

Fall 8-29-2014

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This thesis, EFFECTS OF ELECTRONIC REMINDERS FOR PROMOTING EXERCISE MOTIVATION AND ADHERENCE IN UNIVERSITY STUDENTS, by ASHLEE HAMILTON, was prepared under the direction of the candidate's Thesis Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Master of Science, in the College of Education, Georgia State University.

The Thesis Committee and the student's Department Chairperson, as representatives of the faculty, certify that this thesis has met all standards of excellence and scholarship as determined by the faculty. The Dean of the College of Education concurs.

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ABSTRACT

EFFECTS OF ELECTRONIC REMINDERS FOR PROMOTING EXERCISE MOTIVATION AND ADHERENCE IN UNIVERSITY STUDENTS

By
Ashlee Hamilton

Under the Direction of Rebecca Ellis, PhD

Less than half of all adults meet the federal exercise recommendations (CDC, 2010) and college-aged adults may be more vulnerable to the consequences of physical inactivity with about two-thirds of college students leading sedentary lifestyles (Harvey-Berino, Pope, Gold, et al., 2012; Tully & Cupples, 2011). Mobile apps provide an efficient way to track physical activity and electronic prompts can enhance mobile apps by reminding individuals to participate. Therefore, the purpose of this study was to examine the effectiveness of a mobile app and electronic prompts sent via Twitter for promoting exercise motivation and adherence in sedentary university students. The hypotheses tested were: (a) a significantly greater percentage of participants in the treatment group would progress through the stages-of-change (SOC) from pre- to post-program compared to the control group, and (b) the treatment group would demonstrate significantly greater exercise adherence than the control group. Thirteen participants followed an 8-week running program on a mobile app. The control group ($n = 8$) followed the running program while the treatment group ($n = 5$) also received electronic prompts sent via Twitter to remind participants to exercise. The SOC modified four stage algorithm was used pre- and post-program to assess exercise motivation. Exercise adherence was measured by total number of completed workouts out of the 24 prescribed. A significantly greater number of participants in the control group progressed at least one stage from pre- to post-program compared to participants in the treatment group, $\chi^2 = 6.9$,

$p = 0.008$. Additionally, participants in the control group reported a greater number of completed workouts ($M = 12.5$, $SD = 7.6$) compared to the participants in the treatment group ($M = 3.6$, $SD = 4.0$). These findings suggest that while the mobile app may be beneficial for promoting exercise motivation and adherence, the electronic prompts sent via Twitter appeared to have no effect. Further studies are needed to determine the most effective way to use Twitter to increase exercise motivation and adherence of sedentary university students.

EFFECTS OF ELECTRONIC REMINDERS FOR PROMOTING EXERCISE MOTIVATION
AND ADHERENCE IN UNIVERSITY STUDENTS

By
Ashlee Hamilton

A Prospectus

Presented in Partial Fulfillment of Requirements for the
Degree of
Master of Science
in
Exercise Science
in
the Department of Kinesiology and Health
in
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2014

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Acknowledgements

I would like to express my sincerest gratitude to my advisor and thesis committee chair, Dr. Rebecca Ellis, who has been a tremendous mentor to me. Her knowledge, guidance, and motivation were fundamental to the success of this project. I would like to thank the members of my thesis committee: Dr. Beth Cianfrone and Dr. L. Jerome Brandon, for their encouragement, insightful comments, and hard questions. Additionally, I would like to thank my colleague and co-investigator on this project, David Ferrer for his assistance on all aspects of this study. Lastly, I would like to thank my family, friends, and classmates for their continued praise and support.

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Introduction

According to the World Health Organization (WHO), physical inactivity is the fourth leading cause of global mortality (WHO, 2010). Physical inactivity contributes to increased rates of cardiovascular disease, stroke, diabetes, hypertension, colon cancer, breast cancer, and depression (WHO, 2010). In the United States, less than half of all adults meet the federal exercise recommendations needed for health promotion of at least 150min/week of moderate intensity exercise or 75 min/week of vigorous intensity exercise (CDC, 2010). College-aged adults may be more vulnerable to the consequences of physical inactivity because this is usually their first time making decisions regarding their health behaviors. As a result, there is a significant decline in physical activity rates from adolescence to young adulthood, with about two-thirds of college students leading sedentary lifestyles (Harvey-Berino, Pope, Gold, et al., 2012; Tully & Cupples, 2011). Unfortunately, exercise interventions that target this population are also scarce (Harvey-Berino, et al., 2012; Tully & Cupples, 2011). Therefore, it is important to develop and test theoretically grounded exercise interventions that promote adoption and maintenance in college students.

When designing physical activity interventions, it is important to consider psychological behavior change theories. The Transtheoretical Model (TTM) for behavior change is used to describe how individuals' progress through behavior change and it is often applied to physical activity interventions (Adams & White, 2003). One of the key constructs, *stages-of-change* (SOC), suggests that individuals move through a series of five stages for adopting a desired behavior change (Adams & White, 2003; Dishman, 1994; King et al., 1992). These stages include: (1) *pre-contemplation*-individuals are not participating in exercise and have no intention to do so within the next six months; (2) *contemplation*-individuals are not participating in

exercise, but intend to do so within the next six months; (3) *preparation*-individuals have attempted changes in exercise behavior and intend to begin participating in regular exercise in the next month; (4) *action*-individuals are participating in recommended levels of exercise for less than six months; and (5) *maintenance*-individuals have met recommended criteria for exercise for at least six months (Adams & White, 2003; Prochaska & DiClemente, 1982).

