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Stepping Up UMD Group Health Coaching: A Behavioral Intervention

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Abstract

Dangerous health risks due to sedentary lifestyles prove to be a serious issue, especially to those holding traditional desk jobs in the workplace. Upon request of the UMD Health and Wellness Center's Lifestyle Management Health Coach, a behavioral systems analysis of the UMD Group Health Coaching Program was conducted and revealed several opportunities to evaluate and improve its current format. This study sought to evaluate the UMD Group Health Coaching Program during the implementation of a 10-week program offered to a group of 12 UMD employees who indicated interest in increasing stepping behavior. Program evaluation included assessment of: (a) the effectiveness of the UMD Group Health Coaching program to promote increased stepping behavior of participants while using the Fitbit measurement system, (b) the influence of participant access to the Fitbit website and mobile phone app on participants' levels of physical activity, (c) the effects of social competition mediated through the Fitbit system on individuals' participation in the challenges and levels of physical activity while engaged in these challenges, and (d) the UMD Lifestyle Coach's perception of the usefulness of recommendations derived from the BSA approach. Visual analysis of time-series data revealed an overall decrease in stepping behavior and levels of intensity of physical activity across the 10-week program. Findings are discussed with regard to implications for designing effective intervention components that include setting unique step goals for each individual and incorporating contingent positively reinforcing consequences to increase participants' stepping behavior in relation to their goal.

Table of Contents

List of Tables

List of Figures

Introduction

Health Risks to Sedentary Workers

The workplace is an environment intended to promote productivity, creativity, and profitability for both organizations and workers alike, and one in which adult workers spend a large part of every day. According to a recent Gallup poll, 92% of full-time adult workers in the U.S. reported working over 40 hours per week (Saad, 2014). Similarly, findings from the U.S. Bureau of Labor Statistics (2014) indicate that, on average, adult employees work 8.7 hours per day, 5 days per week. While at work, the average full-time worker spends the majority of that time in a sitting position. Survey results from a sample of 1,000 full-time workers revealed that 86% of respondents reported that their jobs require them to sit all day (Ergotron, 2013). Owen, Healy, Matthews, and Dunstan (2010) assert that the changes in transportation, communications, the workplace, and domestic-entertainment technologies have been associated with significantly-reduced demands for physical activity, which has led to increased time spent sitting.

The problems associated with workers spending most of their days in a sedentary position have led to a host of unhealthy complications. Several studies have found that sedentary workers are more prone to have health risks such as: cardiac risk factors and job stress (Emeny, Lacruz, Baumert, Zierer, Autenreigh, & Ladwig, 2012); chronic diseases such as obesity, diabetes, certain cancers, arteriosclerosis, or apnea (Garcia Villar, Oreffice, & Quintana-Domeque, 2011); and cardiovascular disease, hypertension, and stroke (Landsbergis, Schnall & Dobson, 2009). These health risks have been connected to rising healthcare costs (Harbin, 2013; Schröer, Haupt, & Pieper, 2014;

Stewart, 2013), as well as reduced productivity and increased absenteeism (Schröer, Haupt, & Pieper, 2014). According to the Centers for Disease Control and Prevention (*CDC*; 2013), chronic diseases such as heart disease, stroke, cancer, and diabetes can account for 75% of the 2 trillion dollars spent on medical care each year. The CDC also reports that health insurance premiums covered by employers for a typical family of four have increased 114% since 2000, with the annual worker contributions increasing by $293 for single coverage and $3,281 annually toward the cost of family coverage due to the negative effects of a largely sedentary workforce.

Reducing Sedentary Risks

The CDC (2014) recommends a minimum of 150 minutes per week of moderate-intensity aerobic activity for adults. This can be broken down into increments as little as 10 minutes at a time spread throughout the week. A brisk walk (i.e., pace of 3-4.5 mph) is one common physical activity that qualifies as moderate-intensity aerobic activity (CDC, 2015). The physiological measure equivalent to a moderate-intensity level of physical activity is 3.0-5.9 METs (i.e., Metabolic Equivalent of Task: the ratio of metabolic rate during a specific physical activity to a reference metabolic rate) or 3.5-7 kcal/min. Exercise-related health benefits for adults (e.g., reduced weight, reduced risk of cardiovascular disease, reduced risk of type 2 diabetes, reduced risk of metabolic syndrome, reduced risk of some cancers, improved mental health, improved mood, and increased chances of living longer) may also be obtained through participation in at least 150 minutes of moderate-intensity physical activity (≥ 3.0 METs) or 75 minutes of vigorous-intensity physical activity (≥ 6.0 METs) during the course of a week (CDC, 2014). For even greater additional health benefits, the CDC (2014) recommends 300 minutes of moderate-intensity physical activity or 150 minutes of vigorous-intensity physical activity per week.

Although recommended amounts of moderate and vigorous levels physical activity exist for working-aged adults (aged 18-65), none exist for light-intensity aerobic activity (1.1-2.9 METs) such as walking slowly, standing, and lifting lightweight objects (Office of Disease Prevention and Health Promotion, 2008). Research on the benefits of light-intensity physical activity on health outcomes has focused on older adults (65+ years) who are less likely to be part of the workforce. Health benefits for older adults related to increased levels of light-intensity aerobic activity include decreased levels of depression (Loprinzi, 2013); reduced risk of cardiovascular disease (Loprinzi, 2015); congestive heart failure (Loprinzi, 2016); improvements in flexibility, balancing, and lower limb muscle strength (Andy, Tse, Wong, & Lee, 2015); and lower levels of body mass index, insulin resistance, and chronic disease (Loprinzi, Lee, & Cardinal, 2015). The opportunity for adult office workers to engage in light-intensity levels of exercise may be higher, as extended periods of sitting, rather than physical labor, are commonplace (Biernat, Tomaszewski, & Milde, 2010; Clemes, O'Connell, & Edwardson, 2014), and casual walking or stretching may be more easily incorporated into work breaks.

Physical activity accelerometer devices allow individuals to self-monitor activity levels and can be used to track progress toward the CDC's recommended activity amount and intensity. One popular physical activity monitoring device, the Fitbit, has a user base of more than 20.8 million individuals (Dolan, 2015). Fitbit developers have focused its software and tracker design to help individuals to quantify and set exercise goals to increase levels of physical activity. As such, developers recently changed the criteria for tracking "active minutes" to include a minimum number of consecutive activity minutes (Pai, 2015) to support the CDC's (2014) support for breaking up bouts of physical activity into increments as little as 10 minutes at a time. Thus, until the activity monitor user engages in 10 consecutive minutes of moderate-to-vigorous-intensity physical activity, the user will not earn minutes toward their default daily total "active minutes" goal of 30 minutes/day. Fitbit activity monitors do monitor and record the amount of time users engage in light-intensity physical activity; however, these minutes do not count towards the user's "active minutes."

In addition to the development and use of physical activity monitoring devices, the goal to accumulate 10,000 steps per day has become the benchmark step goal believed to be associated with health benefits associated with physical activity (Rettner, 2014; Tudor-Locke et al., 2011). Tudor-Lock et al. reviewed pedometer/accelerometer-based studies and found that 7,100 to 11,000 steps/day of habitual activity (e.g., walking at a casual pace, light-intensity physical activity) can be considered equivalent to meeting the weekly minimum recommendation for 150 minutes of moderate-intensity physical activity. Greater productivity, average lifespan increase, greater staff morale, increase in mental agility, greater staff retention, and return on investments in the millions of dollars have been identified as byproducts associated with employees achieving this activity benchmark (ACT Occupational Health and Safety Commission, 2009; Mijayan, 2010;

National Business Group on Health, 2010). As such, the current research project will focus on increasing the number of daily steps that employees at the University of Minnesota Duluth take with the intent to positively impact both individual and organizational health.

Sedentary UMD

Two studies were conducted at the University of Minnesota Duluth to examine the amount of physical activity that employees engage in during a typical workday. In the first study, Fountaine, Piacentini, and Liguori, (2014) asked UMD employees to complete an online survey based on the validated *Occupational Sitting and Physical Activity Questionnaire* (*OSPAQ*; Chau, Van der Ploeg, Dunn, Kurko, & Bauman, 2012). The sample included 625 full-time and part-time University of Minnesota Duluth employees, and respondents self-reported the percent of time during an average workday they spent sitting, standing, walking, or performing heavy labor in the last seven days. The groups primarily affected by being sedentary were administrative staff and faculty; respondents holding traditional "blue-collar" jobs (i.e., facilities management) reported higher rates of physical activity and general movement throughout the day. Results showed that employees spent the majority of the workday (394 ± 112 min/day for administrative staff, 394 ± 170 min/day for faculty, 338 ± 143 min/day for staff, and 158 ± 162 min/day for facilities management) sitting. Participants also reported infrequent breaks from sitting during the workday (1.6 ± 1.4 breaks/hour for administrative staff, 1.3 ± 1.2 breaks/hour for faculty, 1.5 ± 1.4 breaks/hour for staff, and 1.3 ± 1.6 breaks/hour for facilities management). These findings suggest that traditional "white-collar" workers (i.e., administration, faculty, and staff) are predisposed to be more sedentary due to the nature of their work. Fountaine et al. suggest the need for more research to provide evidence for effective intervention techniques.

Slowiak, Fountaine, and Hessler (2014) conducted a pilot study on the UMD campus to provide a more objective and quantifiable measure of sedentary behavior of campus employees ($N = 15$). Participants wore portable, research-grade accelerometers for a five-day period that recorded intensity of physical activity. Average recorded daily physical activity levels of employees revealed that employees were sedentary for 328 min/day (78.2%), lightly active for 62 min/day (14.8%), moderately active for 27 min/day (6.5%), and vigorously active for 1.8 min/day (0.4%). The results of Fountaine et al. (2014) and Slowiak et al. (2014) illustrate that the UMD workforce spends the majority of the day engaged in sedentary behaviors, suggesting that efforts to increase physical activity could greatly benefit both employees and the University of Minnesota Duluth.

The UMD Employee Wellness Program is one employee benefit that provides a variety of health and wellness resources to UMD employees. As a whole, the UMD Employee Wellness Program offers a range of services, including stress reduction, mindfulness, and group fitness classes, to help promote and support the physical, emotional health, and well-being of UMD employees and their dependents (UMD Employee Wellness Program, 2015). Group Health Coaching is one specific program of the UMD Employee Wellness Program that serves to enhance wellbeing and healthy behaviors through a supportive group environment. This 10-week program consists of weekly meetings that offer support, accountability, motivation, and resources to help UMD employees reach wellness goals (UMD Group Health Coaching Program, 2015). It was brought to the attention of the researcher that the UMD Health and Wellness Center's Lifestyle Management Health Coach was interested in having the Group Health Coaching Program evaluated to both identify potential areas for improvement, as well as to introduce methods and techniques to more objectively measure clients' success with their desired behavior change. The Group Health Coaching Program serves as an ideal platform to devise and administer a physical activity intervention to help combat the sedentary behavior of UMD employees. Therefore, the current study attempted to improve the current system's procedural components to increase the healthy behavior of stepping to levels recommended by the CDC (2014). The first step to identify potential performance improvement opportunities was to conduct a behavioral systems analysis.

Behavioral Systems Analysis Approach to Intervention Development

The workplace is made up of many structures such as departments and teams wherein individuals perform work. These organizational structures influence individual employees' ability to do work indirectly through resource allocation, communication between structures, workflow in and between structures, and more. The ability to map out and develop work systems that promote performance-related behaviors and organizational effectiveness at a broad level would therefore be a desirable goal. One way to accomplish this goal is to use a method called a behavioral systems analysis (*BSA*). A behavioral systems analysis is a tool that incorporates behavior analysis (the science of prediction and control of behaviors that are considered socially important), along with general systems theory (an approach to understanding organizational systems by examining the relationships between the system and the external environment) (Johnson, Casella, McGee, & Lee, 2014). A BSA results in multilevel organizational solutions that may include process redesign, policy changes, resource allocation, strategy development, and more.

Diener, McGee, and Miguel (2009) describe a BSA as a multi-system approach that delineates an organization's behavioral systems and allows the analyst to provide solutions when performance-related "gaps" are found within an organization's processes. The BSA process is conducted to map how work flows in an organization through its relevant suppliers and customers (Rummler & Brache, 2013). First, an organizational-level analysis is conducted to identify factors that influence the organization externally (e.g., environmental factors) and between internal functions (i.e., administration and finance). Once performance gaps are identified at the organizational-level, a process-level analysis is conducted. Any process (e.g., shipping) identified as not functioning as well as it could is then mapped to show how the work actually flows through relevant cross-functional interfaces. The last level of analysis, the job/performer level, analyzes a specific position's job responsibilities, standards, feedback, rewards, and relevant training. For an organization to function as efficiently as possible, goals, design, and management must work in harmony across these three levels of an organization.

Performance gaps identified in a behavioral systems analysis take on many different forms such as lack of goals, feedback, or measures. Any performance gaps found through this process provide rationale for forming recommendations for performance management improvements systemically within an organization. While a BSA approach is the recommended way to map an organization and how the work is done (Diener et al., 2009; Johnson et al., 2014), it is not always practical. Usually when a consultant is brought in to conduct a BSA, the management of the target organization have a preconceived idea of what needs to be done (i.e., improve their shipping process) and may not agree to an analysis of all three levels of an organization (Rummler & Brache, 2013). This is not an ideal way to conduct a BSA when problems in a certain area may actually be due to problems at a different level of that organization. Johnson et al. reviewed the current state of the behavioral systems analysis literature and found little empirical evidence of this approach's longitudinal effectiveness. This is mainly due to the consultant-client relationship in that most consultants do not have access to data after recommendations for interventions are made.

The UMD Health and Wellness Center's Lifestyle Management Health Coach agreed to allow the researcher to utilize the BSA approach to help illustrate how the Group Health Coaching Program fits within the larger UMD Employee Wellness Program. The use of the BSA approach provided an opportunity to map the current Group Health Coaching process to identify areas for improvement and to allow for a clearer understanding of the role of the group health coach as a facilitator of the program. The current study provided the researcher with a unique opportunity to utilize the behavioral systems analysis approach to evaluate longitudinal change guided by the recommendations produced from the analysis of the UMD Group Health Coaching Program. Most importantly, this analysis provided the UMD Health and Wellness

Center's Lifestyle Management Health Coach with recommendations regarding effective intervention strategies for promoting physical activity that may benefit the current process.

The BSA analysis was conducted using a series of performance improvement tools from the Performance Blueprints Toolkit (Ludwig & McGee, 2014). At the time of the analysis, the UMD Group Health Coaching Program utilized a number of behavior change techniques and strategies: goal setting, social support, feedback, self-monitoring, accountability, educational group activities, and quantifiable weight measures. Of the components identified, however, several provided opportunities for improvement in increasing healthy behaviors. Use of an objective measurement system to monitor and evaluate healthy behavior change outside of weight loss was currently not available to participants in the program. Feedback, while delivered to participants every week, was not delivered immediately or contingent upon their behavior. Weekly activities (i.e., completing wellness-related self-assessments to identify potential behaviors to change, generating lists of individuals to provide social support, suggesting a variety of behavioral tracking methods such as journaling or charting, etc.) were used with the intent of facilitating goal achievement and prompting participants to engage in wellness behaviors outside of weekly classes.

Although weekly activities served as prompts for individuals to engage in wellness behaviors outside of weekly meetings, they did not guarantee wellness behaviors would occur between meetings or be sustained in the long-term. The A-B-C three-term contingency model is typically used in behavioral psychology to describe and predict the frequency of observed behavior (Daniels & Bailey, 2014). “A” refers to an antecedent, which is a stimulus that *precedes* behavior and prompts an individual to act; “B” refers to the behavior of an individual; and “C” refers to the consequence(s) that occurs *after* of the behavior. The most powerful predictor of the frequency of an observed behavior is the power of its consequences (Martin & Pear, 2015). Two behavioral processes that increase the frequency of a behavior are positive reinforcement (increases the future probability of behavior in order to get something one wants) and negative reinforcement (increases the future probability of behavior in order to avoid or remove something we do not want). Additionally, consequences are more effective at reinforcing and increasing a desired behavior when they are presented closely and contingently upon the behavior occurring. Therefore, to increase and maintain wellness behaviors, reinforcing consequences should to be paired with and provided contingently on engagement in wellness behaviors. Within the UMD Group Health Coaching program, however, no programmed reinforcing consequences existed for engaging in wellness behaviors. To increase the frequency of wellness behaviors, positively reinforcing consequences could be added by providing verbal praise of group members upon goal achievement. Though providing positive social reinforcers is preferred (Daniels & Bailey, 2014), requiring participants to report goal achievement each meeting may also increase stepping behavior through a negative reinforcement contingency, as participants may engage in the desired behavior in order to avoid judgment from peers when goals are not met.

Requiring participants to report their activity during weekly meetings may also be viewed as a strategy to promote accountability (Hall, Frink, & Buckley, 2015). Hall et al. reviewed 57 empirical articles between 1998 and 2014 in which “accountability” was cited as a variable in order to provide a current and inclusive evaluation of individual accountability. From their review, Hall and colleagues propose a conceptual model of accountability that integrates common themes discussed across the literature. This conceptual model contends that accountability is a perceived expectation that one’s decisions or actions will be evaluated by a salient audience and that rewards or sanctions are believed to be contingent on this expected evaluation. Thus, fostering an emphasis on group discussions about individual goal achievement during weekly meetings could increase the reinforcing effect of peer judgement (negative reinforcer) or praise (positive reinforcer). This increased reinforcing effect could evoke an increase in participant wellness behaviors in order to gain praise or to avoid judgement from peers.

The group setting of the Group Health Coaching Program provided a supportive environment that allowed accountability through a social contract among group members for performing healthy behaviors. This social support component has the potential to provide opportunities for inter- and intra-group competitions to further promote an increase in physical activity. Lastly, While goal setting may have helped participants develop achievable goals, a lack of immediate, frequent feedback made it difficult for participants to set specific goals and to evaluate and compare their current performance in relation to their goals. A review of recent literature, described in the following section, provides empirical support to guide recommendations for improvement to components of the Group Health Coaching Program.

Interventions to Promote Physical Activity

A review of the current breadth of behavioral intervention techniques to promote general health behavior is out of the scope of the current literature review. The aim of this review was to identify a subset of research studies evaluating the promotion and measurement of increasing physical activity (Andrade, Barry, Litt, & Petry, 2014; Chan, Ryan, & Tudor-Locke, 2004; De Cocker, De Bourdeaudhuij, Brown, & Cardon, 2007; De Cocker, De Bourdeaudhuij, Brown, & Cardon, 2008; De Cocker, De Bourdeaudhuij, & Cardon, 2008; Groppel, 2014; Kurti & Dallery, 2013; Merom, Rissel, Phongsavan, Smith, Van Kemenade, Brown, & Bauman, 2007; Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Mummery, Schofield, Hinchliffe, Joyner, & Brown, 2006; Spink & Carron, 1993; Washington, Banna, & Gibson, 2014; Wing & Jeffery, 1999). All studies reviewed were evaluated according to: (a) intervention components, (b) single component interventions versus package interventions, (c) type of measurement system used, and (d) statistical and clinical significance of intervention effects. Results revealed several patterns related to successful intervention components. Components of the studies identified were goal setting, professionally instructed health coaching, quantifiable measurement devices, electronically delivered interventions, contingent monetary and non-monetary incentives, required homework prompting individuals to engage in walking-related behaviors, accountability in the form of reporting homework progress in a group setting, self-monitoring, and social support. Of the studies reviewed, walking was the primary physical activity behavior under investigation.

Michie et al.'s (2015) meta-analysis of studies that evaluated interventions to promote physical activity and healthy eating reflect the findings of the review of intervention components identified above. Michie and colleagues identified the following statistically significant common intervention components in their review: specific goal setting, providing instruction, tasks with accountability, social support, self-monitoring, and opportunities for social comparison. Of all components identified, the researchers reported that interventions in which participants were encouraged or instructed to self-monitor were the most likely to be effective with medium to large pooled effect size (Q = 0.42, 95% CI = 0.30 to 0.54, I^2 = 71%, p = .003, Higgins, Thompson, Deeks, & Altman, 2003). Studies without self-monitoring had a smaller pooled effect size (Q = 0.26, 95% CI = 0.21 to 0.30, I^2 = 61%, p = .003). These results suggest that popular intervention components should be combined with self-monitoring techniques.

The literature reviewed supports findings and subsequent recommendations from the pre-intervention BSA conducted on the UMD Group Health Coaching Program. Goal setting is currently done through self-set goals that are checked on every week through group check-ins along with a midway program check-in. While these goals are established and tracked, they are not tracked continuously, and there is lack of an objective measure to set specific, achievable goals for participants. Several studies employed goal setting with contingent feedback to increase physical activity (Chan et al., 2004; Kurti & Dallery, 2013; Merom et al., 2007; Mummery et al., 2006; Washington et al., 2014; Wing & Jeffery, 1999). In these successful studies, researchers used objective measurement methods (i.e., pedometers) along with specific, achievable goals and contingent feedback to demonstrate participants' actual behavior in relation to their goal. Achievement of specific, achievable goals has also been effectively promoted through internet-based objective tracking methods (e.g., smartphone interface, web-based tracking software). These methods have proven to help participants with smoking cessation, improving physical activity, promoting weight loss, increasing healthy eating, and reducing alcohol consumption (Dallery et al., 2014).

The UMD Group Health Coaching Program provides participants with in-person guidance and instruction from a certified lifestyle health coach. In a group setting, individuals participate in discussion of wellness-related topics and learn about various tools and evidence-based change techniques to support behavior change. More specifically, along with facilitation by a qualified instructor, the UMD Group Health Coaching Program also includes activities to promote education (e.g., providing participants with empirically-backed literature and behavior change techniques), collaborate on healthy behavior intention forming (e.g., increasing steps or reducing the amount of fatty foods eaten), prompt specific goal setting (e.g., conducting conversations to create specific achievable goals for each participant in line with desired behavior change), provide feedback on performance (e.g., providing contrast between actual performance and personal goals), prompt review of behavioral goals (e.g., reflection and adjustment of goals based on actual participant performance), and provide accountability. Participants acquire accountability with one another through weekly group check-in sessions during which they talk about their wellness goal progress. Participants share one success and one struggle they encountered while trying to meet their goals during the previous week.

These program elements are strengths of the current Group Health Coaching Program and are supported by Michie et al.'s (2015) finding that the use of several theoretically-derived self-monitoring techniques in combination were found to be statistically significant in improving or achieving health behavior-related goals. Specific self-regulation techniques found by Michie et al. include prompting intention forming, providing feedback on performance, prompting self-monitoring of behavior, prompting specific goal setting, and prompting review of behavioral goals. Moreover, Chan et al. (2004) utilized an in-person health coaching program that included several of these self-regulation techniques and found that participants increased their average baseline steps from 7,029 ± 3,100 (*SD*) to a plateau of 10,480 ± 3,224 (*SD*).

At the end of each weekly UMD Group Health Coaching session, the health coach facilitates an activity to both educate and promote participants' use of empirically supported behavior change techniques to maintain healthy behaviors. Activities are designed to be interactive to provide participants the opportunity to collaborate with one another and apply what they are learning within a socially supportive setting. The inclusion of the social support and health coaching components are supported by Bandura's (1977) social learning theory. This theory posits that the cognitive process of learning can occur through direct observation of others' behavior or instruction in a social setting. Wing and Jeffery (1999) demonstrated the efficacy of social support in promoting weight loss. Participants were recruited alone or with friends and were given standard behavioral treatment along with homework accountability to help maintain weight loss. Of the participants recruited with others and given social support through standard behavioral treatment, 95% completed treatment and 66% maintained weight loss. Of those recruited alone, 76% completed treatment and only 24% maintained weight loss.

Although there is a group support component in the UMD Group Health Coaching Program, the program does not currently employ a competitive social component to promote healthy behaviors. The inclusion of a competitive component is supported by social comparison theory, which states that individuals are driven to gain accurate self-evaluations by comparing themselves to others in order to reduce the uncertainty of their own opinions and abilities (Festinger, 1954; Suls & Wheeler, 2012; Plante et al., 2010). According to Corning, Krumm, and Smitham (2006), people look to their social environments and compare themselves with others around them. Social competitions inherently provide a social environment with individuals working toward the same objective in relation to others, and group competitions and social activities have been used successfully in previous research (e.g., Michie, 2013; Plante et al., 2010; Wing & Jeffrey, 1999). Plante et al. found that when college students exercised with a perceived high or low physically fit confederate, the students' exercise outcome gravitated toward the behavior of those around them. More specifically, males and females both had significantly higher average heart rates when exercising in the presence of a perceived high physically fit confederate. Wing and Jeffrey (1999) employed intergroup competitions in which participants were assigned to groups to compete for a

$25 cash prize given to the group that had the highest percentage of participants that maintained their weight loss until the end of the study. Overall, participants who engaged in the intergroup competitions maintained weight loss significantly better than participants who did not engage in the competition.

