted to take approximately 15-20 minutes for participants to complete. In total, the adapted survey featured a total of 28 questions. Fourteen questions were asked regarding fruit consumption and the other fourteen regarding vegetable consumption. The process of narrowing the survey questions entailed removing questions that do not pertain to fruit and vegetable consumption. Additionally, some questions regarding the consumption of a single specific food in the original survey were combined with other closely related foods. For example, in the original questionnaire, frequencies for the consumption of apple juice, grape juice, and orange juice were asked separately. In this study, these three items were combined into one question in order to ensure the questionnaire was completed in a timely manner by the participants. The questions used an 8-item scale for participants to self-report their frequency of specific dietary behaviors. Frequencies participants can select from range from no consumption (1) to greater than two daily servings of a specific food (8). At the end of the pre- and post-test periods, participant responses for both sections were extrapolated into numeral values, summed,

and used to calculate average fruit and vegetable consumption scores. See Appendix B for the modified Food Questionnaire.

Intervention Program

The texting program's duration was for a total of seven weeks and consisted of 21 messages at a rate of three per week for both the intervention and control groups. Text messages were based off motivational messages adapted from the USDA's MyPlate website. Text messages were designed to be less than 160 characters. EZ Texting, a mass messaging company, was used to send text messages to the participants in both the intervention and control groups. Text messages were sent to participants every Monday, Wednesday, and Friday at either 11:00am or 5:00pm CST. These times were selected so that participants received a text message one hour prior to lunch or dinner. Participants in both the intervention and control groups withdrew from the study by texting STOP. Participants who withdrew from the study were not included in the post-intervention data analysis; however, the pre-test data for these participants was included to compare the control and intervention groups' initial fruit and vegetable consumption. After seven weeks, the intervention was completed. The week following the last set of text messages, all participants were sent a text link to complete the post-intervention survey, which was administered by Qualtrics. The online post-intervention survey featured the same NHANES Food Frequency Questionnaire but did not ask for demographic variables. All participants were sent reminder text messages containing a link to the survey one week later following the same Monday, Wednesday, Friday schedule after the initial text message link to the post-intervention survey was sent.

Data Analysis

IBM SPSS Statistics Version 22 software was used for data analysis. Descriptive statistics analyzed the demographics of participants. To evaluate the effectiveness of message-framing in promoting fruit and vegetable consumption compared to the control group, paired t-tests were used to analyze the pre- and post-intervention means for both the intervention and control groups with a significance value of $p < .05$. The control and intervention groups' mean scores pre- and post-intervention on the condensed NHANES food frequency questionnaire were compared with independent t-tests to determine if message framing had a significant impact on fruit and vegetable consumption.

Results

Participants

For the pre-intervention survey, 88 individuals opened the survey and consented to participate, of which 58 completed the survey. Individuals who completed the survey were then randomly assigned to the intervention or control group. A total of five participants replied "STOP" during the intervention period to opt out of the study; four in the control group and one in the intervention group. Upon completion of the seven-week intervention program, 44 participants opened the post-intervention survey and 33 (17 intervention, 16 control) fully completed the program. Of the 33 participants who completed both surveys, the majority were 21 years of age (60.6%), white (78.8%), female (72.7%), seniors in college (69.7%).

Pre- and Post-Score Means Between Groups

Mean scores for fruit and vegetable domains were calculated before and after the intervention. An independent t-test was conducted to determine if there were any significant

differences in fruit and vegetable consumption between groups prior to the intervention. The mean fruit consumption scores for the intervention group ($m = 33.59, sd = 7.71$) was not significantly different from the mean of the control group ($m = 39.38, sd = 9.95$) at the $p = .05$ level. Similarly, the mean vegetable consumption scores for the intervention group ($m = 36.47, sd = 9.94$) was not significantly different than the mean for the control group ($m = 40.75, sd = 8.93$) at the $p = .05$ level. Because the variances were not significantly different, the t-tests did assume equality of variances.

An independent t-test was again conducted to determine if there were any significant differences between mean fruit or vegetable consumption post-test scores between groups. The mean fruit consumption score for the intervention group ($m = 35.17, sd = 7.42$) was not significantly different from the mean score for the control group ($m = 35.25, sd = 7.29$) at the $p = .05$ level. Likewise, the mean vegetable consumption score for intervention group ($m = 36.59, sd = 8.60$) was not significantly different from the mean score for the control group ($m = 38.75, sd = 9.54$) at the $p = .05$ level. Because the variances were not significantly different, the t-tests did assume equality of variances. These results demonstrated the hypothesis that the intervention group would have significantly higher post-test fruit and vegetable consumption scores was not supported.

Pre- and Post-Score Means Within Groups

The calculated mean scores for fruit and vegetable consumption were also used to conduct a dependent t-test to determine if there were any significant changes in mean fruit and vegetable scores within groups after the intervention concluded. For the intervention group, the mean fruit consumption score marginally increased from 33.6 ($sd = 7.71$) on the pretest to 35.2

($sd = 7.42$) on the post-test. The difference between the two means were not statistically significant at the $p=.05$ level ($t= -.980, df=16$). Likewise, the mean vegetable consumption scores slightly increased, from 36.5 ($sd=9.94$) on the pre-test to 36.6 ($sd=8.60$) on the post-test. The difference between the two means were not statistically significant at the $p=.05$ level ($t= -.067, df=16$).

For the control group, the mean fruit consumption score decreased from 39.4 ($sd=9.95$) on the pretest to 35.3 ($sd=7.29$) on the post-test. The difference between the two means were statistically significant at the $p=.05$ level ($t=2.538, df=15$), meaning that fruit consumption among the control group significantly decreased from pre- to post-intervention. Likewise, the mean vegetable consumption scores slightly decreased from 40.8 ($sd=8.93$) on the pre-test to 38.8 ($sd=9.54$) on the post-test; however, the difference between the two means were not statistically significant at the $p=.05$ level ($t=1.394, df=15$). These results do not support the hypothesis that both the intervention and control group's fruit and vegetable scores would increase following the intervention.

