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Using Self-Monitoring and Goal Setting to Increase Swimming in Adults

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by

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Abstract

Many people in the United States do not engage in the recommended levels of physical activity. Self-management strategies, including self-monitoring and goal setting, are among the interventions that have been used to increase physical activity in adults. Visual feedback has also been incorporated into interventions to increase physical activity. Minimal research has focused on increasing swimming behavior. The current study investigated the effectiveness of self-management strategies to increase swimming activity in adults. An automated recording device (watch) was used to collect data on participants' swimming behavior. The effect of self-monitoring in the form of a self-graphing intervention to increase swimming activity was evaluated. If self-graphing alone was not effective, goal setting was added to the intervention. Three participants showed an increase in swimming activity when self-graphing was implemented. Two participants showed little or no change in activity across all phases. This study did not include any reinforcement contingencies for engaging in an increase in swimming activity. Future research directions are discussed.

Chapter One: Introduction

The U.S. Department of Health and Human Services (2008) recommends that adults engage in 150 min per week of moderate-intensity aerobic activity or 75 min per week of vigorous-intensity aerobic activity and two muscle-strengthening activities per week. Unfortunately, many U.S. adults are not adhering to these guidelines. According to the Centers for Disease Control and Prevention (CDC) (2013), about half of the adult population in the United States in 2011 engaged in the recommended levels of aerobic activity, and less than 30% engaged in the recommended levels of muscle-strengthening activity. Only 20.6% of adults met both the aerobic and muscle-strengthening guidelines in 2011 (CDC, 2013).

Engaging in physical activity can result in health benefits, such as a decreased risk of developing heart disease, stroke, some cancers, diabetes, and osteoporosis (U.S. Department of Health and Human Services, 2008). High blood pressure and cholesterol are also lowered when an individual engages in physical activity, decreasing the risk of developing certain diseases (U.S. Department of Health and Human Services, 2008).

The U.S. Department of Health and Human Services (2008) suggests that adults should engage in some level of physical activity even if the recommended levels of activity cannot be reached. In other words, if an individual cannot allocate 150 min per week to engaging in physical activity, engaging in less than 150 min per week is better than not engaging in any physical activity. Further, as the frequency, duration, and intensity of physical activity increase, so do the potential health benefits (U.S. Department of Health and Human Services, 2008).

Self-monitoring and goal setting are two self-management strategies that are often combined with other intervention components to increase physical activity. Studies have shown the effect of package interventions, including self-monitoring, goal setting, and feedback, on increasing steps (Normand, 2008; Tudor-Locke et al., 2004) and calorie expenditure (Donaldson & Normand, 2009). Donaldson and Normand (2009) reported that feedback may not be a necessary intervention component; one participant showed an increase in calorie expenditure when the feedback component was not implemented due to technological complications. Normand (2008) found that all participants increased steps, yet they did not consistently meet their goals. Tudor-Locke et al. (2004) increased steps in adults with diabetes using the package intervention described above and called it *First Step Program*. Although these package interventions of self-monitoring, personal goal setting, and feedback successfully increased physical activity, a conclusion cannot be drawn about which component of the intervention was effective because they were all implemented together.

Kurti and Dallery (2013) compared the effects of self-monitoring and goal setting with and without contingency management to increase physical activity. Self-monitoring and goal setting with monetary incentives increased participants' steps, and goal setting continued to have an effect once the contingency was removed. Kurti and Dallery (2013) showed that contingency management may not be a necessary component of a package intervention to increase steps, but they did not determine if self-monitoring or goal setting was the effective component of the intervention.

Goal setting without self-monitoring has been included in different intervention packages to increase specific sports skills including soccer skills (Brobst & Ward, 2002), running skills (Wack, Crosland, & Miltenberger, 2014), and football skills (Ward & Carnes, 2002). Brobst and

Ward (2002) implemented a goal setting with public posting and feedback intervention to increase soccer skills. Similarly, Ward and Carnes (2002) increased football skills using a goal setting and public posting intervention, and suggested that coach feedback that the researchers did not experimentally control for may have affected performance. Personal goal setting with feedback has also been shown to increase running (Wack et al., 2014).

Research has shown that intervention packages can increase physical activity, however, the effectiveness of each component has not yet been determined. To evaluate the effectiveness of each component of package interventions component analyses must be conducted. Mellalieu, Hanton, and O'Brien (2006) implemented a goal setting intervention to increase rugby skills; however, only pre- and post-test measures (not a true experimental design) were taken to evaluate the interventions efficacy.

Further investigation into the effects of individual components of package interventions is needed. One study found that self-monitoring alone increased participants' steps, but steps were further increased with the addition of a feedback (e-counseling) component (Van Wormer, 2004). However, VanWormer (2004) mentioned that there was a possible social reinforcement component present during intervention that could have influenced the increase in step counts during the self-monitoring condition.

Interestingly, a handful of studies have investigated the effects of self-monitoring on different behaviors related to swimming (Critchfield, 1999; Critchfield & Vargas, 1991; McKenzie & Rushall, 1974; Paloha, Allen, & Studley, 2004; Schonwetter, Miltenberger, & Oliver, 2014). McKenzie and Rushall (1974) investigated the effect of self-monitoring to increase work output during swim practice. Program boards were placed at one end of the pool providing participants a place to record completed laps. Participants' work rates were determined

by dividing the total laps recorded on the program board by the observation time. An increase in work rate (laps per minute) of swimming was observed. During the intervention, participants referred to their program boards instead of waiting for their coach's instruction, which affected the rate of swimming. Also, recording laps on the program boards served as visual feedback, and unprogrammed social reinforcement was provided to participants from coaches and peers.

Contrary to McKenzie's and Rushall's (1974) report that self-monitoring increased the rate of swimming, Critchfield (1999) found that self-monitoring during swim sessions interrupted the continuous activity of swimming. Critchfield (1999) conducted a study with children to determine how many laps they could swim in 10-min sessions. When participants stopped to record lengths swam during a swim session, they were observed talking to each other rather than continuing to swim. Compared to an instruction only phase, self-monitoring increased performance only when the children recorded their lap counts at the end of the session but not when recording took place during the 10-min session (Critchfield, 1999). Because the sessions were only 10 min, little effort may be required to count and recall lap count immediately following a swim session. However, more effort may be required for longer duration swims. Recent technology innovations can be used to automatically record swim distance without interrupting the flow of swimming.

