2016

Testing Fitness-Related Phone Application Technology in Physical Activity Classes

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TESTING FITNESS-RELATED PHONE APPLICATION TECHNOLOGY IN PHYSICAL ACTIVITY CLASSES

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and Agricultural and
Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Science

in

The School of Kinesiology

by
Angela Nicole Simonton
B.S., University of Wyoming, 2014
May 2016

ACKNOWLEDGEMENTS

First, I thank my husband, Kelly, for he has been instrumental not only in my graduate school experience but in my life. If it weren't for his unconditional love and support, I would not have been able to reach my goals. Next I thank Dr. Alex Garn for his mentorship and genuine concern for my success. He has helped provide me with incredible opportunities that have helped me grow as a graduate student, future professional, and as a person. Dr. Solmon has also played a large role in my development, and I thank her for the continuous opportunity, support, and advocacy in my potential. I am also thankful for the other members of my committee, Dr. Lisa Johnson and Dr. Kip Webster who have each played a significant part in my education at LSU. Finally, I am incredibly grateful for my family, both the Chambers' and the Simonton's, and all of my amazing friends in Baton Rouge and back home because without them I would not have been able to experience all of the wonderful things that I have this early in my life.

TABLE OF CONTENTS

ABSTRACT

Many young adults are inactive (Centers for Disease Control and Prevention, 2010) and time spent on smartphones and applications ("apps") is high (Pew Research Center, 2014; The Nielsen Company, 2014). Technology is often viewed as a barrier to health behavior, so seeking ways of using technology to facilitate physical activity (PA) and other health-related behaviors could be beneficial. The Social Cognitive Theory (SCT) framework was used to determine if the NexTrack smartphone app could increase PA behaviors and SCT-related constructs among university students in PA courses. Participants in the NexTrack app intervention group were hypothesized to report increased psychosocial and behavioral PA outcomes compared to students in the control condition.

Using quasi-experimental design, university students (N=181) were randomly assigned to one of two groups during an eight-week intervention. The intervention group was introduced to NexTrack and asked to log PA while control participants used paper and pencil logs. All received an instructional presentation on goal setting and were emailed weekly reminders to log their activity. Each participant completed previously established surveys on self-reported PA behavior, self-efficacy (SE), and self-regulation (SR) at baseline and post-intervention.

Descriptive statistics, bivariate correlation estimates, and internal consistency estimates were calculated. Main analyses included a series of 2 (gender: male; female) x 2 (group: intervention; control) x 2 (time: baseline; 8-weeks) repeated measures analysis of variance (RM-ANOVA) tests and follow-up mean comparisons to examine group differences. Findings revealed no significant differences in PA, SE, or SR as a result of the intervention. However, participants in the control group logged significantly more events than those in the intervention.

Results can help guide technology use in PA courses. Findings revealed that incorporating the NexTrack smartphone app did not facilitate students' PA or psychosocial related behavior. Although

increases in SCT related constructs were not seen by the control group, it may be beneficial to incorporate paper and pencil logging for a comprehensive understanding of PA habits. Based on the findings, use of NexTrack did not facilitate SE, SR, or increases in PA. More research is needed to determine how to best use app technologies as facilitators of PA.

INTRODUCTION

It is estimated that approximately one fifth of the adult population is reported to be physically inactive (Centers for Disease Control and Prevention [CDC], 2010). Physical inactivity has been linked to numerous cardiovascular illnesses including obesity, diabetes, and high blood pressure (National Physical Activity Plan Alliance, 2014). It is also known that following recommendations for engagement in physical activity (PA) and eating a healthy diet help reduce health risks associated with chronic diseases (Carlson, Fulton, Schoenborn, & Loustalot, 2010; McCracken, Jiles, & Blanck, 2007; U.S. Department of Health and Human Services, 2008). One factor contributing to physical inactivity is sedentary behavior (World Health Organization, 2015) and possibly the use of information and communications technology (ICT). The creation of the internet provided a way for two people to communicate and share information without having to meet face-to-face (Leiner et al., 2015). Tim Berners-Lee created the World Wide Web (WWW) and released its use to the public in 1991 (WWW Foundation, 2015). As one of the first forms of ICT, the WWW provided the opportunity to share an immense amount of information in one place and disseminate it to everyone, not just between two people (WWW Foundation, 2015). Since its development, the percentage of Americans who use it has increased to 87 percent (Pew Research Center, 2014).

Additionally, 68 percent of Americans use devices like smartphones, tablets, and laptops to access the internet and WWW, with 97 percent of those individuals being young adults ages 18 to 29 or persons who have obtained a college degree (Pew Research Center, 2014). Drastically increasing in popularity, smartphone use in particular has grown from 35 to 58 percent since 2011 (Pew Research Center, 2014), and in 2009 almost 98,750 applications (“apps”) had been created for these phones (Bartlett, 2009). The problem, however, is not the ownership or general use of the smartphone or other new technologies, but the time spent using them and lack of time spent being physically active.

PA recommendations for young adults are 150 minutes of moderate to vigorous PA (MVPA) a week (U.S. Department of Health and Human Services, 2008). The American College of Sports Medicine (ACSM; 2007) found that over half of college students don't meet these recommendations. Furthermore, time spent on technology decreases the time available to accomplish the recommendation. When examining use and perceptions of cell phones, Emanuel (2013) found that 85 percent of the college students surveyed owned a smartphone. Undergraduates indicated that they spent 6.49 hours talking on their smartphone, 14.35 hours texting, and 5.43 hours on Facebook or Myspace each week (Hanson, Drumheller, Mallard, McKee, & Schlegel, 2011). Time spent on the vast number of apps has also increased. On average in 2014, 43 hours were spent using apps per month compared to only 32 hours in 2013 (The Nielsen Company, 2014), and anywhere from one to five apps are used each day (Emanuel, 2013). With increasing time spent on smartphones and apps, and coupled with concerns about physical inactivity, it would be beneficial to determine if fitness-related apps accessible from a smartphone could be used to motivate these individuals to meet current PA recommendations.

Of the 98,000 plus apps created, close to 40,000 are fitness-related, and of the smartphone owners with at least one fitness-related app, almost 40 percent of those are for exercise, fitness, or PA measurement (i.e. step/heart rate monitoring; Fox & Duggan, 2012). Fitness apps have a variety of features including GPS tracking of distance and time, estimated calories burned, exercise logging, and goal setting. It has also been determined that a fitness-related app uses five behavior change techniques on average, and that they have the potential of effectively promoting engagement in PA (Middelweerd, Mollee, van der Wal, Brug, & Te Velde, 2014). Within the last few years there has been a large volume of research supporting the success of computer-tailored PA interventions (Broekhuizen, Kroeze, van Poppel, Oenema, & Brug, 2012; Vandelanotte, Spathonis, Eakin, & Owen, 2007), but to date the

effectiveness of fitness apps have not been heavily explored. Therefore, there is a clear need for theoretically grounded investigations to determine the impact that fitness apps have on PA outcomes.