The UMD Group Health Coaching Program has been without an objective measurement system to monitor and provide immediate feedback to program participants. The opportunity does exist for participants to objectively monitor weight through weekly weigh-ins; however, weigh-ins are not required or monitored consistently and calorie consumption not factored in against calorie exertion. Additionally, weekly weigh-ins, as an *outcome* measure, does not provide *process* feedback to participants on the daily behaviors they are targeting to change. Kurti and Dallery (2013) evaluated an internet-based contingency management intervention with an objective measurement system (i.e., Fitbit activity monitor) to increase healthy stepping behaviors in 12 sedentary adults over 50 years of age. Participants were screened using a Fitbit to ensure they met the guidelines of being considered sedentary (i.e., walking ≤ 6,000 steps per day) and had the ability to engage in physical activity. The program gradually increased stepping goals to increase steps from ≤ 6,000 steps per day to a recommended goal of 10,000 steps per day. In the first of two experiments, participants received monetary consequences for meeting stepping goals. Participants' steps increased 182% from beginning to the end of the intervention with 87% of the step goals met during each week.

In Kurti and Dallery's (2013) second experiment, the same methods were employed with one exception; monetary incentives were not available. The participants in experiment two increased steps by 108% with 52% of weekly step goals being met. The researchers concluded that internet-based interventions could efficaciously increase walking in adults self-reporting to exercise ≤ 60 minutes per week and ≤ two days per week with and without the use of monetary consequences. Use of reinforcing consequences to maintain or increase the frequency of occurrence of target behaviors is reflective of operant conditioning theory (Skinner, 1969). Kurti and Dallery's results also illustrate how behavior is influenced by motivating operations (Dallery et al., 2014; Iwata, Smith, & Michael, 2000; Laraway, Snycerski, Michael, & Poling, 2003; McGee & Johnson, 2015; Michael, 2000). Motivating operations alter the effectiveness of reinforcers or punishers (a value altering effect) and the frequency of operant response rates (a behavior altering effect) related to those consequences (Laraway et al., 2003). Two defining behavior-altering effects of motivating operations are an evocative effect, where an increase in responding can be observed, and an abative effect, where a decrease in responding can be observed. Kurti and Dallery's (2013) use of monetary incentives in experiment one to increase participants' frequency of meeting established goals produced an evocative effect to increase participants' stepping behaviors. The motivating operation for the individuals in the study was the deprivation of reinforcement for meeting objective stepping goals. Since participants did not have effective reinforcement, the researchers paired reaching objective goals with monetary incentives to increase the value of reaching stepping goals for participants, which produced an evocative effect on increasing stepping behavior.

There are examples of potential motivating operations in the UMD Group Health Coaching Program. Like Kurti and Dallery's (2013) study, potential participants may be deprived from effective consequences related to meeting physical activity goals. Utilizing reinforcing praise and social support through the group health coaching format may provide an evocative effect to increase the value of meeting stepping goals to increase stepping behavior in participants. Another potential motivating operation could come from the lack of immediate feedback on stepping progress. A lack of immediate, contingent feedback on participants' progress to stepping goals increases the reinforcing value of participants receiving feedback on meeting their goal. In providing an efficient and objective monitoring system that provides immediate, contingent feedback to participants in relation to goal achievement, participants are able to contact positive consequences associated with goal achievement that may reinforce and subsequently increase participants' stepping behavior.

Kurti and Dallery's (2013) use of the Fitbit to monitor stepping behavior in sedentary adults is supported by the findings of several other studies that have used Fitbit technology to increase stepping behaviors and have studied the efficacy of Fitbit as an electronically-delivered physical activity measurement monitor (e.g., Lyons, Lewis, Mayrsohn, & Rowland, 2014; Washington et al., 2014; Yu, 2015). Each has found that the Fitbit can be used as an efficient and objective measurement system for physical activity tracking. Lyons et al. reviewed over 60 different sources that outlined effective behavioral change techniques related to changing behavior associated with physical activity. The authors created a list of these techniques and then identified whether popular brands of physical activity monitors fell into each category of technique. The Fitbit system was associated with the majority of successful behavioral change techniques. The techniques associated with the Fitbit system include (a) setting modifiable goals, (b) reviewing goals, (c) displaying discrepancies between current behavior and goals, (d) providing specific feedback on stepping behavior, (e) self-monitoring behavior and outcomes, (f) providing social support through personal networks, (g) providing social comparison through competitions, (h) providing prompt cues, (i) displaying social rewards from competitions, (j) presenting stimuli to the user through mobile application screen prompts and wristband visual and haptic feedback, (k) presenting situation-specific rewards, and (l) allowing users to review past progress and successes. Studies have tested the reliability and validity of the Fitbit monitoring system to assess accuracy of calculating the number of steps taken by users (e.g., Gusmer, Bosch, Watkins, Ostrem, & Dengel, 2014; Takacset al., 2014). These studies found high correlations when walking at a brisk pace ($r = .910$, $p < .001$) and a slow pace ($r = .0974$, $p < .001$) with research-grade ActiGraph accelerometers and found that the Fitbit is more reliable when users walk at slower speeds. Gretzinger (2014) personally tested the reliability of the Fitbit Flex pedometer by counting steps manually while wearing the device and reported relatively high accuracy (97.8 ± 17.4%). Current literature therefore supports that the Fitbit provides a reliable and objective physical activity monitoring system in addition to a host of effective behavior change components. While the efficacy and reliability of the Fitbit measurement system is well-documented in the literature, the way in which specific components of the system influence individuals' behaviors has yet to be assessed (Dallery et al., 2014; Kurti & Dallery, 2013).

The Current Study

The current study sought to evaluate the UMD Group Health Coaching Program during the implementation of a 10-week program offered to a group of UMD employees who indicated interest in increasing stepping behavior. Program evaluation included assessment of: (a) the effectiveness of the UMD Group Health Coaching program to promote increased stepping behavior of participants while using the Fitbit measurement system, (b) the influence of participant access to the Fitbit website and mobile phone app on participants' levels of physical activity, (c) the effects of social competition mediated through the Fitbit system on individuals' participation in the challenges and levels of physical activity while engaged in these challenges, and (d) the UMD Lifestyle Coach's perception of the usefulness of recommendations derived from the BSA approach.

Method

Participants

Participants included 12 UMD employees aged 33-64 who self-reported an interest to increase walking (stepping) behavior. Participants self-reported their sex as female (11) and male (1); their race as White (11) and Asian (1); their highest degree completed as high school diploma (1), bachelor's degree (5), master's degree (4), and Ph.D. (2); their marital status as never married (1), married (6), and divorced or separated (5); the amount of children in their household as one child (1), two children (2), three children (1), and no children (8); having animals in their household as dogs (5), cats (4), both cats and dogs (1), and no animals (2). Participant occupations included: professor (1), instructor (1), secretary (2), statistician (1), project specialist (1), professional writer (1), information technology (2), accountant (1), and facilities management (1). Fifteen participants were recruited for participation, but three withdrew at different times in the study citing different reasons: (a) one withdrew out before the screening session citing they were no longer interested in Group Health Coaching; (b) another withdrew during the second week of the study citing the program was not what they had expected; and (c) the third participant withdrew after the loss of their Fitbit during the second week of the study and preferred to discontinue participation. Recruitment took place on the UMD campus before the start of the Fall 2015 semester to ensure necessary time to send recruitment messages to potential participants before the start of the UMD Group Health Coaching Program during the second week of September. Participants were recruited using traditional group health coaching recruitment procedures: (a) a statement to indicate that this specific Group Health Coaching session is part of a research project, (b) eligibility requirements, (c) an outline of specific health risks associated with sedentary behavior, (d) the potential benefits of increasing physical activity in the form of walking/stepping to help ameliorate these health risks according to the CDC's recommendations, (e) a brief explanation of the format used in the UMD Group Health Coaching Program, (f) the program's planned meeting dates and times, (g) the program's focus on the target behavior of stepping, (h) the opportunity to earn 250 points within the employee Wellness Points Program to earn points for a reduction on their annual health care premium, (i) the opportunity to receive a $20 Amazon gift card, and (j) the use of a Fitbit Flex activity monitor while participating in the Group Health Coaching Program.

Eligibility for participation was determined based on participants' answers on the Physical Activity Readiness Questionnaire (*PAR-Q*, American College of Sports Medicine, 2015, see Appendix B). This questionnaire identifies individuals for whom low- to moderate-intensity exercise is not recommended. Participants that answer "yes" to any of the questions in the PAR-Q will be considered at a possible health risk for increasing their stepping behavior and were encouraged to consult their primary care physician or a 24-hour nursing hotline on whether their participation in this study was feasible. This criterion helped to ensure that individuals who are not able to engage in the physical activity being promoted in this study are excluded for health and safety reasons. Two participants answered "yes" to questions on the PAR-Q, but both were cleared by their primary care physician to participate in this study.

The UMD Wellness Program offers participants of the Group Health Coaching Program the opportunity to earn 200 Wellness Points for attending a minimum of eight Group Health Coaching sessions over the 10-week period. Participants who attend and complete the entire 10-week Group Health Coaching Program and complete the post-study questionnaire received a $20 Amazon gift card as an additional incentive upon completion of the post-study questionnaire. All 12 participants met the incentive requirements, earning the 200 Wellness Points and the $20 Amazon gift card.

Informed consent (see Appendix C) was obtained from all participants during the screening session (see below), and the University's Institutional Review Board approved all study documents, methods, and procedures.

Setting

The study took place during the Fall 2015 UMD Group Health Coaching Program. This 10-week program was hosted weekly in a UMD conference space located on the UMD campus. This conference space also served as a designated meeting space for participants who had questions about their participation in the study or technical problems with their Fitbit Flex activity monitors. Participants were also asked to attend an Informed Consent and Screening Session as well as a debriefing session with the researcher in two conference rooms in the UMD Psychology Department. The setting for the behavior of interest, walking (stepping), occurred anywhere at the participants' convenience.

Measurement System

The Fitbit Flex was the primary measurement tool used in this study. The Fitbit Flex is a wrist-based wearable physical activity tracker that primarily measures an individual's steps via an accelerometer. The accelerometer located within the wearable wristband is a three-dimensional motion sensor that utilizes accelerometer technology to measure raw tilt, motion, and orientation data measured in m/s^2. These raw signals are then converted into physical activity measures (daily steps and METs in min/day) using mathematical formulas. The physical activity of interest measured by the Fitbit in this study will be the number of steps completed by participants as well as minutes per day remaining sedentary ($\leq$ 1.0 METs), engaging in light (1.1-2.9 METs), moderate (3.0-5.9 METs), and vigorous ($\geq$ 6.0 METs) intensity physical activity.

Participation in Fitbit-facilitated group challenges (e.g., Workweek Hustle, Weekend Warrior) was also monitored via the Fitbit measurement system. This allows the researcher to assess participants' level of interest in the group competition component, along with its potential to increase participants' stepping behavior.

The Fitbit Flex activity monitor was synchronized with a laptop or smartphone device wirelessly to track and convey the tracked exercise statistics to the user. These exercise statistics were then accessed via a smartphone or web-based interface (see Appendices C and D) that provided feedback to the user via visual graphs and numerical statistics. The wearable Fitbit Flex monitor also had a direct feedback reporting system that the user could access whenever they wanted to know their status toward reaching their specific daily stepping goal. Five LED lights stayed solid or blink to give immediate feedback in 20% increments to indicate how close the user's progress was to their established step goal.

The Fitbit measurement system also gave the participants access to engage in social networking by adding other Fitbit users to their friends list. Users had access to friends' profiles and are able to see friends' daily step totals. This allowed participants to engage in social competitions where users tried to complete the most steps within a specified amount of time (e.g., day, week). While participating in competitions, progress updates and notifications were intermittently sent among users via the Fitbit mobile and web-based interfaces.

The researcher set up participants' user profiles before the beginning of the study. Participants gained access to their profile on the Fitbit website and mobile phone application later in the study (see specific details in the *Experimental Design* section). Initial Fitbit user profiles were set up with generic email accounts (e.g., P701@gmail.com) generated by the researcher. This was necessary to prevent participants from obtaining feedback on their stepping behavior while baseline measures were established and while participants habituated to the "newness" of participation in the UMD Group Health Coaching sessions.

Participants were instructed on the proper use of the Fitbit Flex during the Informed Consent and Screening Session. During the screening session, participants were provided with a Fitbit Flex activity monitor and wristband. Participants received a Fitbit USB power charger and wireless sync dongle at the Group Health Coaching meeting during week five. The researcher attended each weekly session to ensure users were not experiencing problems with their Fitbit, and participants were encouraged to contact the researcher if they encountered any issues. The researcher monitored activity levels of participants throughout the course of the study, in part to observe for prolonged periods of inactivity that suggested a technology problem that needed to be addressed. At the conclusion of the study, participants were asked to report any unique events may have influenced physical activity levels in an abnormal way (e.g., participation in a local run/walk or an unusually long hike) on their post-study questionnaire (see Appendix F). This information helped ensure that any unusual (i.e., outlier) data could be explained.

Experimental Design

An ABCDB′ within-subjects design was used to assess step counts and exercise intensity, wherein A was baseline (no access to the Fitbit website or mobile application and participants did not receive behavior change instruction), B was traditional Group Health Coaching (TGHC; no access to the Fitbit website or mobile application), C was "Fitbit-enhanced" Group Health Coaching (FGHC) with participant access to the Fitbit website and mobile application (no promotion of group competitions), D was Fitbit-enhanced Group Health Coaching and promotion of participation in Fitbit social challenges (FGHC+S), and B′ was a reversal to traditional Group Health Coaching (rTGHC). Conditions in B′ were the same as those in Phase B; however, this condition is denoted as B′ to recognize the potential for carry-over effects from participants' exposure to the Fitbit features and their ongoing participation in Group Health Coaching over time. Each phase lasted a period of two weeks within the 10-week UMD Group Health Coaching Program.

Independent Variable

The effects of four conditions were examined: (1) traditional Group Health Coaching (TGHC), (2) "Fitbit-enhanced" Group Health Coaching (FGHC), (3) Fitbit-enhanced Group Health Coaching with promotion of Fitbit social challenges (FGHC+S) and (4) a reversal to traditional Group Health Coaching (rTGHC).

Dependent Variables

The primary dependent variable in this study was the number of daily steps. Steps were tracked via a Fitbit Flex accelerometer when a participant engaged in any activity requiring a stepping motion (e.g., running, hiking, walking). Daily and weekly step counts were calculated and evaluated at both the individual and group levels.

Level of intensity of physical activity was a second dependent variable, assessed as the number of minutes per day that participants engaged in light/sedentary (0-2.9 METs), moderate (3.0-5.9 METs), and vigorous (≥ 6.0 METs) levels of physical activity. Frequency of participation in Fitbit-facilitated group challenges was a third dependent variable and was evaluated to examine the level of participant interest in utilizing the group competition component of the Fitbit system.

Social Validity Measures

Social validity measures were obtained via post-study questionnaires for both Group Health Coaching participants (see Appendix F) and the UMD Health and Wellness Center's Lifestyle Management Health Coach who led the group health coaching sessions (see Appendix G). The purpose of the post-study questionnaire that participants filled out was to measure participants' satisfaction with the UMD Group Health Coaching Program and their experience with the Fitbit measurement system, measure level of frustration before and after receiving access to personal data, identify which components of the Fitbit measurement system influenced stepping behavior, and collect participants' demographic information. An example item is, "The numerical feedback regarding my steps/weight provided by the Fitbit website/mobile application prompted me to engage in physical activity."

The purpose of the post-study questionnaire that the Lifestyle Management Health Coach filled out is to measure satisfaction with the Behavioral Systems Analysis approach and process, satisfaction with the subsequent recommendations provided by the researcher, and the intention to use the recommendations from the analysis to help guide program improvement. An example item is, "The resulting recommendations provided by the researcher will be used to improve performance management of the UMD Group Health Coaching Program."

Items using a Likert scale asked individuals to rate certain items on a six-item scale ranging from 1 (*Very Strongly Disagree*) to 6 (*Very Strongly Agree*). Questions on the participants' post-study questionnaire also included multiple-choice items, an open-ended question to identify potential for confounds, and relevant demographic items. The post-study questionnaire for the UMD Lifestyle Management Health Coach included an open-ended item that allowed any other comments to be conveyed regarding the BSA process. Results were recorded and analyzed by the researcher after the study concluded.

Experimental Procedures

Two weeks before the start of the UMD Fall 2015 semester, potential participants received recruitment messages (see Appendix A) and were able to sign up for the UMD Group Health Coaching Program. Participants were asked to meet the researcher at least one week before the first Group Health Coaching session. The purpose of this meeting was to provide an overview of the study, obtain informed consent, and ensure participants met all eligibility requirements. The eligibility screening procedure, as stated above, required participants to fill out the Physical Activity Readiness Questionnaire (*PAR-Q*) to ensure that participants were healthy enough to participate in low to moderate physical activity. After review of participants' responses on the PAR-Q it was explained that any individuals answered "yes" to any question may be at an increased health risk if they engaged in low to moderate physical activity. These participants were instructed to consult with their physician and/or their insurance provider's 24-hour nursing hotline before participating in this study. All participants were cleared to participate in this study.

Weekly 45-minute Group Health Coaching sessions typically began with a mindfulness activity, such as a meditative silence, to get participants focused on the meeting. Once participants were focused, individuals shared their current progress with the group according to their current goals. Participants would then be asked to share one success and one struggle they encountered while engaging in physical activity during the previous week. After individuals discussed their progress, an open discussion was held to elaborate on any thoughts or ideas regarding their progress. Next, an activity or lecture related to promoting physical activity was held under direction of the health coach. Finally, the group members would discuss take-aways from the meeting followed by the adjourning of the meeting.

During the first two weeks of the 10-week program, participants were instructed by the researcher to wear the Fitbit Flex and to behave normally in order to establish an average baseline measure of daily steps. Participants did not have access to their Fitbit user profiles or the features associated with the Fitbit user interfaces. After baselines were established, the group health coach worked with participants to set personal goals to meet during the 10-week Group Health Coaching Program. The efficacy of the traditional Group Health Coaching process was assessed during weeks three to four; participants used techniques and strategies recommended by the group health coach during this time.

Participants engaged in stepping behavior without access to the Fitbit user interfaces in order to gauge how stepping behavior is affected without influence of the Fitbit system.

During weeks five to six, participants gained access to their Fitbit user profiles and all the components the Fitbit system has to offer (e.g., goal monitoring, prompts, social connections). Participants were contacted by the researcher via email and provided with their username and password, along with instructions on how to access their Fitbit user profiles and how to use the Fitbit website and mobile application. Evaluation of how stepping behavior was affected when users had access to the behavioral change components associated with the Fitbit website and mobile application occurred during this phase. The researcher promoted the availability of Fitbit group challenges to participants during Weeks seven to eight in order to assess participants' interest in and choice to engage these challenges as well as to evaluate effects on stepping behavior. During the week 7 meeting, the researcher provided participants with instructions on how to add one other as "Fitbit friends" and how to initiate and engage in Fitbit social challenges.

During the final two weeks, participants' access to the Fitbit website and mobile application was removed in order to evaluate how participants' stepping behaviors were affected when participants no longer had access to the enhanced features offered by the Fitbit system. The researcher changed user profile passwords so that participants no longer had access to the Fitbit website and mobile application. Participants were notified via email when access had been restricted. Participants were informed as to why access to their profiles was removed during the debriefing process in order to remove any negative effects of the profile removals.

At the end of their participation in the 10-week Group Health Coaching Program participants were asked to fill out a post-study questionnaire (see Appendix F), debriefed (see Appendix H), and sent a $20 Amazon e-gift card upon their return of the Fitbit Flex activity monitor components to the researcher.

Visual Analysis of Time-Series Data

Data were evaluated through visual analysis of participants' steps at both the individual and group levels. A visual analysis is the standard means of determining the reliability and magnitude of a single case design (Dallery & Raiff, 2014). There are four steps and six outcome measures to evaluate when conducting visual analysis of time-series data (Kratochwill et al., 2013). The four steps include: (1) documentation of a stable baseline; (2) identification of within-phase patterns of responding; (3) comparison of data across phases; and (4) integration of information from all phases. The six outcome measures include: (1) level; the average outcome of measures within a phase, (2) trend; the slope of the best-fitting line of the outcome measures within a phase, (3) variability; the range, variance, or standard deviation of the best-fitting line of the outcome measures within a phase, or the degree of overall scatter, (4) immediacy of the effect; the change in level between the last few data points of one phase and the first few data points in the next, (5) overlap; the proportion of data from one phase that overlaps with data from the previous phase, and (6) consistency of data patterns; the consistency in the data patterns from phases with the same conditions. Additionally, Hedges, Pustejovsky, and Shadish's

(2012) method of standardized mean difference effect size for single case designs was used to determine individual effect sizes of change between phases.

Results

Total Number of Steps

The total number of steps recorded at the end of each day was used to compare physical activity across the five phases of the study: Baseline (Phase A; no access to the Fitbit website or mobile application and participants did not receive behavior change instruction), traditional Group Health Coaching (Phase B; TGHC; no access to the Fitbit website or mobile application), "Fitbit-enhanced" Group Health Coaching (Phase C; FGHC; no promotion of group competitions), Fitbit-enhanced Group Health Coaching with social challenges (Phase D; FGHC+S), and a reversal to traditional Group Health Coaching (Phase B′; rTGHC). Daily step averages were calculated by averaging the sum of individual daily step counts across participants. Daily averages were then summed and averaged within their respective phases (i.e., ABCDB′) to determine overall phase step averages. Along with phase averages, standard deviation, range, slope and Hedges *d*-statistic (Hedges, Putejovsky, & Shadish, 2012; Shadish et al., 2014) were calculated. Values of Hedges *d*-statistic are interpreted as small (0.2), medium (0.5), and large (0.8). Individual and group summaries of participant step data are described in Table 1.

Group daily steps per phase. Average stepping behavior across all participants within each phase (see Figure 1) was as follows: Phase A: 9,235.0 steps (range 7,621 to 11,701, *SD* = 1,273.9); Phase B: 9,211.1 steps (range 7,665 to 11,162, *SD* = 1,047.0); Phase C: 9,180.9 steps (range 7,279 to 11,076, *SD* = 1,132.2); Phase D: 9,117 .4 steps (range 7,051 to 11,918, *SD* = 1,259.7); and Phase B′: 8,919.3 steps (range 6,592 to 10,285, *SD* = 1,004.7). Given the similar ranges and standard deviations, this data suggests relatively similar patterns of stepping behaviors across all phases.

Slope was calculated using a regression equation in which slope is indicated by its beta (β) weight. Slopes for individual phases were mixed in direction and magnitude overall: Phase A (β = .006, p = .985); Phase B (β = .086, p = .771); Phase C (β = .095, p = .746); Phase D (β = -.071, p = .808); and Phase B′ (β = -.351, p = .218). A positive trend was observed from phases A-C, followed by a negative trend from phases D-B′. Although increasing trends were observed across phases A-C, the absence of an increasing trend in phase D does not support the hypothesis of a continued increasing trend in stepping behavior before a return to TGHC.

The immediacy of the effect between subsequent phases was calculated by averaging the last and first three data points of adjacent phases and determining the difference between the averages. Phases A-B had a difference of -136.69 steps; Phases B-C had a difference of -138.89 steps; Phases C-D had a differences of -1,062.22 steps; and Phases D-B′ had a difference of -765.86 steps. As indicated, the largest differences between adjacent phases occurred between Phases C-D and Phases D-B′.

Percent overlap between adjacent phases revealed consistent and high levels of overlapping data points: Phase A-B: 89% overlap; Phase B-C: 89%; Phase C-D: 93%; Phase D-B′: 89%; and B-B′ 86%.