Three swimming studies have been conducted to determine the effectiveness of self-monitoring alone, and then self-monitoring with feedback (Critchfield & Vargas, 1991; Paloha et al., 2004; Schonwetter et al., 2014). Paloha et al. (2004) had adult participants self-monitor by counting their strokes in one pool length. A swim stroke is most efficient when the fewest strokes are required to complete a lap. The researchers observed decreases in stroke count but changes were very small and unstable. Paloha et al. (2004) continued the study by adding visual

feedback to the self-monitoring intervention. Participants counted their strokes and recorded stroke counts on a marker board at the end of the pool in a graph format. Paloha et al. (2004) found that the intervention was effective but had a greater effect for less experienced swimmers with higher baseline stroke counts. Critchfield and Vargas (1991) implemented a self-monitoring alone intervention and saw an initial increase in pool lengths swam per 10-min session followed by a gradual decrease or relatively stable frequency of pool lengths swam across the phase. When public self-graphing was added to self-monitoring, the researchers found that participants' rate of swimming did not change from self-monitoring, and that participants' inflated their performance on the graphs. Critchfield and Vargas (1991) reported that participants could view other participants in different conditions of the study, which may have affected performance.

Schonwetter et al. (2014) conducted a study with high school swimmers, however, the researchers also investigated a reactivity effect from being observed. During the self-monitoring phase, the participants recorded completed laps on a program board at one end of the pool. Schonwetter et al. (2014) found that all seven participants increased the percentage of assigned laps completed with self-monitoring, and four of the participants increased performance even further when a feedback component (praise for using the program board) was added to the intervention. Schonwetter et al. (2014) also found that four participants showed a decrease in performance when the researcher was absent, indicating reactivity to being observed. Thus, further research is warranted in this area.

Visual feedback in the form of graphs has been incorporated into interventions in many studies to increase physical activity (Critchfield & Vargas, 1991; Donaldson & Normand, 2009; Kurti & Dallery, 2013; Paloha et al., 2004; Normand, 2008; Wack et al., 2014; Ward & Carnes, 2002). While some researchers delivered visual feedback to participants (Normand, 2009; Kurti

& Dallery, 2013; Wack et al., 2014; Ward & Carnes, 2002), other researchers had participants graph data themselves as part of a self-monitoring intervention (Critchfield & Vargas, 1991; Donaldson & Normand, 2009; Paloha et al, 2004). Although Critchfield and Vargas (1991) had participants create their own graphs, they did not report accurate data. It is unknown whether the participants (children) did so knowingly or reported what they believed they swam. Additionally, Paloha et al. (2004) investigated a discrete stroke count, which may improve swimming performance but is not a behavior that would be a focus when the goal is to increase overall levels of physical activity.

There is evidence to support the effectiveness of self-monitoring and goal setting interventions, but no known research has been done to assess the effect of self-monitoring and goal setting on swimming behavior to increase physical activity. Also, research has yet to be conducted using an automatic recording device (similar to pedometers or accelerometers in studies measuring steps) to measure swimming behavior. The purpose of this study was to determine if self-monitoring (using an automatic recording device and self-recorded data on a graph) and self-monitoring with personally-set goals will increase swimming behavior in the absence of experimenter feedback.

Chapter Two: Method

Participants

The participants in this study were five adult swimmers. Lee was a 20-year-old male, and Amy was a 22-year-old female. Both Lee and Amy were undergraduate college students. Dori was a 49-year-old female who worked at a university. Claudia was a 63-year-old female professional. Reagan was a 69-year-old female living in a retirement community. Participants were recruited from flyers posted around a university's campus in Florida and from an emailed newsletter to the residents in a retirement community in Florida. Interested individuals were provided with an Information Questionnaire/Study Eligibility and Pre-Screening Consent Form (see Appendix A). To determine if individuals met criteria for participation in the study, interested individuals were also provided with a Motivation to Increase Physical Activity Questionnaire (MIPAQ) (see Appendix B) and a Physical Activity Readiness Questionnaire (PAR-Q) (see Appendix C). The MIPAQ was developed by the researchers for this study. Criteria included: being at least 18 years old, stating they are motivated and interested in increasing their swimming activity, reporting having not participated in any coached or competitive swimming programs in the past 3 months, reporting pre-requisite swimming skills, having convenient access to a pool where they can swim laps, owning a computer with internet access or having easy access to such, and owning a device capable of taking and sending digital pictures.

Participants' motivation was assessed using the MIPAQ. Participants had to report a 4 or 5 (agree or strongly agree) on questions 3, 4, and 5 on the MIPAQ. The response to questions 1,

2, and 6 were used to gather information and were not used to determine eligibility for participation. Participants had to be willing to commit to meeting four times during the study for 15-30 min, and correspond with the investigators via email, text, or phone at least once per week.

Potential health hazards may arise when increasing physical activity. In order to participate in the study, participants were required to answer "no" to all seven questions on the PAR-Q. To minimize risks, if potential participants answered "yes" to a question on PAR-Q they were required to get a note from a doctor that approved their participation in the study. Only one participant, Dori, did not answer "no" to all seven questions. Dori obtained written consent from her doctor approving her participation in the study, and gave the letter to the researchers. Also, the participants were instructed that if at any time they feel pain in their chest or have any other form of medical emergency they should contact 911 immediately. The participants were told that if their health condition changed at any point throughout the study, so that they would answer "yes" to any question in the PAR-Q, they should notify the investigators immediately, and this would be a termination criterion unless a doctor's note was provided that approved the participant's continued participation in the study. This did not occur during the course of this study. Additionally, the potential benefits to participants for participating in this study were improvements in health and fitness. Potential benefits outweighed minimal risks.