Social Cognitive Theory

Social Cognitive Theory (SCT) posits dynamic interactions between personal, behavioral, and environmental factors (Bandura, 1977, 1986, 1989, 2004). Each factor interacts with the other in a bidirectional manner, also known as triadic reciprocal determinism (Bandura, 1986, 1989). SCT theorists do not assume that the sources of influence are equal; it is common for the strengths of sources to differ (Bandura, 1989). When applying the theory to health promotion, Bandura (2004) indicates that within each of the three factors there are core determinants of health behaviors including the personal influence of knowledge, outcome expectations, self-efficacy (SE) of an individual, the behavioral effects of goal setting, and finally the environmental impacts of perceived facilitators and barriers (Bandura, 2004).

Knowledge includes understanding health risks and benefits of different health practices and is a prerequisite for positively changing a health behavior (Bandura, 2004). Connecting how personal behaviors affect health can provide reasons to implement health behaviors. For example, undergraduates who realize that they spend too much time sitting during classes, but have the knowledge that regular PA will help provide more energy as well as increase their productivity will be more likely to engage in PA. Unfortunately, knowledge alone may not help a person overcome a previously established behavior. Bandura (2004) identifies knowledge as a precondition, and he indicates that most people need other self-influences to help them change their health behavior.

Outcome expectations are the anticipated products of an individual's actions, and they also have an influence on health behaviors (Bandura, 2004). Individual's outcome expectations can take different forms, specifically physical, social, and self-evaluative. Physically, individuals may expect pleasurable

effects, such as seeing an improvement in one's weight management, or aversive effects like constant injury or soreness. Social relationships also remain an important factor in peoples' lives, and whether the behavior will receive social approval or disapproval is anticipated. Self-evaluative reactions are the third type of outcome expectation, and individuals' behaviors are aimed to avoid self-dissatisfaction based on the personal standards they set for themselves (Bandura, 2004). Although outcome expectations tend to help sway individuals' decisions to change behavior, SE has a greater impact on actually changing behavior (Bandura, 2004). In fact, Bandura (2004) identifies it as a central factor due to its impact on the core determinants, directly influencing health behaviors. SE is defined as the confidence in one's ability to successfully perform a behavior in a specific context (Bandura, 1998). An individual's beliefs related to producing a behavior directly impacts their motivations and actions (Bandura, 2004). SCT constructs including outcome expectations and goals are both affected by SE. High SE has been related to higher goals and outcomes expected (Bandura, 2004). "Whatever other factors may serve as guides and motivators, they are rooted in the core belief that one has the power to produce desired changes by one's actions," (Bandura, 2004, p. 3).

Given that SE plays such an instrumental role in changing behaviors through its direct impact on the other core determinants within the SCT, it is important to understand the common ways in which SE is developed. Four factors influence and are used to guide strategies to increase individuals' SE including: mastery experiences, vicarious experiences, emotional arousal, and verbal persuasion (Bandura, 1977). Providing a mastery experience includes progressively increasing the behavior or pieces of a behavior, thus allowing individuals to gradually gain competency and experience success (Bandura, 1977). Beliefs of competency also increase when watching individuals that appear relatively similar and comparable perform a behavior, also known as a vicarious experience. Third, physical and emotional conditions can diminish or raise personal SE. For instance, fear and pain from injury during

PA are often perceived as a result of a lack of SE, so interventions should aim to decrease these experiences. Finally, verbal persuasion is used to encourage individuals so they can successfully engage in the behavior, and hopefully this will help increase effort put toward taking action.

The behavioral factor within Bandura's SCT for health promotion (2004) emphasizes self-regulatory behavior, also known as self-regulation (SR). Schnoll and Zimmerman (2001) identify setting goals, using strategies to attain them, and self-monitoring success in attaining goals as SR. Participation in behaviors that include setting goals, planning, and scheduling in relation to PA can help individuals reach their broader health goals. It is suggested, however, that goals be short-term and attainable because long-term goals are too distal to control present behavior (Bandura, 2004). "Goals are significant to behavior change because, when met, they assist one in attaining success," (Marmo, 2013, p. 446).

Finally, perceptions of facilitators and barriers within the environment play a large role in changing health behaviors; barriers may have a greater influence over behavior than facilitators. Physical environmental obstacles might include the weather or the built environment to support the behavior. Socially, individuals may feel that they are unaccepted by doing things out of the norm from their social groups. Impediments must be overcome or absent before a behavior can become easy to perform (Bandura, 2004). Since barriers are almost always present, facilitators, specifically new tools and/or resources are used to enable and empower individuals to engage in the desired behavior.

Applying SCT to PA &and ICT

SCT is a powerful framework to understand and explain PA behavior (Young, Plotnikoff, Collins, Callister, & Morgan, 2014). In fact, Bauman, Sallis, Dzewaltowski, and Owen (2002) found that 70 percent of PA interventions include SCT variables. Bandura (1997) argues that SCT is one of the most robust health behavior change theories due to its ability to inform, enable, guide, and motivate health habits.

Several web-based intervention studies with college populations have used SCT to impact PA behavior through a variety of methods targeting SR and social environmental factors. Most studies in the college population have included mostly female participants (Joseph et al., 2013; Joseph, Keller, Adams, & Ainsworth, 2015; Sriramatr, Berry, & Spence, 2014). SR strategies consistently implemented include goal setting (Grim, Hortz, & Petosa, 2011; Sriramatr et al., 2014; Suminski & Petosa, 2006) and exercise logging or tracking (Grim et al., 2011; Joseph et al., 2013; Sriramatr et al., 2014). Other strategies targeting SR, including lessons on time management (Suminski & Petosa, 2006) and wearing a pedometer (Grim et al., 2011). With high agreement related to the strategies that help increase SR, is it not surprising that it has consistently been found that, in comparison to the control group, treatment groups are more efficacious by the end of interventions (Grim et al., 2011; Joseph et al., 2013; Sriramatr et al., 2014).

Social environmental factors have also been addressed consistently, mostly in the form of social support (Grim et al., 2011; Joseph et al., 2013; Suminski & Petosa, 2006), but the methods targeting social support vary. For example, Grim and colleagues (2011) incorporated finding a fitness buddy, identifying preferences for types of support, and finding professionals for support within their lessons, while Joseph et al. (2013) included use the of message boards, personal profile pages, wall posting, and blogging to target social support from both family and friends. It is evident from the inconsistency in approaches targeting social support that there is still no consensus on the most effective approach, however, a few studies have found that if the social support comes from friends, it can make a significant impact (Grim et al., 2011; Joseph et al., 2013).