Discussion

This study's finding of no significant differences between the post-intervention fruit and vegetable consumption scores of the intervention and control group may indicate that gain-framed messages did not promote dietary behaviors to any greater degree than the non-framed control messages. There is evidence in the message framing literature that the message framing rationale provided by Rothman et al. (2006) may not on its own explain the effect of message framing on health behaviors. One possible explanation for the non-significant findings of this study was the influence of an unaccounted moderator variable. The message framing literature

has explored the influence of various cognitive and emotional variables and their impact on the efficacy of message framing (Churchill & Pavey, 2013; Mann et al., 2004; Riet et al., 2010; Sun et al., 2015). Two studies of relevance looked at moderating variables of message framing for dietary behaviors. Churchill & Pavey (2013) found that gain-framed messages only promoted changes in fruit and vegetable consumption among the undergraduate participants with high self-reported autonomy. Similarly, Riet et al. (2010) found loss-framed messages when controlling for high self-efficacy resulted in the greatest reduction in salt consumption. These studies suggest that participants' sense of competence in their ability to enact dietary changes may play an important part in the effectiveness of dietary change-promoting messages. The lack of significant improvements in fruit and vegetable consumption in both groups in this present study may stem from the text messages failing to stimulate variables that relate to the participant's sense of their ability to initiate dietary changes.

The second important finding of this study was that only the intervention group increased, though non-significantly, its post-intervention fruit and vegetable consumption scores, whereas the control group's fruit score decreased significantly and its vegetable score decreased marginally. This result may indicate that the texting message regimen did not promote positive dietary behavior change independent of message frame. Several factors may explain why fruit and vegetable scores did not improve or decline significantly within groups, except for the control group's fruit consumption. Head et al. (2013) notes that studies that employed text messaging programs that were tailored (customized to individual participants) and targeted (customized to target populations) to the individual participants tended to be more effective than those which only employed tailoring, and several studies reflect the effectiveness of this

approach (Bauer, de Niet, Timman, & Kordy, 2010; Fukuoka et al., 2010; Norman, Kolodziejczyk, Adams, Patrick, & Marshall, 2013). The present study did not tailor text messages to individual participants based on their reported fruit and vegetable consumption. The lack of improvement in the intervention and control groups' fruit and vegetable consumption scores may stem from the absence of individualized performance feedback provided in the text messages. Without individualized feedback, participants may have been less engaged with the text messages sent as part of the intervention.

Another potential contributing factor to why the texting message regimen did not promote positive dietary behavior changes independent of message frame may be related to the fixed schedule of the text messaging program. Head et al. (2013) noted that text message interventions that enabled participants to set their own texting schedule tended to be more effective than programs that sent text messages at fixed intervals. The authors noted that fixed-schedule text message programs operate independently of an individual participant's health behavior. This in turn may lead to the participant acquiring the impression that the text messages are not responsive to his or her needs (Head et al., 2013). It is possible that participants in both the intervention and control groups in the present study developed a sense that the text messaging program was not tailored to him or her specifically, and thus may have disregarded the text messages they received.

Participant habituation to the text messages may also in part explain why the text message regimen did not promote positive dietary behavior change independent of message frame. Several studies have cited text message frequency as affecting the effectiveness of their intervention (Brown et al., 2014; Kerr et al., 2016; Sharpio et al., 2013; Weitzel et al., 2007).

Studies such as Brown et al. (2014) and Kerr et al. (2016) utilized a biweekly messaging schedule to intervention participants. Both studies cited their texting schedule as a possible limitation to the intervention's effectiveness. By contrast, studies such as Weitzel et al. (2007) and Sharpio et al. (2012) utilized a daily text messaging schedule. In the former study, participants reported receiving too many text messages. In the latter study, the authors cited habituation to daily text messages as a potential contributor to their intervention's lack of efficacy. The triweekly text message schedule of this study was designed to address the text message frequency concerns of studies like Brown et al. (2014) while attempting to preclude the potential participant habituation to text messages that arose in studies like Sharpio et al. (2012). A total of five participants texted STOP to be removed from the study during the intervention and twenty participants failed to complete the post-intervention survey for a completion rate of 57%. Thus, it is possible that participants became habituated to the three weekly text messages they received. To address concerns for participant habituation to frequent text messages, future studies should attempt to promote fruit and vegetable consumption in this population utilizing decreasing frequency or participant-selected text message regimens as noted by Head et al. (2013).

A final factor in why the text message regimen did not promote positive dietary behavior change independent of message frame may stem from the characteristics of the participants who completed the study. The majority of the participants who completed the study were senior-level college females. Studies have shown that college-age women are more likely than men to engage in nutrition facts label reading, which is in turn associated with greater nutrition knowledge and healthier eating habits (Christoph, An, & Ellison, 2016; Christoph, Larson, &

Neumark-Sztainer, 2018). It is possible that the participants had been engaging in the behaviors promoted in the text messages prior to the study. Alternatively, it is possible that the participants were familiar with the health benefits of such dietary habits prior to the text message intervention.

The present study has several limitations. First, the small final sample size (n=33) was predominantly white (78.8%) and female (72.7%). Thus, the generalizability of these findings to other populations is limited. A second limitation of the study relates to the text messaging program utilized in this study. The text messaging program utilized in this study provided confirmation that a text message had been received, but it was unable to determine whether a text message was actually read by a participant. It is possible that uninterested participants may have consented to participate in this study for the incentive, ignored some or all the text messages in the intervention, then completed the post-intervention survey for the chance to win the incentive. This is a known issue within text message studies that did not incorporate a message tailoring element which necessitates participants responding to text messages (Brown et al., 2014), and future studies should attempt to confirm that text messages are read by participants.

Third, participant attrition was an issue in this study. Of the 58 participants who completed the pre-intervention survey, only 33 of them completed the post-intervention survey, 17 in the intervention and 16 in the control group respectively. Prior studies have shown text messaging to be more effective at garnering responses than print or email responses sent to participants (Brown et al., 2014; De Niet, Timman, Bauer, Van den Akker, de Klerk, Kordy, & Passchier, 2012). One explanation for the attrition may be that some participants did not have access to smart phones or MMS (multi-media messaging service) messaging. The link to the

final survey was sent via a text message containing the link to the survey. Participants who used phones that do not have access to the Internet may have been unable to access the final survey.