Setting and Materials

All sessions took place at pools to which the participant had convenient access. Prior to beginning the study and implementation of each phase of the intervention, each participant met separately with the researcher for a training session (explained below) at a location decided upon by the participant and researcher. All other correspondence took place via phone or email.

The initial meeting took place before implementing the Open-Loop Feedback (OLF) phase. At the initial meeting, participants were provided with a Garmin Swim watch and USB ANT stick. The researchers provided the participant with instructions for using the Garmin Swim watch. The Garmin Swim watch was used to track distance swam (http://sites.garmin.com/swim/). A purpose of this study was to limit the feedback provided by the researcher. The benefit to using the Garmin Swim was that participants could track their own activity while the researcher could also access the data. The Garmin Swim uses wireless technology to upload user's activity to the Garmin Connect website (http://connect.garmin.com/en-US/).

Prior to implementing the Open-Loop Feedback and Self Graphing (OLF+SG) phase of intervention, the researcher met with each participant for a second time. Participants were provided with a previously prepared and individualized graph paper or Excel file. The researcher provided the participants with instructions for graphing their swimming activity. Each participant remained in possession of his/her designated Garmin Swim and graph throughout the course of the study.

Validity and Reliability

The researcher assessed the validity and reliability of the Garmin Swim watch prior to beginning the study. The researcher incorporated different stroke topographies during the validity and reliability assessments.

To assess validity, the researcher swam while wearing a Garmin Swim as the researcher counted and recorded distance swam. Three sessions of 1000 yards each with two different Garmin Swim watches (six sessions total) were conducted to assess validity. During one session, an observer observed and recorded the distance swam by the researcher. Validity was determined

by calculating the percent agreement between the researcher's data and Garmin Swim's data (smaller distance divided by larger distance multiplied by 100). The percent agreement ranged from 93 to 97.5%.

To assess reliability of the Garmin Swim watch, two Garmin Swim watches were worn at the same time; either one watch was worn on each wrist or two watches were worn on the same wrist. Two sessions of 1000 yards each of the two types of reliability checks (four total sessions) were conducted to assess reliability. Reliability was determined by calculating the percentage of agreement between the distances recorded on the two Garmin Swim watches (smaller distance divided by larger distance multiplied by 100). The percentage of agreement between the distances recorded on two Garmin Swims when worn on the same wrist was 97.62% and 95.12%. The percentage of agreement between the distances recorded on two Garmin Swim when worn on different wrists was 95.35% and 92.86%.

Target Behaviors and Data Collection

The primary dependent variable in this study was distance swam measured by a Garmin Swim watch. Participants uploaded data from the Garmin Swim to the Garmin Connect website during each phase of the study. The researcher had access to additional data collected by the Garmin Swim on the Garmin Connect website including pace and duration of swims; however, these data were not collected or assessed in this study.

There was no need to collect Inter Observer Agreement data during this study because data collection via Garmin Swim was automated and objective. However, each participant's implementation fidelity was assessed to determine if data on each swim were recorded correctly and accurately on each participant's graphs. A graph is constructed correctly if the date is recorded on the x-axis, a data point is used to represent distance swam, a solid line is used to

connect data points in a given week, and a goal line (if applicable) is represented as horizontal dashed lines. Implementation fidelity for correct graphing was calculated by dividing the number of components graphed correctly by the number of graph components multiplied by 100 (see appendix D).

Accuracy of a graph is defined as agreement between data recorded on the participant's Garmin Swim and data recorded by the participant on his/her graph and goal line (if applicable) recorded at the pre-determined level. To assess accuracy, the researcher collected data from the Garmin Connect website and recorded the date and distance for each swim session. The participants collected data from the Garmin Swim watch and recorded the date and distance on a graph. During the Open-Loop Feedback, Self-Graphing, and Goal Setting (OLF+SG+GS) phase, the researcher and participant also recorded the weekly goal line. Implementation fidelity for accurate graphing was defined as exact agreement on the date, distance, and goal (if applicable) between the participant's graph and the Garmin Connect data. The percentage was calculated by dividing the number of agreements by the number of opportunities for agreement multiplied by 100 (see appendix D).

Adherence was measured by looking at whether a participant uploaded his/her Garmin Swim data and submitted his/her graph by the end of the week. During OLF, participant adherence was only assessed for uploading Garmin Swim data. Data were recorded as a Yes (Y) or No (N) for uploaded data on time (see appendix E). During OLF+SG and OLF+SG+GS, if a participant uploaded his/her data and submitted his/her graph by the end of the week, adherence was scored at 100% adherence for that week. Adherence was scored at 50% if only data were uploaded on time or only his/her graph was submitted on time. Adherence was scored at 0% if both data were not uploaded and graph was not submitted by the end of the week. The researcher

assessed participants' adherence to wearing the Garmin Swim during swims through weekly self-report of number of swims that week that the Garmin Swim was not worn during a swim. Adherence data were assessed across all phases.

Following completion of the study, the researcher meet in-person with each participant. Participants completed a social validity questionnaire developed by the researcher (see appendix F). The participants responded to the questions using a 5-point Likert scale and open-ended questions that were used to assess each participant's view of the effectiveness and feasibility of the intervention.

Experimental Design

A multiple baseline design across participants was used to assess the effectiveness of the self-graphing intervention alone for five participants and the self-graphing with personally-set goals for two participants.