In contrast to previous research, the current intervention aims to use a PA smartphone app, NexTrack, as a facilitator (Bandura, 2004) to increase PA behavior. Male and female university students engaged in goal setting and activity logging SR strategies, and had the option to engage in social

supportive features like viewing others' logs, challenging others, and blogging. Verbal persuasion in weekly email messages was used as a strategy to target SE throughout the intervention, as it was an anticipated mediator of PA within the study. In terms of SCT related constructs, PA behavior has been consistently predicted by SE, SR, and social support, but less often by outcome expectations (Anderson, Wojcik, Winett, & Williams, 2006; Young, Plotnikoff, Collins, Callister, & Morgan, 2014). As Emanuel (2015) found, one in five college students rated themselves dependent on their smartphone and the information, entertainment, and personal connection it provided. Therefore it is beneficial to seek strategies for using this technology to facilitate PA and other health-related behaviors because it could be an effective approach for promoting health behavior.

Purpose

The purpose of the current investigation was to use the SCT to examine whether a smartphone app, NexTrack, could increase PA behaviors and SCT related constructs among university students enrolled in PA courses. Outcome measures include PA behavior, SE, and SR. It was hypothesized that:

- Participants using the app would report increased psychosocial and behavioral PA outcomes compared to students in the control group.

METHODS

Participants and Setting

University students (*N*=181), ages 18 to 30, with access to a smartphone with app capabilities were recruited for this study. Thirty-one participants withdrew from the study for various reasons including lack of time, increasing school demands, and forgetfulness. Additionally, those who identified their use of other apps throughout the study were excluded. The mean age was 20.66 (*SD*=1.54), and the group comprised of 137 females and 44 males. Of those participants, 73% self-identified as White, 17% as Black, and 3% of participants or less identified as Multi-Racial, Asian, Hispanic, other, and American Indian. Average BMI was 24.11 (*SD*=4.29) and 24.47 (*SD*= 4.54) at baseline and post respectively, and 148 participants were declared Kinesiology majors. Participants were from a large public university in the Southeastern United States enrolled in 12 PA courses. The content of these classes included beginning aerobic dance, beginning weight training, beginning tennis, beginning golf, and bootcamp. Bootcamp and beginning golf activity courses met two days a week for an hour and twenty minutes, and the remainder of classes met three days a week for fifty minutes, for the eight-week time frame of the study.

Instrumentation

Demographics

Demographic variables including gender, age, race, major, and grade classification were self-reported by the participants. Students were asked about their history using health-related smartphone apps. Specifically, students were asked to report the names and timeframe of any previous or ongoing use of health-related apps.

Height and weight were measured using a portable stadiometer attached to a weight scale. Steps outlined by the CDC (2015) were taken to ensure reliable and accurate height and weight measurements

were implemented. Participants removed their shoes and stood erect with their feet flat on the floor and heels, mid-body, and upper-body as far back on the scale as possible. Accuracy of the scale was checked by ensuring it read zero before a measurement was taken (CDC, 2015). Measurements of height and weight were taken at baseline and post in centimeters (cm) and kilograms (kg) respectively. Body mass index (BMI) was then calculated in IBM SPSS Statistics by using the equation provided by the CDC (2015), which is weight in kg is divided by height in meters squared (m^2). Although skinfolds have been deemed more accurate measures of body composition (Castro-Pinero et al., 2009), BMI is a more feasible option with large class sizes (Bryan, Solmon, Zanovec, & Tuuri, 2011). When using BMI to interpret the category of weight an individual falls under, Bryan and colleagues (2011) suggested that caution should be used for individuals that lie near cut-points because BMI has been found to show racial and gender disparities. In the current study, however, BMI was not used to interpret weight categories but as a descriptor of the population.

Self-report Physical Activity

PA behavior was assessed using the short version of the International Physical Activity Questionnaire (IPAQ-S; Booth, 1998). The IPAQ-S is a recall measure composed of seven items related to the duration in minutes and frequency in days spent performing vigorous PA, moderate PA, and walking throughout the past week. The value for baseline and post PA was reported in total metabolic equivalent (MET) by adding the values found for all three intensities using the formula (vigorous METs · min · days) + (moderate METs · min · days) + (walking METs · min · days) (Kaminsky, 2014). Using coding that takes the rate of energy expenditure to classify specific PA, vigorous activities are scored as 8 METs, moderate are 4 METs, and walking activities are 3.3 METs (Craig et al., 2003). For example, a participant who reported vigorous activity on 3 days a week for 30 minutes per day, moderate activity on 4 days a week for 45 minutes per day, and mild activity on 7 days a week for 60 minutes per day would

have obtained 2826 total METs [(8 METs · 30 · 3) + (4 METs · 45 · 4) + (3.3 METs · 60 · 7)]. Reliability and validity testing has been established, and the survey has been deemed an acceptable measure for participation in PA in this population (Craig et al., 2003; Hallal & Victora, 2004).

Self-Efficacy

The Self-Efficacy for Exercise Behaviors Scale was used to measure undergraduates' confidence in performing PA, and has been found both valid and reliable (Sallis, Grossman, Pinski, Patterson, & Nader, 1988). Twelve items make up the scale and ask participants how confident they are to motivate themselves to do things that may occur while trying to increase or continue their PA consistently over a period of time. Items were asked in the following manner: "*How sure are you that you can do these things?"* (a) Get up early, even on weekends, to exercise, (b) Stick to your exercise program after a long, tiring day at work, and (c) Exercise even though you are feeling depressed. Answers to the survey are on a five point Likert scale ranging from one (I know I cannot) to five (I know I can).

Self-Regulation

Personal SR related to PA was measured using the Exercise Goal-Setting Scale (EGS; Rovniak, Anderson, Winett, & Stephens, 2002). The EGS scale measured how individuals set exercise goals and plan for exercise activities. Rovniak et al. (2002) proved the scale reliable previously in a college population. A five point Likert scale from one (does not describe) to five (describes completely) was used for participants to rate their SR for the 14 items on the EGS. Items on the EGS were asked in the following manner: "Please indicate the extent to which each of the statements below describes you" (a) I often set exercise goals, (b) I usually have more than one major exercise goal, and (c) I usually set dates for achieving my exercise goals.