Other constructs included in the TTM and that are hypothesized to vary according to the individual's SOC include *self-efficacy* (the amount of confidence an individual has for maintaining behavior change in a challenging situation), *decisional balance* (set of values seen as the pros and cons of making a behavior change), and *processes of change* (cognitive and behavioral strategies that individuals use to alter experiences and environments to support attempts to move between stages of behavior change; Bandura, 1997; Dishman, Vandenberg, Motl & Nigg, 2010; Marshall & Biddle, 2001). Cognitive processes are (1) *consciousness raising*-seeking/gaining information, (2) *dramatic relief*-emotional arousal regarding change, (3) *environmental reevaluation*-assessing how behavior affects others, (4) *self-reevaluation*-reassessing problem behavior in regards to self, and (5) *social liberation*-societal acceptance of behavior change (Adams & White, 2003; Dishman et al., 2010; Prochaska & DiClemente, 1982). Behavioral processes include (1) *counter conditioning*-replacing undesired behavior with desired, (2) *helping relationships*-use of social support for change, (3) *reinforcement management*-rewarding positive behavior, (4) *self-liberation*-commitment to change, and (5) *stimulus control*-managing stimuli that prompts change (Adams & White, 2003; Dishman et al., 2010; Prochaska & DiClemente, 1982). It is hypothesized that physical activity levels, as well as self-efficacy increase as individuals' progress through higher stages (Marshall & Biddle, 2001). Additionally, it is suggested that perceived benefits of exercise (pros) increase while perceived

disadvantages of exercise (cons) decrease throughout each forward stage change (Marshall & Biddle, 2001). Regarding processes of change, it is predicted that individuals in the precontemplation stage will experience fewer change processes than individuals in any other stage (Prochaska & DiClemente, 1983). Also, individuals are hypothesized to use more cognitive processes while in the earlier stages and more behavioral processes as they advance through the stages (Prochaska & DiClemente, 1983). A meta-analysis of the TTM found that changes in physical activity levels, self-efficacy, and decisional balance at each stage were consistent with TTM predictions (Marshall & Biddle, 2001). Marshall and Biddle (2001) also reported the largest effects across all processes of change were from pre-contemplation to contemplation and the smallest from action to maintenance. Finally, a critical review of 16 TTM physical activity interventions found that they produced generally positive short term adoption while long term maintenance needed further studies (Adams & White, 2003).

In addition to identifying an individual's readiness to begin exercise, interventions also should include behavior modification strategies (Dishman & Buckworth, 1996). Self-monitoring is a behavior change technique that involves self-observation, recording, and evaluation of a particular behavior and it is often used within health behavior change interventions (Olsen, Schmidt, Wrinkler, & Wipfli, 2011). Many studies support positive physical activity adoption results when self-monitoring is utilized (Morgan, Lubans, Collins, Warren, & Callister, 2011; Olsen et al., 2011). Stimulus control is another behavior change strategy (also identified as one of the TTM's behavioral processes of change) that involves manipulating situations that may create behavior change (Dishman et al. 2010). It has often been used in the form of periodic prompting in physical activity interventions and its use has shown promising results (Fry & Neff, 2009). In a systematic literature review of periodic prompts, the results indicated that frequency

of prompts played a significant role in behavior change (Fry & Neff, 2009). Individuals who received more frequent prompts made greater progress towards physical activity uptake or weight loss (Fry & Neff, 2009).

Factors such as lack of time, convenience, cost, structure, and flexibility of the program all affect exercise participation (King et al., 1992). Incorporating cellphone technology within exercise interventions may be a promising and cost effective way to address these factors while reaching large populations. According to the Pew Internet Study (2012), 91% of adult Americans have a cellphone and 56% have a smartphone, making mobile devices an effective channel to reach large populations. Additionally, smartphone owners use their phones to look up health related info (2%) and download applications to track or manage health (19%; Pew Internet Study, 2012). Several studies have relied on cellphones to interact with intervention participants using daily or weekly phone calls and text messages (Fanning, Mullen & McAuley., 2012; Gerber, Stolley, Thompson, Sharp & Fitzgibbon, 2009). One study found that of 68 women who received and read 3 weekly text message prompts, 54 believed the prompts helped them towards their weight loss goal (Gerber et al., 2009). A recent meta-analytic review of the efficacy of mobile devices on physical activity behavior change found a significant moderate effect size ($g = 0.52$) for exercise interventions delivered via mobile device (Fanning et al., 2012). They further suggested that when combined with a broader intervention, text messages are an efficient way to provide feedback/information to participants, as well as assess participant behavior (Fanning et al., 2012). However, because other counseling components were included, the analysis was unable to determine if text message interventions were as successful as all-encompassing interventions (Fanning et al., 2012). Although research is limited on health-related mobile

applications (apps), they are promising in that they are relatively inexpensive and can provide self-monitoring and data collection features (Fanning et al., 2012).

Common mobile apps that may have potential for influencing health-related behavior are social media apps such as Facebook and Twitter. In the United States, 83% of 18-29 year olds access social networks (Pew Internet Study, 2012). Social networks can aid in behavior change because individuals may receive emotional, informational, and decision making support (Li, Barnett, Goodman, Wasserman & Kemper, 2012). Another benefit of social media is that because it is associated with age and not education, race, or healthcare access, it can reach underserved populations (Harris, Mueller, Snider & Haire-Joshu, 2013; Pew Internet Study, 2012). However, social networks are more likely to be used by adults under 50 years of age and therefore, are not likely to be successful at targeting older adult populations (Pew Internet Study, 2012). Twitter, a relatively new social network that allows users to post and read 140 character messages, has not been studied extensively in relation to health-related behaviors, but can be used as a way to prompt or remind participants of a desired behavior change. It has 140 million users worldwide with 98,000 tweets being sent each minute (Harris et al., 2013). According to a study by the CDC, local health departments nationwide are beginning to use Twitter accounts to disseminate information regarding disease treatment and management (Harris et al., 2013). Further research could establish an understanding of how Twitter (and other social media) can be used effectively within physical activity interventions.