Procedure

Prior to beginning the study, each participant completed the questionnaires. Eligible participants met with the researcher at a mutually agreed upon time and location to sign the consent form and receive the Garmin Swim watch and USB ANT stick. The researcher taught the participants to use the Garmin Swim to record swimming distance by modeling and having the participant demonstrate proficiency at using the Garmin Swim to ensure data would be collected. The participant was required to bring his/her computer to the meeting, and the researcher set up Garmin Connect on each participant's computer so data from his/her Garmin Swim could sync. Because participants did not have access to Garmin Connect website at any point during the study, there was no need to demonstrate how to use the website. Participants were told to wear the watch every time they swim. The researcher and participants chose a

strategy to remember to wear the Garmin Swim if they went swimming (e.g., participant attached Garmin Swim to goggles or participant wore Garmin Swim watch daily). Participants were told to sync their data by the day after the end of each week throughout the study. To sync the data, participants plugged the USB stick into the computer and had the Garmin Swim nearby; syncing occurred automatically. At the beginning of the next week the researcher emailed or texted the participant to determine if a participant engaged in swimming but forgot to wear his/her Garmin Swim (see appendix G). The researcher reminded participants to wear their Garmin Swim when they swam in the upcoming week. If at any time during the study a participant reported forgetting to wear his/her Garmin Swim twice in a week for two consecutive weeks, the researcher implemented a prompting procedure. Every day a participant received an email or text before 9:00 am that said: "If you go swimming today, please wear your Garmin Swim watch."

If a participant did not upload his/her Garmin Swim data by midnight the last day of the week, the researcher emailed or texted the participant the following morning and said: "Please upload your Garmin Swim watch data."

Open-loop feedback. The first phase of the study was the OLF phase. In order to use the Garmin Swim, one must manually start and stop the watch for each swim, as well as save the data following the swim. To avoid potential difficulties and loss of data during the initial phase, the open-loop format was used rather than covering the face of Garmin Swim during a baseline phase. Goldfield, Kalakanis, Ernst and Epstein (2000) described an open-loop feedback system as one where individuals can access an "accurate measurement of physical activity." Thus, this phase was called open-loop feedback because the watch provided the report of the participants' activity. The OLF phase was implemented at the initial meeting. Participants were told to wear

the Garmin Swim if they engaged in swimming. Data were collected on the distance of swims in the OLF phase until stable responding (flat or negative slope) in weekly distance was observed.

Open-loop feedback and self-graphing. The first intervention was OLF+SG. Before beginning this phase, each participant met separately with the researcher. The researcher gave participants the graphing materials and taught each participant to correctly complete the graph using the data from the Garmin Swim watch. The participants were told to update the graph as soon as possible following each swim. The researcher and participant chose a strategy to ensure the graphs were updated following each swim (e.g., posting graph on the refrigerator or setting daily reminders on a participant's computer). The data stream on the graph was cumulative distance of swims across a week. A new data stream began each week (on the same graph). If a participant's implementation fidelity fell below 80% for two consecutive weeks, the researcher met with the participant in-person to conduct a booster session or provided detailed instructions to retrain graphing skills and ensure participant was graphing correctly and accurately.

Participants were told to continue uploading their data by the end of the week and to now begin submitting their graph to the researcher by the end of the week, as well. Participants were told to send the graph to the researcher via text message (picture of the paper-and-pencil graph) or email (Excel file).

If a participant did not upload his/her Garmin Swim data and/or submit his/her graphs by the last day of the week at midnight, on the following morning the researcher emailed and text the participant asking: "Please upload your Garmin Swim watch data," "Please submit your graphs," or "Please upload your Garmin Swim watch data and submit your graphs."

Open-loop feedback, self-graphing, and goal setting. Goal setting was implemented in addition to OLF+SG when an increase in responding was not observed for a participant in the

OLF+SG phase. Prior to implementing OLF+SG+GS, the researcher met with the participant to describe the goal setting component. During this meeting, the researcher told the participant to choose his/her first weekly goal based on data from OLF+SG. The researcher calculated the participant's average weekly distance (in meters or yards) swam during the last three weeks of OLF+SG. The participant chose a weekly distance goal in 100-m/yd increments that was 10-30% higher than that average (the researcher provided the participant with the 10-30% range). The two participants that advanced to OLF+SG+GS had an average of 0 yards (Lee) and 0 meters (Dori), therefore, the researcher gave them a range of 100 m/yd-300m/yd to choose from for their weekly goals. The researcher used instruction, modeling, rehearsal, and feedback to teach the participant to add a goal line to his/her graph. A participant needed to meet his/her goal for two consecutive weeks to increase the weekly goal. If participants met the criteria for increasing their weekly goal, they chose new distance goals in 100-m/yd increments that were 10-30% higher than their previous goal. However, no participants in the study met the criteria to increase their weekly goal.

If data were uploaded and the graph was submitted by midnight on the last day of the week, the researcher emailed or texted the participant on the following morning saying: "Your weekly distance goal is going to increase. Please respond with your desired goal that is a 100-m/yd increment between ___ and ___m/yd." If a participant did not meet his/her goal it remained the same as the previous week. In this case, if data were uploaded and the graph was submitted by midnight on the last day of the week, the researcher emailed or text the participant the following morning: "Your weekly distance goal will remain the same at ___m/yd."

If data were not uploaded on time and/or graphs were not submitted, the researcher asked the participant to upload or submit in the morning on the first day of the week (as discussed

above). Once the researcher could view the participant's data, the same correspondence between the researcher and participants as described above occurred to set a new weekly goal or keep the goal the same. The researcher conducted a booster session as described above if a participant's overall implementation fidelity fell below 80% for two consecutive weeks.

Chapter Three: Results

Swim Data

Data on all participants' weekly distance swam are displayed in figure 1. During OLF, Lee did not engage in any swimming, No trend was observed in both Amy and Claudia's swimming behavior, and Reagan's data showed a decreasing trend. Dori did not engage in any swimming for 2.5 weeks, so a meeting was set to implement OLF+SG. During the time between setting up the meeting and actually meeting, Dori engaged in 575m of swimming. Dori's data were not synced prior to the meeting and implementing OLF+SG, so the researcher was unaware of the activity in OLF.