A fourth limitation of this study was that both fruit and vegetable consumption was self-reported by participants. This study did not use additional dietary behavior measures to determine the accuracy of the participant's self-reported fruit and vegetable consumption. Participants may have felt pressured or made uncomfortable by questions that asked their height, weight, and dietary habits, driving some participants to alter their answers. Future studies should attempt to utilize additional measures, such as incorporating 24-hour food recalls, to cross-validate fruit and vegetable consumption as part of a text messaging regimen.

Conclusion

Prior studies have shown text messaging to be an effective but modest tool for promoting health behaviors. This study was the first to incorporate gain-framed messages based on Prospect Theory into a text message regimen to promote fruit and vegetable consumption among college-aged young adults. The results of this study found that the Prospect Theory-guided text messages led to marginal and insignificant increases in fruit and vegetable consumption. The study also found that the text message regimen failed to promote fruit and vegetable consumption independent of the gain-framed behavior messages. Despite this, health educators may be able to use this study's findings to foster small changes in the college-age adults' fruit and vegetable consumption or maintain their existing consumption levels.

TABLES

Table 1

Mean Fruit and Vegetable Consumption Scores

Measure	Pre-Intervention		Post-Intervention		Change	
	INT	CNT	INT	CNT	INT	CNT
Fruit	33.59	39.38	35.18	35.25	1.59	-4.13
Vegetable	36.47	40.75	36.59	38.75	0.12	-2

Note. Scores were derived from participants' response to a condensed version of the CDC's

NHANES Food Questionnaire. Scores represent the summed and averaged totals of

participants' response to fruit and vegetable consumption frequency questions.

Table 2

Participant Demographics

Measure	Frequency	Percent
Ethnicity		
White	26	78.8
Hispanic or Latino	1	3
Black or African American	3	9.1
Asian or Pacific Islander	2	6.1
Other	1	3
Gender		
Male	9	27.3
Female	24	72.7
Year in School		
Junior	2	6.1
Senior	23	69.7
Graduate	8	24.2
Age		
21	20	60.6
22	6	18.2
23	3	9.1
24	4	12.1

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CHAPTER II
EXTENDED REVIEW OF THE LITERATURE
Young Adults and the U.S. Food Environment

Diet-related chronic disease currently affects the lives of nearly half of all adults in the U.S. (Wilson, Reedy, & Krebs-Smith, 2016). The prevalence of diet-related chronic disease in the U.S is often attributed in part to the characteristics of its food supply (Fouladkhah, Berlin, & Bruntz, 2015; Miller, Reedy, Kirkpatrick, & Krebs-Smith, 2015). The U.S food supply collectively did not meet the federal government's standards of what constitutes a healthy diet (Miller et al., 2015). Specifically, the high prevalence of refined grains, saturated fat, and sodium was cited as contributing to the rates of chronic disease in the U.S. (Miller et al., 2015). For example, the prevalence of sodium in the food supply is indicative of the food supply's role in chronic disease development. It is estimated that the average sodium intake of Americans two years of age and older is 3400 milligrams per day, compared to the 2300 milligrams per day recommended upper limit (Fouladkhah et al., 2015). As much as 75% of American sodium intake was attributed to the consumption of processed foods as opposed to table salt intake (Fouladkhah et al., 2015). Consumption of high amounts of sodium over many years is associated with increased risk of high blood pressure, stroke, and heart attack (Fouladkhah et al., 2015). Though there is some evidence that the average American's diet quality has improved modestly in the past decade, much research has been directed towards the prevention of such diseases by targeting the behaviors of children and young adults (De Niet, Timman, Bauer, Van den Akker, de Klerk, Kordy, & Passchier, 2012; Head, Noar, Iannarino, & Harrington, 2013; Wilson et al., 2016).

An individual's college years has been identified as a critical period in the development of long-term health behavior habits (Leone, Morgan, & Ludy, 2015; Racette, Deusinger, Strube, Highstein, & Deusinger, 2005). This period in an individual's life is associated with increased stress related to living in a new environment and the increased autonomy that comes with it (Leone et al., 2015). Unfortunately, diet quality and physical activity habits tended to decline as an individual transitions from high school into college (Brown, O'Connor, & Saviano, 2014; Leone et al., 2015; Racette et al., 2005). It is well established that college freshmen tend to gain weight over the course of their first year in college, though the extent of this weight gain varies across studies (Leone et al., 2015). Leone et al., (2015) found that most weight gain occurred within the first and final two months of a freshmen's academic year. They found that college students gained a significant amount of fat in this period, which indicates the adoption of unhealthy eating habits, particularly evening snacking and increased consumption of high-fat foods. Researchers aim to substitute high-fat, calories-rich foods for more nutrient-rich foods as a means of weight management in college-age adults.

The insufficient consumption of whole grains, fruits, and vegetables in the average American diet are important to address, as these food groups are known to promote weight management (Wilson et al., 2016). Studies of weight management often used fruit and vegetable consumption as an indicator of a program's effectiveness (Bech-Larsen & Grønhøj, 2013; Brown et al., 2014; Kerr, Harray, Pollard, Dhaliwal, Delp, Howart, & Boushey, 2016). Fruit and vegetable consumption is targeted in these studies as a weight management behavior due to their effects on energy regulation and satiety (Rolls, Ello-Martin, & Tohill, 2004). Fruits and vegetables are less energy dense than high-fat or processed foods. This means that fruits and

vegetables contain less calories per given weight of food than other food groups. The lower energy density of fruit and vegetables stems from their higher water content relative to other food groups. Water found naturally in fruit and vegetables adds to the weight of food without contributing any additional calories. Thus, eating greater amounts of fruits and vegetables allow for the consumption of higher total weight of food for the same amount of calories in a given diet (Rolls et al., 2004).