Data patterns were not consistent within phases B and B′ in which experimental conditions were the same. Step averages differed (B: *M* = 9,211.1, *SD* = 1,047.0 and B′:

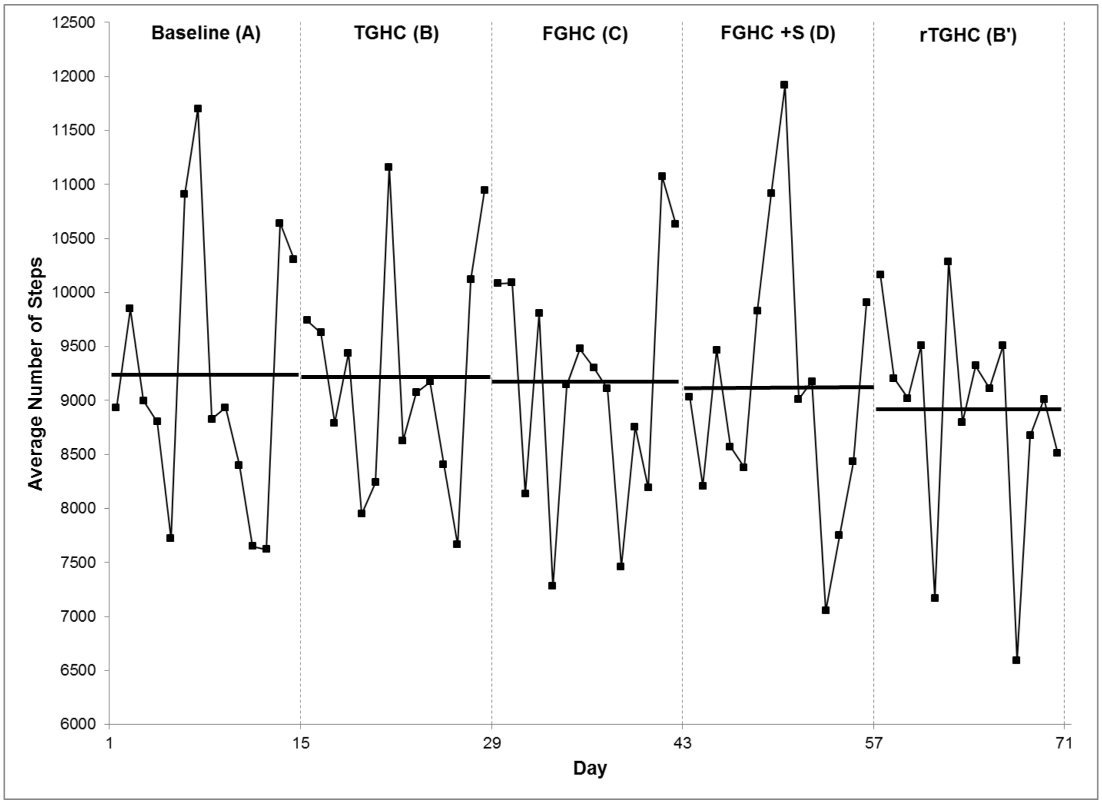
M = 8,919.3, *SD* = 1,004.7), effect size (*d* = -0.28) was larger than between other phases, and the lowest level of overlap in data points (86%) was observed between phases B and B′.

Visual analysis of overall trends across phases (see Figure 1) reveals a small, general decrease in stepping behavior. The magnitude of the difference in the average number of steps is small at first but starts to progressively increase with each subsequent phase. This visual trend is supported by the increasing negative value of the Hedges *d*-statistic for each adjacent phase change: A-B: *d* = -0.02; B-C: *d* = -0.03; C-D: *d* = -0.06; D-B′: *d* = -0.17. The difference in stepping behavior between Phases B and B′ had an effect size of *d* = -0.28; this effect indicates that the pattern of stepping behavior differed under similar treatment conditions.

In summary, the overall (group) decrease in the average number of steps across phases does not support the hypothesis that exposure to TGHC, FGHC, and FGHC+S would each evoke subsequent increases in stepping behavior. In addition, the continued decrease in stepping behavior in the final phase of the study cannot be attributed to the removal of Fitbit access because of the already-decreasing trends in previous phases.

Individual daily steps per phase. Data were analyzed at the individual level to examine individual treatment effects. As shown in Table 1, variability, trends, and effect sizes were generally mixed across individual participants. Stepping behavior, on average, was typically the highest during the baseline phase for all participants.

Figure 1. Group Daily Average Steps



Note: bold horizontal lines represent average phase step levels

Table 1

Total Number of Days, Averages, Standard Deviations, Ranges, Slopes, and Effect Sizes Within Each Phase Across and Within Participants Regarding Daily Steps

Participant	Phase	*N**	Average Steps (*SD*)	Range	Phase Slope (*β*)	*d*
Overall	A	14	9235.0 (1273.9)	7621 – 11701	.006	
	B	14	9211.1 (1047.0)	7665 – 11162	.086	-0.02
	C	14	9180.9 (1132.2)	7279 – 11076	.095	-0.03
	D	14	9117.4 (1259.7)	7051 – 11918	-.071	-0.06
	B´	14	8919.3 (1004.7)	6592 – 10285	-.351	-0.17
	B-B´					-0.28
701	A	14	20454.9 (7362.6)	13139 – 37448	.204	
	B	14	16287.4 (2528.0)	12709 – 19525	.217	-0.75
	C	14	17009.9 (4018.4)	9392 – 25378	-.026	0.21
	D**	14	18920.0 (3041.6)	13175 – 24586	.570	0.54

Table 1 *Continued*

701	B´	14	16866.6 (2640.2)	10265 – 20385	.208	-0.72
	B-B´					-0.22
702	A	14	7876.7 (2109.6)	5705 – 12628	-.206	
	B	14	7842.6 (2275.6)	4612 – 11809	.306	-0.02
	C	14	7480.2 (2367.6)	4785 – 13626	.168	-0.16
	D	14	6384.8 (1789.8)	2768 – 10036	-.440	-0.52
	B´	14	7095.0 (1854.4)	4630 – 10703	.100	0.39
	B-B´					-0.36
703	A	14	5342.5 (2688.8)	2226 – 10672	-.085	
	B	14	6911.3 (2386.4)	3322 – 10711	.127	0.62
	C	14	5423.6 (3195.5)	1884 – 10649	.201	-0.53
	D	14	7359.2 (4199.7)	1475 – 17408	-.036	0.52
	B´	14	6566.8 (3918.6)	301 – 11879	-.207	-0.20
	B-B´					0.11
705	A	14	4607.2 (2078.0)	2520 -9297	.339	
	B	14	5204.1 (2805.3)	493 – 12152	-.577	0.24
	C	14	6540.1 (2433.2)	2461 – 11160	.203	0.51
	D	14	5103.3 (1652.4)	3076 – 7993	-.673	-0.69
	B´	14	6282.1 (3134.1)	2662 – 13214	-.650	0.47
	B-B´					0.36
707	A	14	12272.9 (3505.5)	7390 – 19843	-.242	
	B	14	13944.2 (3703.1)	7762 – 21500	.206	0.46
	C	14	11141.0 (2487.7)	7179 – 15218	-.373	-0.89
	D**	14	11912.8 (1411.0)	10203 – 14310	.471	0.38
	B´	14	10387.9 (3384.7)	4800 – 18245	-.208	-0.59
	B-B´					-1.00
708	A	14	9364.9 (1813.2)	7003 – 13459	.214	
	B	14	8095.1 (2654.2)	2998 – 13274	.618	-0.17
	C	14	10115.1 (2919.7)	4606 – 15952	-.038	0.27
	D	14	9298.4 (2584.3)	4530 – 13279	.396	-0.30
	B´	10	7971.4 (2588.6)	3477 – 11718	.373	-0.51
	B-B´					-0.05
709	A	14	8035.7 (4179.5)	2000 – 13993	-.191	
	B	14	10034.2 (3960.1)	2655 – 17665	-.354	0.49
	C	14	11791.6 (2688.6)	6459 – 16177	-.268	0.52
	D	14	10567.4 (4154.4)	3890 – 18853	.364	-0.35
	B´	14	12108.2 (4763.6)	3061 – 20261	-.079	0.34
	B-B´					0.47

Table 1 *Continued*

710	A	14	4612.7 (1312.5)	1576 – 6460	-.176	
	B	14	4654.1 (1482.5)	2185 – 7227	.104	0.03
	C	14	4428.7 (1630.9)	1507 – 7328	.076	-0.14
	D	14	4067.8 (1164.6)	1844 – 5526	-.347	-0.25
	B′	12	4059.1 (1057.6)	2305 – 6221	.012	-0.01
	B-B′					-0.46
711	A	14	7359.1 (2602.6)	2666 – 11126	-.065	
	B	14	6927.8 (2666.4)	1577 – 12186	.108	-0.16
	C	14	6056.6 (1916.8)	3678 – 8757	.282	-0.38
	D	14	5764.7 (2239.5)	1242 – 10325	.081	-0.14
	B′	14	8254.3 (3194.4)	4475 – 17091	.003	0.90
	B-B′					0.45
712	A	14	11875.6 (3389.1)	6679 – 18631	-.302	
	B	14	11314.2 (3011.9)	6617 – 16434	-.134	-0.18
	C	14	10542.6 (4872.0)	3256 – 20255	.061	-0.19
	D**	14	11789.4 (6582.2)	992 – 21696	-.368	0.22
	B′	14	10003.0 (2996.4)	4400 – 13500	-.193	-0.35
	B-B′					-0.44
713	A	14	7536.9 (3613.7)	2017 – 13764	.091	
	B	14	8850.9 (4661.0)	1737 – 18545	.184	0.32
	C	14	10738.7 (3045.6)	6154 – 16235	.339	0.48
	D	14	9060.8 (4139.3)	2826 – 16917	-.271	-0.46
	B′	14	6576.7 (2341.0)	2451 – 11720	-.533	-0.74
	B-B′					-0.62
714	A	14	11481.4 (3433.8)	6163 – 17474	.262	
	B	14	10466.8 (2715.9)	6019 – 16475	-.275	-0.33
	C	14	8902.1 (2166.3)	4490 – 13691	-.171	-0.64
	D	14	9180.0 (2149.9)	5012 – 12793	-.089	0.13
	B′	12	10352.8 (1790.5)	7838 – 14623	-.412	0.59
	B-B′					-0.05

* *N* refers to the total number of observations on each day within its respective phase.
** Denotes participation in Social Challenges.
Effect size is calculated as a *d*-statistic indicating magnitude of difference between phases as well as direction as indicated by (+/-) sign using Hedges, Pustejovsky, and Shadish's (2012) method of standardized mean difference effect size for single case designs.

Trends for some individual participants partially support the hypothesized predicted changes in the direction of stepping behavior across phases. Despite the initial high baseline in Phase A, stepping behavior changed as hypothesized between certain phases for P701 (B-C: $d = 0.21$; C-D: $d = 0.54$; D-B′: $d = -0.72$); P703 (A-B: $d = 0.62$; C-D: $d = 0.52$); P705 (A-B: $d = 0.24$; B-C: $d = 0.51$); P707 (A-B: $d = 0.46$; C-D: $d = 0.38$; D-B′: $d = -0.59$); P708 (B-C: $d = 0.27$); P709 (A-B: $d = 0.49$; B-C: $d = 0.52$); P712 (C-D: $d = 0.22$); P713 (A-B: $d = 0.32$; B-C: $d = 0.48$); and P714 (C-D: $d = 0.13$). Other than the partial support observed in the data from these participants, individual patterns in stepping behavior overall did not support the hypothesized direction of change across phases in this study. Likewise, though treatment conditions were similar during Phases B and B′, a wide range of differences in individual step behavior were observed between the two phases (range of magnitude: $d = -1.00$ to 0.47). Individual trend graphs of daily step behavior are included in Appendix I.

Level of Intensity of Physical Activity

The number of minutes per day that participants engaged in various levels of intensity of physical activity was assessed via the Fitbit Flex measurement system in METs. Given the CDC's (2015) recommendations for engaging in physical activity that requires an energy expenditure of ≥ 3.0 METs, the total number of minutes per day that participants engaged in activity ≥ 3.0 METs was summed and averaged across all phases (see Table 2). MET data was also further analyzed at the across all possible levels of intensity: sedentary activity (≤ 1.0 METs), light-intensity physical activity (1.1-2.9 METs), moderate-intensity physical activity (3.0-5.9 METs), and vigorous-intensity physical activity (≥ 6.0 METs).

Technical and user errors (i.e., device unpairing from Fitbit database, battery dying, user taking wristband off and forgetting to put it back on) required that estimated step counts be entered manually on 50 unique days for six of the 12 participants across the 10 weeks. The number of missing days for individual participants ranged from 5-12 days (6-24%). Estimation of steps on these days prohibited calculation of MET data for six of the 12 participants. Therefore, the data reported below represent activity levels for the six participants for whom accurate MET data was available.

Group daily minutes ≥ 3.0 METs per phase. The average number of minutes participants engaged in physical activity ≥ 3.0 METs within each phase (see Figure 2) was as follows: Phase A: 28.70 minutes (range 6.67 to 52.00, *SD* = 11.72); Phase B: 31.70 minutes (range 10.33 to 61.50, *SD* = 13.60); Phase C: 31.27 minutes (range 13.83 to 47.00, *SD* = 9.94); Phase D: 28.88 minutes (range 5.0 to 68.00, *SD* = 15.57); Phase B′: 17.18 (range 7.50 to 39.17, *SD* = 8.30). Given the similar ranges and standard deviations, this data suggests relatively similar patterns of activity minutes across all phases.

Slope was calculated using a regression equation in which slope is indicated by its beta (β) weight. Slopes for individual phases were mixed overall: Phase A (β = -.055, p = .852); Phase B (β = .505, p = .066); Phase C (β = -.009, p = .976); Phase D (β = -.228, p = .434); and Phase B′ (β = -.603, p = .023). Observed slopes for individuals phases are mixed with an increasing trend in Phase B, but with an overall decreasing trend for phases A, C, D and B′. These findings do not support the hypothesized increase in physical activity minutes when participants were exposed to FGHC, and FGHC+S.

The immediacy of the effect between subsequent phases was calculated in the same manner as average daily steps between phases. Phases A-B had a difference of +7.28 minutes; Phases B-C had a difference of -6.28 minutes; Phases C-D had a difference of -4.83 minutes; and Phases D-B′ had a difference of -5.00 minutes. The largest differences are observed between Phases A-B and D-B′.

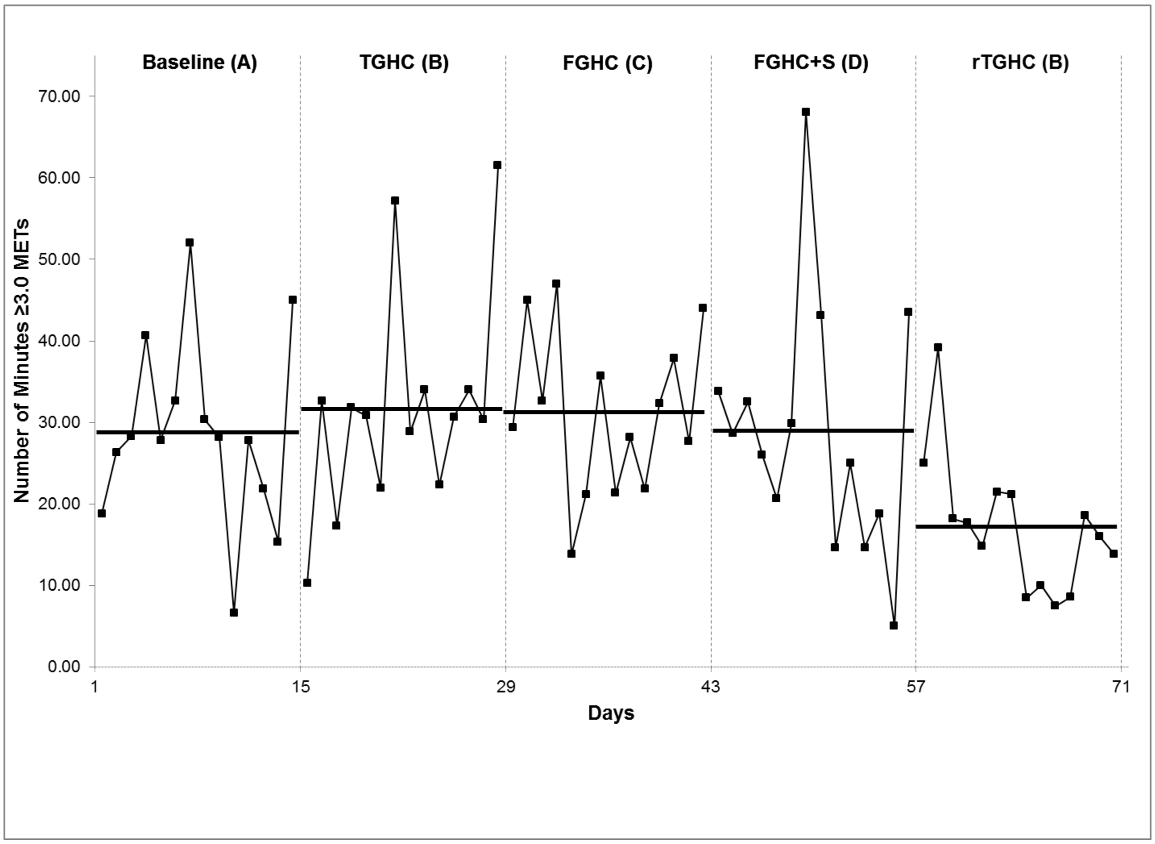
Percent overlap between adjacent phases revealed consistent and high levels of overlapping data points: Phases A-B 89% overlap; Phases B-C 89%; Phases C-D 93%; Phases D-B′ 93%; and B-B′ 93%.

Data patterns were not consistent within phases B and B′ in which experimental conditions were the same. Minute averages differed (B: $M = 31.70$, $SD = 13.60$ and B′: $M = 17.18$, $SD = 8.30$), effect size ($d = -1.29$), was larger than between other phases and the highest overlap in data points (93%) was observed between phases B and B′.

Visual analysis of overall trends across phases (see Figure 2) reveals an overall general decrease in minutes engaging in physical activity ≥ 3.0 METs. The magnitude of the difference in the average number of minutes increases slightly at first before decreasing variably over each subsequent phase. This visual trend is supported by the Hedges *d*-statistic for each adjacent phase change: A-B: $d = 0.24$; B-C: $d = -0.04$, C-D: $d = -0.18$; D-B′: $d = -0.94$. The difference in minutes between Phases B and B′ had an effect size of $d = -1.29$; this effect size indicates that the pattern of minutes differed under similar treatment conditions.

In summary, the overall (group) decrease in average minutes participants engaged in physical exercise ≥ 3.0 METs does not support the hypothesis that exposure to TGHC, FGHC, and FGHC+S would each evoke subsequent increases in physical exercise. There is partial support for the hypothesis that exposure to TGHC may have evoked an increase in activity minutes ≥ 3.0 METs (d = 0.24). The continued decrease in minutes in the final phase of the study cannot be attributed to the removal of Fitbit access because of the already decreasing trends in previous phases.

Figure 2. Group Daily Average Activity Minutes ≥ 3.0 METs



Note: bold horizontal lines represent average phase activity minute levels

Individual daily minutes ≥ 3.0 METs per phase. Data were analyzed at the individual level to examine individual treatment effects. As shown in Table 2, variability, trends, and effect sizes were generally mixed across individual participants. The vast majority of trends reflect those seen in stepping data, where the average number of minutes typically decreases from baseline to the end of the study. Trends for some individuals partially support the hypothesized predicted changes in direction of stepping behavior across phases for: P702 (B-C: *d* = 0.09); P705 (B-C: *d* = 0.78); P707 (A-B: *d* = 0.40; C-D: *d* = 0.38; D-B′: *d* = -0.92); P708 (A-B: *d* = 0.22); P712 (B-C: *d* = 0.13; C-D: *d* = 0.23; D-B′: *d* = -0.92); and P713 (A-B: *d* = 0.25; B-C: *d* = 0.31). Other than the partial support observed in the data form these participants, individual patterns in activity minutes overall did not support the hypothesized direction of change across phases in this study. Likewise, though treatment conditions were similar during Phases B and B′, a wide range of differences in activity minutes were observed between the two phases (range of magnitude: *d* = -1.29 to 0.34). Individual trend graphs of activity minutes are included in Appendix J.

Table 2

Total Number of Days, Averages, Standard Deviations, Ranges, Slopes, and Effect Sizes Within Each Phase Across and Within Participants Regarding Activity Minutes ≥ 3.0 METs.

Participant	Phase	*N**	Average Minutes (*SD*)	Range	Phase Slope (*β*)	*d*
Overall	A	14	28.70 (11.72)	6.67 – 52.00	-.055	
	B	14	31.70 (13.60)	10.33 – 61.50	.505	0.24
	C	14	31.27 (9.94)	13.83 – 47.00	-.009	-0.04
	D	14	28.88 (15.57)	5.00 - 68.00	-.228	-0.18
	B′	14	17.18 (8.30)	7.50 – 39.17	-.603	-0.94
	B-B′					-1.29
702	A	14	25.79 (13.91)	6 - 48	-.020	
	B	14	24.50 (18.14)	0 -58	.276	-0.08
	C	14	26.5 (26.47)	0 - 100	.196	0.09
	D	14	21.71 (15.67)	0 - 63	.047	-0.22
	B′	14	21.29 (15.52)	0 - 68	-.139	-0.03
	B-B′					-0.19
705	A	14	9.43 (16.86)	0 - 46	.389	
	B	14	5.93 (11.25)	0 - 36	.024	-0.24

Table 2 *Continued*

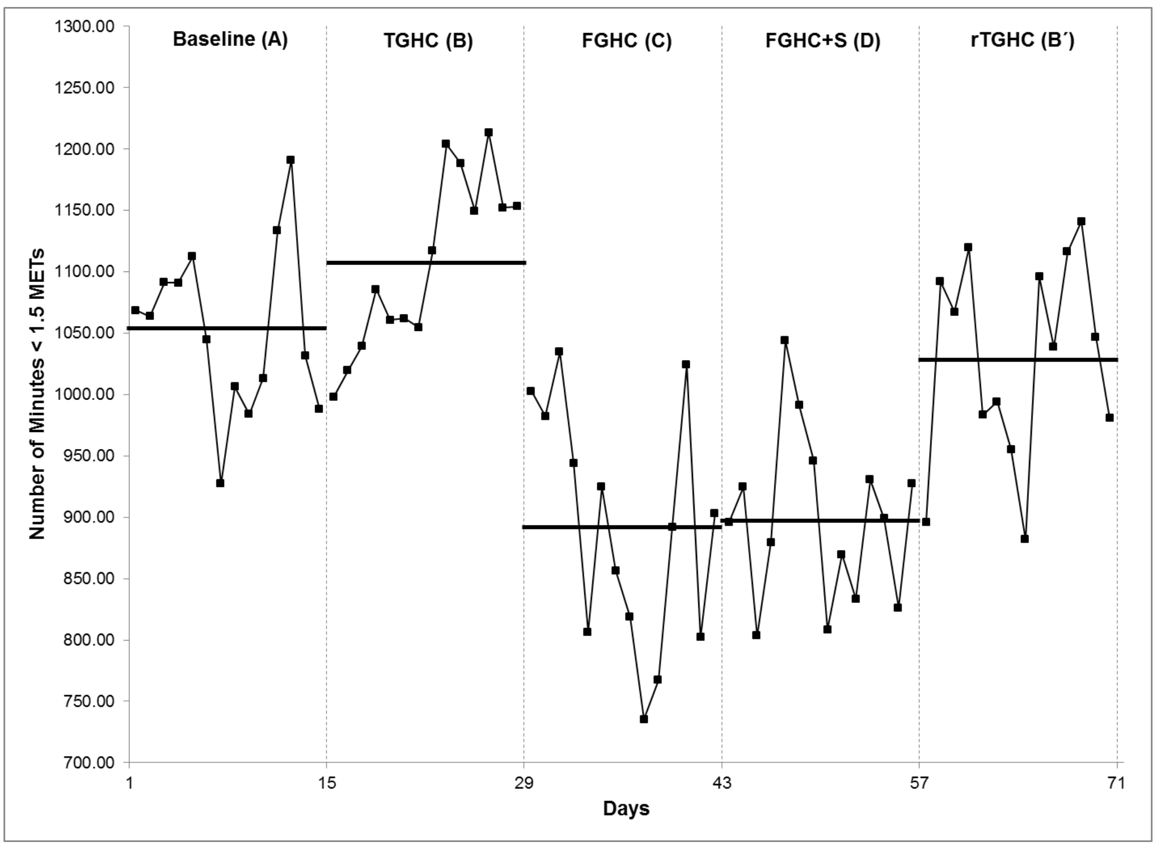
705	C	14	19.71 (22.40)	0 - 68	.122	0.78
	D	14	4.79 (11.30)	0 - 27	-.517	-0.84
	B′	14	10.50 (15.37)	0 - 44	-.688	0.42
	B-B′					0.34
707	A	14	39.00 (36.80)	0 - 112	-.288	
	B	14	55.79 (46.51)	0 - 159	.324	0.40
	C	14	23.00 (28.43)	0 - 79	-.147	-0.85
	D**	14	32.57 (21.29)	8 - 76	.495	0.38
	B′	14	15.71 (15.02)	0 - 50	-.234	-0.92
	B-B′					-1.16
708	A	14	26.29 (16.10)	0 - 53	-.267	
	B	14	30.64 (22.45)	0 - 69	.534	0.22
	C	14	29.21 (26.73)	0 - 81	-.223	-0.06
	D	14	26.29 (23.62)	0 - 67	-.405	-0.12
	B′	10	16.00 (20.92)	0 - 56	-.389	-0.46
	B-B′					-0.67
712	A	14	51.00 (39.13)	0 - 134	-.079	
	B	14	44.29 (31.36)	0 - 103	.067	-0.19
	C	14	48.86 (38.23)	0 - 130	-.069	0.13
	D**	14	58.36 (45.38)	0 - 122	-.338	0.23
	B′	14	26.71 (17.54)	0 - 56	-.385	-0.92
	B-B′					-0.69
713	A	14	20.71 (26.31)	0 - 70	.298	
	B	14	29.07 (38.32)	0 - 118	.177	0.25
	C	14	40.36 (34.41)	0 - 104	.126	0.31
	D	14	29.57 (29.10)	0 - 95	-.107	-0.34
	B′	14	13.36 (13.96)	0 - 42	-.172	-0.71
	B-B′					-0.54

* *N* refers to the total number of observations on each day within its respective phase.
** Denotes participation in Social Challenges.
Effect size is calculated as a *d*-statistic indicating magnitude of difference between phases as well as direction as indicated by (+/-) sign using Hedges, Pustejovsky, and Shadish's (2012) method of standardized mean difference effect size for single case designs.