When OLF+SG was implemented, an immediate change in was observed for two (Amy and Reagan) of the five participants. Amy's average weekly distance swam was 1488yd during OLF and 5475yd during OLF+SG. However, as discussed below, Amy's data during OLF+SG was not recorded on the Garmin Swim but was all self-reported. Reagan's average weekly distance swam was 442yd during OLF and 1043yd during OLF+SG. There was only one week (week 13) of the OLF+SG phase where Reagan did not engage in any swimming. This week occurred immediately following her return from a skiing vacation. However, Reagan engaged in 1850yd of swimming during week 14, which was the longest distance she swam across all weeks. Claudia did not demonstrate an effect following implementation of OLF+SG. Her average weekly distance swam was 5581yd during OLF and 4356yd during OLF+SG. Dori and Lee did not show any intervention effect when OLF+SG was implemented; they were the only participants that advanced to the OLF+SG+GS phase. Lee showed an effect during the first week

of the OLF+SG+GS phase. Lee had a goal of 100yd, and he exceeded it by swimming 200yd during that week. However, the effect did not maintain; Lee did not engage in any swimming during the next four weeks in which he participated in the study. The implementation of the OLF+SG+GS phase had no effect on Dori's swimming behavior. Dori did not engage in swimming during either of the intervention phases.

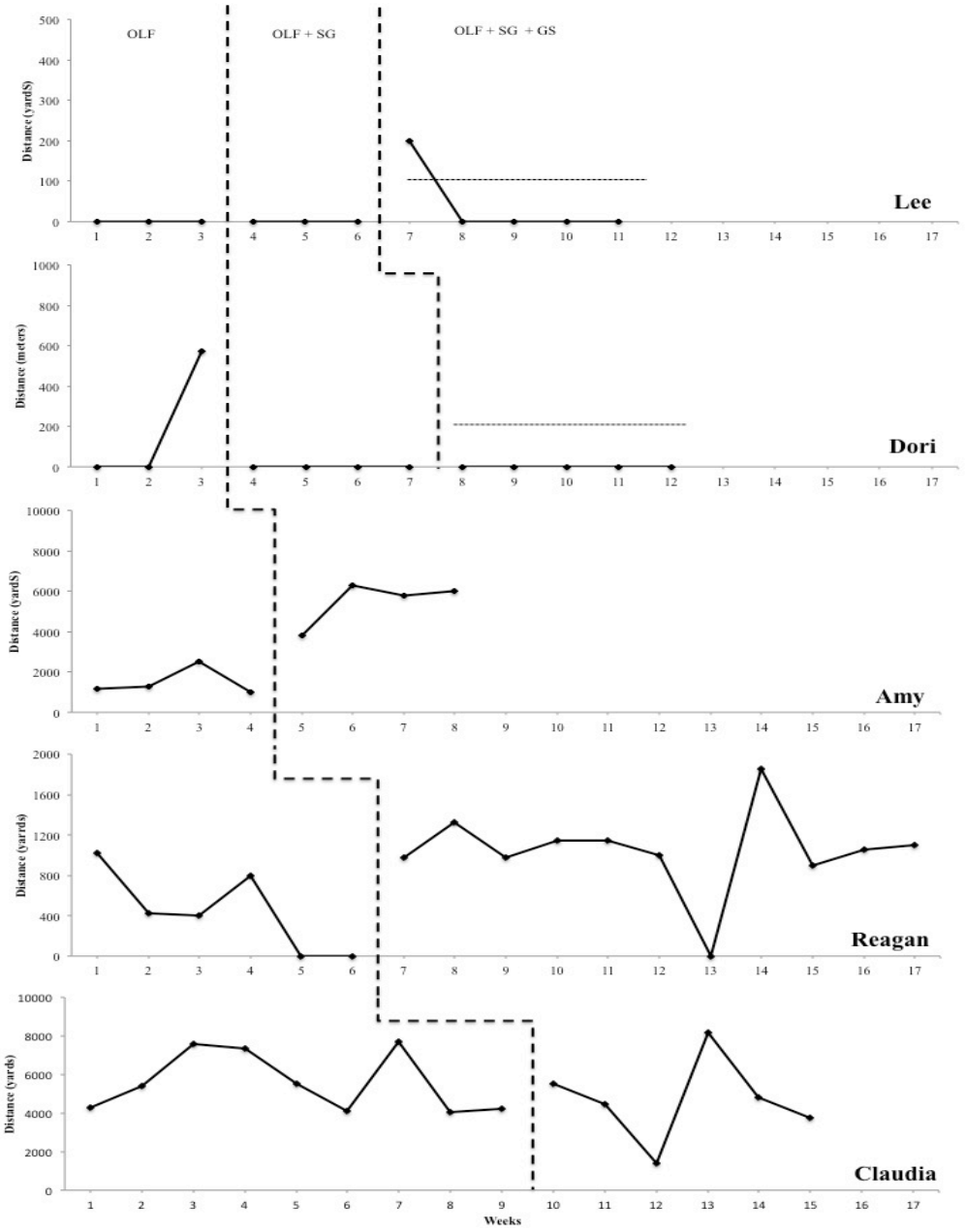

Figure 1. Weekly distance of swims across all participants.

Motivation Assessment

The summary of the participants' responses to the MIPAQ is reported in table 1. All five participants reported that they were motivated to engage in more swimming to increase endurance. Four participants wanted to increase strength and/or improve overall health. One participant (Dori) reported that she was motivated to engage in more swimming to prepare for a triathlon.

Table 1. Summary of the Motivation to Increase Physical Activity Questionnaire.*

	Question 1	Question 2	Question 3	Question 4	Question 5
Average Score	4	4	4.4	4.4	4.8
Lowest Score	2	2	4	4	4
Highest Score	5	5	5	5	5

**Participants had to report a 4 or 5 on Question 3-5 to be eligible for participation in the study.*

Implementation Fidelity

Data were collected on the participants' implementation fidelity for graphing correctly and accurately during the OLF+SG phase and OLF+SG+GS phase (if applicable). Reagan, Lee, and Dori used the paper-and-pencil graphing methods. However, Lee and Dori switched to the Excel graphing method. Amy and Claudia used the Excel graphing method throughout the entire intervention phase. The implementation fidelity data are displayed in table 2.

Dori and Lee were the only two participants that advanced to the OLF+SG+GS phase. Their data on graphing correctly and accurately were below 100% because they did not include the goal lines on their graphs.