Text Messaging to Promote Health Behaviors

Nearly two-thirds of the world's population owns a mobile phone, the vast majority of which regularly use text messaging services (Head et al., 2013). Mobile phones are increasingly becoming an integral part of U.S. and other societies (Bauer, de Niet, Timman, & Kordy, 2010). Among youth, text messaging is a popular form of communication, with one study estimating that U.S. teenagers send or receive 50 text messages per day on average (Head et al., 2013). In light of the ongoing concern regarding the rates chronic disease and obesity in the U.S., health promotion researchers have increased their focus on incorporating text messaging as a health behavior promotional tool in recent years.

Text messaging as an intervention medium has several unique advantages to other health promotion platforms. First, the aforementioned popularity and prevalence of mobile phones and text messaging services make it a desirable tool to reach a variety of populations easily and affordably (Bauer et al., 2010; Norman, Kolodziejczyk, Adams, Patrick, & Marshall, 2013). Second, text messaging allows for messages to be sent and received at any time and place, allowing for interventions to be less disruptive of participants' daily lives (Bauer et al., 2010; Norman et al., 2013). Third, text messaging is an interactive medium that allows for near

instantaneous communication between researchers and participants, creating the potential for participants to receive real-time feedback. Fourth, more recent developments in app technology used in smartphones allow for the sharing of images, videos, and a variety of other tools to be utilized for health promotion (Head et al., 2013; Kerr et al., 2016).

Text messaging has shown promise and utility as a platform for providing health promotion interventions (Brown et al., 2014; Head et al., 2013). Obermayer, Riley, Asif, and Jean-Mary (2004) provided an early example of the promise of text message-based health interventions. They created a text messaging program that, among other features, allowed participants in a smoking cessation study to send SOS text messages to researchers when they had a strong craving to smoke a cigarette. The study found that nearly half of the participants made one or more one-day attempts to quit smoking, 22% of the participants successfully quit smoking, and that the average number of cigarettes smoked by participants decreased significantly (Obermayer et al., 2004). Another early text message study by Weitzel, Bernhardt, Usdan, Mays, and Glanz (2007) focused on using tailored text messages to reduce alcohol-related consequences among college adolescents. The study found that the intervention group, which received daily texts messages, reported drinking significantly fewer drinks per drinking day than the control group, further validating the potential of text messaging as a health behavior intervention tool (Weitzel et al., 2007).

More recent studies of text messaging have expanded their scope to target dietary behaviors (Bech-Larsen et al., 2013; Brown et al., 2014; Norman et al., 2013). Many studies have found that incorporating a text messaging component into their interventions led to a significant benefit on dietary behaviors. One study of particular relevance by Brown et al.

(2014) compared text messages to paper mail as a means of dietary knowledge and behavior promotion. In this study, the intervention group was sent text messages of the MyPlate icon coupled with a dietary behavior message, while the control group was given the same information sent via paper mail (Brown et al., 2014). One example of these behavioral messages is, “Balance your calories. Go to the website and find out how many calories YOU need. Balance your food intake and your energy output to help you manage a healthy weight.” Of the intervention group, 84% responded that text messages helped them to maintain focus on their health during a post-intervention survey. Additionally, Brown et al. (2014) found the text-message intervention group had higher recognition of the MyPlate-based dietary guidelines and self-reported fruit consumption, demonstrating one effective nutrition education intervention utilizing text messaging.

A similar study conducted by Bech-Larsen & Grønhøj (2013) used SMS text messaging as a food dairy and dietary feedback tool in conjunction with nutrition education lessons to measure the rate of attrition, goal accommodation, and intake of fruit and vegetable consumption of Danish schoolchildren. The study found that the participants in the SMS text messaging treatment group who self-reported low fruit and vegetable consumption at baseline had a significant increase in fruit and vegetable intake; however, the authors also found that participants with high pre-intervention fruit and vegetable consumption at baseline reduced their fruit and vegetable consumption over the study’s duration.

Another relevant study by Norman et al. (2013) examined whether fruit and vegetable consumption as well as eating behaviors mediated a text message intervention’s effect on weight loss. The study found that both fruit and vegetable consumption and eating behaviors mediated

the intervention's effect on weight loss. This study confirmed the role of fruit and vegetable consumption in weight loss, and it showed that text messaging programs can significantly alter fruit and vegetable consumption to promote short-term weight loss.

As the number of studies utilizing text message interventions has grown, more focus has been put on the factors that may optimize a text message intervention. One such factor is the frequency of text messages that participants received. In Head et al.'s (2013) meta-analysis of text message interventions, the authors found that studies which incorporated less than or equal to one text message per week or varied text message frequency were less effective at promoting the targeted behavior than studies in which participants were able to choose their own frequency or studies that incorporated decreasing text message frequency. The authors speculated that programs that allow for flexibility in text message frequency were more effective at sending behavior motivating messages at times in which they were most relevant to participants. The authors further argued that this increases message processing and conveys social presence, the perception that a health promotion program is tailored to the needs of an individual. The increased message processing and sense of social presence may in turn improve the effectiveness of text message interventions (Head et al., 2013).

Despite their inability to convey social presence, studies that have incorporated a fixed text messaging schedule have shown to significantly impact health behavior (Bauer et al., 2010; Brown et al., 2014; Fukuoka, Vittinghoff, Jong, & Haskell, 2010). The text message frequency utilized in these studies is varied. Some studies, such as Norman et al. (2013) and Weitzel et al. (2007) sent participants several text messages on each day of the intervention period. Other studies, such as Brown et al. (2014) and Bauer et al. (2010) sent text messages to participants

only once or twice per week. In studies that used less than one text message per day, some authors speculated that more frequent text messages could enhance the efficacy of their interventions (Brown et al., 2014; Kerr et al., 2016). Conversely, some studies that have incorporated greater than one text message per day have speculated that the daily text message schedule may have hindered the efficacy of their interventions (Sharpio, Koro, Doran, Thompson, Sallis, Calfas, & Patrick, 2012; Weitzel et al., 2007). In particular, a study by Sharpio et al., (2012) argues that the multiple text messages per day that intervention participants received for one year may have habituated these participants to receiving text messages, lowering the intervention's effectiveness. Thus, it remains unclear what text message frequency is optimal for studies that utilized a fixed text message frequency in their interventions.