Statement of the Research Question

Although there are many studies demonstrating successful exercise interventions, there is a need for further investigation to develop interventions that allow for large scale progress. Specifically, the best type of prompt that facilitates long term behavior change has not yet been

determined (Fry & Neff, 2009). Because research on mobile physical activity apps is limited, more research is warranted to expand upon how to effectively use it within large scale interventions. Despite Twitter having appealing qualities, there has been limited published use of Twitter (social media) as a method for delivering electronic exercise prompts. Therefore, in this study we determined if the use of a mobile app and electronic prompts sent via Twitter promoted exercise motivation and adherence in low active university students.

Literature Review

To date, three studies have used mobile phone apps/programs as a means for participants to self-monitor their physical activity levels. These studies included 1 randomized, stratified controlled trial (Hurling et al., 2007), 1 randomized controlled trial (Turner-McGrievy & Tate, 2013), and 1 uncontrolled pilot study (Fukuoka, Vittinghoff, Jong & Haskell, 2010). The study participants consisted of underactive adults age 30-55 years (Hurling et al., 2007), overweight/obese adults age 18-60 years (Turner-McGrievy et al., 2013), and sedentary women age 25-70 years (Fukuoka et al., 2010). Study durations ranged from 3 weeks to 6 months and sample sizes (*N*) ranged from 41-77.

Each study used a different mode of prompts in addition to their chosen mobile app intervention. In a 6-month intervention, the study targeting overweight/obese adults included a biweekly podcasts control group and a podcast + mobile app intervention group. The podcasts provided information on nutrition, physical activity, and problem solving. Participants in the intervention group were encouraged to download a mobile app and Twitter app to self-monitor their diet and exercise, as well view posts that reinforce the podcasts (Turner-McGrievy et al., 2013). Intervention group participants reported higher intentional physical activity at 6 months than the control group ($p = 0.02$).

The intervention targeting sedentary women required participants to wear a pedometer and self-report their steps via mobile phone (Fukouka et al., 2010). Participants received daily, tailored prompts from the researcher (via mobile phone) that asked them to record their steps in a mobile phone diary. The results showed an increase in average daily steps at the end of the 3-week period ($p = 0.001$). In the study targeting underactive adults, all participants wore a Bluetooth compatible accelerometer (Hurley et al., 2007). The intervention group was asked to use an internet, email, and mobile phone behavior change program to self-report their weekly activity, pre-plan their physical activity for the upcoming week, as well as receive motivational prompts and physical activity feedback via email or mobile device. The control group was advised at the start of the intervention on recommended physical activity levels, but had no access to the behavior change program and received no feedback. There was no significant difference in the MET minutes per week between test and control groups ($p = 0.12$). However, when only MET minutes per week within leisure time were analyzed, the test group was significantly higher than the control.

Although these interventions showed promising results for using mobile apps/programs for increasing physical activity participation, they are not without limitations. Two interventions included additional elements such as the use of accelerometers and pedometers, which may have resulted in participants altering their behavior in response to wearing these measurement devices (i.e., reactivity; Fukuoka et al, 2010; Hurley et al, 2007). This makes it difficult to determine whether the mobile apps and prompts were the primary cause of the changes in physical activity behavior. Also, none of the studies compared a mobile app only group with a group using both a mobile app and receiving prompts. Moreover, only one study used social media as a method for delivering prompts, but it cannot be determined if it played a role in the intervention group's

success because participants may have missed the prompts (Turner-McGrievy et al., 2013). Additional research is needed to determine the effectiveness of social media on physical activity promotion. Other limitations related to design and procedures included discrepancies in self-reporting (Turner-McGrievy et al., 2013), small sample sizes (Fukuoka et al, 2010), short intervention period (Fukuoka et al, 2010), and lack of a control group (Fukuoka et al, 2010). Finally, the study populations included mostly female (Fukuoka et al, 2010; Hurley et al, 2007; Turner-McGrievy et al., 2013), overweight/obese populations (Fukuoka et al, 2010; Turner-McGrievy et al., 2013), and only one study included adults less than 25 years (Turner-McGrievy et al., 2013). These results may not translate to other participant groups and leaves a need to study physical activity interventions involving mobile apps among college-aged populations.

Rationale, Statement of the Research Purpose, and Hypotheses

Mobile apps provide an efficient way to track physical activity goals and progress. Electronic prompts can enhance mobile apps by encouraging and reminding individuals to participate in physical activity. The goal of the studies reviewed was to increase physical activity among participants and two of the studies were successful at significantly increasing physical activity in the intervention participants (Fukouka et al, 2010; Turner-McGrievy et al., 2013). As evident by the limited number of studies reviewed, research on the use of mobile apps and social media for physical activity promotion is limited, despite both having promising qualities. More research is warranted to expand upon how to effectively use both within large scale interventions. Therefore, the purpose of this study was to examine the effectiveness of a mobile app and electronic prompts sent via Twitter for promoting exercise motivation and adherence in sedentary university students. The following hypotheses were tested within a

quasi-experimental design that compared a treatment group (mobile app + Twitter prompts) to a control group (mobile app):

- (a) a significantly greater percentage of participants in the treatment group would progress through the SOC from pre- to post-program compared to the control group, and
- (b) the treatment group would demonstrate significantly greater exercise adherence than the control group.