NexTrack App

The app is available for immediate download in both the iTunes and android app store. Features of the app include the ability to log current and previous exercises from a list of over 300 activities. When logging a PA, the app also includes an input of the date and duration. The log is then synced to a calendar displaying the days in which PA was engaged in throughout the week, month, or year based on what the participant wants to view. Another feature includes the use of a reward system. Rewards come in the form of exercise points (XP) and medals based on the duration of the activity and general estimation of caloric expenditure. The final feature of the app is called connection. In connection, users of NexTrack can follow friends and view their logs, XP, and medals. An opportunity for engagement in PA challenges is also provided among an individual's friends. Finally, blogging is also available under the connection feature of the app, and users can see blogs of other NexTrack users or create their own. Although there are a variety of PA smartphone apps available, NexTrack is available at no cost, allowing the target of larger populations of smartphone users. This app in particular was also chosen due to its ability to observe compliance of participants and that it aligns with the SCT attributes targeted.

Log Entries

PA log entries were collected from all participants at the end of the eight-week intervention. The primary investigator went through logs submitted by both groups to determine the total number of activities entered by each participant. A log was defined as a single item identifying the type of activity participated in and the minutes engaged in the activity. On several occasions participants logged multiple entries a day, and each of these logs were counted toward their total. Items that were not categorized in one of the three classifications of PA, walking, moderate, or vigorous as described by Craig and colleagues (2003) were excluded from the logs. For example, an activity such as "*standing while getting ready,*" was not considered an entry.

Data Collection

Following approval from the university institutional review board, participants were informed of the purpose of the study and provided informed consent. This study used a quasi-experimental design with a comparison group to test the efficacy of the NexTrack app to increase PA outcomes. Data were collected during in-class time at two time points, baseline and post. University students in the courses who (a) did not own a smartphone containing app capability, (b) owned a smartphone with app capability, but intended on using other apps throughout the study, (c) had a physical injury or limitation to participate in PA, and/or (d) did not provide consent were excluded from the study. Classes were assigned to the intervention or control groups using a random number generator (see Figure 1) before baseline data collection, but prior to data input or analysis. The control included two beginning tennis activity courses, two beginning aerobic dance, and two beginning weight training courses. Intervention classes included two bootcamp activity courses, two beginning weight training, one beginning aerobic dance, and one beginning golf PA course. Baseline measures collected comprised of demographics including height and weight, self-reported PA, SE, and SR on the first day of implementation of the intervention.

Participants in the intervention group were then led through a 20-minute instructional session on the download and use of the NexTrack app (see Table 1). During the instructional session, students in the intervention group were notified that their PA logging would be checked each week for compliance. The type, minutes, and number of logs were gathered from the app for each participant to measure compliance and total log entries. Other features of the app, such as the social features and weight tracking were indicated as optional. A paper/pencil PA log was created for participants in the control group (see Appendix D) and posted to their online classroom dashboard. Participants in the control were encouraged to print off and use the log created for them, but were informed they could use other sources

of paper/pencil logging. Finally, they were also notified that their logs would be collected at the end of the eight-week intervention to measure total log entries. They were not notified of compliance checks.