A significant gap within these studies pertains to how the behavioral text messages were presented. According to Head et al. (2013), the health promotion literature is deficient in theory-based work as it relates to text messaging. Slightly more than half of the 19 studies analyzed in the authors' meta-analysis explicitly incorporated a theory, most of which used either the Transtheoretical Model or Social Cognitive Theory, as opposed to a theory that guided the development of text messages. From the results of the meta-analysis, the authors concluded that incorporating a theory into text message-based health promotion interventions did not significantly impact an intervention's efficacy, though the authors state this may have resulted from flawed coding methodology.

Additionally, Head et al. (2013) called for more studies to extend current theory to better suit text messaging interventions as well as to explore how text message characteristics influence a message's effectiveness. The deficiency of theory-based work in the text message health

promotion literature needs to be addressed, as it is established that theory-guided work in other media had significant influence on health behavior (Apanovitch, McCarthy, & Salovey, 2003; Mann, Sherman, & Updegraff, 2004; Riet, Ruiter, Smerecnik, & Vries, 2010). To the author's knowledge, only Woolford, Clark, Strecher, and Resnicow (2010) incorporated a theory pertaining to text message formation to inform the wording of dietary behavior text messages; however, the study focused on the feasibility of a computerized program sending such messages as part of a weight management intervention. Changes in the participants' health behavior were not recorded in the study. Therefore, research is needed to substantiate how the wording or framing of a text message can influence the efficacy of a dietary behavior intervention.

Message Framing and Health Promotion

An important consideration in public health promotion is how the public perceives health promoting messages. To guide the crafting of future public health promotional campaigns, Puhl, Peterson, and Luedicke (2013) investigated the perceptions of a representative sample of U.S. adults toward obesity-related public health campaign messages. The authors showed these participants a random sample of ten messages from major obesity campaigns in English-speaking countries and then asked participants to rate the messages with positive or negative descriptors. Participants were also asked whether they perceived the messages to be motivating or stigmatizing. The results of this study found that participants had ranked messages that promoted fruit and vegetable consumption as well as those which promoted confidence to be the most favorable and motivating. By comparing favorability scores of messages that implied personal responsibility for excess weight, the authors speculated that health behavior messages

may be more effective when they focus on promoting self-efficacy for specific health behaviors than implying personal responsibility (Puhl et al., 2013).

They further noted that the most motivating messages were those that made no mention of obesity whatsoever, which suggests messages that focus on health may be more effective than those which focus on body weight (Puhl et al., 2013). An equally important finding of this study was that a participant's body weight influenced their perception of the various health messages they viewed. Specifically, the study found that participants with higher body weight tended to favor messages that advocated specific behavioral strategies or actions, and they rated messages that did not promote a specific action less favorably (Puhl et al., 2013). Overall, this study lays the groundwork for crafting health promotion messaging interventions to focus on specific, actionable behaviors (especially fruit and vegetable consumption) and to emphasize health over body weight.

Prospect Theory has been incorporated into other mediums to guide the construction of behavioral messages for promoting a variety of health behaviors (Rothman, Bartels, Wlaschin, & Salovey, 2006). Prospect Theory constructs messages to have either a gain or a loss-framed behavioral appeal (Rothman et al., 2006). In a gain-framed behavioral appeal, the message emphasizes the benefits of taking action, or the bad events that will not happen. An example of a gain-framed behavioral message from Mann et al (2004) is, "Flossing your teeth daily removes particles of food in the mouth, avoiding bacteria, which promotes great breath" (pg.332). According to Prospect Theory, the frame best suited for a behavioral message depends on whether the behavior in question is perceived as being risk-averse or risk-seeking (Rothman et al., 2006). A behavior is labelled as risk-averse or risk-seeking based on an individual's belief

that the behavior can lead to an unpleasant outcome. In this sense, getting a colonoscopy would be classified as a risk-seeking behavior, due to the potential result in the negative consequence of a colon cancer diagnosis (Rothman et al., 2006). Risk averse health behaviors, such as putting on a seatbelt, are meant to preserve one's health status and may prevent an illness or injury from occurring if followed. As it relates to health behaviors, Prospect Theory predicts that gain-framed behavioral appeals will be more effective in promoting risk averse health behaviors (Rothman et al., 2006).

Studies using print-media have shown message-framing can significantly influence health behaviors (Apanovitch et al., 2003; Mann et al., 2004; Riet et al., 2010). For example, a study of message framing to motivate HIV testing among low socioeconomic, minority women by Apanovich et al. (2003) found that participants exposed to two gain-framed videos and were certain about their outcomes reported higher rates of HIV testing than those exposed to loss-framed videos. Another study by Mann et al. (2004) looked at how message framing of printed materials in congruence with one's motivational disposition influenced flossing behavior. Motivational dispositions were classified as either approach or avoidance-oriented. Approach-oriented individuals tended to be more responsive to reward and incentive stimuli, whereas avoidance-oriented individuals were more responsive to punishment or threat stimuli (Mann et al., 2004). The study found that avoidance-inclined participants flossed more than approach-inclined participants after reading a loss-framed article. Conversely, approach-inclined participants flossed more than avoidance-inclined participants after reading a gain-framed article.

More recently, researchers began to utilize Prospect Theory for the promotion of dietary behaviors as well as to research factors that may impact the effectiveness of these interventions.

Churchill and Pavey (2013) found that gain-framed dietary behavior promoting messages only increased self-reported fruit and vegetable consumption in participants with high autonomy scores, the participants' sense of their behavior being under their own control. Gerend and Maner (2011) investigated how participants' emotional state may influence the effectiveness of framed dietary behavior-promoting messages. The study found that participants who completed a fear-inducing task ate more fruits and vegetables after receiving a loss-framed message. Lastly, Riet et al. (2010) examined the impact that participant self-efficacy had on the effectiveness of gain and loss-framed messages at reducing participants' salt intake. The study found that the greatest salt intake reduction came from participants who received a loss-framed message, but only when their salt reduction self-efficacy was high (Riet et al., 2010).