Method

Participants

Participants were recruited from the student body at Georgia State University (GSU) through passive recruitment techniques including announcements in undergraduate classes, flyers posted on campus, and postings on social media sites (i.e., Facebook; see Appendix A). The participants met the following inclusion criteria: (1) 18-24 years old, (2) inactive (not physically active 3 days a week for the past 6 months), (3) had an intention to be more physically active (contemplation or preparation SOC), (4) physically able to start a low to moderate-intensity exercise program, (5) had access to an Apple iPhone, ITouch, or iPad or an Android phone or tablet, (6) willing to pay \$2.99 for the mobile app, and (7) willing to create (if they did not previously have a Twitter account) and follow the research study Twitter account.

Measures

Personal history questionnaire. A demographics questionnaire was developed for this study that assessed age, height, weight, gender, year in school, and race/ethnicity. This questionnaire also asked about the type of phone the participant uses, willingness to purchase a mobile app, and his/her typical Twitter usage (see Appendix B). Body mass index was calculated from self-reported height and weight.

Physical activity readiness questionnaire (PAR-Q). The PAR-Q is a seven-item, self-reported, pre-participation questionnaire that assesses an individual's readiness to begin a physical activity program (ACSM, 2013; see Appendix C). One or more answers of "yes" indicate that the individual may have potential limitations for beginning a physical activity program. Participants were not allowed to participate in the study if they responded "yes" to any of the seven items.

SOC modified four stage algorithm. This four item self-report instrument was used to assess participants SOC. It categorized individuals into either a (1) precontemplation, (2) contemplation, (3) preparation, or (4) action/maintenance stage (Kosma & Ellis, 2010; see Appendix D). Construct validity is supported because the algorithm accurately distinguished physical activity levels across the stages (Kosma & Ellis, 2010). For participants who indicated not being physically active (stages 1-3), there was a follow-up question that determined how long it has been since the individual was regularly physically active.

Exercise adherence. Exercise adherence was determined by the number of completed training sessions during the 8-week program (3 workouts x 8 weeks = 24 training sessions; see Appendix E). Participants were asked to record each training session and email them to the researcher.

Procedures

The study procedures were approved by the Georgia State University Institutional Review Board (see appendix F). Students who responded to the study advertisements were scheduled a face-to-face meeting with the study PI in the Exercise Psychology lab. During this meeting, potential participants first reviewed and signed the IRB approved consent form (see Appendix G) and then completed the Personal History Questionnaire, the PAR-Q, and the SOC

questionnaire to determine study qualification. Participants who did not meet the inclusion criteria were thanked and excused from the meeting.

Participants who met the inclusion criteria were then randomized into a mobile app group (control) or a mobile app + Twitter group (treatment). All participants were asked to download the 5kRunner mobile app (Apple) or Ease into 5k mobile app (Android) and to show confirmation to the researchers upon downloading the app. The participants were shown by the researcher how to use the mobile app. In addition, the mobile app + Twitter group was asked to provide their Twitter account information and follow the Twitter account set up by the researcher.

Both groups were advised to follow the running program that was pre-set by the mobile apps over an 8-week period. The programs were designed for beginning runners to run 3 days per week, with running time gradually increasing from 25 minutes to 45 minutes. Participants were asked to record each training session and email them to the researcher. Tweets containing the message “Don’t forget to do your workouts this week” were sent three times a day, at 8:00 am, 1:00 pm and 6:00 pm, seven days a week to the mobile app + Twitter group. The researcher used the program TweetDeck to pre-schedule all of the tweets so they were delivered at the same time every day. No other tweets were sent from the researcher’s account.

Upon completion of the 8-week program, participants were asked to complete a follow-up visit. At this time, they were asked to complete the SOC Modified 4 Stage Algorithm again. Participants in the mobile app + Twitter group were encouraged to stop following the researchers Twitter account.

Statistical Analyses

Tests of normality and outliers were performed before analyses. Multivariate analysis of variance (MANOVA) and Chi-square were used to examine baseline differences on demographic variables between the treatment and control groups. Demographic variables (age, BMI, race, education, year in school) were summarized using frequencies, means, and standard deviations.

To test the first hypothesis, SOC progression was examined with Chi-square analysis using three stage movement groups (progress, regress, stable). Stage progression was defined as an increase of one or more stages from baseline, stage regression is a decrease of one or more stages from baseline, and stable is maintaining baseline stage. Intention-to-treat procedures were used by carrying forward the pre-program SOC score for participants who did not attend the post-program visit (stage progression = stable). To test the second hypothesis, one-way analysis of variance (ANOVA) was used to examine the differences between the treatment and control groups on exercise adherence. The proportion of variance in the dependent variable explained by the independent variable (i.e., η_p^2) was determined by using thresholds of .01 = small, .06 = moderate, and .14 = large variance (Cohen, 1988). Statistical calculations were considered significant at alpha level of $p < .05$. All analyses were conducted using SPSS version 21.

Results

Twenty-one students attended the pre-screening visit, but eight did not meet the inclusion criteria ($n = 4$ were not in the appropriate SOC, $n = 2$ had at least 1 yes response on the PAR-Q, $n = 2$ were older than 24 years of age). The final sample included 13 students with an average age of 21.5 years ($SD = 0.9$; Range = 20-23 years). Most of the participants were females (84.6%) enrolled in their senior (61.5%) year of school (see Table 1 for participant characteristics). The exercise adherence data were normally distributed with no identified outliers with skewness of 1.0 ($SE = 0.6$) and kurtosis of 0.5 ($SE = 1.2$). Finally, there were no

significant group differences on the demographic variables of age, BMI, race, education, and year in school between the treatment and control groups. It should be noted that a possible group difference for BMI (M treatment group = 30.9; M control group = 24.7) was not detected by the MANOVA because of insufficient power (observed power = 0.3); however, as a result of the small sample size, BMI was not used as a covariate in further analyses.