Group Daily Sedentary Minutes (≤ 1.0 METs) per phase. The average number of minutes participants engaged in physical activity ≤ 1.0 METs within each phase (see Figure 3 and Table 3) was as follows: Phase A: 1053.33 minutes (range 927.17 to 11.91, *SD* = 68.76); Phase B: 1107.04 minutes (range 997.67 to 1213.50, *SD* = 70.71); Phase C:

892.44 minutes (range 735.50 to 1034.67, *SD* = 97.74); Phase D: 898.55 minutes (range 803.50 to 1044.00, *SD* = 69.28); Phase B´: 1029.20 (range 881.83 to 1141.20, *SD* = 82.82). Given the similar ranges and standard deviations from A-B and C-D, this data suggests relatively similar patterns of activity minutes across these phases. Alternatively, differences in ranges and standard deviations with a decrease from B-C suggesting a decrease in daily sedentary minutes, and an increase from D-B′ suggesting an increase in sedentary minutes overall.

Figure 3. Group Daily Average Sedentary Activity Minutes (≤ 1.0 METs)



Note: bold horizontal lines represent average phase activity minute levels

Slope was calculated using a regression equation in which slope is indicated by its beta (β) weight. Slopes for individual phases were mixed overall: Phase A (β = -1.763, *p*

= .715); Phase B (β = 14.557, p = .001); Phase C (β = -9.960, p = .129); Phase D (β = -2.230, p = .646); and Phase B′ (β = 3.851, p = .505). Observed slopes for individuals phases are mixed with an increasing trend in Phase B, but with an overall decreasing trend for phases A, C, D. Finally, there is a slight increase from D-B′. These findings do not support the hypothesized decrease in sedentary minutes when participants were exposed to FGHC, and FGHC+S, but shows partial support for a decreasing trend when exposed to TGHC.

The immediacy of the effect between subsequent phases was calculated in the same manner as average daily steps between phases. Phases A-B had a difference of +51.44 minutes; Phases B-C had a difference of -166.50 minutes; Phases C-D had a difference of +35.17 minutes; and Phases D-B′ had a difference of +134.33 minutes. The largest differences are observed between Phases A-B and D-B′.

Percent overlap between adjacent phases revealed mixed levels of overlapping data points: Phases A-B 78% overlap; Phases B-C 14%; Phases C-D 79%; Phases D-B′ 57%; and B-B′ 57%.

Data patterns were not consistent within phases B and B′ in which experimental conditions were the same. Minute averages differed (B: M = 1107.04 SD = 70.71 and B′: M = 1029.20, SD = 82.82), effect size (d = -1.01), was larger than between other phases and the highest overlap in data points (57%) was observed between phases B and B′.

Visual analysis of overall trends across phases (see Figure 3) reveals mixed levels of change in sedentary minutes among phases. The magnitude of the difference in the average number of minutes increases slightly at first before decreasing greatly to phase C.

Average phase minute levels then increase variably from phase C-B′. This visual trend is supported by the Hedges *d*-statistic for each adjacent phase change: A-B: $d = 0.77$; B-C: $d = -2.52$, C-D: $d = 0.07$; D-B′: $d = 1.71$. The difference in minutes between Phases B and B′ had an effect size of $d = -1.01$; this effect size indicates that the pattern of minutes differed under similar treatment conditions.

In summary, the overall (group) change in average participant sedentary minutes does not support the hypothesis that exposure to TGHC, and FGHC+S would each evoke a reduction in daily sedentary minutes. There is partial support for the hypothesis that exposure to FGHC may have evoked a decrease in sedentary minutes ($d = -2.52$).

Group Daily Light-Intensity Minutes (1.1-2.9 METs). The average number of minutes participants engaged in physical activity between 1.1 and 2.9 METs within each phase (see Figure 4 and Table 3) was as follows: Phase A: 239.51 minutes (range 197.00 to 268.83, $SD = 21.33$); Phase B: 234.62 minutes (range 198.67 to 270.00, $SD = 20.74$); Phase C: 239.40 minutes (range 198.83 to 283.83, $SD = 25.47$); Phase D: 240.51 minutes (range 170.00 to 277.83, $SD = 27.09$); Phase B′: 229.10 (range 185.20 to 278.50 $SD = 26.92$). Given the similar ranges and standard deviations among all phases, this data suggests relatively similar patterns of light-intensity physical activity minutes.

Slope was calculated using a regression equation in which slope is indicated by its beta (β) weight. Slopes for individual phases were mixed overall: Phase A ($\beta = -1.052$, $p = .479$); Phase B ($\beta = -2.310$, $p = .093$); Phase C ($\beta = 4.502$, $p = .003$); Phase D ($\beta = -2.537$, $p = .116$); and Phase B′ ($\beta = -3.374$, $p = .054$). Observed slopes for individuals phases are mixed with an decreasing trend in for phases A and B, an increasing trend for phase, and final decreasing trends for phases D and B′. These findings do not support the hypothesized increase in light-intensity physical activity minutes when participants were exposed to TGHC and FGHC+S, but shows partial support for an increasing trend when exposed to FGHC.

Table 3

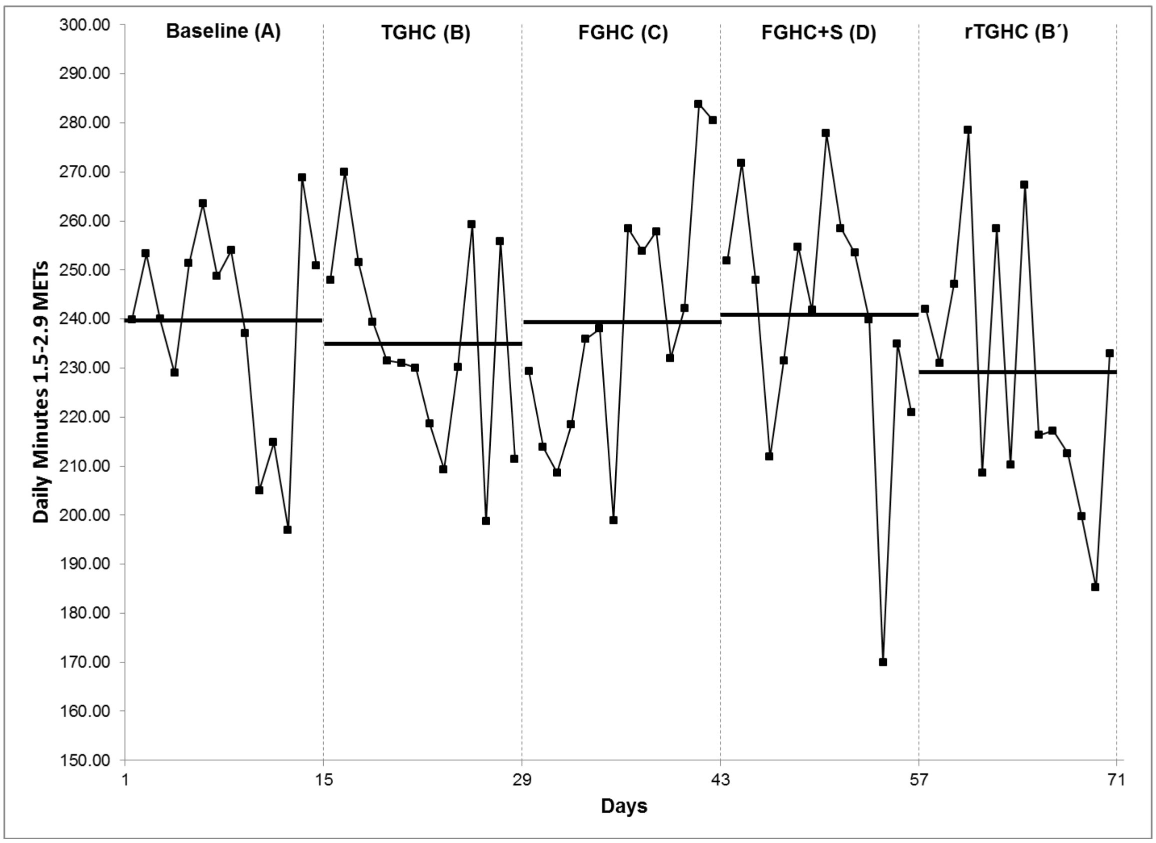
Total Number of Days, Averages, Standard Deviations, Ranges, Slopes, and Effect Sizes Within Each Phase Across and Within Participants Regarding Activity Minutes in different MET ranges.

METs	Phase	*N**	Average Minutes (*SD*)	Range	Phase Slope (*β*)	*d*
≤ 1.0	A	14	1053.33 (68.76)	927.17 - 1191.17	-1.763	
	B	14	1107.04 (70.71)	997.67 - 1213.50	14.557	0.77
	C	14	892.44 (97.74)	735.50 - 1034.67	-9.960	-2.52
	D	14	898.55 (69.28)	803.50 - 1044.00	-2.230	0.07
	B′	14	1029.20 (82.82)	881.83 - 1141.20	3.851	1.71
	B-B′					-1.01
1.1-2.9	A	14	239.51 (21.33)	197.00 – 268.83	-1.052	
	B	14	234.62 (20.74)	198.67 – 270.00	-2.310	-0.23
	C	14	239.40 (25.47)	198.83 – 283.83	4.502	0.21
	D	14	240.51 (27.09)	170.00 – 277.83	-2.537	0.04
	B′	14	229.10 (26.92)	185.20 – 278.50	-3.374	-0.42
	B-B′					-0.23
3.0-5.9	A	14	12.89 (6.35)	2.50 – 24.67	0.087	
	B	14	12.69 (7.00)	1.67 – 26.00	0.341	-0.03
	C	14	15.39 (3.93)	9.17 – 23.17	0.181	0.34
	D	14	13.08 (5.50)	3.17 – 25.00	0.300	-0.18
	B′	14	8.94 (4.12)	4.50 – 20.67	-0.220	-0.30
	B-B′					-0.22
≥ 6.0	A	14	15.35 (8.60)	4.33 – 35.50	-0.080	
	B	14	18.18 (10.97)	5.83 – 46.00	1.123	0.29
	C	14	17.11 (7.97)	3.67 – 29.00	-0.209	-0.11
	D	14	16.30 (8.33)	3.67 – 32.83	-0.430	-0.10
	B′	14	8.57 (5.68)	0.00 – 20.67	-0.634	-1.08
	B-B′					-1.10

* *N* refers to the total number of observations on each day within its respective phase.
Effect size is calculated as a *d*-statistic indicating magnitude of difference between phases as well as direction as indicated by (+/-) sign using Hedges, Pustejovsky, and Shadish's (2012) method of standardized mean difference effect size for single case designs.

The immediacy of the effect between subsequent phases was calculated in the same manner as average daily steps between phases. Phases A-B had a difference of -17.61 minutes; Phases B-C had a difference of +4.67 minutes; Phases C-D had a difference of +11.61 minutes; and Phases D-B´ had a difference of -31.39 minutes. The largest differences are observed between Phases A-B and D-B´.

Figure 4. Group Daily Average Light-Intensity Activity Minutes (1.1-2.9 METs)



Note: bold horizontal lines represent average phase activity minute levels

Percent overlap between adjacent phases revealed mixed levels of overlapping data points: Phases A-B 93% overlap; Phases B-C 100%; Phases C-D 86%; Phases D-B´ 93%; and B-B´ 100%.

Data patterns were partially consistent within phases B and B′ in which experimental conditions were the same. Minute averages differed (B: *M* = 234.62 *SD* = 20.74 and B′: *M* = 229.10, *SD* = 26.92), a small difference in effect size (*d* = -0.23), and the highest overlap in data points (100%) was observed between phases B and B′.

Visual analysis of overall trends across phases (see Figure 4) reveals mixed levels of change in light-intensity activity minutes among phases. The magnitude of the difference in the average number of minutes decreases slightly at first between phases A-B before increasing slightly from phase B-D. Average phase minute levels then sees the greatest decrease from phase D-B′. This visual trend is supported by the Hedges *d*-statistic for each adjacent phase change: A-B: *d* = -0.23; B-C: *d* = 0.21, C-D: *d* = 0.04; D-B′: *d* = -0.42. The difference in minutes between Phases B and B′ had an effect size of *d* = -0.23; this effect size indicates that the pattern of minutes differed slightly under similar treatment conditions.

In summary, the overall (group) change in average participant sedentary minutes does not support the hypothesis that exposure to TGHC, and FGHC+S would each evoke an increase in daily light-intensity activity minutes. There is partial support for the hypothesis that exposure to FGHC may have evoked a slight increase in sedentary minutes (*d* = 0.21).

Group Daily Moderate-Intensity Minutes (3.0-5.9 METs). The average number of minutes participants engaged in moderate-intensity physical activity between 3.0 and 5.9 METs within each phase (see Figure 5 and Table 3) was as follows: Phase A: 12.89 minutes (range 2.50 to 24.67, *SD* = 6.35); Phase B: 12.69 minutes (range 1.67 to 26.00, *SD* = 7.00); Phase C: 15.39 minutes (range 9.17 to 23.17, *SD* = 3.93); Phase D: 13.08 minutes (range 3.17 to 25.00 *SD* = 5.50); Phase B´: 8.94 (range 4.50 to 20.67 *SD* = 4.12). Given the similar ranges and standard deviations among phases A, B D, and B′, this data suggests relatively similar patterns of light-intensity physical activity minutes. The main difference is observed in phase C which has the smallest range and standard deviations.

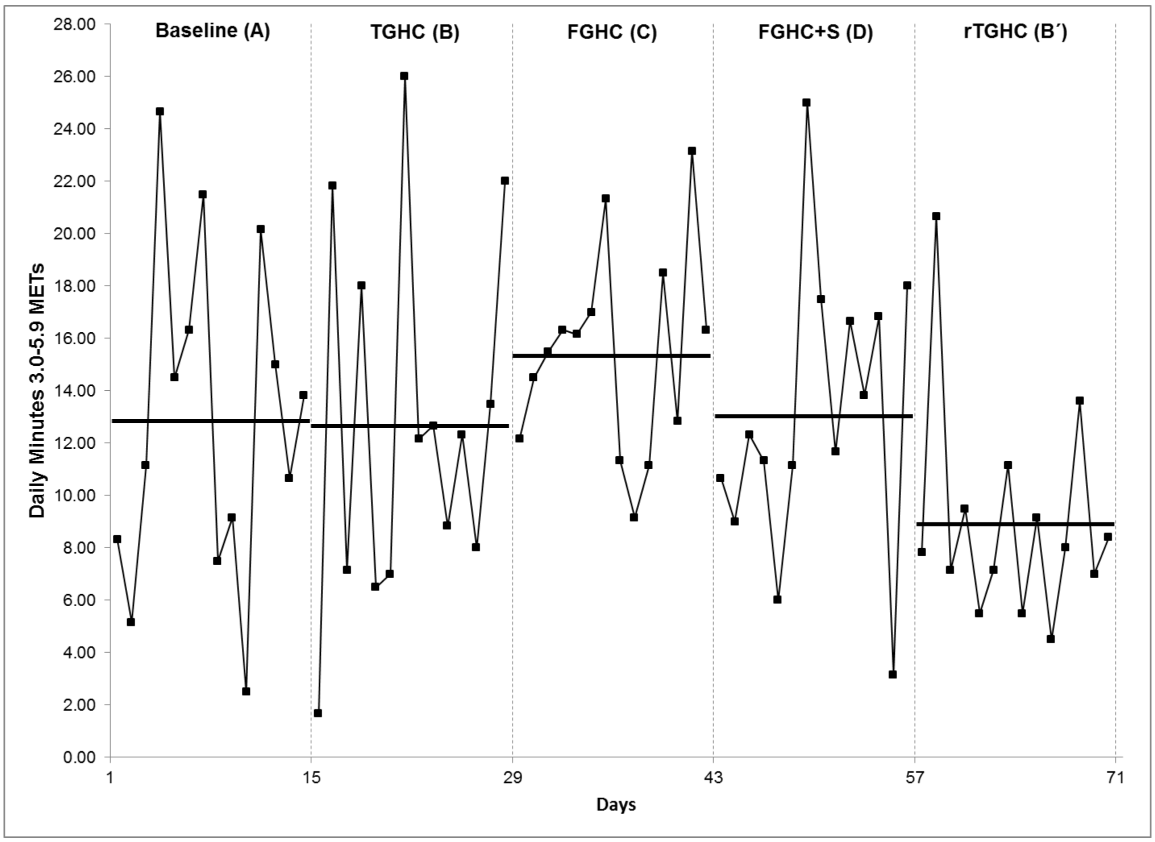
Slope was calculated using a regression equation in which slope is indicated by its beta (β) weight. Slopes for individual phases were mixed overall, but generally in the hypothesized positive direction: Phase A (β = 0.087, p = .846); Phase B (β = 0.341, p = .484); Phase C (β = 0.181, p = .511); Phase D (β = 0.300, p = .433); and Phase B´ (β = -0.220, p = .442). Observed slopes for individual phases are generally positive with an increasing trend in for phases A-D, with a final decrease in phase B′. These findings support the hypothesized increasing trend in moderate-intensity physical activity minutes when participants were exposed to TGHC, FGHC and FGHC+S.

The immediacy of the effect between subsequent phases was calculated in the same manner as average daily steps between phases. Phases A-B had a difference of -2.94 minutes; Phases B-C had a difference of +0.44 minutes; Phases C-D had a difference of -6.78 minutes; and Phases D-B´ had a difference of -0.78 minutes. The largest differences are observed between Phases A-B and C-D.

Percent overlap between adjacent phases revealed mixed levels of overlapping data points: Phases A-B 100% overlap; Phases B-C 57%; Phases C-D 100%; Phases D-B´ 86%; and B-B´ 71%.

Data patterns were not consistent within phases B and B´ in which experimental conditions were the same. Minute averages differed (B: M = 12.69, SD = 7.00 and B´: M = 8.94, SD = 4.12), effect size (d = -.22), and the overlap in data points (71%) was observed between phases B and B´.

Figure 5. Group Daily Average Moderate-Intensity Activity Minutes (3.0-5.9 METs)



Note: bold horizontal lines represent average phase activity minute levels

Visual analysis of overall trends across phases (see Figure 5) reveals mixed levels of change in moderate-intensity activity minutes among phases. The magnitude of the difference in the average number of minutes decreases slightly at first between phases A-B before increasing moderately from phase B-C to the highest average. Average phase minute levels then sees moderate decreases from phase C-D and D-B′. This visual trend is supported by the Hedges *d*-statistic for each adjacent phase change: A-B: *d* = -0.03; B-C: *d* = 0.34, C-D: *d* = -0.18; D-B′: *d* = -0.30. The difference in minutes between Phases B and B′ had an effect size of *d* = -0.23; this effect size indicates that the pattern of minutes differed slightly under similar treatment conditions.

In summary, the overall (group) change in average participant sedentary minutes does not support the hypothesis that exposure to TGHC, and FGHC+S would each evoke an increase in daily light-intensity activity minutes. There is partial support for the hypothesis that exposure to FGHC may have evoked a slight increase in sedentary minutes (*d* = 0.34).

Group Daily Vigorous-Intensity Minutes (≥ 6.0 METs). The average number of minutes participants engaged in vigorous-intensity physical activity between ≥ 6.0 METs within each phase (see Figure 6 and Table 3) was as follows: Phase A: 15.35 minutes (range 4.33 to 35.50, *SD* = 8.60); Phase B: 18.18 minutes (range 5.83 to 46.00, *SD* = 10.97); Phase C: 17.11 minutes (range 3.67 to 29.00, *SD* = 7.97); Phase D: 16.30 minutes (range 3.67 to 32.83 *SD* = 8.33); Phase B′: 8.57 (range 0.00 to 20.67 *SD* = 5.68). Given the similar ranges and standard deviations among phases A-D, this data suggests relatively similar patterns of light-intensity physical activity minutes. The main difference is observed in phase B′ which has the smallest range and standard deviations.

Slope was calculated using a regression equation in which slope is indicated by its beta (β) weight. Slopes for individual phases were mixed overall, but generally in the negative direction: Phase A (β = -.080, *p* = .894); Phase B (β = 1.123, *p* = .127); Phase C (β = -0.209, *p* = .709); Phase D (β = -.430, *p* = .458); and Phase B′ (β = -0.634, *p* = .092).

Observed slopes for individual phases are generally negative with an increasing trend in for phases A-B, with an overall decrease to phase B′. These findings do not support the hypothesized increasing trend in vigorous-intensity physical activity minutes when participants were exposed to FGHC and FGHC+S. There is partial support for the hypothesis that vigorous-intensity activity minutes increased when exposed to TGHC.

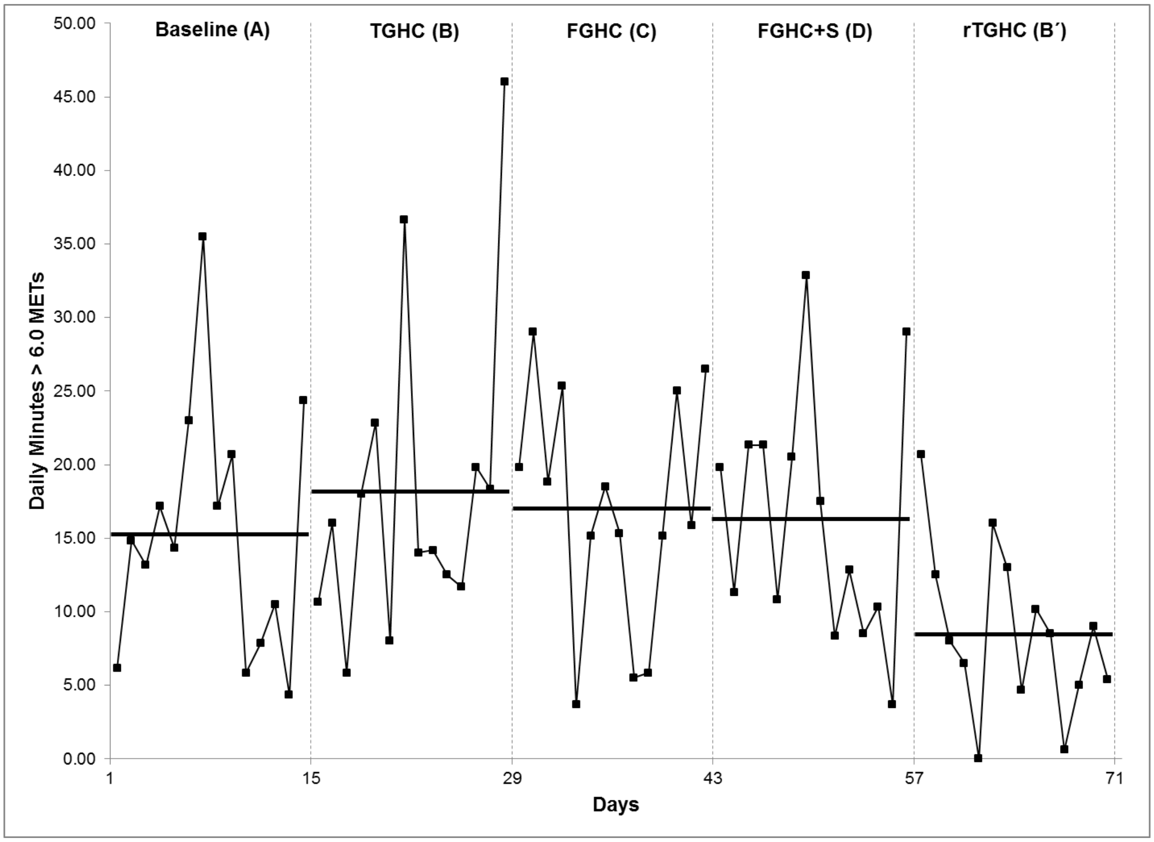
The immediacy of the effect between subsequent phases was calculated in the same manner as average daily steps between phases. Phases A-B had a difference of +2.22 minutes; Phases B-C had a difference of -5.50 minutes; Phases C-D had a difference of -4.94 minutes; and Phases D-B´ had a difference of -0.61 minutes. The largest differences are observed between Phases B-C and C-D.