A 2011 meta-analysis by Gallagher and Updegraff reaffirmed the effect that gain-frame messages had on promoting preventative or risk-averse behaviors. From their analysis of 94 studies, they found that gain-framed messages were superior at promoting prevention behaviors than loss-frame messages. The authors then speculated on the factors that mediate the effect of gain-framed messages on prevention behaviors. They speculated that gain-framed messages may convey other, implicit types of information that may promote social and cognitive variables such as self-efficacy, positive emotion, and outcome expectations. The authors emphasized the role of self-efficacy in particular, as it may have a direct influence on stimulating health behaviors (Gallagher and Updegraff, 2011). Likewise, the importance of self-efficacy or other similar variables has been demonstrated in studies that incorporated text messaging to promote a variety of health behaviors (Fukuoka et al., 2013; Norman et al., 2013). Norman et al. (2013) in particular noted the importance of text messaging's role in improving participants' self-efficacy

to promote behavior change. Thus, studies that seek to promote health behavior should be mindful of the role that gain-framed health behavior promoting messages have on mediating variables such as self-efficacy.

A common shortcoming among studies that incorporated Prospect Theory is the lack of a message-framing control group (Apanovich et al., 2003; Mann et al., 2004; Riet et al., 2010). In each of the studies presented, the change in the health behavior of a group exposed to a gain-framed message is compared to that of a group exposed to a loss-framed message. Without seeing how unframed motivational messages influences health behavior, it is difficult to accurately depict the effectiveness of message framing as a health behavior strategy. Future studies should include a non-framed control group to better assess the effectiveness of message-framing overall, as well as to potentially shed light on some of the mechanisms that create the message framing effect. It should also be noted that some of the dietary behavior studies relied on self-reported data in which its accuracy was not verified with additional measures (Brown et al., 2014; Riet et al., 2010). Thus, future studies need to incorporate additional measures to verify the accuracy of the data reported by participants. For example, future studies could include intermittent 24-hour food recalls, in which participants are asked to list what they ate over a 24-hour period, with food frequency questionnaires at the start and conclusion of an intervention.

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APPENDIX A: BEHAVIOR MOTIVATING TEXT MESSAGES

MyPlate Behavioral Messages

1. Frozen juice bars (100% juice) make healthy alternatives to high-fat snacks
2. Select fruits with more potassium often, such as bananas, prunes and prune juice, dried peaches and apricots, and orange juice.
3. Keep a package of dried fruit in your desk or bag. Some fruits that are available dried include apricots, apples, bananas, figs, dates, prunes, and raisins.
4. As a snack, spread peanut butter on apple slices or top plain fat-free or low-fat yogurt with berries or slices of kiwi fruit.
5. Buy fruits that are dried, frozen, or canned (in water or 100% juice) as well as fresh, so that you always have a supply on hand.
6. Use a microwave to quickly zap vegetables. White or sweet potatoes can be baked quickly this way.
7. Include a green salad with your dinner every night.
8. Buy packages of veggies such as baby carrots or celery sticks for quick snacks.
9. Include beans or peas in flavorful mixed dishes, such as chili or minestrone soup.
10. Order a veggie pizza with toppings like mushrooms, green peppers, and onions, and ask for extra veggies.
11. Many vegetables taste great with a dip or dressing. Try a low-fat salad dressing with raw broccoli, red and green peppers, celery sticks or cauliflower.
12. Buy canned vegetables labeled "reduced sodium," "low sodium," or "no salt added."
13. Try crunchy vegetables, raw or lightly steamed
14. Add color to salads by adding baby carrots, shredded red cabbage, or spinach leaves
15. Stock up on frozen fruits or vegetables for quick and easy cooking in the microwave
16. Make a fruit smoothie by blending fat-free or low-fat milk or yogurt with fresh or frozen fruit
17. For dessert, have baked apples, pears, or a fruit salad
18. Add fruit like pineapple or peaches to kabobs as part of a barbecue meal
19. Pair veggies with your favorite dips, such as carrots with hummus or celery with peanut butter.
20. Hummus can be paired with almost anything! Dip red pepper slices, carrots, or celery into this delicious dip
21. Pair low-sodium salsas with a small serving of whole-grain tortilla chips or raw veggies

Prospect Theory Adapted MyPlate Messages

1. Frozen juice bars (100% juice) make healthy alternatives to high-fat snacks. Eating less high-fat snacks helps keep your heart healthy.
2. Pick fruits with potassium, such as bananas, prunes, and dried peaches. Potassium can help your blood pressure. Managing it keeps your blood vessels healthy
3. Keep a bag of dried fruit with you. Some dried fruits include apricots, apples, bananas, prunes, and raisins. Dried fruit has fiber that promotes fullness.
4. As a snack, spread peanut butter on apple slices or top plain, low-fat yogurt with berries. These fruits contain vitamin C which keeps your skin healthy.
5. Buy fruits that are frozen, canned, or fresh so that you always have some on hand. Eating fruits and vegetables each day can reduce your risk of many diseases.
6. Use a microwave to quickly zap vegetables. Sweet potatoes can be baked quickly this way. Sweet potatoes have vitamin A that keeps your eyes and body healthy.
7. Include a green salad with your dinner every night. Leafy greens contain antioxidants that can decrease the risk of developing some cancers.
8. Buy bags of veggies such as baby carrots or celery sticks for quick snacks. Most veggies have fiber and nutrients that keep you full and your body healthy.
9. Include beans or peas in dishes such as chili or minestrone soup. Beans are a great source of dietary iron that help you feel energetic during the day.
10. Order veggie pizza with toppings like onions and green peppers, and ask for extra veggies. Veggies provide nutrients to stay healthy even when eaten with pizza
11. Many veggies pair with a dip/dressing. Try low-fat dressing with broccoli, cauliflower, or celery. Veggies have antioxidants that protect your cells from harm
12. Buy canned veggies labeled "reduced sodium," "low sodium," or "no salt added." Lowering your sodium intake can help prevent high blood pressure as you get older
13. Try crunchy veggies, raw or lightly steamed. This preserves their nutrient content and helps your body absorb more of the nutrients necessary to stay healthy
14. Add color to salads by adding carrots, shredded red cabbage, or spinach. They make salads look great and provide vitamins to keep your skin and eyes healthy
15. Stock up on frozen fruits or veggies for quick, easy cooking in the microwave. Frozen berries are high in fiber, which help prevent constipation
16. Make a fruit smoothie by blending fat-free or low-fat milk or yogurt with fresh or frozen fruit. This provides your muscles the protein they need to grow.
17. For dessert, have baked apples, pears, or a fruit salad. This provides your body with a variety of nutrients to stay healthy and keep you feeling full
18. Add fruit like pineapple or peaches to kabobs to a BBQ meal. The nutrients in many fruits help you absorb iron in meat. Iron helps you feel energetic each day
19. Pair veggies with dips, such as carrots with hummus or celery with peanut butter. These combos provide protein and fiber to keep you healthy
20. Hummus can be paired with almost anything! Dip red pepper slices, carrots, or celery into this delicious dip. Hummus has soluble fiber that reduces cholesterol