Table 1 *Participant Characteristics*

<i>Characteristics</i>		<i>Control</i>		<i>Treatment</i>		<i>Total</i>	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age (years)		21.6	1.0	21.4	0.8	21.5	0.9
BMI		24.7	6.4	30.9	5.4	27.1	6.6
		<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
Gender	Female	7	87.5	4	80.0	11	84.6
	Male	1	12.5	1	20.0	2	15.4
Race	African-American	4	50.0	1	20.0	5	38.5
	Caucasian	2	25.0	2	40.0	4	30.8
	Hispanic or Latino	2	25.0	2	40.0	4	30.8
Year in school	Junior	3	37.5	1	25.0	4	30.8
	Senior	4	50.0	4	75.0	8	61.5
	Graduate	1	12.5	0	0.0	1	7.7
Twitter user prior to intervention		6	46.2	2	15.4	8	61.5

As the result of the study inclusion criteria, participants were in the contemplation ($n = 3$; 23.1%) or preparation stages ($n = 10$; 76.9%) before the 8-week exercise program. After the program, 46.2% ($n = 6$) were in action, 38.5% ($n = 5$) were in preparation, and 15.4% ($n = 2$) were in contemplation. When comparing the treatment and control groups on SOC movement, a significantly greater number of participants in the control group progressed at least one stage from pre- to post-program compared to participants in the treatment group, $\chi^2 = 6.9$, $p = 0.008$. Six of the eight participants in the control group progressed; whereas all participants in the treatment group remained stable (see Table 2). These findings do not support the first hypothesis.

Table 2 *SOC Progression*

		SOC Progression				Total
		stable	%	progress	%	
Group	Control	2	25.0	6	75.0	8
	Treatment	5	100.0	0	0.0	5
Total		7	53.8	6	46.2	13

Group differences were also detected between the treatment and control groups on exercise adherence, $F = 5.6$, $p = .03$, $\eta_p^2 = .3$, observed power = .5. Specifically, participants in the control group reported a greater number of completed workouts ($M = 12.5$, $SD = 7.6$) compared to the participants in the treatment group ($M = 3.6$, $SD = 4.0$). This finding does not support the second hypothesis.

Discussion

Although two-thirds of college students lead sedentary lifestyles, exercise interventions that target this population are limited (Harvey-Berino, et al., 2012; Tully & Cupples, 2011). Therefore, the purpose of this study was to examine the effectiveness of a mobile app and

electronic prompts sent via Twitter for promoting exercise motivation and adherence in sedentary university students. Contrary to study hypotheses, it was found that exercise motivation and exercise adherence were significantly lower in the treatment group (Mobile App + Twitter prompts) than in the control group (Mobile App). These findings suggest that while the mobile app may be beneficial for the promotion of exercise motivation and adherence, the electronic prompts sent via Twitter appeared to have no effect.

The first hypothesis was that a significantly greater percentage of participants in the treatment group would progress through the SOC from pre- to post-program compared to the control group. However, it was found that more participants in the control group progressed at least one SOC while all of the participants in the treatment group remained stable. These findings are contrary to previous research on the use of electronic prompts to enhance exercise motivation. Gerber et al. (2009) used text message prompts to motivate healthy diet and exercise behaviors in adult African-American women and found that 79% of the participants reported that the prompts motivated them to make changes to meet their weight loss goals. These equivocal results indicate that more research is needed to gain a better understanding of how electronic prompts can motivate individuals for exercise.

The second hypothesis was that the treatment group would demonstrate significantly greater exercise adherence than the control group. The control group, instead, completed significantly more workouts than the treatment group. The findings of this study do not support previous research on the use of electronic prompts to promote exercise. Previous studies that examined the use of electronic prompts on exercise adherence showed a positive association between the use of electronic prompts and physical activity participation (Fukuoka et al., 2010; Hurley et al., 2007; Turner-McGrievy et al., 2013). More specifically, a study by Turner-

McGrievy et al. (2013) found participants reported higher intentional physical activity when they used a mobile app and Twitter to receive reinforcing prompts versus the control group that only received biweekly podcasts. Contrary to the current results, previous research suggests that mobile apps and Twitter are useful in promoting exercise behavior.

Although these findings suggest that the electronic prompts sent via Twitter appeared to have no effect on exercise motivation and behavior, these results should be interpreted with caution due to study limitations. First, the analyses were not sufficiently powered because of the small sample size; therefore, increasing the risk of type II error. Several factors contributed to the small sample size including: (a) passive recruiting techniques that may have limited the number of individuals who knew about the research, (b) strict inclusion criteria that removed eight participants at the pre-program visit, but possibly prevented others from volunteering altogether, and (c) the use of a running program that may have further limited the number of individuals interested in the research because although they may be interested in becoming more active, they are not interested in doing that by running. As a result of insufficient power, potential confounding variables also went undetected. In this study, the treatment group had a higher average BMI at baseline than the control group. Although BMI was not used as a covariate in the analyses, as a determinant of exercise, higher BMI has been associated with lower levels of physical activity (King et al., 1992), and thus may explain the contradictory results. Another possible study limitation is that intention-to-treat procedures had to be used for all participants in the treatment group because none of them completed the post-program visit. Lastly, participants in the treatment group (15.4%) were either new users to Twitter or had accounts that were inactive before the start of this study; whereas, more participants in the control group (46.2%) were regular Twitter users. This makes it difficult to account for how

many of the tweets were actually seen by the participants in the treatment group and therefore, may not have been exposed to the intervention. It may be beneficial for future studies to examine the use of Twitter prompts on active Twitter users.