Amy's and Claudia's data on graphing correctly were below 100% because they did not always add their daily distances in a week together for a cumulative daily distance. The data points on the graph were supposed to be cumulative daily distance rather than daily frequency. Amy only made this error during her first week of graphing.

Reagan's data on graphing accurately were below 100% because the data points recorded on her graph were not always the same as the data her Garmin Swim recorded. However, she was never off by more than 100 yards.

Table 2. Participants' implementation fidelity data during intervention phases.*

	Graphed Correctly		Graphing Accurately	
	OLF + SG	OLF + SG + GS	OLF + SG	OLF + SG + GS
Amy	96.4%	NA	NA*	NA
Claudia	90.3%	NA	95.8%	NA
Dori	100%	90%	100%	75%
Lee	100%	90%	100%	80%
Reagan	100%	NA	87%	NA

**Amy's data during OLF + SG were self-reported, so data recorded could not be compared to Garmin Swim data.*

Adherence

Data were collected on the participants' adherence to uploading their Garmin Swim data and submitting their graphs "on time," which is displayed in table 3.

During the OLF phase, participants were only required to upload their data. The average adherence ranged from 11% (Claudia) to 100% (Amy, Dori, and Reagan). One participant (Lee) had no data to upload during the OLF phase. Claudia required prompts for eight out of nine weeks of this phase to upload her data.

During the OLF+SG phase participants not only had to upload their data but they also had to submit their graphs. The average adherence ranged from 0% to 91%. Again, Lee had no data to upload during the OLF+SG phase, and he also did not submit his graph on time for any of the weeks during this phase. When the researcher prompted Lee to submit his graph, he complied within a day. Reagan always uploaded her data on time, but she required prompts for two of her weeks to submit her graph. For five of Claudia's seven weeks in OLF+SG, she did not upload her data or submit her graph on time. There was one week that Claudia uploaded her data and submitted her graph on time. Dori did not have any data to upload during this phase; she

submitted her graph independently for one out of four weeks. Amy did not have data to upload during this phase because she did not have access to her Garmin Swim. However, she independently submitted her graph on time for four out of five weeks of this phase.

Only Dori and Lee participated in the OLF+SG+GS phase. Dori did not have data to upload at any point during this phase. She independently submitted her graph on time for three out of five weeks. Lee only had one week of data to upload, which he did on time. He submitted his graph on time for one out of five weeks of this phase.

Only two participants reported that they forgot to wear their Garmin Swim watches at any point during the study. Reagan reported that she forgot to wear the Garmin Swim one time during the OLF phase. As mentioned previously, Amy did not have access to her Garmin Swim during the OLF+SG phase. Therefore, all of her swims during these four weeks were self-reported (17 total swims). During the OLF phase, Amy used the Garmin Swim incorrectly, and the data from one of her swims was not recorded.

Table 3. Participants average adherence percentages in each phase.

	Average Adherence in OLF	Average Adherence in OLF+SG	Average Adherence in OLF+SG+GS
Amy	100%	75%	NA
Claudia	11%	21%	NA
Dori	100%	25%	60%
Lee	NA	0%	30%
Reagan	100%	91%	NA

Social Validity

Social validity questionnaires were completed by three of the five participants (Dori, Lee, and Reagan). Reagan responded to all statements with a rating of 4 or 5. The thing she liked most about the study was the accountability. She reported that the watch was like her "buddy." The thing she liked least was the size of the graph. She reported, "A larger zoom and less brackets would work for me." Reagan also reported that the "long distance worked well for this short term commitment."

On the other hand, Dori and Lee had more variable responses to the social validity questionnaire. Dori reported a 5 to statement 1, 2, and 5, and she reported a 4 to statement 4 and 7. Dori disagreed (score of 2) with statement 4, and she strongly disagreed with statement 8 (score of 1). Dori reported, "The study was clear and easy to follow." She also stated, "Life was too busy to add another activity like swimming, but I will some other time." Lee reported all 2-4 to the statements on the social validity questionnaire. He agreed that he liked using the Garmin Swim watch and that it was easy to use. He disagreed that self-graphing helped him improve his swimming, and he did not plan to continue to use self-graphing or goal setting. The thing that Lee liked most about the study was "wearing the watch." He stated, "I never bothered to graph, or swim really."

Chapter Four: Discussion and Limitations

The purpose of this study was to determine if self-monitoring via self-graphing using an automated recording device and goal setting, if necessary, would increase adults' swimming behavior. The researcher limited the amount of interaction with the participants by teaching the participants how to track their own swimming behavior on a graph. The results of the study indicate that self-graphing can be an effective intervention to increase swimming behavior with some individuals but not all. Self-graphing was effective for Amy and Reagan. As a retired individual, Reagan had substantial time to engage in enjoyable activities. She expressed her interest in staying active and participating in fitness activities, including her involvement with a tennis club. Amy also reported that she liked to stay active. Amy had participated in a coached swimming program during high school. She was interested in staying active by increasing her swimming behavior. However, it is important to note that although Amy adhered to the self-graphing intervention, her data were self-reported so the accuracy of her graphing cannot be determined because there was no data from the Garmin Swim to compare it to.

Self-graphing showed no effect on Dori's and Lee's swimming behavior. Dori and Lee were moved into the next phase that included goal setting. In the OLF+SG+GS phase, Dori's behavior did not change; Dori did not engage in any swimming during both OLF+SG and OLF+SG+GS. Dori reported that could not find time to add swimming into her schedule during the course of the study. Further, Lee met his goal of 100yd during his first week in the OLF+SG+GS phase; however, he did not swim at any point during the rest of the study. Lee

reported that he liked wearing the Garmin Swim watch because people would ask him about it. It is suspected that wearing the watch resulted in social reinforcement for Lee.

Claudia's distance swam weekly did not change substantially between OLF and OLF+SG. She was the only participant that engaged in a high level of swimming during the OLF phase. During OLF+SG, Claudia maintained the level of swimming slightly below the level recorded during OLF. It is likely that Claudia was set in a routine prior to beginning the study. Claudia's implementation fidelity for graphing correctly and accurately was 90.3% and 95.8% respectively, but her adherence with the intervention was low (11% during OLF and 21% during OLF+SG). Therefore, it is difficult to determine the effect of OLF+SG because she did not consistently implement the intervention or adhere to uploading and submitted her data. Because of her low adherence with the first intervention, the second intervention was not implemented with Claudia.