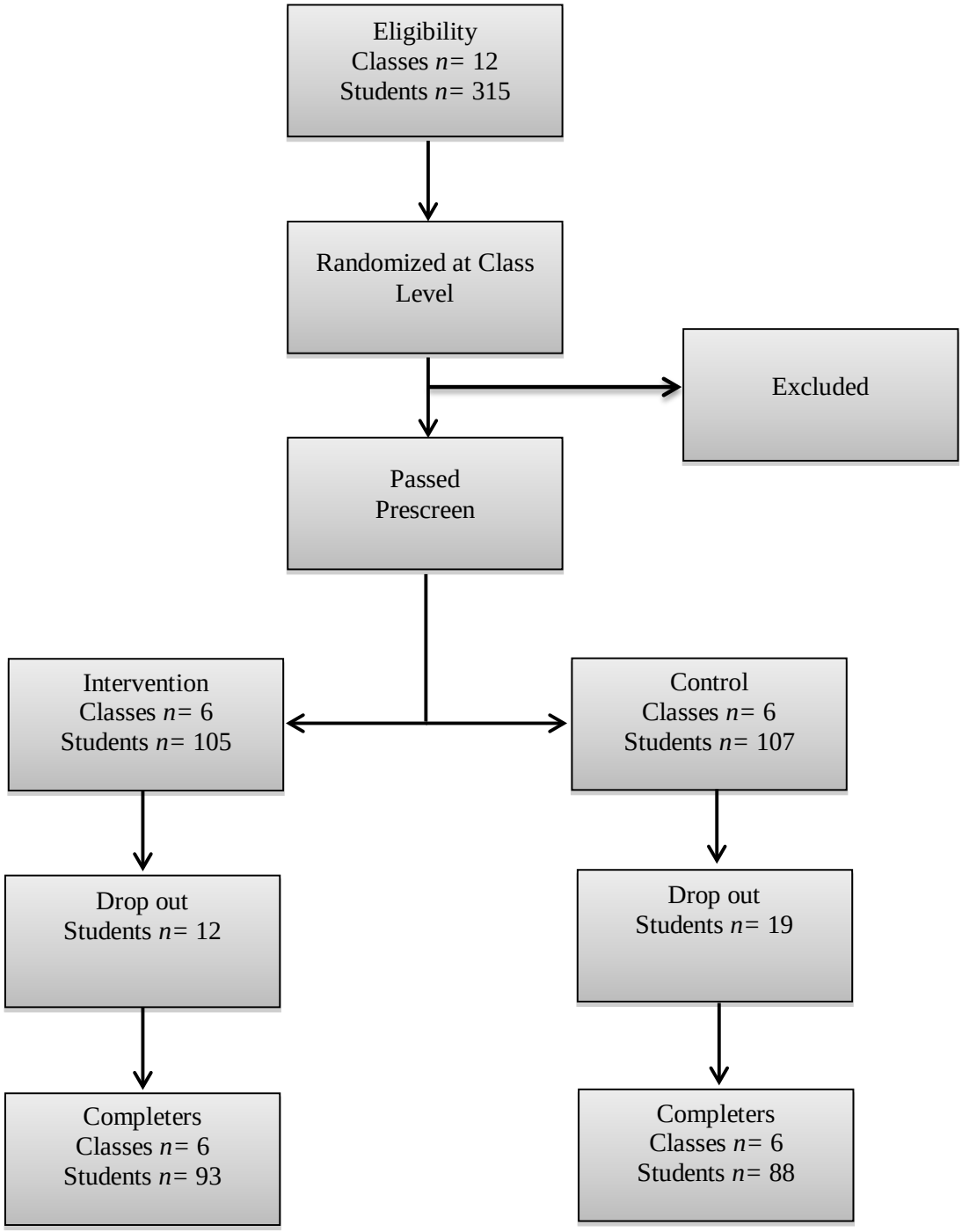

Figure 1. Flow of Study Participants

Table 1. NexTrack Download and Use

1	Internet Connection: Students were taught how to access the wifi provided on campus to avoid data usage from engagement in the app if on campus. Lead investigator provided a visual and verbal demonstration of the procedures.
2	Download: Instructions were provided on how to locate the specific app for download onto the phone. Lead investigator provided a visual and verbal demonstration of the procedures.
3	Sign Up: Directions related to registering for the app were given including information related to email and password set up. Lead investigator provided a visual and verbal demonstration of the procedures.
4	Profile: Students were directed through their profile page. This page includes a tab on an individual's exercise statistics including daily, weekly, and monthly earned XP, time worked out, and distance traveled. The tab labeled medals displayed the medals the individual has earned based on their statistics. An activity tab was also available in the profile, allowing for students to look at their past logged activities. Finally, the profile page allowed access to an exercise calendar, also displaying the days in which PA was engaged in. Lead investigator provided a visual and verbal demonstration of the procedures.
5	Home Page: Lead investigator provided verbal description of the visual features displayed on the home page.
6	Activities: How to log past activities, start new activities, and view activity history was described to all students in the intervention. Lead investigator provided a visual and verbal demonstration of the procedures. Participants went through a running example provided for logging past activities and crunch example provided for starting new activities.
7	Connect: Students learned how to invite friends for following and challenging within the NexTrack app via their contacts, text message, Twitter, name, or email. They were also walked through how to view and comment on public blogs used in NexTrack. A reminder was be provided to students that this feature is a suggestion of the study, but not a required feature to engage in.
8	Rewards: After logging an activity, XP and medals would be displayed on the home screen. Display of the XP and medals was shown to the students and described for understanding. Lead investigator provided a visual and verbal demonstration of the procedures. Participants went through a running example provided for logging past activities and crunch example provided for starting new activities. A reminder was provided to students that this feature is a suggestion of the study, but not a required feature to engage in.
9	Settings: Aspects found within the settings including profile information, social networks, display preferences, notifications, rewards, and in-app privacy were ran through with all participants. Lead investigator provided a visual and verbal demonstration of the procedures.
10	Questions: An opportunity for any questions was provided at the end of the workshop.

Note. PA = physical activity; XP = exercise points

Both groups then received a 10-minute instructional session on goal setting following the collection of baseline data. Post data were collected on the last day of the eight-week intervention and included all the measures that were taken at baseline.

Two goals were developed by all participants to target SR. Goal development followed SMART criteria (specific, measurable, attainable, realistic, timely), and was briefly addressed following the NexTrack instructional session for intervention participants, and following the collection of baseline data for control. A short term goal and a long term goal were created in relation to PA behavior. Also to promote logging in both groups throughout the intervention, a strategy targeting the SE construct of verbal persuasion was used. Each week, students were emailed a reminder to log their physical activities. For example one statement said, “Don’t forget to log all of your PA today! You can do it!”

Data Analysis

All data were screened for outliers, missing data, and normal distribution properties. Descriptive statistics, bivariate correlations, and internal consistency estimates were calculated. Intraclass correlation coefficients were used to identify clustering variance at the class level and determine the appropriateness of analyzing data at the individual level. Independent *t*-tests were used to determine if there were significant differences in self-reported PA, SE, and SR between the two groups at baseline. A series of 2 (gender: male; female) x 2 (group: intervention; control) x 2 (time: baseline; 8-weeks) repeated measures analysis of variance (RM-ANOVA) tests were used to examine group differences in self-reported PA, SE, and SR. The alpha level for all mean comparison tests was set at .05.

RESULTS

Descriptive statistics and internal consistency estimates were then calculated for all participants at baseline and post time points for all variables (see Table 2). Independent t-tests revealed that no significant differences were present between groups with respect to PA (t_{157}=.62, p=.54), SE (t_{177}=.10, p=.92), or SR (t_{175}=-1.35, p=.18) at baseline.

Table 2. Descriptive Statistics and Internal Consistency Estimates

	Variable	*M*	*SD*	Min	Max	A
1	Baseline PA	4688.23	4333.39	0.00	28009.50	
2	Post PA	4521.08	3526.68	53.00	17544.00	
3	Baseline SE	3.63	0.72	1.92	5.00	0.89
4	Post SE	3.41	0.79	1.25	5.00	0.90
5	Baseline SR	2.97	0.68	1.00	4.46	0.84
6	Post SR	2.92	0.86	1.00	5.00	0.91

Note. PA = self-report PA measured in METs; SE = self-efficacy measure; SR = self-regulation measure; M = mean; SD = standard deviation; Min = minimum value; Max = maximum value; α = Cronbach alpha; SE & SR on scale range from 1-5.

Bivariate correlations are reported in Table 3. All relationships were significant except between baseline SE and post PA and the relationship between post PA and post SR. Relationships among variables were small to moderate except for baseline and post SE (r=.70, p< .01) as well as baseline and

Table 3. Bivariate Correlation Matrix

	Baseline PA	Post PA	Baseline SE	Post SE	Baseline SR	Post SR
Baseline PA	1					
Post PA	0.42**	1				
Baseline SE	0.26**	0.05	1			
Post SE	0.21*	0.17*	0.70**	1		
Baseline SR	0.26**	0.18*	0.44**	0.42**	1	
Post SR	0.19*	0.17	0.36**	0.49**	0.70**	1

Note. PA = self-report physical activity; SE = self-efficacy measure; SR = self-regulation measure; *p< .05; ** p< .01

post SR (r=.70, p< .01), which shared strong relationships. Findings from intra-class correlation (ICC) analyses revealed limited clustering variance associated with students nested within PA classes (SE,

ICC=.01; SR, ICC=.01; self-reported PA; ICC=.06). Therefore, data were analyzed at the individual level.

Table 4 presents descriptive statistics by gender, group assignment, and time. Separate 2 (group) X 2 (gender) X 2 (time; pre-post) ANOVAs with repeated measures on the last factor were conducted for for PA, SE, and SR. For PA, the main effects for time [$F(1,120) = .664$ $p = .42$)] and group [$F(1, 120) = .007$, $p = .94$)] were not significant, while a significant effect for gender was evident [$F(1, 120) = 11.33$, $p = .001$)]. Males reported higher levels of PA than females. None of the interactions were significant.

For SE, the main effect for time was significant [$F(1, 143) = 3.82$, $p = .05$]. Overall levels of SE tended to declined overtime. The main effect for gender was also significant [$F(1, 143) = 15.92$, $p < .001$)], with males reporting higher levels of efficacy across time. The main effect for group was not significant [$F(1, 143) = .601$, $p = .44$]. The time by gender interaction was significant [$F(1, 143) = 8.37$, $p = .0045$)], represented in Figure 2, suggests that males maintained their SE over time while females decreased. The remaining interactions were not significant.