In summary, the results of the current study suggested that the use of a mobile app may aid in the promotion of exercise motivation and adherence, but no added benefits were observed from the use of electronic prompts delivered through Twitter. However, before definitive conclusions can be made about the use of electronic prompts delivered via Twitter to promote exercise motivation and behavior of sedentary college students, future studies with larger samples sizes and active Twitter users are necessary. It should also be noted that no negative consequences were reported while participants followed the 8-week exercise program; therefore, the use of mobile apps can be recommended as a tool that can potentially improve exercise motivation and participation in low active college students, while more research is needed to determine the most effective way to use Twitter to do the same.

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Appendix A

Recruitment Advertisement

RESEARCH VOLUNTEERS NEEDED

Exercise Adherence using a mobile application

Volunteers that want to go from sitting on the couch to running a 5k are needed to participate in a study to determine how well a mobile application helps people stick with an exercise program. Join a study that helps whip you into shape and may improve your health!



Eligibility Requirement:

- GSU undergraduate students from the Atlanta campus between the ages of 18-24 who are willing to walk/run for 25-45 minutes 3 days a week for 8 weeks
- Have not been consistently active for the past 6 months
- Own an iPhone and willing to pay for an app
- Willing and able to use Twitter
- If you are interested in the study, please contact 1 of the following people:
 - David Ferrer at dferrer1@gsu.edu
 - Ashlee Hamilton at ahamilton16@student.gsu.edu
 - Dr. Rebecca Ellis at rellis@gsu.edu

Appendix B

Personal History Questionnaire

1. DATE _____		
2. NAME: LAST _____	FIRST _____	MI _____
3. PHONE NUMBER _____	4. EMAIL ADDRESS _____	
5. AGE _____		
6. HEIGHT _____ <i>ft</i> _____ <i>in</i>	7. CURRENT WEIGHT _____ <i>lbs</i>	
8. GENDER ____ Male ____ Female		
9. YEAR IN SCHOOL: ____ Freshman (0-29 credit hours) ____ Sophomore (30-59 credit hours) ____ Junior (60-89 credit hours) ____ Senior (90 or more credit hours)		
10. RACE/ETHNICITY: ____ White or Caucasian ____ Black or African American ____ Hispanic or Latino ____ Asian ____ Native Hawaiian or Pacific Islander ____ Multiracial ____ Other		
11. DO YOU OWN AN IPHONE? ____ Yes (If yes, please answer the question below): Are you willing to pay \$2.99 for a mobile app? ____ Yes ____ No ____ No		
12. DO YOU HAVE A TWITTER ACCOUNT? ____ Yes (If yes, please answer the questions below): a. What is your Twitter account name? _____ b. How long have you had this Twitter account? _____ c. On a typical day, how many times do you Tweet? _____ d. Typically, how many times a day do you check Twitter? _____ e. How many Twitter followers do you have? _____ f. How do you check your Twitter account? Check all that apply. ____ Phone ____ Computer ____ i-Pad ____ Other ____ No (If no, please answer the question below): Would you be willing to make a Twitter account? ____ Yes ____ No		

Appendix C

Physical Activity Readiness Questionnaire (PAR-Q)

Physical Activity Readiness
Questionnaire (PAR-Q)
(revised 1998)

PAR - Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
<input type="checkbox"/>	<input type="checkbox"/>	1. Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?
<input type="checkbox"/>	<input type="checkbox"/>	2. Do you feel pain in your chest when you do physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	3. In the past month, have you had chest pain when you were not doing physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	4. Do you lose your balance because of dizziness or do you ever lose consciousness?
<input type="checkbox"/>	<input type="checkbox"/>	5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
<input type="checkbox"/>	<input type="checkbox"/>	7. Do you know of <u>any other reason</u> why you should not do physical activity?

YES to one or more questions

If
you
answered

Talk with your doctor by phone or in person **BEFORE** you start becoming much more physically active or **BEFORE** you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want—as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active—begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal—this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever—wait until you feel better; or
- if you are or may be pregnant—talk to your doctor before you start becoming more active.

Please note: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Important Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agent assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

You are encouraged to copy the PAR-Q but only if you use the entire form

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.

NAME _____

SIGNATURE _____

DATE _____

SIGNATURE OF PARENT
or GUARDIAN (for participants under the age of majority) _____

WITNESS _____

© Canadian Society for Exercise Physiology
Société canadienne de physiologie de l'exercice

Supported by:  Health Canada  Santé Canada

Appendix D

SOC Modified Four Stage Algorithm

Regular physical activity includes an accumulation of 30 minutes or more of activities of moderate intensity for 5 days per week or an accumulation of 20 minutes or more of activities of vigorous intensity for 3 days per week. **Such physical activities include** walking (with or without crutches, canes, braces, or prostheses), jogging, wheeling, ball games (e.g., doubles and/or singles tennis, softball, basketball, golf without a cart), swimming, cycling, arm cranking, dancing, and other similar activities. Activities that are primarily sedentary, such as bowling, playing golf with a cart, and passive stretching, are **NOT** considered regular physical activity.

Vigorous-intensity activities largely increase your breathing and heart rate, and conversation is difficult or broken.

Moderate-intensity activities raise your heart rate and make you break a sweat, yet you are still able to carry on a conversation.

Based on the above definition of regular physical activity, are you regularly active and do you intend to continue being regularly physically active?

_____ Yes

_____ No

If you answered “No” above, then please CHECK one of the three statements below that describes you the best:

_____ 1. I am inactive or less active than the recommended activity levels and I do **NOT** intend to become regularly physically active in the next 6 months.

_____ 2. I am inactive or less active than the recommended activity levels and I intend to become regularly physically active in the next 6 months.

_____ 3. I am inactive or less active than the recommended activity levels and I intend to become regularly physically active in the next month.

If you do not currently participate in physical activity (you answered “No” above), then please CHECK one of the statements below that describes you the best:

How long has it been since you did regular physical activity or exercise?