It appears from the data that the participants in this study fell into two groups, responders (Amy and Reagan) and nonresponders (Lee, Dori, and Claudia). However, it is not clear what variables contributed to the success of the responders and the failure of the nonresponders. One pattern did emerge; the responders had higher treatment adherence than did the nonresponders, although it is not possible to know if adherence was a factor contributing to the results. The data are consistent with the results of Valbuena, Miltenberger, and Solley (in press) and Ek, Miltenberger, and Valbuena (2015). Each of these studies implemented an intervention to increase physical activity (measured as daily steps) and found some individuals responded to the intervention and some did not. This finding was consistent across children (Ek et al., 2015) and adults (Valbuena et al., in press).

The interventions in this study were designed to be largely self-management procedures that required little face-to-face time with the researcher. The value of such interventions is that they require less response effort and are thus more accessible than interventions requiring weekly meetings. However, the limited contact with the researcher also may have been a factor that contributed to the ineffectiveness of the procedure for three of the participants. It is possible that weekly face-to-face or skype type of meetings could have provided more social support and thus evoked and reinforced more swimming. Valbuena et al. (in press) found that more contact with the researchers providing behavioral coaching contributed to greater increases in physical activity than an intervention that did not include such contact. Future research should investigate the optimal level of social support needed to produce increases in physical activity.

There are some limitations to this study worth noting. The self-graphing and goal-setting interventions used in this study did not include any reinforcement contingency as an intervention component. In the future, the effect of reinforcement contingencies on swimming behavior should be investigated. Also, future research could evaluate whether adherence and implementation fidelity could increase if a reinforcement contingency was associated with those behaviors.

Another limitation is that the Garmin Swim watch did not record all swimming behaviors. Claudia reported that she engaged in "kick sets" during her swim sessions where she swam using her legs and feet only while her upper body and arms remained stable. Since the Garmin Swim is worn on the wrist, it did not record "kick sets." A more advanced automated recording device would be required to account for the different swimming styles in future research.

Although the participants were given instructions for using the Garmin Swim and the graphing material, the researchers were often asked follow-up questions via email and text. In future research, the participants may benefit from having a task analysis for using an automated recording device such as the Garmin Swim and for completing the graphing procedure. However, all participants reported they did not prefer the graphing procedure. A different self-monitoring strategy should be investigated in future research.

This study focused on increasing individuals' physical activity through increasing weekly swim distance. Motivation was assessed prior to participation through a questionnaire and participants were chosen based on a stated level of desire to increase exercise. More advanced motivation assessments and analyses should be developed to determine individuals' motivation to increase physical activity as it appears that increases in swimming distance (as shown on the watch and on the graph) were not powerful enough reinforcers to increase swimming for at least two of the participants (Lee and Dori).

This study only measured swimming behavior. Four out of five participants reported that they engaged in other forms of physical activity during the course of the study. Dori reported that she engaged in yoga and running. Dori may have found those activities more reinforcing than engaging in swimming, or her involvement in those activities could be considered competing responses. In either case, she was engaging in beneficial physical activity, but it eluded assessment because only swimming was recorded. Future research should seek to measure all relevant forms of physical activity to provide a more sensitive measure of change following intervention.

The results of this study provide information on the effectiveness of self-monitoring via self-graphing and goal setting on swimming behavior. Self-graphing was effective for increasing

weekly swim distance for some participants. Some participants did not show an increase in weekly swim distance when self-graphing was implemented as well as no change when goal setting was added to the intervention. Future research should be conducted to a) identify factors that contribute to the success or failure of such interventions, b) identify ways to enhance the effectiveness of such interventions, c) identify participants most likely to benefit from such interventions, and d) determine the effectiveness of other interventions on increasing total weekly distance swam and other forms of physical activity.

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Appendices

Appendix A: Information Questionnaire/Study Eligibility and Pre-Screening Consent

Hello, my name is Sarah Abraham. Thank you for volunteering to participate in this study eligibility screening for my study entitled: Using Self-Monitoring and Goal Setting to Increase Swimming in Adults. I am a member of the research team serving the University of South Florida.

We are conducting a study to evaluate the effectiveness of self-management strategies on increasing swimming. Before you are enrolled in the study, we need to ask you a few questions to determine if you meet certain requirements. If you would like to participate, please answer the following questions and return this form to the investigators via email.

Name: _____ Age: _____

1. When was the last time you participated any coached or competitive swimming program?
   □ Currently □ 1-2 years ago
   □ Within the past 3 months □ 2+years ago
   □ 3 months-1 year ago □ Never
2. How far can you swim without stopping? _____
3. When was the last time you swam for exercise? _____
4. If I swim, it is typically: □ On my own □ With a group □ Not applicable
   □ In a class □ Other _____
5. Do you have convenient access to a pool where you can swim laps? Yes or No
   - If Yes, where? _____
6. Do you foresee any problems accessing your lap pool? Yes or No
7. Has your doctor indicated that you should limit the amount of swimming you should engage in? Yes or No
8. Do you know of any reason why you should not engage in swimming laps regularly (at least 3 times/week)? Yes or No
9. Do you own or have daily access to a computer with Internet access? Yes or No
   - Do you own a Mac or PC? _____
   - What operating system do you run on your computer? _____
10. Do you own a cellphone? Yes or No
    - Can your cellphone take pictures that can be sent electronically? Yes or No
11. Can you commit to meeting at least four times during the course of the study for 15-30 mins and correspond with the researcher via email, text, or phone once a week? Yes or No
12. Do you have plans for vacation or will you be traveling during the next 4 months? Yes or No
    - If yes, for how long will you be out of town? _____

If you meet the criteria for participating in the study, the investigators will contact you to enroll you in the study. If you do not meet the criteria for participation, the investigators will notify you, and the information that we have collected from you today will be destroyed (all electronic files permanently deleted).