Percent overlap between adjacent phases revealed mixed levels of overlapping data points: Phases A-B 93% overlap; Phases B-C 86%; Phases C-D 100%; Phases D-B´ 71%; and B-B´ 79%.

Data patterns were not consistent within phases B and B´ in which experimental conditions were the same. Minute averages differed (B: $M = 18.18$, $SD = 10.97$ and B´: $M = 8.57$, $SD = 5.68$), effect size ($d = -1.10$), and the overlap in data points (79%) was observed between phases B and B´.

Visual analysis of overall trends across phases (see Figure 6) reveals mixed levels of change in vigorous-intensity activity minutes among phases. The magnitude of the difference in the average number of minutes increases moderately at first between phases A-B before decreasing variably from phase B-B′ to the highest average. This visual trend

Figure 6. Group Daily Average Vigorous-Intensity Activity Minutes (≥ 6.0 METs)



Note: bold horizontal lines represent average phase activity minute levels

is supported by the Hedges *d*-statistic for each adjacent phase change: A-B: *d* = 0.29; B-C: *d* = -0.11, C-D: *d* = -0.10; D-B´: *d* = -1.08. The difference in minutes between Phases B and B´ had an effect size of *d* = -1.10; this effect size indicates that the pattern of minutes differed greatly under similar treatment conditions.

In summary, the overall (group) change in average participant sedentary minutes does not support the hypothesis that exposure to FGHC, and FGHC+S would each evoke an increase in daily vigorous-intensity activity minutes. There is partial support for the hypothesis that exposure to TGHC may have evoked a slight increase in sedentary minutes (*d* = 0.29).

Participation in social challenges. Analysis of the frequency of participation in social challenges revealed a 25% ($N = 3$) participation rate (P701, P707, and P712). The three individuals who engaged in social challenges participated every day during the 14-day period in which Fitbit-mediated challenges were promoted and accessible. Average stepping behavior for all three participants increased from the previous phase (P701: $d = 0.54$, 11% increase; P707: $d = 0.38$, 7% increase; and P712: $d = 0.22$, 12% increase), as did the average minutes engaging in activity ≥ 3.0 METs (P707: $d = 0.38$, 42% increase; and P712: $d = 0.23$, 19% increase).

Social Validity Outcomes

Group health coaching participants. Social validity measures were taken in order to assess the fidelity of the intervention, as well as participants' perceptions of treatment effects (see Table 4). Participants rated Likert-type items on a scale from 1 (*Very Strongly Disagree*) to 6 (*Very Strongly Agree*).

Five questions asked participants their perceptions on how useful certain components were regarding the Fitbit measurement system such as: (1) numerical feedback ($M = 4.40$, $SD = 0.97$); (2) graphical feedback ($M = 4.25$, $SD = 1.09$); (3) step change in relation to goals ($M = 4.00$, $SD = 1.05$), (4) wristband LED feedback ($M = 3.91$, $SD = 1.04$), and (5) overall positive experience with Fitbit system ($M = 4.42$, $SD = 0.67$). Five additional questions asked participants about their positive perceptions of the UMD Group Health Coaching Program such as: (1) weekly meeting activities ($M = 4.00$, $SD = 0.95$), (2) weekly group progress check-ins ($M = 4.45$, $SD = 0.69$), (3) sharing of successes and struggles ($M = 4.58$, $SD = 1.00$), (4) group health coaching helped participants reach their goals (*M* = 4.50, *SD* = 0.91), and (5) recommendation of group health coaching to a co-worker (*M* = 5.08, *SD* = 1.08). Two final questions asked participants to rate their level of frustration before and after receiving access to Fitbit exercise data on a scale of on a scale from 1 (*Not Frustrated at all*) to 5 (*Extremely Frustrated*): before: *M* = 2.67, *SD* = 1.30; after: *M* = 1.75, *SD* = 1.06).

Two questions evaluated frequency of participants' use of Fitbit interfaces such as: (1) access to Fitbit interfaces (website only: *N* = 5; mobile application only: *N* =1; both: *N* = 4; and neither: *N* = 2), and (2) daily frequency checking Fitbit interfaces (0 times/day: *N* = 1; 1-2 time/day: *N* = 5; 3-4 times/day: *N* = 3; and 7-8 times/day: *N* = 1; did not answer: *N* = 2). Two questions evaluated participants' engagement in Fitbit social challenges such as: participated in social challenges (participated: *N* = 3; did not participate: *N* = 9); (2) perceived effect of participation in social challenges (increased steps: *N* = 2; did not affect steps: *N* = 1).

Table 4

Participant Post-Study Questionnaire Response Rates, Average Ratings, and Standard Deviations.

Question	*N*	Response
Perceptions of how usefulness of Fitbit Measurement System		
Numerical feedback	10	*M* = 4.40 *SD* = 0.97
Graphical feedback	10	*M* = 4.25 *SD* = 1.09
Step change in relation to goals	10	*M* = 4.00 *SD* = 1.05
Wristband LED feedback	11	*M* = 3.91 *SD* = 1.04
Overall positive experience	11	*M* = 4.42 *SD* = 0.67

Table 4 *Continued*

Positive Perceptions of UMD Group Health Coaching		
Weekly meeting activities	12	*M* = 4.00 *SD* = 0.95
Weekly group progress check-ins	11	*M* = 4.45 *SD* = 0.69
Sharing of successes and struggles	12	*M* = 4.58 *SD* = 1.00
Group Health Coaching helped reach goals	12	*M* = 4.50 *SD* = 0.91
Recommend Group Health Coaching to a co-worker	12	*M* = 5.08 *SD* = 1.08
Level of frustration before and after access to data		
Before access to data	12	*M* = 2.67 *SD* = 1.30
After access to data	12	*M* = 1.75 *SD* = 1.06
Use of Fitbit interfaces		
Access to Fitbit interfaces	12	Website only: *N* = 5 Mobile App: *N* = 1 Both: *N* = 4 Neither: *N* = 2
Daily frequency checking Fitbit interfaces	10	0 times/day: *N* = 1 1-2 times/day: *N* = 5 3-4 times/day: *N* = 3 7-8 times/day: *N* = 1
Engagement in Fitbit social challenges		
Participated in social challenges	12	Participated: *N* = 3 Did not Participate: *N* = 9
Perceived effect of social challenges on steps	3	Increased steps: *N* = 2 Did not affect steps: *N* = 1

Group health coaching facilitator. Social validity measures were taken in order to assess the usefulness and accuracy of the BSA as rated by the UMD Health and Wellness Center's Lifestyle Management Health Coach (see Table 5). This questionnaire contained 8 questions using a Likert-scale response format of 1 (*Very Strongly Disagree*) to 6 (*Very Strongly Agree*). The first two questions reflected the information gathered about the organizational background that asked: (1) if the information was accurate regarding the UMD Employee Wellness Center (rating: 5, *Very Accurate*); and (2) if the information was accurate regarding the UMD Group Health Coaching Program as it fits within the UMD Employee Wellness Center (rating: 5, *Very Accurate*). The next two questions reflected how the information regarding the BSA approach was presented to the UMD Group Health Coach that asked: (3) if the explanation regarding if the explanation of the analysis and tools used to conduct the BSA helped the understanding of its process and utility (rating: 5, *Strongly Agree*); and (4) how confident the UMD Group Health Coach would be in explaining the BSA approach to a fellow employee (rating: 4, *Somewhat Confident*). The next three questions reflected the final findings and recommendations report that asked: (5) if the findings and recommendation appear to be logical (rating: 5, *Very Logical*); (6) if the findings presented were potentially useful to the UMD Group Health Coaching Program (rating: 5, *Very Useful*); and (7) how likely the UMD Group Health Coach would consider implementing recommendations found by the researcher (rating: 5, *Very Likely*). Finally, the last question reflected the final summary presented in the findings and recommendations report that asked: (8) if the summary provided a good overview of the BSA analysis and its findings and recommendations (rating: 5, *Strongly Agree*).

Table 5

Group Health Coach Facilitator Post-Study Questionnaire Responses.

Question	Response
Information gathered about organizational background	
Information was accurate about UMD Wellness Center	5, Very Accurate
Information was accurate about UMD Health Coaching Program	5, Very Accurate
Information gathered using the BSA approach	
Explanation of BSA process helped understanding	5, Strongly Agree
Confidence in being able to explain BSA to someone else	4, Somewhat Agree
Final findings and recommendations	
Findings and recommendations appear to be logical	5, Very Logical
Findings are useful for UMD Group Health Coaching Program	5, Very Useful
How likely would implement recommendations for GHC	5, Very Likely
Final Summary	
Summary provided good overview of BSA and findings	5, Strongly Agree

Discussion

Findings from this study do not support the hypothesis that stepping behavior increases as a result of traditional Group Health Coaching (TGHC) or Fitbit-enhanced Group Health Coaching (FGHC and FGHC+S). The addition of an objective measurement system that allowed self-monitoring of physical activity, as well as participation in social challenges, did not evoke an increase in participants' stepping behavior. Instead, an overall decrease in activity was observed. Overall analysis of participants' activity revealed the highest average stepping behavior during the baseline phase; following baseline, activity levels decreased with increasing acceleration across subsequent phases. This trend was contrary to the stated hypothesis that predicted an *increase* in overall average steps among participants from Baseline to TGHC, TGHC to FGHC, FGHC to FGHC+S, and a *decrease* from FGHC+S to rTGHC. Furthermore, TGHC and rTGHC phases (B and B′) did not produce similar effects on stepping behavior. Additionally, an overall analysis of participants' daily minutes engaged in physical exercise ≥ 3.0 METs revealed an increase in minutes from (a) baseline to TGHC, then a continued decrease with each subsequent phase. These results, only provide partial support from the aforementioned hypothesis in that TGHC saw an initial increase in physical activity minutes, but then subsequently decreased from there. Additional analysis of levels of physical activity revealed partial support for FGHC in reducing sedentary minutes (*d* = -2.52), as well as increasing moderate-intensity physical activity (*d* = +0.34). At the individual level of analysis, mixed levels of change were observed among phases for both step counts and level of physical activity. Largely, the results of this study provide only small partial observable effects of successful increases in steps and physical activity levels due to the aforementioned intervention components, but no consistent trend fully supports the hypothesis that exposure to TGHC, FGHC, FGHC+S fully increases steps or levels of intensity of physical activity.

High Baselines

An unanticipated observation in this study was the result of a high initial baseline of average steps among participants. The level of the baseline phase was expected to be at its lowest level comparatively to every other Phase within this study. It is possible that these step levels reflected the number of steps participants were normally taking at this point and when exposed to intervention components, steps decreased.

An additional explanation for this high baseline level is that presentation of the Fitbit wristband may have acted as a novel prompt to engage in activity during the beginning of the study. Recall that before a behavior is evoked, an antecedent first prompts an individual to engage in said behavior (Daniels & Bailey, 2014). Considering most of the participants had not worn a visible activity monitor before this study, the Fitibit Flex wristband may have initially acted as visual prompt/reminder for individuals to engage in an increase in stepping behaviors. As indicated by the decrease in overall average participant steps, participants may have habituated to the presence of the Fitbit; thus, the evocative effect of this prompt may have diminished over time. This can be explained due to the absence of positively reinforcing consequences paired contingently with stepping behavior. Antecedents prompt behavior to occur, but without reinforcing consequences (positive or negative), the effectiveness of the antecedent may diminish if the individual is not exposed to programmed (e.g., acknowledgment of goal achievement) or natural reinforcers (e.g., natural benefits of the behavior, such as improved health).

Similarly, initial introductions to Group Health Coaching in Phase A may have also initially acted as a prompt for individuals to engage in exercise. Again, without positively reinforcing consequences paired with Group Health Coaching its effectiveness of prompting participants to engage in exercise may have diminished. This explanation assumes that ten weeks provided sufficient time for participants to habituate to the Fitbit measurement system and Group Health Coaching.

A final explanation for high baselines might be that participants attempted to elicit feedback from the Fitbit wristband before access to data was given. During this baseline phase, step goals were manually set to impossible levels (500,000 daily steps); in doing so, the Fitbit could record steps, but LED feedback would not be elicited (each wristband LED light activates for achieving 20% of daily step goals for a total of 5 LED lights). P701 did self-report attempts to elicit this wristband feedback during this baseline phase (daily step peak of 37,448). P702, P708 and P712 also informally reported attempting to elicit Fitbit wristband feedback during phase A; however, specific days of interest were not reported by these individuals. As such, observed high baselines may have been due to participants' natural high step levels, natural prompting through wearing the Fitbit Flex and participating in Group Health Coaching, as well as attempting to elicit electronic feedback from the Fitbit Flex early on in the study.

Decreasing Trend in Stepping Behavior Across Time

The overall decreasing trend from baseline through duration of the 10-week Group Health Coaching program indicates a twofold unsuccessfulness for the incorporation of an objective measurement system (via the Fitbit) in addition to the Group Health Coaching Program to evoke and sustain a lasting increase in individuals' stepping behavior. First, these outcomes may be explained by the structure used for the current Group Health Coaching program under investigation. The current Group Health Coaching session structure consisted of many different components during the 10-week program. Weeks one and two consisted of welcoming participants, establishing group norms, completing wellbeing assessments, and explaining information about SMART goals. Weeks three and four consisted of conveying information about creating self-set goals, encouraging participants to establish self-set goals (these goals did not have to be specific to stepping), using techniques to monitor goal progress (e.g., journals, making charts, utilizing mobile applications), and discussing individual goal progress in a group setting.

Weeks five and six consisted of engaging in behavior change activities such as completing a consequence analysis (a behavior change activity to identify how powerful a consequence can be in changing behavior), identifying social support needs, and participating in an activity where participants were to identify how to utilize social support to enhance a well-being goal achievement. Weeks seven and eight consisted of reflecting on past and current goal progress in relation to participant end-goals, discussing what participants have learned through their experiences, and engaging in a mindful eating activity. Finally, weeks nine and ten consisted of reflecting upon Group Health Coaching and identifying what participants have learned, discussing individual action plans for obtaining long-term and short-term wellness goals, and providing helpful resources to continue participants' efforts to increase wellness behaviors.

The UMD Health and Wellness Center's Lifestyle Management Health Coach took a broader, holistic approach to the Group Health Coaching program where conversations and activities for each meeting were not specifically focused on increasing stepping behavior. Rather, sessions included discussion and activities related to stepping behavior and other wellness behaviors such as eating, sleep, social interactions, and kindness to one's self. This approach to Group Health Coaching had the benefit of allowing a broad range of conversations that did not limit participants to a single wellness topic, providing an opportunity for participants to inquire and speak about a variety of other health-related issues in addition to stepping behavior and physical activity.

This format, while designed to promote general discussion and to support a wider variety of participants' wellbeing behaviors, may have unintentionally decreased participants' focus on increasing their stepping behavior. In addition, individually tailored stepping goals were not present within the current Group Health Coaching structure. The Lifestyle Management Health Coach indicated that this was done in an attempt to allow participants to practice setting their own goals using information about goal-setting presented during weekly meetings. As a result, self-set participant goals were not disclosed, and the appropriateness of those goals is unknown. A participatory approach to goal setting (i.e., assisting participants with setting specific step goals) may have better directed participants' efforts to increase their stepping behavior relative to a specific, assigned goal.

Goals can function as motivating operations, producing an evocative effect and increasing the reinforcing effectiveness that a stimulus has on an individual's behavior (Dallery et al., 2014; Iwata, Smith, & Michael, 2000; Laraway, Snycerski, Michael, & Poling, 2003; McGee & Johnson, 2015; Michael, 2000). Specific step goals could have evoked an increase in stepping behavior and increased the reinforcing effectiveness of goal achievement through feelings of satisfaction or receipt of social reinforcement from peers or positive feedback from the Fitbit measurement system. When individuals received access to their Fitbit accounts, they all had the standard daily goal of 10,000 steps; however, this 10,000-step goal was not tailored to individuals' baseline stepping behavior, nor was stepping beyond 10,000 steps emphasized or reinforced. Given the results of the current study, it is unlikely that the "default" 10,000-step goal functioned as a motivating operation. One method to attend to this limitation might be to encourage individuals to meet similar, but different step goals such as climbing five flights of stairs a day, or increasing walking distance by one mile per week. Similarly, the Lifestyle Management Health Coach encouraged and recommended individuals to participate in walking clubs through UMD to increase their step levels at a broad level. To enhance this recommendation, addition of specific stepping-related goals that are objectively tracked and paired with specific consequences could be added in the future.

An additional explanation for the decreasing step trends across time could be the absence of reinforcing consequences paired with step goal achievement. Support for using reinforcing consequences to increase stepping behavior comes from successful studies utilizing reinforcing monetary consequences to increase step outcomes (Kurti & Dallery, 2013; Wing & Jeffrey, 1999). A future recommendation would be to cater programs towards utilizing positive reinforcement upon goal completion as a potential format. An example that could be applied to the current Group Health Coaching format could come from the utilization of Wellness Points earned by participants. Participants could earn theses Wellness Points upon reaching the goal of attending a certain amount of meetings, rather than achieving physical activity milestones. In a behavioristic perspective the reinforcing value of the Wellness Points are reinforcing the behavior of attending meetings, rather than increasing steps. If participants were to earn Wellness

Points only upon completion of specific step goals, a potential increase of steps may then be realized as per the studies described above.

The observed decreasing step trend may also be interpreted as the Fitbit measurement system's ineffective ability to increase stepping behavior over and above the addition Traditional Group Health Coaching. Despite the Fitbit measurement system and its successful behavior change components (Lyons et al., 2014), an increase in stepping behaviors on top of Traditional Group Health Coaching was not realized when participants were exposed to their personal exercise data. Several reasons may account for these results.

The reinforcing effect of the Fitbit measurement system exercise feedback itself may have been altered due to participants' frustration due to the inability to access their data at certain points throughout the course of the study. As indicated by the frustration survey results, a higher level of frustration was observed when Fitbit feedback was withheld from participants (before: $M = 2.67$, $SD = 1.30$; after: $M = 1.75$, $SD = 1.06$). The feelings of frustration may have acted as a punishing consequence, which would cause the pattern of stepping behaviors decrease in order to avoid the feelings of frustration associated with Fitbit feedback. Feelings of frustration may have also acted as an abolishing operation that reduced or eliminated the potential reinforcing effect of Fitbit feedback. If Fitbit feedback was given to participants early on in the study, an evocative effect may have been realized since participants were deprived of exercise feedback; however, since feedback was not administered until the fifth week of the study, mounting frustration may have reduced the reinforcing effectiveness of the Fitbit feedback in increasing stepping behavior. Informal comments from multiple participants (P701, P709, P714) reflected this line of reasoning as they expressed frustration of needing to wear the Fitbit during the third and fourth weeks of the study, and elected to stop wearing it whenever they were inactive.

Participants' daily schedules, as well as the weather, serve as external factors that may have had a negative influence on stepping behavior throughout the duration of this study. In a university environment, faculty and staff become increasingly busy as time passes throughout the semester. This is especially true during the last few weeks of the semester, during which increasing amounts of time are spent on preparations for final exams, projects, presentations, and the subsequent semester's classes. Increased workloads would, therefore, potentially deter employees from taking frequent breaks during the workday, thereby reducing overall step levels. Additionally, during weeks four and eight, faculty and staff had short work weeks (3 days) due to a mid-semester fall break and Thanksgiving break, respectively. These additional breaks in daily routines may have resulted in a decrease in steps due to relaxing rather than walking around the workplace as normal.

Relatedly, changing weather patterns over the course of the semester may have been a factor in why steps decreased over time. Duluth, MN, has a humid continental climate; therefore, temperatures start to drop during this time of year. As the temperature became colder, participants may have found walking outdoors more aversive. This explanation is supported by the general decrease of average temperatures during each phase of the study (Weather Underground, 2016): Phase A (48.20°F); Phase B (45.11°F); Phase C (43.44°F), Phase D (29.94°F); and Phase B′ (34.06°F).

Another explanation for the decreasing step trend may be that participants perceived monitoring their steps as "work". Recent research has evaluated the role of affect and self-monitoring steps in individuals. Etkin (2015) conducted three studies that measured 95 college students to rate the enjoyment of walking in groups that randomly assigned participants to self-monitoring steps via a pedometer versus control groups that stepped without a pedometer. Etkin found that participants using pedometers to self-monitor their physical activity increased their steps; however, they also enjoyed walking less compared to participants in a control group. These finding support the contention that self-monitoring and quantifying the behavior of stepping via a measurement tool (i.e., Fitbit) may have led participants in the current study to view stepping as "work", thereby reducing the positive reinforcing effect of the feedback provided by the Fitbit measurement system and, instead, eliciting feelings of frustration. This frustration may have pervaded from the beginning to the end of the study. Additionally, several participants reported being ill during weeks five (P705), seven (P710 and P712), eight (P708), nine (P712), and ten (P703); it is unknown, however, how participants' illness influenced their steeping behavior.

Fidelity of Fitbit-Enhanced GHC Intervention with Social Challenges

At a broad level, Fitbit-enhanced Group Health Coaching with the promotion of social challenges (FGHC+S; Phase D) did not increase overall stepping behavior of participants. This is most likely due to the low participation rate in the available social challenges promoted during this time. Out of the 12 participants, only three chose to engage in social challenges throughout the two weeks in Phase D (P701, P707, and P712). All three of these participants increased their average stepping behavior from Phase C (FGHC) to D (FGHC+S), providing partial support for the efficacy of participation in social challenges to increase steps. Participation in these social challenges was voluntary; therefore, it is possible that only individuals that enjoy hierarchically ranked competitions such as those mediated via Fitbit (i.e., Workweek Hustle; Weekend Warrior; and Daily Showdown) choose to engage in these activities. Thus, participation in social challenges for those that have an aversion to competition may evoke an increase in stepping behavior.

Another explanation for this low participation rate in social challenges can be explained by the diffusion of innovation theory (Kaminski, 2011). This theory postulates that acceptance of technology happens over time and the adoption trend resembles a normal bell curve where a small percentage of individuals adopt the technology up front. Considering the majority of participants were older adults, who are more likely to adopt technology later in its lifetime, the unwillingness to adopt the Fitbit measurement system and its components may reflect the diffusion of innovation. In support of this theory, the individuals that elected to participate in social challenges happened to be two that worked in information technology positions, and the third was the youngest of the group. Additionally the ability to engage in Fitbit social challenges requires the use of a smart phone, which several participants informally reported having a difficult time navigating. These individuals needed additional technical help and troubleshooting from the researcher to ensure the Fitbit mobile application was set up correctly to allow access to social challenges. Additionally, two of the 12 participants reported not accessing the Fitbit website or the mobile application, and only four participants accessed both the app and the website during the course of the study. Again the low rate of access could be due to the unwillingness to adopt the use of the Fitbit data feedback via computer or smartphone early on.

Study Strengths

Over the course of this study, several strengths were noted. A major strength of this study includes the external validity considering this study was a field experiment evaluating the UMD Group Health Coaching Program. This study approach was an observational research study with the addition of the Fitbit measurement system during planned intervals during the 10-week program. The addition of the Fitbit was administered in a near-naturalistic way with the only difference being that individuals did not have access to exercise data until the fifth week of the program. After this time, individuals had the same access any individual would have if they were to own and access the Fitbit measurement system. An additional strength of this study was the within-subjects single-case design. This design has the benefit of showing the change progression over time of an individual's behavioral responding before and after the presence of treatment effects. This allows individuals to behave naturally with and without the presence of treatment effects and allows the outcome of stepping to naturally be observed.

Study Limitations

A primary limitation of the current study is that participant recruitment methods and selection criteria allowed any individual to participate in the Fall UMD Group Health Coaching Program regardless of physical activity levels. This choice was made for ethical reasons in that the essence of the UMD Group Health Coaching Program is available for any individuals seeking to improve on healthy behaviors including, but not limited to, stepping. Thus, the recruitment message reflected this by allowing any individual interested in increasing the amount of walking they do on a regular basis regardless of baseline physical activity level or personal reasons. Additionally, participants, on a daily average, stepped at levels already recommended by the CDC, demonstrating a potential restriction of range. More specifically, participants were already engaging in at least 10 min/day of moderate-intensity physical activity and 10 min/day of vigorous-intensity physical activity; thus, participants were achieving at least 150/75 minutes of Moderate to Vigorous Physical Activity per week. As such, the ability of the current study's intervention to evoke a change in physical activity may have been more difficult since the participant sample was not representative of a sedentary population.