For SR, the main effect for time [$F(1, 141) = .037$, $p = .85$] was not significant. The main effect for group [$F(1, 141) = 3.99$, $p = .048$] was significant, with the control group reporting higher levels of SR overall. The main effect for gender was also significant, [$F(1, 141) = 12.085$, $p = .001$] with males reporting higher levels of SR than females. The group by gender interaction was also significant [$F(1, 141) = 4.65$ $p = .033$]. This interaction is represented in Figure 3.

Table 4. Descriptive Statistics for SCT Outcome Measures

	Baseline			Post-Test		
	Males *M(SD)*	Females *M(SD)*	Total *M(SD)*	Males *M(SD)*	Females *M(SD)*	Total *M(SD)*
PA						
App	7057.78 (*7147.35*)	4023.33 (*3977.08*)	4957.01 (*5294.54*)	5339.43 (*3500.27*)	4239.76 (*3240.17*)	4578.12 (*3334.18*)
Control	6539.00 (*3129.80*)	3930.77 (*3753.43*)	4417.05 (*3762.30*)	6577.73 (*4188.10*)	3842.69 (*3165.72*)	4352.61 (*3507.06*)
SE						
App	3.83 (*0.69*)	3.52 (*0.72*)	3.62 (*0.72*)	3.78 (*0.52*)	3.28 (*0.75*)	3.44 (*0.72*)
Control	3.96 (*0.80*)	3.53 (*0.72*)	3.61 (*0.75*)	4.12 (*0.80*)	3.21 (*0.79*)	3.37 (*0.86*)
SR						
App	3.04 (*0.72*)	2.80 (*0.68*)	2.87 (*0.70*)	3.00 (*0.93*)	2.88 (*0.84*)	2.91 (*0.87*)
Control	3.60 (*0.39*)	2.85 (*0.65*)	2.99 (*0.68*)	3.58 (*0.71*)	2.78 (*0.82*)	2.93 (*0.86*)

Note. PA = self-report PA measured in METs; SE = self-efficacy measure; SR = self-regulation measure; App = NexTrack intervention group; Control = control group

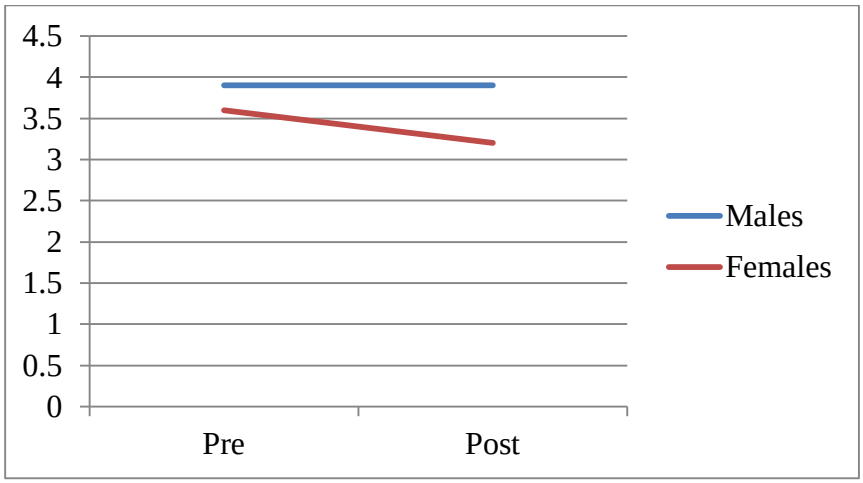

Figure 2. Time by Gender Interaction for SE
Note. SE on scale range from 1-5.

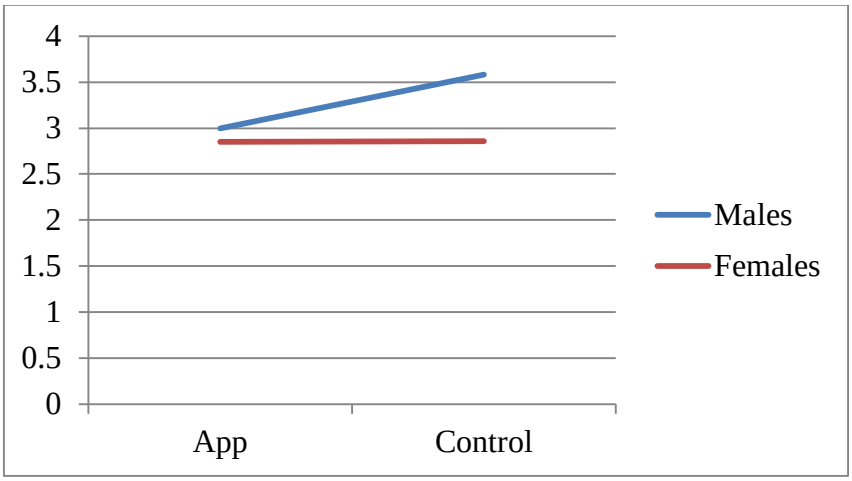

Figure 3. Group by Gender Interaction for SR
Note. SR on scale range from 1-5.

Across time, overall, males in the control condition reported higher levels of SR than males in the app group and all females. This interaction is likely a function of the small number of males in the control condition, and given that there is no effect across time it is not considered to be meaningful.

Participants in the control group logged significantly more PA events (M=55.73, SD =59.69) over the eight-week period than intervention participants (M=15.37, SD =19.14, t_{59} =-4.71, p< .01, d=.98).

DISCUSSION

Finding ways to increase young adults' PA levels is an important task due to their current lack of PA participation (ACSM, 2007; CDC, 2010). With increased time spent on smartphones and smartphone apps (Pew Research Center, 2014; The Nielsen Company, 2014), it is important to investigate whether these technologies can be used to increase PA and other psychosocial outcomes. Through the theoretical constructs of SCT (Bandura, 1986, 1989, 1998, 2004), the purpose of the current investigation was to determine if the NexTrack smartphone app could be used to increase PA behaviors among university students enrolled in PA courses. It was hypothesized that participants in the NexTrack intervention group would benefit from the inclusion of technology.

The main hypothesis of the study, that participants using the app would report increased activity levels, SE, and SR of exercise behavior was not supported. There were no changes in PA levels or SR over time across groups. Additionally, SE was found to decrease from pretest to post test. It is evident that the NexTrack app did not have an effect on PA levels, SE, or SR, as there were no significant group by time interactions. The use of NexTrack did not facilitate SE, SR, or increases in PA.