_____ Less than 6 months

_____ More than 6 months but less than 1 year

_____ More than 1 year but less than 2 years

_____ More than 2 years but less than 5 years

_____ More than 5 years but less than 10 years

_____ More than 10 years

_____ I have never been regularly physically active

Appendix E

Exercise Training Program

5k runner training program

Week 1	Day 1: 25 min Duration		Day 2: 30 min Duration		Day 3: 30 minute Duration
	5 min warm up walk		5 min warm up walk		5 min warm up walk
	15 min: 1 min run + 1.5 Min Walk; complete 6 times		20 min: 1 min run + 1.5 min walk; complete 8 times		20 min: 1 min run + 1.5 min walk; complete 8 times
	5 min cool down walk then stretch		5 min cool down walk then stretch		5 min cool down walk then stretch

Week 2	Day 1: 28 min Duration		Day 2: 28 min Duration		Day 3: 31 minute Duration
	5 min warm up walk		5 min warm up walk		5 min warm up walk
	18 min: 1.5 min run + 2 min walk(4 times) 1 min run + 1 min walk(2 times)		18 min: 1.5 min run + 2 min walk(4 times) then 1 min run + 1 min walk (2 times)		21 min: 1.5 min run + 2 min walk; complete 6 times
	5 min cool down walk then stretch		5 min cool down walk then stretch		5 min cool down walk then stretch

Week 3	Day 1: 26 min Duration		Day 2: 26 min Duration		Day 3: 30 minute Duration
	5 min warm up walk		5 min warm up walk		5 min warm up walk
	16 min: 1.5 run + 1.5 walk then 2.5 run + 2.5 walk (2 times) then 1.5 run + 1.5 walk		16 min: 1.5 run + 1.5 walk then 2.5 run + 2.5 walk (2 times) then 1.5 run + 1.5 walk		20 mi: 2 min run + 2 min walk then 3 min run + 3 min walk (2 times) then 2 min run + 2 min walk
	5 min cool down walk then stretch		5 min cool down walk then stretch		5 min cool down walk then stretch

	Day 1: 34 min Duration		Day 2: 36 min Duration		Day 3: 34 minute Duration
	5 min warm up walk		5 min warm up walk		5 min warm up walk

Week 4	24 min: 3 min run + 2 min walk then 4 min run + 3 min walk (2 times) then 3 min run + 2 min walk		26 min: 3 min run + 2 min walk then 5 min run + 3 min walk (2 times) then 3 min run + 2 min walk		24 min: 3 min run + 2 min walk then 5 min run + 2 min walk (2 times) then 3 min run + 2 min walk
	5 min cool down walk then stretch		5 min cool down walk then stretch		5 min cool down walk then stretch

Week 5	Day 1: 32 min Duration		Day 2: 36 min Duration		Day 3: 31 minute Duration
	5 min warm up walk		5 min warm up walk		5 min warm up walk
	22 min: 5 min run + 3 min walk then 6 min run + 3 min walk then 5 min run		26 min: 5 min run + 3 min walk then 8 min run + 5 min walk then 5 min run		21 min: 8 min run + 5 min walk then 8 min run
	5 min cool down walk then stretch		5 min cool down walk then stretch		5 min cool down walk then stretch

Week 6	Day 1: 35 min Duration		Day 2: 33 min Duration		Day 3: 33 minute Duration
	5 min warm up walk		5 min warm up walk		5 min warm up walk
	25 min: 10 min run + 5 min walk then 10 min run		23 min: 10 min run + 3 min walk then 10 min run		23 min: 15 min run + 3 min walk then 5 min run
	5 min cool down walk then stretch		5 min cool down walk then stretch		5 min cool down walk then stretch

Week 7	Day 1: 30 min Duration		Day 2: 30 min Duration		Day 3: 35 minute Duration
	5 min warm up walk		5 min warm up walk		5 min warm up walk
	20 min run		20 min run		25 min run
	5 min cool down walk then stretch		5 min cool down walk then stretch		5 min cool down walk then stretch

	Day 1: 38 min Duration		Day 2: 40 min Duration		Day 3: 45 minute Duration
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Week 8	5 min warm up walk		5 min warm up walk		5 min warm up walk
	28 min run		30 min		35 min run
	5 min cool down walk then stretch		5 min cool down walk then stretch		5 min cool down walk then stretch

Appendix F

INSTITUTIONAL REVIEW BOARD

Mail: P.O. Box 3999
Atlanta, Georgia 30302-3999
Phone: 404/413-3500
Fax: 404/413-3504

In Person: Alumni Hall
30 Courtland St, Suite 217



February 05, 2014

Principal Investigator: Stephanie Rebecca Ellis

Study Department: GSU - Kinesiology & Health

Study Title: Effects of a Mobile Application and Electronic Reminders for Promoting Exercise Adherence in Sedentary Undergraduate Students

Study Number: H13512

Review Type: Expedited Amendment, Reference Number: 326207

Approval Date: 02/05/2014

Expiration Date: 08/22/2014

Amendment Effective Date: 2/5/2014

The Georgia State University Institutional Review Board reviewed and **approved** the amendment to your above referenced Protocol.

This amendment is approved for the following modifications:

- Modifies inclusion criteria
- Updates materials with new inclusion criteria

The amendment does not alter the approval period which is listed above and the study must be renewed at least 30 days before the expiration date if research is to continue beyond that time frame. Any unanticipated/adverse events or problems resulting from this investigation must be reported immediately to the University Institutional Review Board.

For more information visit our website at www.gsu.edu/irb.

Sincerely,

A handwritten signature in black ink, appearing to read "Cynthia A. Hoffner".