A second limitation is that, in order to reduce participant anticipation of treatment effects, the exact time at which participants would have access to Fitbit-recorded data was intentionally kept from them. This was done to reduce any change in stepping behavior related to an expectation that data was going to be presented or taken away at specific intervals. Had participants known this, they may have either increased steps in preparation of data access or decreased steps in knowing that data access was to be removed. The intentional removal of data access, however, may have increased participants' level of frustration and therefore affected their stepping behavior.

A final limitation of this study is that technological and user errors occurred on multiple occasions throughout the study. Technical and user issues included: devices unexpectedly unpairing from accounts, users forgetting to wear trackers after taking them off for water or work-related activities, users forgetting to charge Fitbit batteries despite weekly reminder emails, and users having difficulty using login and password information for the Fitbit measurement system. In order to document activity that could not be automatically recorded due to these issues, steps were estimated via mobile phone step tracking applications, other pedometer tracking devices, and the Fitbit measurement system's ability to calculate length of walks (in miles) into total steps.

Unfortunately, the level of intensity of physical activity could not be accurately calculated for estimated or manually-recorded data because there is no translational service in the Fitbit measurement system to estimate or track these outcomes. Unpairing of the Fitbit activity monitor to its respective account occurred in participants using the Fitbit mobile application. After troubleshooting with Fitbit.com, the most likely explanation for this unpairing was due to participants attempting to pair the Fitibit wristband to their smartphone when additional Bluetooth connective devices were in close proximity. These technical issues could be mitigated by having the researcher manually set up and program participants' access to components of the Fitbit measurement system in a Bluetooth connectivity-deprived area.

Suggestions for Future Directions

The results of this study provide insight for individuals seeking to further explore any of the variables of interest. First, a between-subject design that includes a control group in comparison to an experimental group could be utilized. Using this type of design could control for any carry-over effects that is inherent in within-subjects designs. This design could also ameliorate potential frustration in participants caused by the lack of feedback being withheld and/or administered at different times of the study. Additionally, increasing the amount of communication and providing a stronger rationale to participants regarding why and how long they will be restricted to data access could potentially ameliorate participants' frustration levels.

Second, the role of social challenges and its efficacy to increase physical activity in individuals warrants further study. This study documents the possibility of social challenge's ability to increase steps and physical activity minutes $\geq$ 3.0 METs in individuals, but with limited participation, it is unclear to what extent social challenges affect physical activity outcomes. Additionally, the Fitbit mobile application is needed to engage in social challenges, so having the ability to provide participants with smart phones or other devices already set up to allow access to social challenges could help with willingness to participate. Another recommendation would be to consider screening participants according to their comfort level with using smart phones/tablets. Doing so may help researchers identify individuals who would have the skills and interest in setting up mobile applications, engaging with web-based interfaces and mobile applications, as well as monitoring physical activity data during this type of intervention. Pairing reinforcing consequences with wearing the Fitbit activity tracker may also encourage participants to remember to wear their Fitbit wristband continuously. For example, during weekly check-ins, participants with continuous daily data may be able to earn additional Wellness Points.

Finally, increasing the screening criteria to only allow individuals who are at risk and/or do not currently meet the CDC recommendations for physical activity levels would eliminate or reduce the observed restriction of range problem in the current study. Researchers might consider recruiting or implementing this type of intervention with individuals who are concurrently participating in a Weight Watcher’s program. Individuals in such a program may be less likely to be engaging in recommended levels of physical activity and may already possess the desire to increase their level of physical activity.

Conclusion and Implications

Several practical implications exist regarding the outcomes observed in this study. Due to the decreasing step trends across time, it should be noted that providing an objective activity monitor to individuals to enhance the effects of Group Health Coaching did not increase stepping behavior. This outcome is most likely due to the absence of individually tailored stepping goals and reinforcing consequences paired with meeting those goals. To improve the efficacy and practicality of a physical activity monitor such as the Fitbit measurement system to enhance Group Health Coaching, positive reinforcing consequences should be paired with specific, individually catered exercise goals. These reinforcers should be paired as closely to the target behavior as possible rather than a prolonged amount of time such as at the end of a group health coaching program. As seen in the high baselines observed, administration of a new piece of technology and/or participation in group health coaching may increase behavior through initial prompting of exercise until participants habituate to its effects. One should be cautious in the way they interpret initial baseline results of individuals. In order to continue this excitement and higher responding pattern seen early on, positive reinforcing consequences that are continuously paired upon the activity monitor's use and the behavior it is measuring may provide useful in increasing physical activity as well as use of the activity monitor and effectiveness of group health coaching. Utilizing the results and suggestions provided throughout this research paper may prove useful to more effectively design and implement group health coaching programs in the future.

References

ACT Occupational Health and Safety Commission (2009). *A Guide to Promoting Health and Wellbeing in the Workplace* [White paper]. Retrieved from http://www.10000stepsusa.com/getfile/PDFs%20Public/A%20Guide%20to%20Promoting%20HealthWellbeing%20in%20the%20Workplace.pdf.

American College of Sports Medicine (2015). Off the couch and active: When to see a physician before exercising. Retrieved from https://www.acsm.org/docs/current-comments/whentoseeadoctortemp.pdf.

Andrade, L. F., Barry, D., Litt, B. M., & Petry, N. M. (2014). Maintaining high activity levels in sedentary adults with a reinforcement-thinning schedule. *Journal of Applied Behavioral Analysis*. *47*(3), 523-536.

Andy, C. Y., Wong, T. W., & Lee, P. H. (2015). Effect of low-intensity exercise on physical and cognitive health in older adults: a systematic review. *Sports medicine-open, 1*(1), 1.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.

Biernat, E., Tomaszewski, P., & Milde, K. (2010). Physical activity of office workers. *Biology of Sport, 27*(4), 289-296.

Centers for Disease Control and Prevention Website. (2013). Workplace health promotion: Rising healthcare costs are unsustainable. Retrieved from http://www.cdc.gov/workplacehealthpromotion/businesscase/reasons/rising.html.

Centers for Disease Control and Prevention Website. (2014). How much physical activity do adults need? *Centers for Disease Control and Prevention.* Retrieved from http://www.cdc.gov/physicalactivity/everyone/guidelines/adults.html.

Centers for Disease Control and Prevention Website. (2015). General physical activities defined by level of intensity. *Centers for Disease Control and Prevention.* Retrieved from http://www.cdc.gov/nccdphp/dnpa/physical/pdf/PA_ Intensity_table_2_1.pdf.

Centers for Disease Control and Prevention Website. (2015). Physical activity and heatlh: The benefits of physical activity. *Centers for Disease Control and Prevention.* Retrieved from http://www.cdc.gov/physicalactivity/basics/pa-health/.

Chan, C. B., Ryan, D. A.J., & Tudor-Locke, C. (2004). Health benefits of a pedometer-based physical activity intervention in sedentary workers. *Preventative Medicine, 39*, 1215-1222.

Chau, J. Y., Van der Ploeg, H. P., Dunn, S., Kurko, J., & Bauman, A. E. (2012). Validity of the occupational sitting and physical activity questionnaire. *Medicine and science in sports and exercise, 44*(1), 118-125.

Clemes, S. A., O'Connell, S. E., & Edwardson, C. L. (2014). Office workers' objectively measured sedentary behavior and physical activity during and outside working hours. *Journal of Occupational and Environmental Medicine,56*(3), 298-303.

Corning, A. F., Krumm, A. J., & Smitham, L. A. (2006) Differential social comparison processes in women with and without eating disorder symptoms. *Journal of Counseling Psychology. 53*(3), 338-349.

Dallery, J., Kurti, A., & Erb, P. (2014). A new frontier: Integrating behavioral and digital technology to promote health behavior. *The Behavior Analyst*, *38*(1), 19-49.

Dallery, J., & Raiff, B. R. (2014). Optimizing behavioral health interventions with single-case designs: From development to dissemination. *Translational behavioral medicine*, *4*(3), 290-303.

Daniels, A. C., & Bailey, J. S. (2014). *Performance management: Changing behavior that drives organizational effectiveness.* Fifth Edition. Atlanta, Georgia: Performance Management Publications.

De Cocker, K. A., De Bourdeaudhuij, I. M., Brown, W. J., & Cardon, G. M. (2007). Effects of "10,000 steps Ghent": A whole-community intervention. *American Journal of Preventative Medicine, 33*(6), 455-463.

De Cocker, K. A., De Bourdeaudhuij, I. M., Brown, W. J., & Cardon, G. M. (2008). The effect of a pedometer-based physical activity intervention on sitting time. *Preventative Medicine, 47,* 179-181.

De Cocker, K. A., De Bourdeaudhuij, I. M., & Cardon, G. M. (2008). The effect of pedometer use in combination with cognitive and behavioral support materials to promote physical activity. *Patient Education and Counseling, 70*, 209-214.

Diener, L. H., McGee, H. M., & Miguel, C. F. (2009). An integrated approach for conducting a behavioral systems analysis. *Journal of Organizational Behavior Management*, *29*(2), 108-135.

Dolan, B. (2015, May 7). Fitbit files for IPO, sold nearly 11 million fitness devices in 2014. *MobiHealthNews.* Retrieved from http://mobihealthnews.com/43412/fitbit-files-for-ipo-sold-nearly-11-million-fitness-devices-in-2014.

Emeny, R., Lacruz, M., Baumert, J., Zierer, A., von, E. R., Autenrieth, C., & Ladwig, K. (2012). Job strain associated CRP is mediated by leisure time physical activity: Results from the MONICA/KORA study. *Brain, Behavior, and Immunity, 26*(7), 1077-1084.

Ergotron. (2013). Ergotron JustStand survey & index report. *JustStand.org.* Retrieved from http://www.juststand.org/portals/3/literature/SurveyIndexReport.pdf.

Etkin, J. (2016). The Hidden Cost of Personal Quantification. Journal of Consumer Research, ucv095.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations, 7*(2), 117-140.

Fountaine, C. J., Piacentini, M., & Liguori, G. A. (2014). Occupational sitting and physical activity among university employees. *International Journal of Exercise Science, 7*(4), 295-301.

Garcia Villar, J., Oreffice, S., & Quintana-Domeque, C. (2011). Physical activity and obesity in Spain: Evidence from the Spanish National Health Survey. *The Economics of Sport, Health and Happiness: The promotion of Well-being through sporting activities,* 54-80.

Gretzinger, S. (2014). *A Review of Methods and Challenges Involved in Biomanufacturing & Evaluating the Validity of Wrist Worn Pedometers* . (Doctoral Dissertation). Retrieved from https://etd.ohiolink.edu/.

Groppel, J. (2014). Strategic movement in the workplace improves employee performance. *The Institute for HealthCare Consumerism*. Retrieved from: http://www.theihcc.com/en/communities/rewards_and_incentives/strategicmovementintheworkplace%E2%80%A8improvesempl_hgf5lgz1.html.

Gusmer, R. J., Bosch, T. A., Watkins, A. N., Ostrem, J. D., & Dengel, D. R. (2014). Comparison of FitBit® Ultra to ActiGraph™ GT1M for assessment of physical activity in young adults during treadmill walking. *Open Sports Medicine Journal*, *8*, 11-15.

Hall, A. T., Frink, D. D., & Buckley, M. R. (2015). An accountability account: A review and synthesis of the theoretical and empirical research on felt accountability. *Journal of Organizational Behavior.*

Harbin, T. L. (2013). *Workplace health promotion programs: An assessment of factors influencing participation* (Doctoral Dissertation). Available from PsycINFO. (1511553417; 2014-99050-555).

Hedges, L. V., Pustejovsky, J. E., & Shadish, W. R. (2012). A standardized mean difference effect size for single case designs. Research Synthesis Methods, *3*(3), 224-239.

Higgins, J. P., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *Bmj*, *327*(7414), 557-560.

Huitema, B. E. (2011). *The Analysis of Covariance and Alternatives*. Hoboken, NJ: John Wiley & Sons, Inc.

Iwata, B. A., Smith, R. G., & Michael, J. (2000). Current research on the influence of establishing operations on behavior in applied settings. *Journal of Applied Behavior Analysis*, *33*(4), 411-418.

Johnson, D. A., Casella, S. E., McGee, H. M., & Lee, S. C. (2014). The use and validation of pre-intervention diagnostic tools in organizational behavior management. *Journal of Organizational Behavior Management, 34*(2), 104-121.

Kaminski, J. (2011). Diffusion of innovation theory. *Canadian Journal of Nursing Informatics, 6*(2), 1-6.

Kratochwill, T. R., Hitchcock, J. H., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2013). Single-case intervention research design standards. *Remedial and Special Education*, *34*(1), 26-38.

Kurti, A. N., & Dallery, J. (2013). Internet-based contingency management increases walking in sedentary adults. *Journal of Behavior Analysis*. *46*(3), 568-581.

Landsbergis, P. A., Schnall, P. L., & Dobson, M. (2009). The workplace and cardiovascular disease. *Unhealthy work: Causes, consequences, cures.* (pp. 89-111) Baywood Publishing Co, Amityville, NY.

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis*. *36*(3), 407-414.

Loprinzi, P. D. (2016). Implications of light-intensity physical activity in improving health-related quality of life among congestive heart failure patients. *International Journal of Cardiology, 212*, 16.

Loprinzi, P. D. (2015). Effects of light-intensity physical activity on red blood cell distribution width: Implications for a novel mechanism through which light-intensity physical activity may influence cardiovascular disease. *International Journal of Cardiology, 203*, 724.

Loprinzi, P. D., Lee, H., & Cardinal, B. J. (2015). Evidence to support including lifestyle light-intensity recommendations in physical activity guidelines for older adults. *American Journal of Health Promotion, 29*(5), 277-284.

Loprinzi, P. D. (2013). Objectively measured light and moderate-to-vigorous physical activity is associated with lower depression levels among older US adults. *Aging & Mental Health, 17*(7), 801-805.

Ludwig, L. & McGee, H. (2014). About us. *Performance Blueprints, Inc*. Retrieved from http://performanceblueprints.com/epages/c4d620cf-87c0-49e5-82bd-af509c52f123.sf/en_US/?ObjectPath=/Shops/c4d620cf-87c0-49e5-82bd-af509c52f123/Categories/AboutUs.

Lyons, E. J., Lewis, Z. H., Mayrsohn, B. G., & Rowland, J. L. (2014). Behavior change techniques implemented in electronic lifestyle activity monitors: A systematic content analysis. *Journal of Medical Internet Research. 16*(8).

Martin, G., & Pear, J. (2015). *Behavior modification: What it is and how to do it*. Tenth Edition. Pearson Education/Allyn & Bacon.

McGee, H. M., & Johnson, D. A. (2015). Performance Motivation as the Behaviorist Views It. *Performance Improvement, 54*(4), 15-21.

Merom, D., Rissel, C., Phongsavan, P., Smith, B. J., Van Kemenade, C., Brown, W. J., & Bauman, A. E. (2007) Promoting walking with pedometers in the community: The step-by-step trial. *American Journal of Preventative Medicine. 32*(4), 290-297.

Michael, J. (2000). Implications and refinements of the establishing operation concept. *Journal of Applied Behavior Analysis*. *33*(4), 401-410.

Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2015). Effective techniques in healthy eating and physical activity interventions: A meta-regression. *Health Psychology, 28*(6), 690-701.

Mummery, W. K., Schofield, G., Hinchliffe, A., Joyner, K., & Brown, W. (2006). Dissemination of a community-based physical activity project: The case of 10,000 steps. *Journal of Science and Medicine in Sport, 9*(5). 424-430.

National Business Group on Health. (2010). *Staying@Work Report: The Health and Productivity Advantage* [White paper]. Retrieved from http://www.10000stepsusa.com/getfile/PDFs%20Public/The%20Health%20and%20Productivity%20Advantage%20-%20Staying@Work%20Study.pdf.

Office of Disease Prevention and Health Promotion. (2008). Physical activity guidelines for Americans. *Health.gov.* Retrieved from http://health.gov/paguidelines/guidelines/.

Owen, N., Healy, G. N., Matthews, C. E., & Dunstan, D. W. (2010). Too much sitting: The population-health science of sedentary behavior. *Exercise and Sport Sciences Reviews*, *38*(3), 105.

Pai, A. (2015, April 9). Fitbit changes the way it tracks active minutes. *Mobihealthnews.* Retrieved from http://mobihealthnews.com/42241/fitbit-extends-minimum-time-frame- for-active-minutes/.

Plante, T. G., Madden, M., Mann, S., Lee, G., Hardesty, A., Gable, N., Terry, A., & Kaplow, G. (2010). Effects of perceived fitness level of exercise partner on intensity of exertion. *Journal of Social Sciences*, *6*(1), 50-54.

Rettner, R. (2014, March 7). The truth about 10,000 steps a day. *Live Science.* Retrieved from http://www.livescience.com/43956-walking-10000-steps-healthy.html.

Rummler, G. A., & Brache, A. P. (2013). *Improving performance: How to manage the white space on the organization chart (3rd ed.)*. San Francisco: Jossey-Bass.

Saad, L. (2014, August 29). The “40-hour” workweek is actually longer – by seven hours. *Economy*. Retrieved from http //www.gallup.com/poll/175286/hour-workweek-actually-longer-seven-hours.aspx.

Schröer, S., Haupt, J., & Pieper, C. (2014). Evidence-based lifestyle interventions in the workplace—An overview. *Occupational Medicine, 64*(1), 8-12.

Shadish, W. R., Hedges, L. V., Pustejovsky, J. E., Boyajian, J. G., Sullivan, K. J., Andrade, A., & Barrientos, J. L. (2014). A d-statistic for single-case designs that is equivalent to the usual between-groups d-statistic. Neuropsychological rehabilitation, *24*(3-4), 528-553.

Skinner, B. F. (1969). *Contingencies of Reinforcement.* East Norwalk, CT: Appleton-Century-Crofts.

Slowiak, J. M., Fountaine, C., & Hessler, E. (2014). Effects of physical positioning and movement on work performance and productivity (Report of Research Activities for the UMD Strategic Plan Goal 4: Small Seed Research Grant). Duluth, MN.

Slowiak, J. M., Huitema, B. E., & Dickinson, A. M. (2008). Reducing wait time in a hospital pharmacy to promote customer service. *Quality Management in Healthcare, 17*(2), 112-127.

Spink, K. S. & Carron, A. V. (1993). The effects of team building on the adherence patterns of female exercise participants. *Journal of Sport and Exercise Psychology, 15*, 39-49

Stewart, C. (2013). *A case study of the development, implementation, and evaluation of a university employee wellness program.* (Order No. AAI3528447). Available from PsycINFO. (1417862299; 2013-99130-138). Retrieved from http://search.proquest.com.libpdb.d.umn.edu:2048/docview/1417862299?accountid=8111.

Suls, J., & Wheeler, L. (2012). Social comparison theory. *Handbook of theories of social psychology (vol 1).*(pp. 460-482) Sage Publications Ltd, Thousand Oaks, CA.

Takacs, J., Pollock, C. L., Guenther, J. R., Bahar, M., Napier, C., & Hunt, M. A. (2013). Validation of the Fitbit One activity monitor device during treadmill walking. *Journal of Science and Medicine in Sport*, *17*(5). 496-500.

Tudor-Locke, C., Craig, C. L., Brown, W. J., Clemes, S. A., De Cocker, K., Giles-Corti, B., Hatano, Y., Inoue, S., Matsudo, S. M., Mutrie, N., Oppert, J-M., Rowe, D. A., Schmidt, M. D., Schofield, G. M., Spence, J. C., Teixeira, P. J., Tully, M. A., & Blair, S. M. (2011). How many steps/day are enough? For adults. *International Journal of Behavioral Nutrition and Physical Activity, 8*(79).

U.S. Bureau of Labor Statistics. (2014). *American time use survey*. Retrieved from: http://www.bls.gov/tus/charts/.

UMD Employee Wellness Program. (2015). Department of Human Resources & Equal Opportunity: UMD Employee Wellness Program. Retrieved from http://www.d.umn.edu/umdhr/wellness/.

UMD Group Health Coaching Program. (2015). Department of Human Resources & Equal Opportunity: UMD Group Health Coaching Program. Retrieved from http://www.d.umn.edu/umdhr/wellness/groupcoaching/index.html.

Washington, W. D., Banna, K. M., & Gibson, A. L. (2014). Preliminary efficacy of prize-based contingency management to increase activity levels in healthy adults. *Journal of Applied Behavior Analysis, 47*(2), 231-245.

Weather Underground. (2016). Weather history for Duluth, MN. Retrieved from https://www.wunderground.com/history/airport/KDLH/2014/1/1/DailyHistory.html.

Wing, R. R. & Jeffery, R. W. (1999). Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. *Journal of counseling and Clinical Psychology, 67*(1), 132-138.

Yu, C (2015). *Social Interface and Interaction Design for Group Recommender Systems* (Doctoral dissertation, École Polytechnique Fédérale De Lausanne).

Appendices

Appendix A

Participant Recruitment Email

UMD
Employee Health & Wellness Center
UNIVERSITY OF MINNESOTA DULUTH

Did you know that according to the CDC, engaging in a minimum of 150 minutes of exercise per week can benefit you with improved energy and mood, and reduced risk of cardiac risk factor, job stress, obesity, diabetes, certain cancers, arteriosclerosis, apnea, cardiovascular disease, hypertension, and stroke? This can be achieved as simply as taking a brisk walk every day!

Are you interested in enhancing your wellbeing in a supportive group environment? Then Group Health Coaching may be for you!

Group Health Coaching is FREE to UMD Faculty and Staff. Earn up to 200 Wellness Points and a $20 Gift Card!!

A SPECIAL session will be conducted starting 10/5 Monday's 2:30-3:15pm or Wednesday's 12:00-12:45 pm. These meetings are structured to help those interested in increasing the amount of steps they take on a daily basis. This session is part of a research project conducted through the Psychology Department's Master's Program. Participants will have the opportunity to try out a Fitbit Flex to track their exercise over the 10-week program!!!

If you are interested please visit z.umn.edu/groupcoaching for more details and to sign up. Space is LIMITED to 15 spots so sign up soon!!

Appendix B

Physical Activity Readiness Questionnaire (PAR-Q)

Physical Activity Readiness Questionnaire

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 done 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?

If you answered yes to one or more of these questions, see your doctor before you start becoming much more physically active or before you have a fitness appraisal.

Appendix C

Informed Consent

CONSENT FORM
University of Minnesota Duluth
Department of Psychology

Step It Up! with UMD Group Health Coaching
Principal Investigator: Matthew C. Daly, B.A.S.
Faculty Advisor: Julie M. Slowiak, Ph.D.

Background Information. I have been invited to participate in a research study designed to help track and provide information related to the effectiveness of the UMD Group Health Coaching Program. I have been selected as a possible participant because I am an employee of the University of Minnesota Duluth and am currently enrolled in UPlan sponsored by the University of Minnesota. I have been asked to read this form and ask any questions I may have before agreeing to participate in the study.

Eligibility Requirements. In order to be eligible to participate in this study, I must able to attend 10 weekly 45-minute group health coaching sessions along with a 20-30-minute Introductory/Screening session as well as a 20-30-minute Debriefing session after the Group Health Coaching Program ends. I must be an employee of University of Minnesota Duluth and at least 18 years of age enrolled in the UPlan health insurance program. Answers that I fill out on the Physical Activity and Readiness Questionnaire will determine if I am able to engage in low- to moderate-intensity walking activity (e.g., hiking, climbing stairs, brisk walking, etc.). My ability to engage in these activities will determine if I will pass the screening assessment.

Study Procedures and Length of Participation. If I agree to be in this study, I will be asked to participate in a 10-week UMD Group Health Coaching Program led by the UMD Health Coach and offered specifically to individuals who would like to increase their level of physical activity through walking (stepping) and other walking-related activities. The typical format of a 45-minute weekly group coaching session consists of group sharing and support, optional weigh-ins, goal setting, feedback, reflection, and educational activities for effective health management. During the 10-week program, I will be asked wear a Fitbit Flex activity monitor to measure my physical activity.

At the conclusion of the 10-week health coaching program, I will be asked to attend a 20-30 minute Debriefing session with the researcher. I will be asked to fill out a questionnaire to provide feedback about my experience during the study. I will also be required to return the Fitbit Flex tracker, wristband, wireless sync dongle, and charging cable.