Appendix B: Motivation to Increase Physical Activity Questionnaire

1. I consider myself to be physically active.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

2. I engage in physical activity regularly. (Regularly means at least 3 times/week.)

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

3. I am motivated to engage in more exercise than I currently engage in.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

4. I am willing to commit to a program to increase my physical activity.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

5. I am motivated to engage in more __**(swimming)**__ than I currently engage in.

1	2	3	4	5
Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

6. Reasons I am motivated to engage in more __**(swimming)**__ (check all that apply):

- ☐ Lose Weight
- ☐ Improve Overall Health
- ☐ Improve Appearance
- ☐ Increase Strength
- ☐ Increase Endurance
- ☐ Decrease Stress
- ☐ Other: _____

_____

Appendix C: The Physical Activity Readiness Questionnaire (PAR-Q)

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: answer YES or NO.

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?

2. Do you feel pain in your chest when you do physical activity?

3. In the past month, have you had chest pain when you were not doing physical activity?

4. Do you lose your balance because of dizziness or do you ever lose consciousness?

5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?

6.Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?

7. Do you know of any other reason why you should not do physical activity?

Appendix D: Implementation Fidelity

Graph completed correctly: (1) Data point is recorded on correct date on the x-axis, (2) Data point is used to represent distance swam, (3) Lines are used to connect data point in a specified week, and (4) Goal line/point (if applicable) is represented as horizontal dashed lines.

Graph completed accurately: (1) Agreement between data recorded on the participant's Garmin Swim and data recorded by the participant on his/her graph, and (2) goal line (if applicable) recorded at the pre-determined level.

Participant: _____ Phase: _____

Date	Distance	Weekly Goal (if applicable)	Graphed Correctly Yes (Y) or No (N)	Graphed Accurately Yes (Y) or No (N)

Graphed Correctly:
Opp. for Correct Graphing: ___
Total Correct: ___
Total Correct/Opp. for Correct x100 =___%

Graphed Accurately:
Opp. for Accurate Graphing: ___
Total Accurate: ___
Total Accurate/Opp. for Accurate x100 =___%

Appendix E: Adherence

"On time" means by midnight on the day after the last day of the participants "week." During OLF, adherence is scored: 100% if data is uploaded on time and 0% if it is not uploaded on time. During intervention, adherence is scored: 100% if both data was uploaded and graph was submitted on time, 50% if only data were uploaded on time or if only graph was submitted on time, 0% if neither data were uploaded or graph was submitted on time.

Participant: _____ Phase:_____

Week	Data Uploaded on Time Yes (Y) or No (N)	Graph Submitted on Time Yes (Y) or No (N)	Percent Adherence	# of Swims Watch not Worn/Total Swims
Week 1				
Week 2				
Week 3				
Week 4				
Week 5				
Week 6				
Week 7				
Week 8				
Week 9				
Week 10				
Week 11				
Week 12				
Week 13				
Week 14				
Week 15				
Week 16				
Week 17				
Week 18				
Week 19				
Week 20				
Week 21				
Week 22				
Week 23				
Week 24				
Week 25				
Week 26				
Week 27				
Week 28				
Week 29				
Week 30				
Week 31				
Week 32				
Week 33				
Week 34				

Average Adherence OLF =____ Average Adherence Phase 1 =____ Average Adherence Phase 2=____

Appendix F: Social Validity Questionnaire

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. I enjoyed participating in this study.	1	2	3	4	5
2. I liked using the Garmin Swim watch.	1	2	3	4	5
3. The Garmin Swim watch was easy to use.	1	2	3	4	5
4. The self-graphing procedure helped me improve my swimming.	1	2	3	4	5
5. The self-graphing procedure was easy to use.	1	2	3	4	5
6. The goal-setting procedure was a helpful addition to self-graphing.	1	2	3	4	5
7. I plan to continue swimming after the study concludes.	1	2	3	4	5
8. I plan to continue using the self-graphing procedure to track my swims.	1	2	3	4	5
9. I plan to continue setting goals to increase or maintain my swimming performance.	1	2	3	4	5
9. What did you like most about the study? _____ _____ _____					
10. What did you like least about the study? _____ _____ _____					
Any other comments: _____ _____ _____					

Appendix G: Weekly Email Communication

Email from researcher to participant:

Hi _____,

I hope you are having a great day!

REMEMBER TO WEAR YOUR GARMIN SWIM EVERY TIME YOU SWIM!

Please respond to the questions below as soon as possible.

Did you forget to wear your Garmin Swim during any swims this week? If so, how many times did you forget?

[This information is being provided for a research study - IRB#19036 - being conducted through the University of South Florida. Your participation is greatly appreciated.]

Please let me know if you have any questions/concerns.

Thank you!

Sarah Abraham, B.S., BCaBA
Master's Student
ABA Program, University of South Florida
(305) 794-7613

Appendix G: IRB Approval Letter

USF
UNIVERSITY OF
SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

10/13/2014

Sarah Abraham, B.S., BCaBA
ABA-Applied Behavior Analysis
13301 Bruce B. Downs Blvd
Tampa, FL 33612

RE: **Expedited Approval for Initial Review**
IRB#: Pro00019036
Title: Using Self-Monitoring and Goal Setting to Increase Swimming in Adults

Study Approval Period: 10/12/2014 to 10/12/2015

Dear Ms. Abraham:

On 10/12/2014, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents outlined below.

Approved Item(s):
Protocol Document(s):
Sarah Abraham Thesis

Consent Document(s)*:
Consent Form Thesis.docx.pdf

Consent Script(s)
Pre Screen Form.docx

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s).

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR

56.110. The research proposed in this study is categorized under the following expedited review category:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your study qualifies for a waiver of the requirements for the documentation of informed consent as outlined in the federal regulations at 45CFR46.117(c) which states that an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either: (1) That the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern; or (2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Kristen Salomon, Ph.D., Vice Chairperson
USF Institutional Review Board