21. Pair low-sodium salsas with a small serving of whole-grain tortilla chips or raw veggies.
Tomatoes are rich in antioxidants that protect your cells from damage

APPENDIX B: MODIFIED NHANES FOOD FREQUENCY QUESTIONNAIRE

Please answer the following questions using the past two months to determine your responses.

1. How often did you drink **100% fruit juice** (apple, grape, orange, pineapple, prune etc.)
 - a. NEVER
 - b. 1 time per month or less
 - c. 2-3 times per month
 - d. 1-2 times per week
 - e. 3-4 times per week
 - f. 5-6 times per week
 - g. 1 time per day
 - h. 2-3 times per day
 2. How often did you eat **apples or applesauce**?
 - a. NEVER
 - b. 1 time per month or less
 - c. 2-3 times per month
 - d. 1-2 times per week
 - e. 3-4 times per week
 - f. 5-6 times per week
 - g. 1 time per day
 - h. 2 or more times per day
 3. How often did you eat **bananas**?
 - a. NEVER
 - b. 1 time per month or less
 - c. 2-3 times per month
 - d. 1-2 times per week
 - e. 3-4 times per week
 - f. 5-6 times per week
 - g. 1 time per day
 - h. 2 or more times per day
 4. How often did you eat **grapes or berries** (strawberry, blueberries, raspberries, etc)?
 - a. NEVER
 - b. 1 time per month or less
 - c. 2-3 times per month
 - d. 1-2 times per week
 - e. 3-4 times per week
 - f. 5-6 times per week
 - g. 1 time per day
 - h. 2 or more times per day
5. How often did you eat **pears**?
 - a. NEVER
 - b. 1 time per month or less
 - c. 2-3 times per month
 - d. 1-2 times per week
 - e. 3-4 times per week
 - f. 5-6 times per week
 - g. 1 time per day
 - h. 2 or more times per day
 6. How often did you eat **pineapple**?
 - a. NEVER
 - b. 1 time per month or less
 - c. 2-3 times per month
 - d. 1-2 times per week
 - e. 3-4 times per week
 - f. 5-6 times per week
 - g. 1 time per day
 - h. 2 or more times per day
 7. How often **dried fruit**, such as **prunes or raisins**?
 - a. NEVER
 - b. 1 time per month or less
 - c. 2-3 times per month
 - d. 1-2 times per week
 - e. 3-4 times per week
 - f. 5-6 times per week
 - g. 1 time per day
 - h. 2 or more times per day

8. How often did you eat **peaches, nectarines, or plums** (fresh, canned, or frozen)?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
9. How often did you eat **melons** (such as cantaloupe, watermelon, or honeydew)?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
10. How often did you eat **oranges, tangerines, clementines, or tangelos** (fresh or canned)?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
11. Over the past 3 months, how often did you eat **other kinds of fresh, dried, canned, or frozen fruit**?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
12. How often did you eat **grapefruit** (fresh or canned)?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
13. How often did you eat **tomatoes** (fresh or canned)?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
14. How often do you eat **zucchini or cucumber**?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day

Over the past 2 months,

15. How often did you drink **tomato juice** or **vegetable juice**?

- a. NEVER
- b. 1 time per month or less
- c. 2-3 times per month
- d. 1-2 times per week
- e. 3-4 times per week
- f. 5-6 times per week
- g. 1 time per day
- h. 2-3 times per day

16. How often did you eat **cooked or raw greens** (such as spinach, turnip, collard, mustard, chard, or kale)?

(We will ask about lettuce later)

- a. NEVER
- b. 1 time per month or less
- c. 2-3 times per month
- d. 1-2 times per week
- e. 3-4 times per week
- f. 5-6 times per week
- g. 1 time per day
- h. 2 or more times per day

17. How often did you eat **carrots** (fresh, canned, or frozen)?

- a. NEVER
- b. 1 time per month or less
- c. 2-3 times per month
- d. 1-2 times per week
- e. 3-4 times per week
- f. 5-6 times per week
- g. 1 time per day
- h. 2 or more times per day

18. How often did you eat **peas**, and/or **corn** (fresh, canned, or frozen)?

- a. NEVER
- b. 1 time per month or less
- c. 2-3 times per month
- d. 1-2 times per week

- e. 3-4 times per week
- f. 5-6 times per week
- g. 1 time per day
- h. 2 or more times per day

19. How often did you eat **coleslaw**?

- a. NEVER
- b. 1 time per month or less
- c. 2-3 times per month
- d. 1-2 times per week
- e. 3-4 times per week
- f. 5-6 times per week
- g. 1 time per day
- h. 2 or more times per day

20. How often did you eat **string beans** or **green beans** (fresh, canned, or frozen)?

- a. NEVER
- b. 1 time per month or less
- c. 2-3 times per month
- d. 1-2 times per week
- e. 3-4 times per week
- f. 5-6 times per week
- g. 1 time per day
- h. 2 or more times per day

21. How often did you eat **broccoli**?

- a. NEVER
- b. 1 time per month or less
- c. 2-3 times per month
- d. 1-2 times per week
- e. 3-4 times per week
- f. 5-6 times per week
- g. 1 time per day
- h. 2 or more times per day