Compensation. I will have the opportunity to receive up to two forms of compensation for my participation in this study: (1) Wellness Points: I can earn up to 250 points in the UMD Wellness Points Program if I meet the participation requirements set by the UMD Wellness Program. Gift Card: I will receive a $20 gift card upon completion of the study and return of the Fitbit Flex and all its components.

Risks and Benefits of Participation. Risks: The study has a risk that is considered minimal. I may experience some physical discomfort, minor fatigue, or mild stress when I am engaging in physical activity. This will be offset because the intensity of exercise is self-regulated, and I will be able to take breaks from engaging in physical activity or group activities whenever I want. I am not required to engage in a specific type of physical activity for any specified amount of time while participating in this study.

Benefits: Direct benefits of my participation in this study include potential health benefits associated with increased physical activity (e.g., reduced risk of heart disease, reduced blood pressure, potential weight loss, etc.). Also, data from my participation may benefit the general scientific community by providing information on factors that increase the effectiveness of group health coaching programs. I may also learn about this research through my participation in this study. This study will add to my general understanding of factors that influence the promotion of healthy behavior in individuals. The findings from studies such as this can be applied to other University programs and workplace settings.

Equipment. The Fitbit Flex activity monitor and its components are the property of Julie M. Slowiak, Ph.D., Associate Professor, in the UMD Department of Psychology. I understand that I must return all equipment to the researcher at the end of my participation in the study. I am responsible in caring for and ensuring the Fitbit Flex and its components are not damaged, lost, tampered, or stolen. If I encounter any problems with the Fitbit Flex or any of its components, I must immediately contact the principle investigator.

Confidentiality. All information obtained in this study will remain strictly confidential. When results of the study are presented publicly, I will not be identified. I will be assigned a number, and that number will be used to identify my data. Research records will be stored securely and only researchers will have access to the records.

Voluntary Participation. My participation in this study is completely voluntary. I may withdraw at any time without penalty. My participation in the study, or my withdrawal from the study, will not affect my current or future relations with the University of Minnesota. If I decide to participate, I am free to not answer any question or withdraw at any time without affecting that relationship. At the end of the study, the experimenter will answer any questions I have and explain how my data will help to learn more about the influence of Step It Up! with UMD Group Health Coaching.

Contacts and Questions. If I have any questions about this study, I should ask them now.

If I have questions later, **I am encouraged** to contact the Principle Investigator, Matthew C. Daly, 320 Bohannon Hall, Duluth, MN 55812, (218) 355-8657, dalyx115@d.umn.edu or Faculty Advisor: Julie M. Slowiak, Ph.D., 320 Bohannon Hall, Duluth, MN 55812, (218) 726-7116, jslowiak@d.umn.edu. If I have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **I am encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650.

Statement of Consent. I have read the above information. I have had the opportunity to ask questions and have received answers to the questions I have asked. My signature below indicates that I agree to participate in this study.

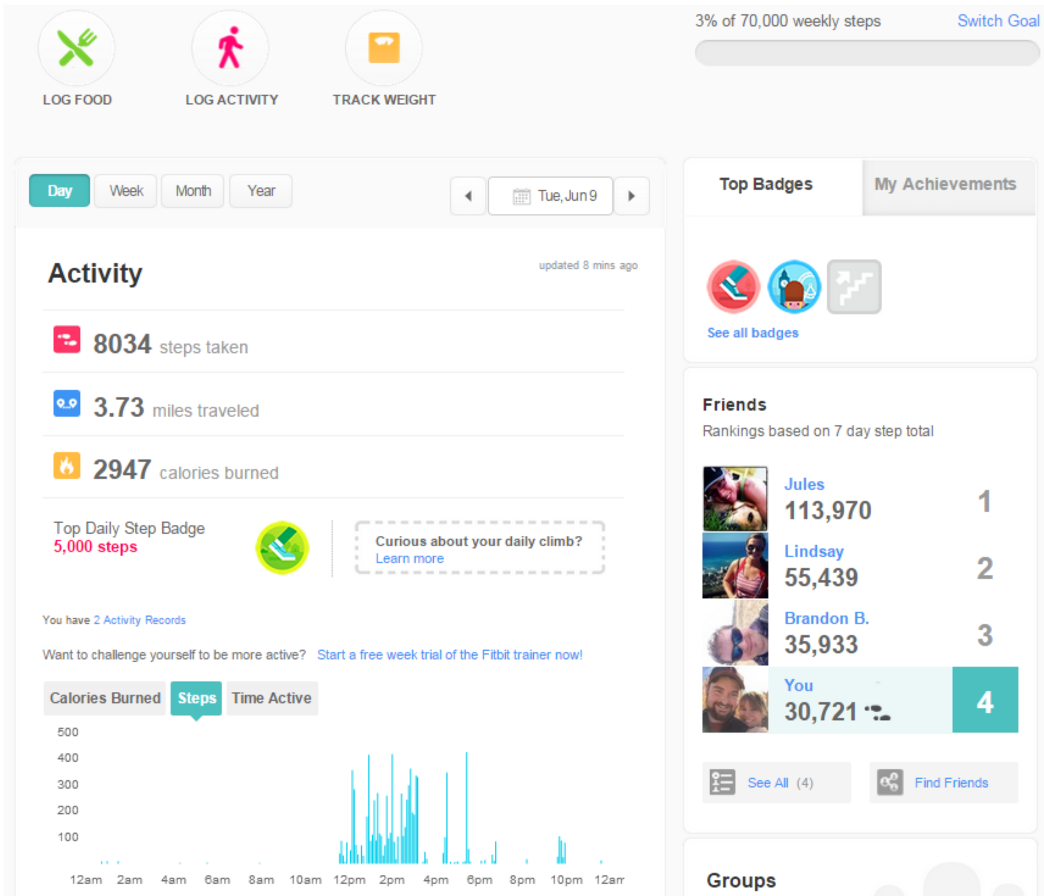
Participant Signature:___________________________ Date:___________

Investigator Signature:___________________________Date:___________

Please keep the attached copy of this form for your records.

Appendix D

Fitbit Website Interface



Appendix E

Fitbit Mobile Application Interface

Appendix F

Step It Up! With UMD Group Health Coaching
Post-Study Questionnaire

Please answer the following questions to the best of your knowledge based on your experience while participating in the UMD Group Health Coaching Program associated with this study. For questions with a number scale or multiple-choice format, please circle the number/letter that corresponds with your answer.

1. During the course of the study did you use/access (Circle one):

    a. The Fitbit website
    b. The Fitbit mobile application
    c. Both
    d. Neither

2. The information (e.g., numerical statistics, visual graphics) provided by the Fitbit website and/or mobile application gave useful feedback regarding my physical activity, as steps taken, and weight.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

3. The numerical feedback regarding my steps/weight provided by the Fitbit website/mobile application prompted me to engage in physical activity.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

4. The graphical feedback regarding my steps/weight provided by the Fitbit website/mobile application prompted me to engage in physical activity.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

5. The feedback showing my step/weight change progress compared to my goals provided by the Fitbit website/mobile application prompted me to engage in physical activity.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

6. The feedback showing my step progress compared to my goals provided by LED lights on the Fitbit Flex wristband prompted me to engage in physical activity.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

7. If you used the Fitbit website/mobile application, how many times, on average, did you access the Fitbit website/mobile application to check your data each day? (Circle one):

   a. 0 (I never used the Fitbit website or mobile application)
   b. 1 – 2 times per day
   c. 3 – 4 times per day
   d. 5 – 6 times per day
   e. 7 – 8 times per day
   f. 9 – 10 times per day
   g. more than 10 times per day

8. Over the course of the study, did you use any other devices or applications meant to measure and/or monitor physical activity and the number of steps taken (e.g., smartphone application, another Fitbit device, another activity monitoring device, such as the Jawbone)? Please write the name of the product(s) and/or application(s) below.

   ____

   ____

9. If you used any other devices or applications to measure and/or monitor exercise, when did you use it? (Circle one)

   a. The entire course of the study
   b. I did not use a device outside of the provided Fitbit Flex
   c. I used a device during part of the study: (please indicate dates below)

   ____

10. During the course of the study, which social challenges did you participate in? (Circle all that apply)

    a. Daily Showdown
    b. Goal Day
    c. Weekend Warrior
    d. Workweek Hustle
    e. I did not participate in a challenge

11. My participation in the Fitbit social challenges (Circle One):

    a. Encouraged me to increase my stepping behavior
    b. Discouraged me from increasing my stepping behavior
    c. Did not affect my typical stepping behavior
    d. I did not participate in a challenge

12. Overall, my experience using the Fitbit Flex and its measurement system was a positive one.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

13. The weekly activities led by the group health coach provided me with useful information that helped me increase my physical activity.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

14. The weekly group check-ins provided me with useful information regarding my progress towards my goals.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

15. The sharing of struggles and successes among group members during weekly coaching sessions provided me with useful information to help me reach my goals.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

16. Overall, the UMD Group Health Coaching Program motivated me to reach my goals.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

17. Overall, I would recommend the UMD Group Health Coaching Program to a co-worker.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

18. Were there any unusual events you participated in (e.g., outdoor vacation, started a new exercise routine, sickness, physical injury, etc.) during the UMD Group Health Coaching Program that abnormally influenced the number of steps you completed? If so, please describe the activity and provide approximate dates.

____

____

____

____

Please rate your level of frustration while wearing the Fitbit Flex monitoring *before* you were given access to your exercise data. (Circle one);

1	2	3	4	5
Not Frustrated at all	*Frustrated a Little*	*Mildly Frustrated*	*Very Frustrated*	*Extremely Frustrated*

19. Please rate your level of frustration while wearing the Fitbit Flex monitoring *after* you were given access to your exercise data. (Circle one);

1	2	3	4	5
Not Frustrated at all	*Frustrated a Little*	*Mildly Frustrated*	*Very Frustrated*	*Extremely Frustrated*

Please fill out the following information as it pertains to you:

Age:_______

Ethnicity: Are you Hispanic or Latino? (Circle one)

a. No, not Hispanic or Latino
b. Yes, Hispanic or Latino

What is your race? (Regardless of how you answered the previous item circle one or more)

a. American Indian or Alaska Native
b. Asian
c. Black or African American
d. Native Hawaiian or Other Pacific Islander
e. White

Sex or Gender (Circle one):

a. Male
b. Female
c. Other (*please specify*):________________________________
d. Prefer not to specify

Highest Education Completed (Circle one):

a. Some High School
b. High School or GED Equivalent
c. Some College
d. Associate's Degree
e. Bachelor's Degree
f. Master's Degree
g. Ph.D.

What is Your Marital Status? (Circle one)

a. Never Been Married
b. Married
c. Not Married, Living with Significant Other
d. Divorced/Separated
e. Widowed

How Many Children Live in Your Household? __________________

What are the ages of all children living in the household? __________________

Do you have any pets in your household? (Circle one)

a. Yes
b. No

If yes, what kind and how often do you walk your pet?

____

If a pet has joined your household during the course of the study, what date(s) did they join?

____

Occupation:

____

Appendix G

Post-Study Questionnaire: UMD Health & Wellness Lifestyle Coach

Post-Study Questionnaire

Please answer the following questions to the best of your knowledge on your experience with the Behavioral Systems Analysis approach, process, and recommendations. For questions with a number scale or multiple choice format, please circle the number/letter that corresponds with your answer.

1. The Organizational Systems Map will be useful in making decisions regarding how performance is managed within the UMD Health and Wellness Center.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

2. The Organizational Relationship Map will be useful in making decisions regarding how performance is managed within the UMD Health and Wellness Center.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

3. The Macro-Level Process Map will be useful in making decisions regarding how performance is managed within the UMD Health and Wellness Center.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

4. The Detailed Process Map will be useful in making decisions regarding how performance is managed within the UMD Health and Wellness Center.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

5. The recommendations provided by the researcher regarding the UMD Group Health Coaching Program, based on the use of the BSA approach, were relevant and appropriate.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

6. The recommendations provided by the researcher will be used to improve program management of the UMD Group Health Coaching Program.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

7. The researcher was courteous and professional during all interactions and meetings.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

8. The amount of time and effort required to provide information on the UMD Wellness Center and the UMD Group Health Coaching Program was worthwhile.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

9. The Behavioral Systems Analysis conducted for the UMD Group Health Coaching Program was an overall positive experience.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

10. I would recommend the use of a Behavioral Systems Analysis approach to another organization or program within an organization.

1	2	3	4	5	6
Very Strongly Disagree	*Strongly Disagree*	*Disagree*	*Agree*	*Strongly Agree*	*Very Strongly Agree*

11. Other Comments:

____

____

____

____

Appendix H

Debriefing Script

The researcher will read the script below to Participants after they have completed the Post-Study Participant Questionnaire:

"Thank you for participating in this study. I would like to explain the purpose of the study to you.

The purpose of this study was to promote an increase in physical activity through walking (stepping behavior). This study was targeted at individuals participating in the UMD Group Health Coaching Program. According to the Centers for Disease Control and Prevention website , the suggested activity standard for adults is 150 minutes per week, which can be broken down into increments as little as 10 minutes. This recommendation can be translated into reaching the goal of 10,000 steps per day.

To evaluate the effectiveness of the UMD Group Health Coaching Program, Fitbit Flex activity monitors and the Fitbit Aria digital scale were used to track the healthy behavior of stepping and weight of participants. Participation in Fitbit social challenges were also measured.

The usefulness of the Fitbit activity monitory as both an objective measurement system and an interface consisting of successful behavior change components (e.g., goal setting, immediate feedback) has been empirically evaluated. In this study, the researcher purposefully provided participants with access to certain components of the Fitbit measurement system such as the Fitbit website, mobile application, and promotion of Fitbit social challenges at specific intervals during the UMD Group Health Coaching Program. This was done in order to evaluate how effective these specific components are in the promotion the healthy behavior of stepping.

As researchers, we are interested in the potential positive impact of behavioral interventions and their relationship in promoting healthy behavior, which may benefit future interventions and the programs that utilize them.

Do you have any questions about this study or your participation?"