Outcomes related to PA may have been impacted by the PA courses. Each of the activity courses typically met for about 150 minutes a week. If participants were engaged in MVPA during this time, they were meeting the adult recommendations of 150 minutes per week of MVPA set by the U.S. Department of Health and Human Services (2008). Some participants may not have chosen to engage in more PA due their achievement of the recommendations. There was also high number of participants who were declared Kinesiology majors. Of the previous studies that implemented goal setting, none indicated that their participants were in a health related field such as Kinesiology (Grim et al., 2011; Sriramatr, Berry, & Spence, 2014; Suminski & Petosa, 2006). As goal setting is a strategy typically taught in the field of Kinesiology, it can be speculated that these participants may have already been

introduced to goal setting behavior previously in their undergraduate careers, and may already use this regulatory behavior.

Men's SE remained stable from pre to post while women's decreased. These findings may help us understand Bandura's (2004) indication that SE has the greatest impact on the other outcome measures. He indicates in his SCT that SE is the strongest predictor of behavior change, and previous studies have indicated that PA behavior has been consistently influenced by SE, SR, and social support (Anderson et al., 2006; Young et al., 2014). Another factor potentially impacting SE may have been the messages of verbal persuasion. When exploring the use of college student PA messages using SCT, it was found that college students were highly motivated by verbal persuasion messages from themselves and significant others (Marmo, 2013). As the lead investigator did not have a previously established relationship with participants, this suggests that the messages may not have made an impact to increase SE. Finally, the negative impact on SE in females also supports the study of mostly female participants, as females have been the focus of most of the previous literature (Joseph et al., 2013; Sriramatr et al., 2014). Since there was a decline in efficacy in women, the evidence suggests that research might be more beneficial targeting this group since they are more vulnerable to the impact of SE.

Another possible explanation for the females' decrease in SE could be the timing of the intervention. Baseline data were collected in early fall when the weather was warm and days were longer than at the conclusion of the eight-week intervention. The SE measure used assessed efficacy to overcome barriers. It may be that the experience over the eight-week period, with increasing demands on time with school activities coupled with colder weather and less daylight, presented barriers that were not present when the baseline data were collected. Once those barriers were encountered during the intervention, the female participants may have realized they were difficult to overcome, which served to decrease their perceptions of efficacy over time.

Unexpectedly, participants in the control group recorded far more events in their activity logs than those using the app to record their activities, although the self-reported activity levels did not differ at the conclusion of the intervention. Bandura (2004) also indicates that environmental factors of facilitators and barriers can impact PA related behaviors, and it may be possible that the app was perceived as a barrier instead of a facilitator to the reporting of participants' PA. When looking at the impact of an intervention with online modules on weight gain in college freshman, more than 50 percent of the participants in the intervention group indicated that online logging required too much time (Dennis, Potter, Estabrooks, & Davy, 2012). As Hanson and colleagues (2011) identified, most of the time spent using smartphones by undergraduates did not require the input of data, so it is possible that participants in the intervention group perceived the app to take too much time to log their PA. It is also possible that there are contrasting perceptions of logging activity inherent in these methodologies. When using the paper/pencil logs, participants were presented with an overall view of their activities, and may have been motivated to record activity when faced with a blank page. Although they could access data from their logs over a time period, participants using the app were not automatically presented with cumulative data and may have been less likely to take the time to enter activities.

Limitations

Despite the findings, a few limitations are evident within the study. Since the short form of the IPAQ was the only measure used to assess PA, the subjectivity of the self-reported measures may have negatively influenced the results of the study. Social desirability, or individual's desire to be socially accepted (Crowne & Marlowe, 1964), may have also affected the information collected on the self-report measures. Specifically, some participants may have over reported their PA because they may perceive that Kinesiology majors should acquire a large amount of minutes toward PA. Use of pedometers or accelerometers could provide a more objective assessment of PA behavior (Kaminsky,

2014), even with the presence of social desirability. Also, content of the PA courses ranged in intensity, possibly influencing the total PA reported on the IPAQ.

The participant pool was also a limiting factor in this study. A large majority of the participants were female and declared Kinesiology majors. Differences in male's outcomes may not have been detected due to their small representation within the group. Also, Kinesiology majors typically enter the field due to their value of health possibly explaining why no differences were found in PA and SR outcomes. Due to these factors, the results may not reflect the larger population.

Finally, participation in the social supportive features of the app was not required among intervention participants. As a few studies have indicated, social support from friends can positively impact PA behaviors (Grim et al., 2011; Joseph et al., 2013), and many students had the capability to interact with fellow friends and classmates within the app. It would have been beneficial to see the impact of social supportive features in the app related to the main outcomes of the study.

Practical Implications

Findings revealed that incorporating the NexTrack smartphone app did not provide benefit for students' PA behavior and psychosocial outcomes in this context. In other words, use of NexTrack does not facilitate SE, SR, or increases in PA. Based on these results, it may not be beneficial to use this particular smartphone app to promote desired increases in these behaviors. However, NexTrack is one app of numerous health-related apps available. It may be that this particular app did not support the tenets of Bandura's SCT (2004) and general PA behavior, but another app very well could. Furthermore, even though the control group did not show any increases in SCT related constructs, it may be beneficial to incorporate paper and pencil logging into PA classes. From this information, instructors are likely to obtain a more comprehensive understanding of PA habits.

Future Research

As this is one of the first studies of its kind, there is still a clear need for more theoretically grounded research to determine the impact that health-related apps have on PA outcomes. There are many other health and fitness apps available that have not been studied. Future studies should also aim to analyze samples that are more representative of the whole population. However, since it was found that only females decreased in barrier SE, it may be important to determine if the apps are perceived as a barrier to PA outcomes in this group of people. Finally, more research is needed to determine how to best use app technologies as facilitators of PA behaviors.

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APPENDIX A
IRB APPROVAL

ACTION ON EXEMPTION APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu | lsu.edu/irb

TO: Angela Chambers-Simonton
Kinesiology

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: June 8, 2015

RE: **IRB#** E9383

TITLE: Testing fitness-related phone application technology in physical activity classes

New Protocol/Modification/Continuation: New Protocol

Review Date: 6/8/2015

Approved X **Disapproved**_____

Approval Date: 6/8/2015 **Approval Expiration Date:** 6/7/2018

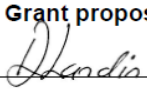
Exemption Category/Paragraph: 1

Signed Consent Waived?: No

Re-review frequency: (three years unless otherwise stated)

LSU Proposal Number (if applicable):

Protocol Matches Scope of Work in Grant proposal: (if applicable)

By: Dennis Landin, Chairman 

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE:**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

APPENDIX B
CONSENT FORM

CONSENT FORM

1. Study Title: Testing fitness-related phone application technology in physical activity classes.

2. Performance Site: LSU campus

3. Investigators: The following investigators are available for questions about this Study M-F, 8:00 a.m. – 4:30 p.m.

   Mrs. Angela Simonton (225)-578-2714

   Dr. Alex Garn (225)-578-5954

4. Purpose of Study: The purpose of this research project is to examine the impact of fitness-related phone application technology compared to paper and pencil goal setting and activity tracking on students' physical activity.