22. How often did you eat **cauliflower** or **Brussels sprouts** (fresh or frozen)?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
23. How often did you eat **onions** (including in mixtures)?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
24. How often did you eat **sweet** or **hot peppers** (green, red, yellow)?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
25. Over the past 3 months, how often did you eat **lettuce salads** (with or without other vegetables)?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
26. How often did you eat **sweet potatoes** or **yams**?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
27. How often did you eat **baked, boiled, or mashed potatoes**?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day
28. Over the past 3 months, how often did you eat **other kinds of vegetables**?
- NEVER
 - 1 time per month or less
 - 2-3 times per month
 - 1-2 times per week
 - 3-4 times per week
 - 5-6 times per week
 - 1 time per day
 - 2 or more times per day

APPENDIX C: RECRUITMENT EMAIL

Subject Line: Eating Behaviors Study

Message:

Dear Prospective Participant,

You are receiving this email because you have been invited to participate in a study, titled “Framed Text Messages as a Nutrition Education Intervention.” The purpose of this study is to determine if how a text message is written can impact a student’s fruit and vegetable intake. The results of this study can help determine how to better promote fruit and vegetable consumption using text messaging among college students.

You will be asked to complete 2 online surveys. Survey #1 before the program begins, and Survey #2 after the program has completed. Each survey will take approximately 15-20 minutes to complete. You will be asked to provide your cell phone number and email. Your cell phone number will be needed in order to receive text messages related to healthy eating behaviors. You will be assigned to one of two groups. Both groups will receive text messages every Monday, Wednesday, and Friday at alternating times of either 11A.M. or 5P.M. Both groups will receive text messages about fruit and vegetable eating behaviors. One group will have their text messages phrased in a manner different than the other group. Standard text messaging rates will apply.

To participate you must be at least 18 years of age to 24 years old. In addition, you must have access to a mobile phone with text messaging capabilities and be able to consistently read and receive text messages at least twice per day. Your participation in this survey will contribute to the body of knowledge relating to nutrition text messaging behaviors in college students.

Participants who complete the first and second survey will be entered to win one of four \$25 Amazon gift card delivered via email.

If you are eligible for this study and are interested in completing the surveys and text messaging program, please click the link below:

https://illinoisstate.az1.qualtrics.com/jfe/form/SV_8BXSvj6v3Fk5AEt

To learn more about this project, please contact Dr. Julie Schumacher at jmraede@ilstu.edu or 309-438-7031 or Michael O’Halloran at mjohall@ilstu.edu or xxx-xxx-xxxx.

Thank you for your time and consideration.

Sincerely,

Michael O’Halloran

APPENDIX D: INFORMED CONSENT

You are receiving this email because you are invited to participate in a study, titled “Framed Text Messages as a Nutrition Education Intervention.” The study is being conducted by Michael O’Halloran, Graduate Student in the Department of Family and Consumer Sciences of Illinois State University, Normal, IL (118B TUR, (xxx) xxx-xxxx, mjohall@ilstu.edu).

To participate in this study, you must be a college student and at least 18 years to 24 years old, not a Nutrition or Kinesiology major, and not enrolled in a Nutrition course during the Fall 2017 semester. **If you have a history of eating disorders or believe that you have an eating disorder, you are not eligible for this study.** You must also have access to a mobile phone with text messaging capabilities, and able to read text messages at least twice daily. Your participation in this survey will contribute to the body of knowledge relating to nutrition text messaging programs.

The purpose of this study is to evaluate the overall effectiveness of a nutrition related text messaging intervention program for college students. The results of this study can help determine ways to improve text messaging interventions that strive to improve eating habits of college students.

If you agree to take part in this study you will be enrolled into one of two text-messaging programs. Both groups will receive text messages that promote eating fruits and vegetables. The way in which these messages are phrased will differ between the two groups. Both groups will receive healthy eating behavior related text messages for 7 weeks, three times per week, or 21 messages total. Text messages will be sent to both groups on Mondays, Wednesdays, and Fridays at alternating times of 11 A.M. or 5 P.M. Additionally, you will be asked to complete 2 online surveys at 2 different time points. You will be asked to complete the first survey before any text messages are sent. This survey will take you approximately 20 minutes. You will then be asked to take the second survey 7 weeks after the first text is sent. This survey will also take you 20 minutes.

There are very minimal risks associated with this study and are no greater than those that occur in daily life. You may feel some discomfort in answering some of the questions, but with the online format of the survey, we hope any discomfort is minimized. Loss of confidentiality is always a risk. The following procedures will be used to protect confidentiality of the data collected from you: You will be assigned an Identification number based on your phone number and will be kept during the survey collection phases for tracking purposes only. No names will be used or recorded during the study. All responses will be stored on a password protected computer. Only members of the research staff will have access to the passwords. Participants' identities will be protected and participation is voluntary. Participants can withdraw from the study at any time. You may withdrawal from the survey by selecting EXIT or by closing the browser. You may withdraw from the text messaging program by texting STOP. You may withdraw from the text message intervention at any time by emailing Michael O’Halloran at mjohall@ilstu.edu. There are no consequences if you decide to withdraw at any point.

There are no costs to you to complete the intervention or surveys. Participants who complete both surveys will be entered to win one of four \$25 Amazon gift cards via email. After you

complete the second survey, you can click a link that will direct you to a separate webpage where we will need to collect your name, email address, and mailing address. This information is only being collected for purposes of distributing the gift card; it will not be linked to your survey responses or retained for other purposes. Please note that compensation for participation in research may be taxable.

Take as long as you like before you make a decision. If you have any questions, you may contact the principal investigator, Dr. Julie Schumacher at 309-438-7031 or jmraede@ilstu.edu or the co-principal investigator Michael O'Halloran at (xxx) xxx-xxxx or mjohall@ilstu.edu. If you have questions regarding your rights or if you are dissatisfied with this study, you may anonymously contact the Research Ethics & Compliance Office at Illinois State University by phone at (309) 438-2529 and/or rec@ilstu.edu. This study has been approved by the Illinois State University Institutional Review Board (Approval Number: [1095486-3]).

By clicking agree, you are indicating that you are consenting to participate in this research.

- Agree, I do wish to participate, I am over 18, and I am a college student at Illinois State University, I am not a Nutrition or Kinesiology major, and I am not enrolled for a nutrition course for the Fall 2017 semester.
- Disagree, I do not wish to participate