Cynthia A. Hoffner, IRB Vice-Chair

Federal Wide Assurance Number: 00000129

Appendix G
Georgia State University
Department of Kinesiology and Health
Informed Consent

Title: Effects of a Mobile Application and Electronic Reminders for Promoting Exercise Adherence in Sedentary Undergraduate Students

Principal Investigator: Rebecca Ellis, PhD
Student Principal Investigator: David Ferrer, MS
Student Principal Investigator: Ashlee Hamilton

I. PURPOSE:

The purpose of this study is to investigate the effects of a mobile application and Twitter reminders on adherence to a training program for beginning runners. To find out if you qualify for this study, you will complete a prescreening assessment.

To qualify to participate in this study, you will need to meet the following criteria:

- you are between the ages of 18-24,
- you are inactive (have not been physically active 3 days a week for the past 6 months),
- you want to be more physically active,
- you are physically able to start a low to moderate-intensity exercise program,
- you own an Apple iPhone,
- you are willing to create and follow the research study Twitter account (if you do not already have one), and
- you are willing to pay \$2.99 for a mobile application.

II. PROCEDURES:

If you qualify, we will contact you to invite you to participate in the 8-week training study. If you decide to participate in the training study, you will be assigned to one of three running groups. One group will follow a training program for beginning runners without a mobile application and Twitter reminders. A second group will follow the same training program for beginning runners using a mobile application, but without Twitter reminders. A third group will follow the same training program for beginning runners using a mobile application and will receive Twitter reminders.

Before beginning the training program, you will be asked to send a confirmation email to the researchers to document the purchase of the iPhone app (for subjects assigned to that group) and the confirmation of the Twitter account (for subjects assigned to that group you will send us the Twitter account name you have established). To determine that the participants assigned to the Twitter group are following the research study, you will be asked to follow the designated researcher who will create a Twitter account strictly for this project. He/she will be able to monitor the study followers and the Twitter reminders will be sent to this group of followers. If assigned to this group, you will be encouraged to stop following the Twitter account associated with the research study once you have completed and/or withdrawn from the study.

During the 8-week training program, you will run 3 days a week. The duration of each session will gradually increase from 25 minutes up to 45 minutes. You will record your completed training sessions and email this information to the researchers. At the end of the 8-week training program, you will complete questionnaires about physical activity and motivation that will be administered by one of the researchers.

The following questionnaires will be completed before and after the 8-week training program unless otherwise noted:



Consent Form Approved by Georgia State University IRB August 23, 2013 - August 22, 2014

- **Physical Activity Readiness Questionnaire (PAR-Q)** will determine if you are physically able to begin a low to moderate-intensity exercise program (only completed before the 8-week training program).
- **Personal History Questionnaire** will include questions about age, race, gender, education level, income, marital status, etc., and frequency of use of social media including Twitter.
- **Physical Activity Questionnaires** will determine the types of physical activity you have done, how often you are physically active, and for how long you do physical activity.
- **Exercise Motivation Questionnaires**, which will measure your motivation for exercise.

III. RISKS:

There are no risks involved in responding to the various questionnaires. Physical activity, however, does provide a small degree of risk for negative responses that include sore muscles, dizziness, nausea, fatigue, heightened blood pressure, heart attack, stroke, and in rare instances death. The most recent statistics suggest that one in four hundred thousand hours of moderate-intensity exercise, among high-risk participants, results in negative responses requiring medical attention. The exercises in this program are of low to moderate intensity, and therefore, pose minimal risk. To identify participants who may be at an increased risk for experiencing these negative responses, all participants will complete the PAR-Q and any participants identified as a high-risk candidate will not qualify to participate in the 8-week training program. If for any reason you sustain an injury during this study, please notify Dr. Ellis (404-413-8370 or rellis@gsu.edu). If the injury requires medical attention, you can visit the Student Health Center located at 141 Piedmont Ave, Suite D Atlanta, GA 30303 (404-413-1930) or your own primary physician. Georgia State University; however, has not set aside funds to pay for this care or to compensate you if an injury should occur.

IV. BENEFITS:

Participation in this study has the potential to benefit you personally. An increase in physical activity level can improve cardiovascular and respiratory function, reduce coronary artery disease risk factors, and decrease morbidity and mortality. In addition, increased physical activity can help you mentally by lowering levels of anxiety and depression. Physical activity can increase your quality of life and improve your feelings of well-being.

V. VOLUNTARY PARTICIPATION AND WITHDRAWAL:

Your participation in this research study is voluntary. If you decide to be in the study and change your mind, you have the right to drop out of the research study at any time without penalty. You may skip questions or stop participating in this research study at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VI. CONFIDENTIALITY:

We will keep your records private to the extent allowed by law. Dr. Rebecca Ellis and members of the research team listed on the consent form will have access to the information you provide. Information may also be shared with those who make sure the study is done correctly [GSU Institutional Review Board, the Office for Human Research Protection (OHRP)]. We will use a code specific to the project number rather than your name on study records. The hard copy of information you provide will be stored in a locked filing cabinet in a locked office, and the electronic data will be stored on password protected files. A code sheet that identifies you will be stored separately from the data to protect privacy. Your name and other facts that might point to you will not appear when we present this study or publish its results. The findings will be summarized and reported in group form. You will not be identified personally.



Consent Form Approved by Georgia State University IRB August 23, 2013 - August 22, 2014

VII. CONTACT PERSONS:

Contact Dr. Rebecca Ellis at 404-413-8370 or rellis@gsu.edu if you have questions about this study. If you have questions or concerns about your rights as a participant in this research study, you may contact Susan Vogtner in the Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu

VIII. COPY OF CONSENT FORM:

If requested, we will give you a copy of this consent form to keep.

If you are willing to volunteer for this research, please sign below.

Participant Date

Principal Investigator or Researcher Obtaining Consent Date