5. Subject Inclusion: LSU Students

6. Number of Subjects: 200

7. Study Procedures: LSU students will be recruited from physical activity classes. Subjects will be randomly assigned to either the technology group or paper and pencil group at the beginning of the semester. All students will complete questionnaires related to demographics, motivation, and physical activity behavior at the beginning, mid-point, and end of the semester. These questionnaires will take approximately 15 minutes to complete. Height and weight will also be measured. Students assigned to the technology group will be given training of how to download and use a fitness-related application for their phone while students assigned to the paper and pencil group will be given directions on how to set physical activity related goals and tack their physical activity. Weekly emails will be sent to students as a reminder to set goals and log their activities or use the phone application. ID numbers will be used in order to track students in a manner that maintains confidentiality.

8. Benefits: There will be no specific benefits to the participant beyond having the opportunity to participate in the study. The information gathered from this study has the potential to extend the understanding of the effectiveness of phone technology.

9. Risks:	There are no foreseeable risks related to this research project. All informed consent sheets will be separated from the questionnaires and both articles will be stored in secure but separate cabinets. The Investigators will be the only persons with access to the data and cabinets.
10. Right to Refuse:	Subjects may choose not to participate or to withdraw from the study at any time without penalty or loss of any benefit to which they might otherwise be entitled.
11. Privacy:	Results of this study may be published, but no names or identifying information will be included in the publication. Subject identity will remain confidential unless disclosure is required by law.
12. Signature:	The study has been discussed with me and all of my questions have been answered. I may direct additional questions regarding study specifics to the investigators. If I have any questions about subject's rights or other concerns, I can contact Dr. Dennis Landin, Institutional Review Board, (225) 578-8692. I agree to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

Signature: _____ Date: _____

The study subject has indicated to me that he/she is unable to read. I certify that I have read this consent form to the subject and explained that by completing the signature line above, the subject has agreed to participate.

Signature of Reader: _____ Date: _____

APPENDIX C
QUESTIONNAIRES

ID#_____

Age: How old are you? (write in) _____

Grade Classification You Just Completed (Please circle below):

Freshman Sophomore Junior Senior Grad Student

Gender (Please circle below):

Male Female

Ethnicity (Please circle below):

Black/African American Asian/ Asian-American White/Caucasian

Hispanic /Latino/Mexican American American Indian/Native Pacific Islander

Multi-Racial Other (please specify) _____

Major: (write in) _____

1. If any, what are the names of the physical activity and/or health related apps have you used before?

   _____

   _____

2. Are you currently using any apps? If so, please list the name(s) of them below.

   _____

   _____

International Physical Activity Questionnaire

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

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

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

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

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

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

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

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

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

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

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

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

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

_____ **days per week**

☐ No walking → ***Skip to question 7***

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

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

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

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

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Self-Efficacy for Exercise Behaviors Scale

Below is a list of things people might do while trying to increase or continue regular exercise. We are interested in exercises like running, swimming, brisk walking, bicycle riding, or aerobics classes.

Whether you exercise or not, please rate how confident you are that you could really motivate yourself to do things like these consistently, for at least six months.

Please circle one number for each question.

How sure are you that you can do these things?

	I know I cannot		Maybe I can		I know I can
1. Get up early, even on weekends, to exercise.	1	2	3	4	5
2. Stick to your exercise program after a long, tiring day at work.	1	2	3	4	5
3. Exercise even though you are feeling depressed.	1	2	3	4	5
4. Set aside time for a physical activity program; that is, walking, jogging, swimming, biking, or other continuous activities for at least 30 minutes, 3 times per week.	1	2	3	4	5
5. Continue to exercise with others even though they seem too fast or too slow for you.	1	2	3	4	5
6. Stick to your exercise program when undergoing a stressful life change (e.g., divorce, death in the family, moving).	1	2	3	4	5
7. Attend a party only after exercising.	1	2	3	4	5
8. Stick to your exercise program when your family is demanding more time from you.	1	2	3	4	5

	I know I cannot		Maybe I can		I know I can
9. Stick to your exercise program when you have household chores to attend to.	1	2	3	4	5
10. Stick to your exercise program even when you have excessive demands at work.	1	2	3	4	5
11. Stick to your exercise program when social obligations are very time consuming.	1	2	3	4	5
12. Read or study less in order to exercise more.	1	2	3	4	5

Exercise Goal-Setting Scale (EGS)

The following questions refer to how you set exercise goals and plan exercise activities.

Please indicate the extent to which each of the statements below describes you:

	Does not Describe				Describes Completely
1. I often set exercise goals	1	2	3	4	5
2. I usually have more than one major exercise goal	1	2	3	4	5
3. I usually set dates for achieving my exercise goals	1	2	3	4	5
4. I don't typically write down my exercise goals	1	2	3	4	5
5. My exercise goals help to increase my motivation for doing exercise	1	2	3	4	5
6. I find it difficult to measure whether or not I have achieved my exercise goals	1	2	3	4	5

	Does not Describe				Describes Completely
7. I tend to break more difficult exercise goals down into a series of smaller goals	1	2	3	4	5
8. I usually keep track of my progress in meeting my goals	1	2	3	4	5
9. I have developed a series of steps for reaching my exercise goals	1	2	3	4	5
10. I usually achieve the exercise goals I set for myself	1	2	3	4	5
11. If I do not reach an exercise goal, I analyze what went wrong	1	2	3	4	5
12. I make my exercise goals public by telling other people about them	1	2	3	4	5
13. My exercise goals tend to focus on beginning or maintaining a regular exercise routine	1	2	3	4	5
14. My exercise goals tend to focus on improving my appearance and /or performance	1	2	3	4	5

APPENDIX D
PAPER/PENCIL LOG

Date & Time	Activity	Notes

Date & Time	Activity	Notes

VITA

Angela Nicole Simonton, a Green River, Wyoming native, received her Bachelor of Science Degree in Kinesiology with emphasis in Physical Education Teacher Education at the University of Wyoming in May 2014. In an effort to seek more knowledge about the field, she enrolled in graduate study at Louisiana State University in August 2014. She expects to graduate in May 2016 with her master's degree and plans to enter the physical education teaching profession.