Appendix I

Individual Daily Average Steps Figures

Note: bold horizontal lines represent average phase step levels

Figure 7. P701 Daily Average Steps

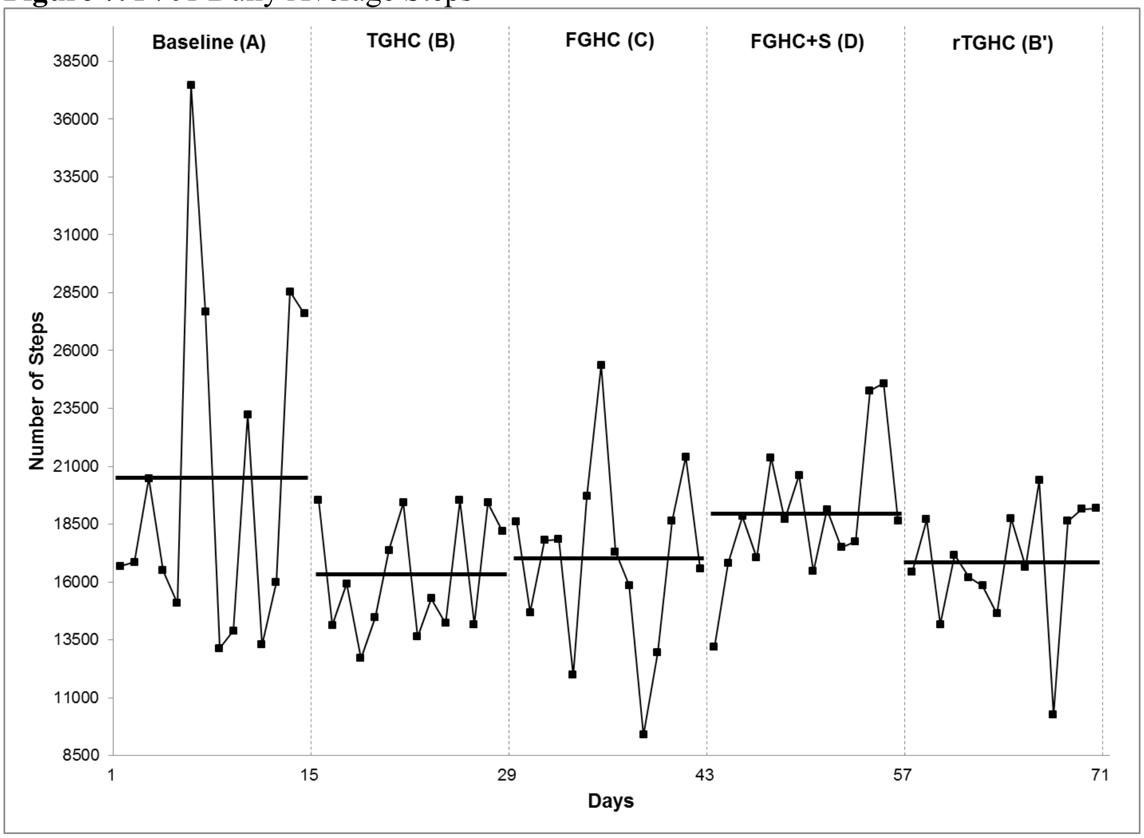


Figure 8. P702 Daily Average Steps

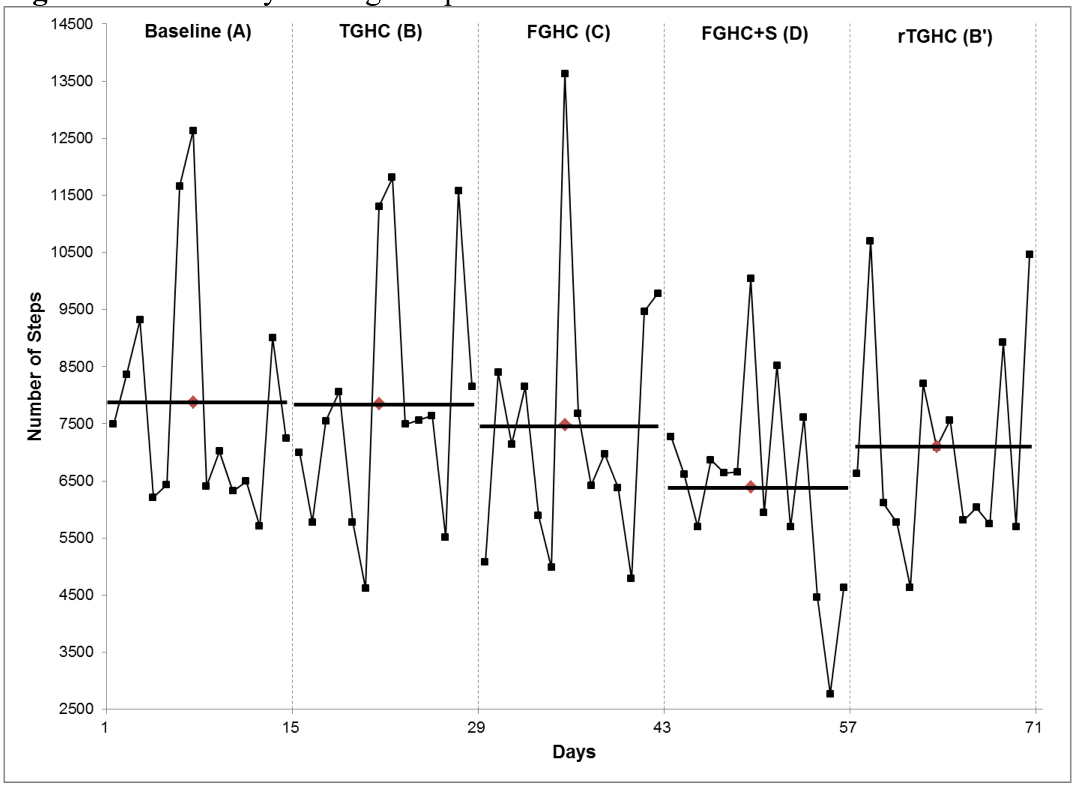


Figure 9. P703 Daily Average Steps

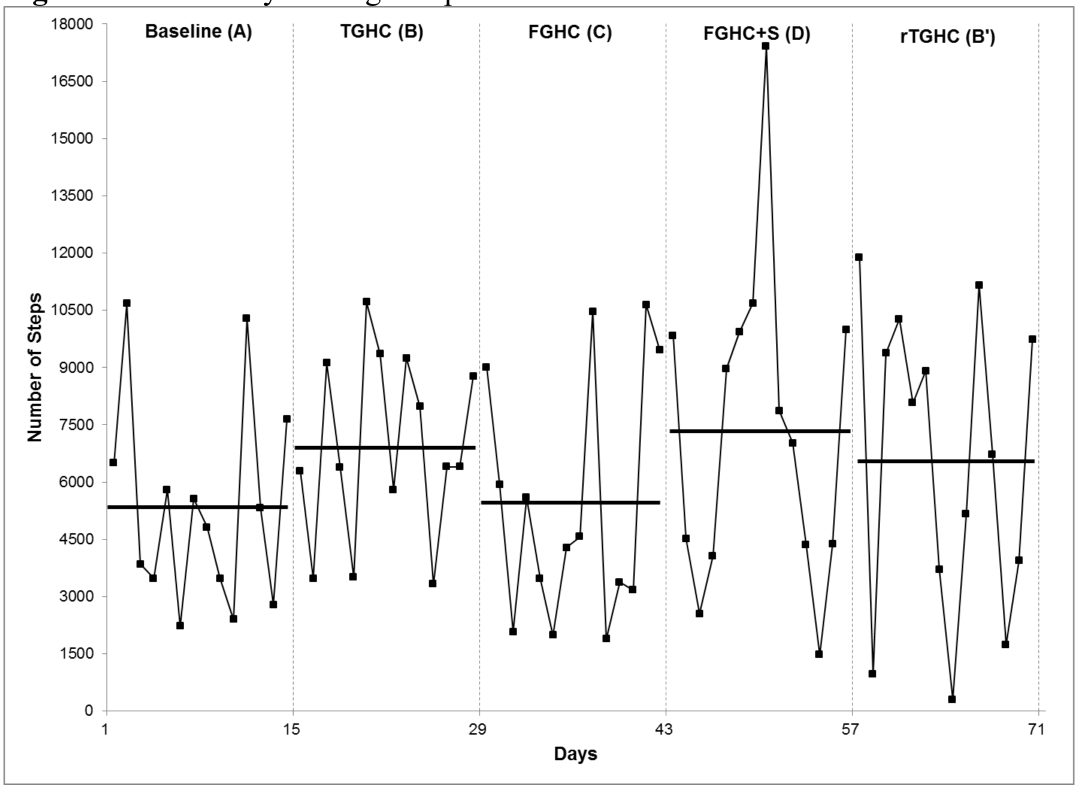


Figure 10. P705 Daily Average Steps

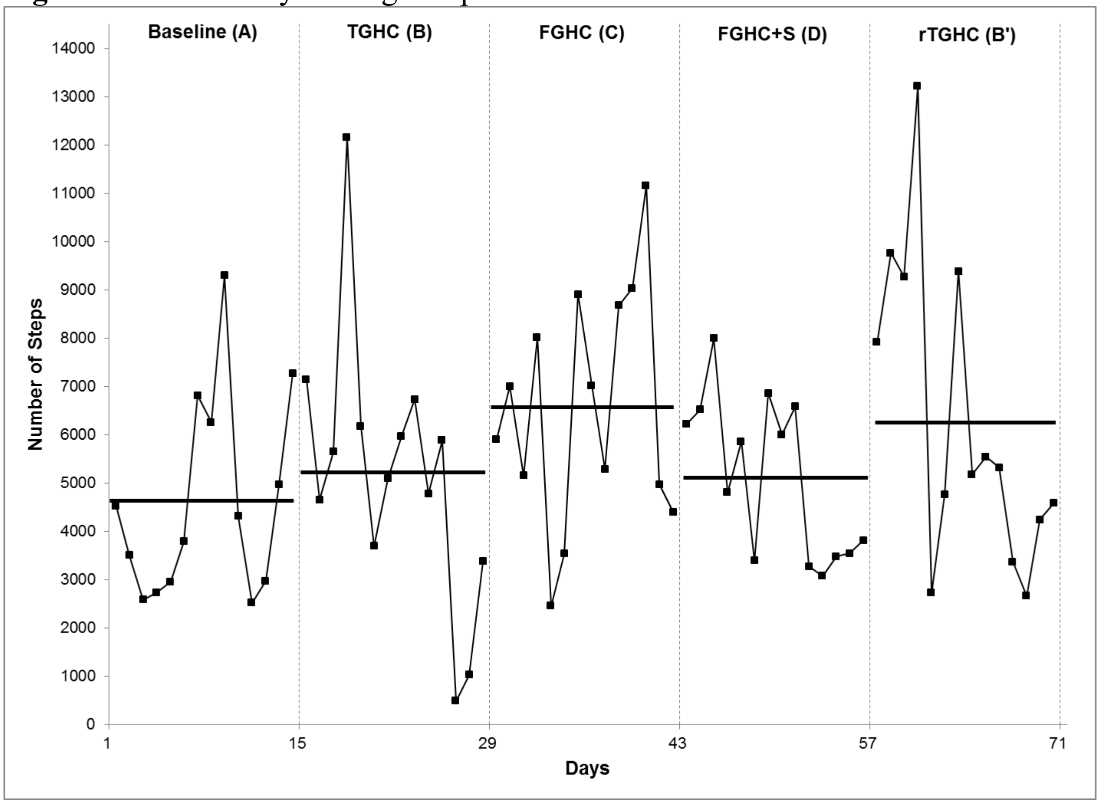


Figure 11. P707 Daily Average Steps

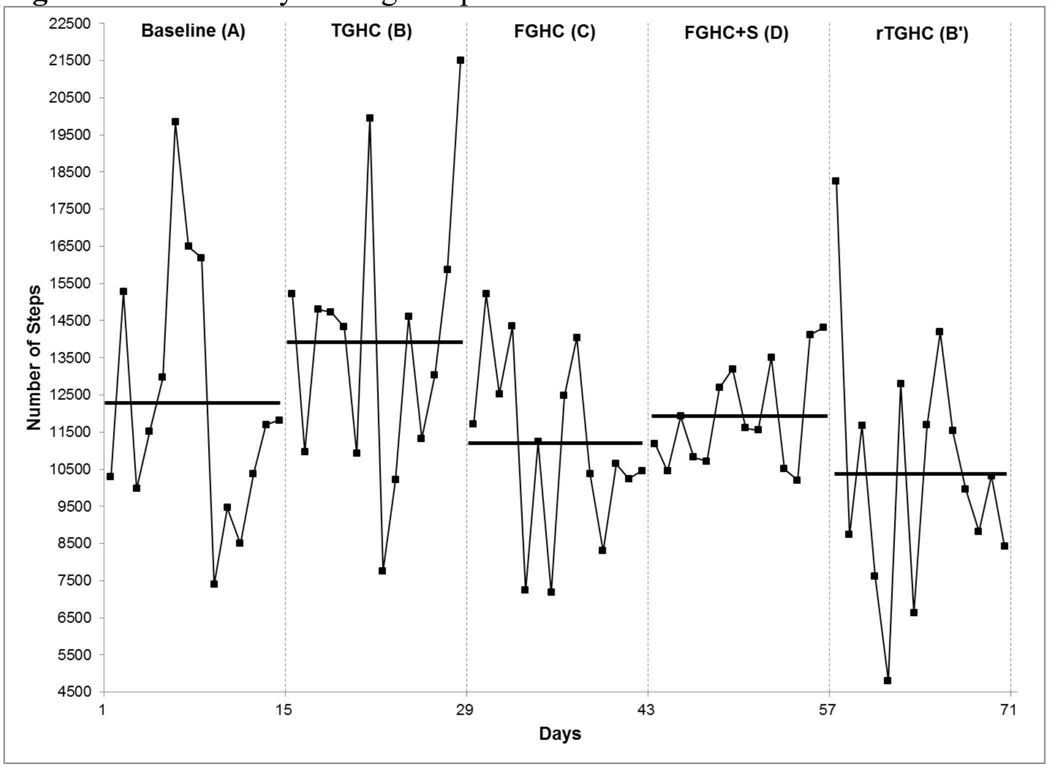


Figure 12. P708 Daily Average Steps

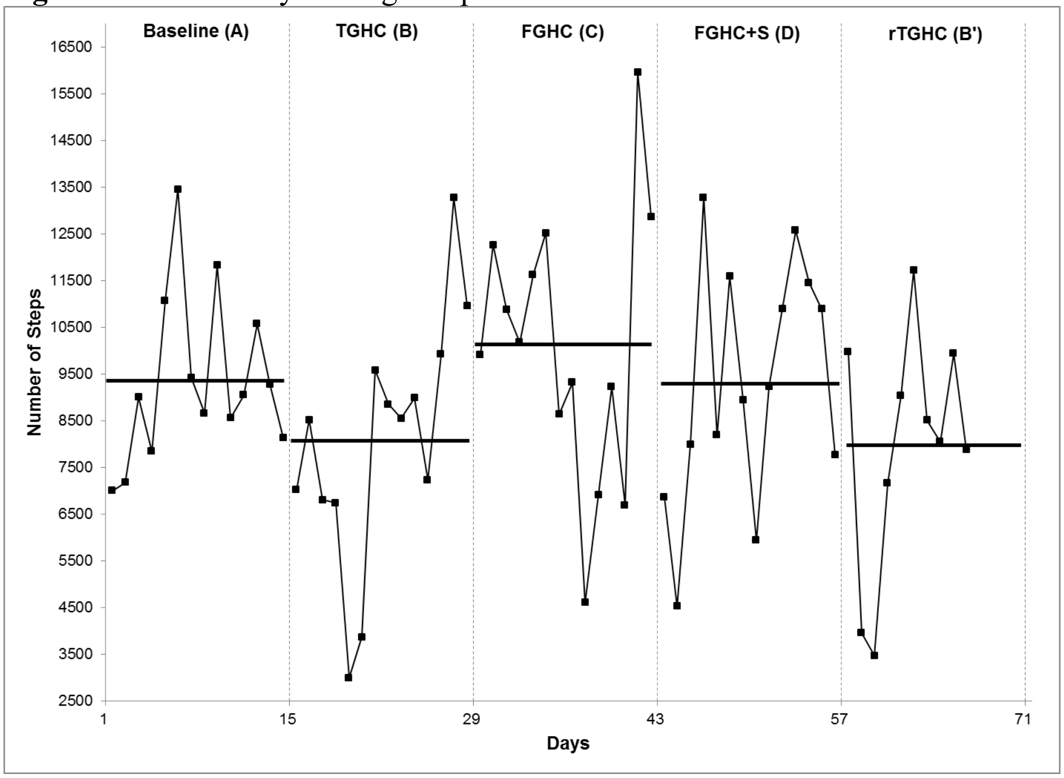


Figure 13. P709 Daily Average Steps

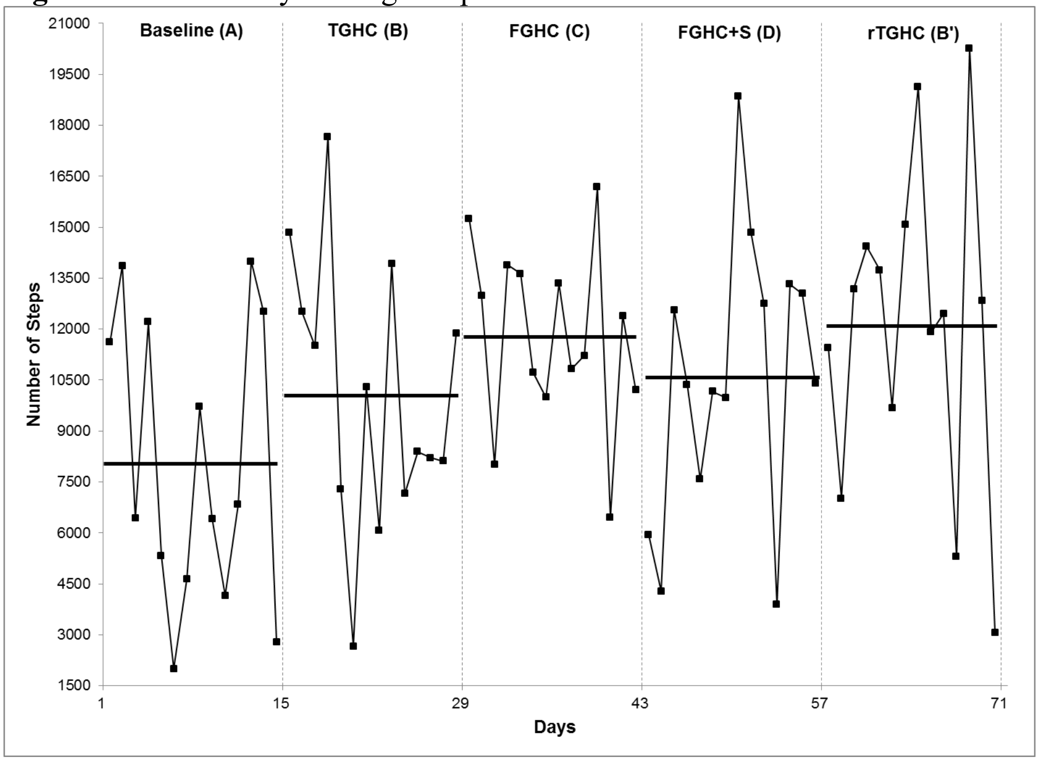


Figure 14. P710 Daily Average Steps

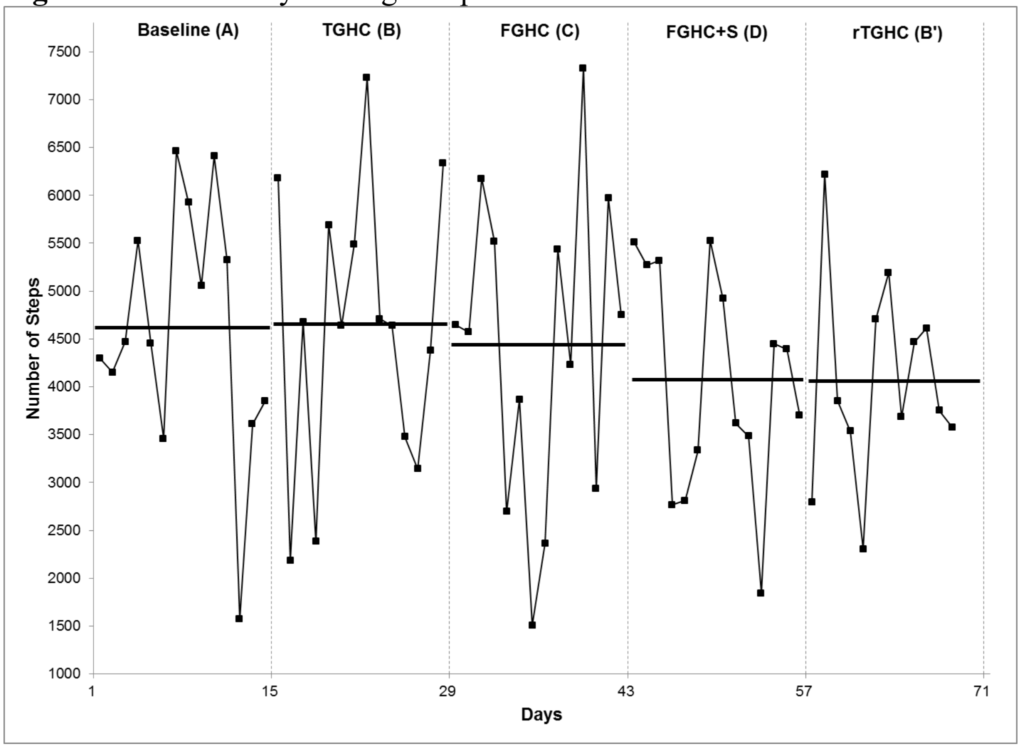


Figure 15. P711 Daily Average Steps

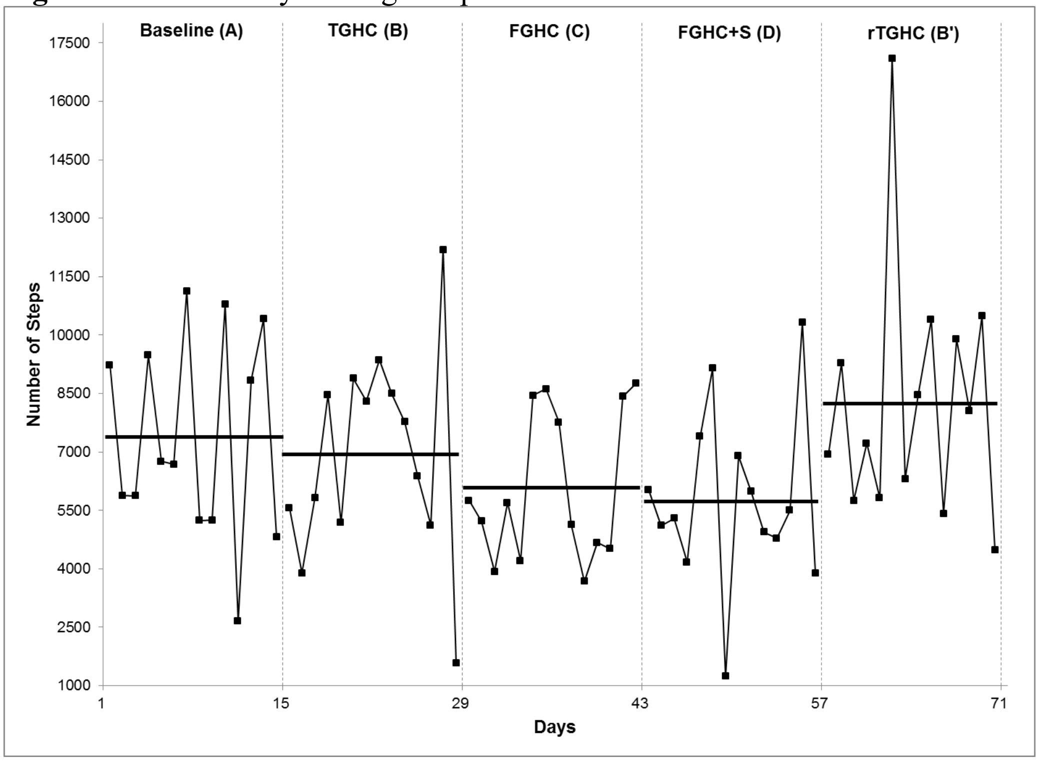


Figure 16. P712 Daily Average Steps

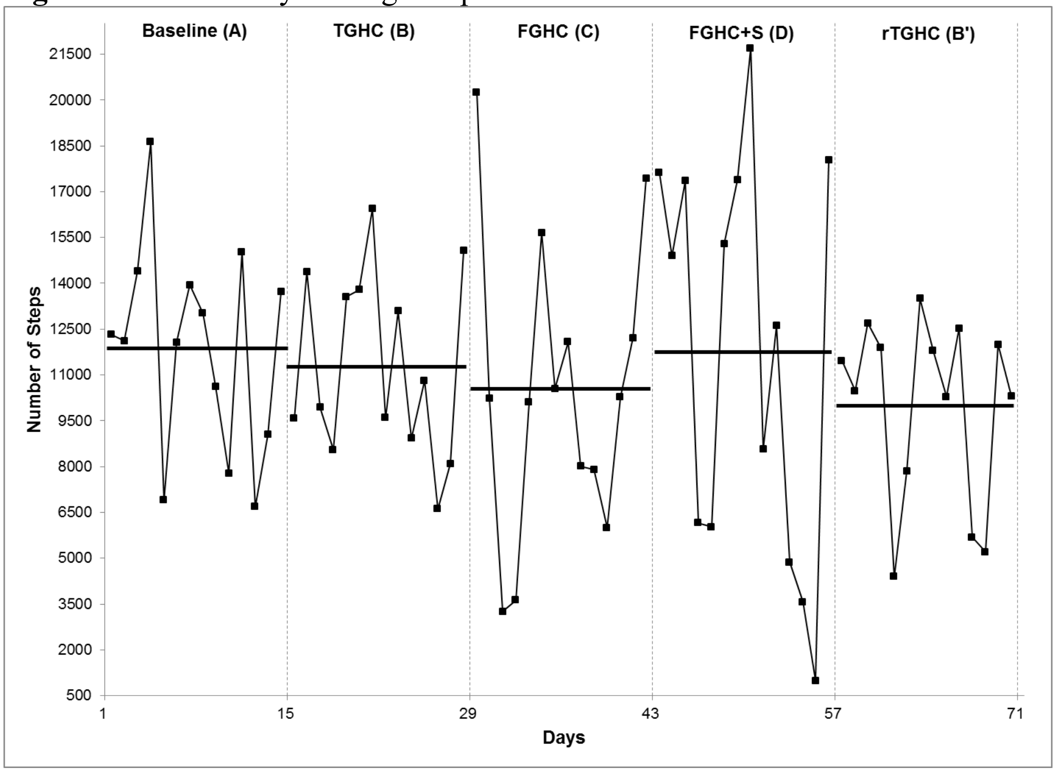


Figure 17. P713 Daily Average Steps

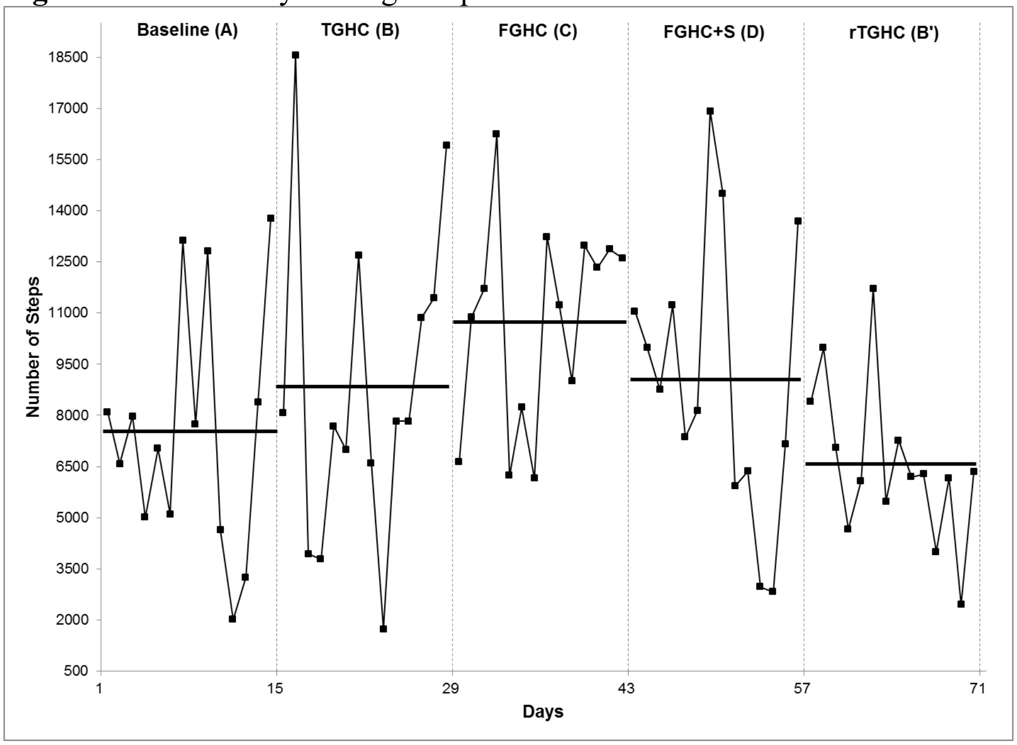
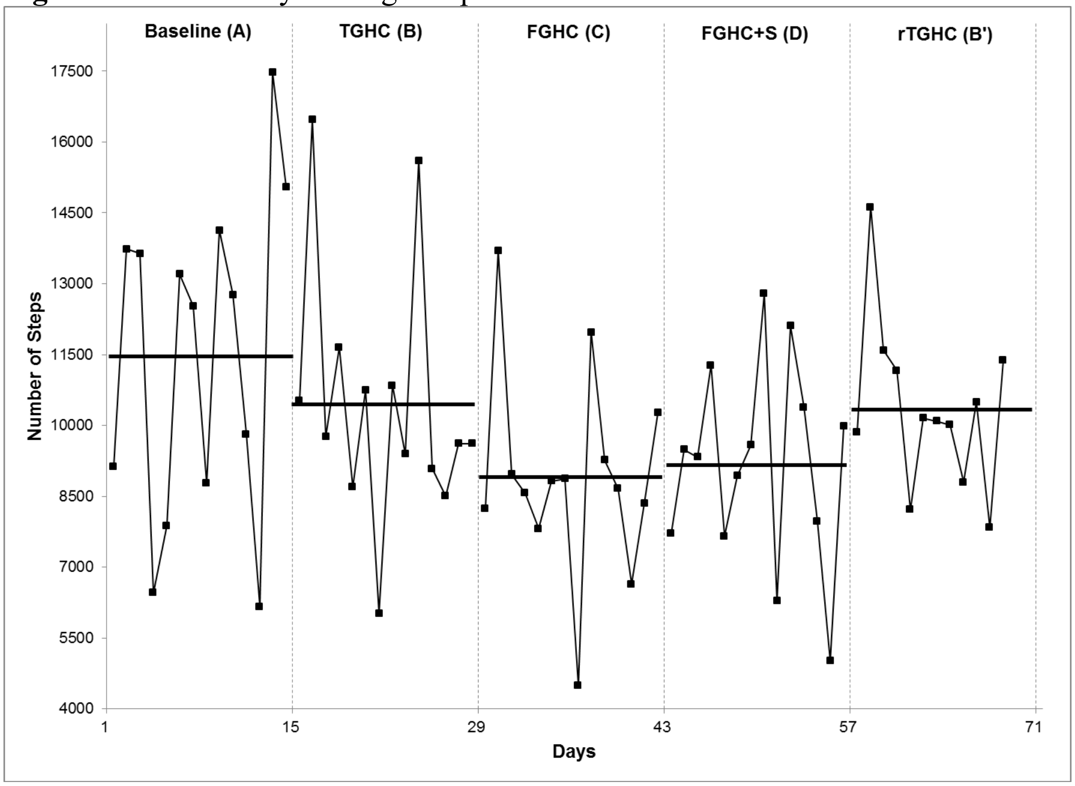


Figure 18. P714 Daily Average Steps



Appendix J

Individual Daily Average Activity Minutes

Note: bold horizontal lines represent average activity minute levels

Figure 19. P702 Daily Average Activity Minutes

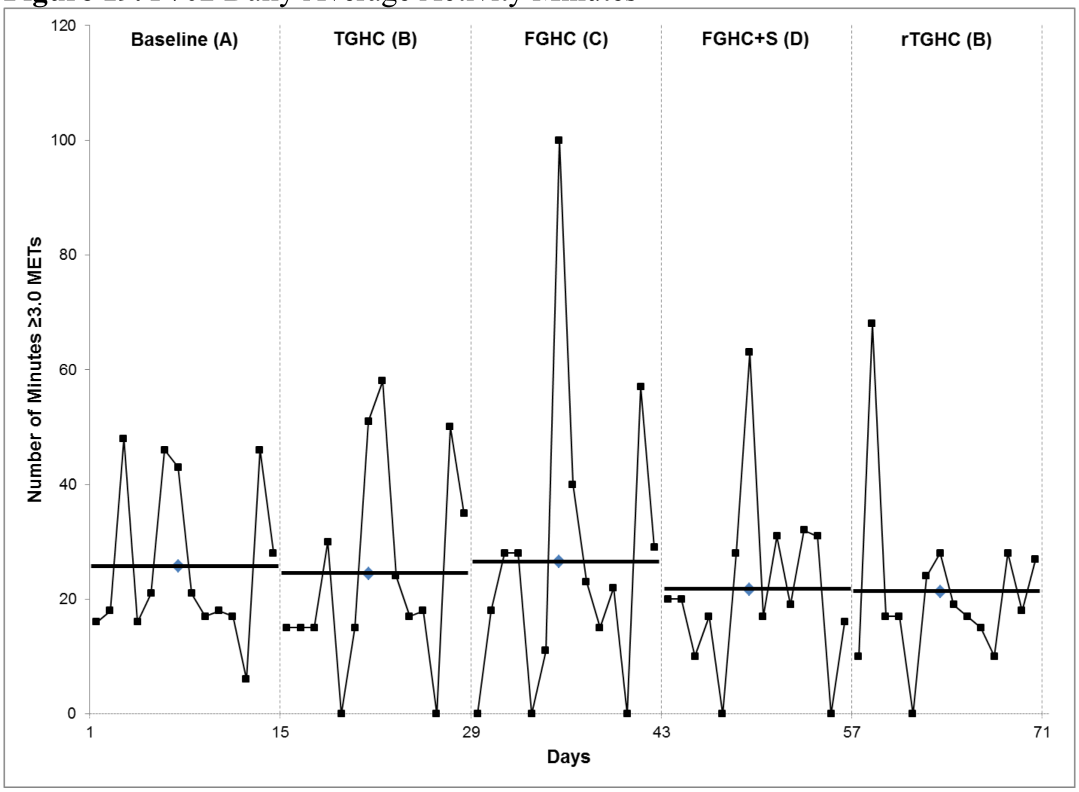


Figure 20 P705 Daily Average Activity Minutes

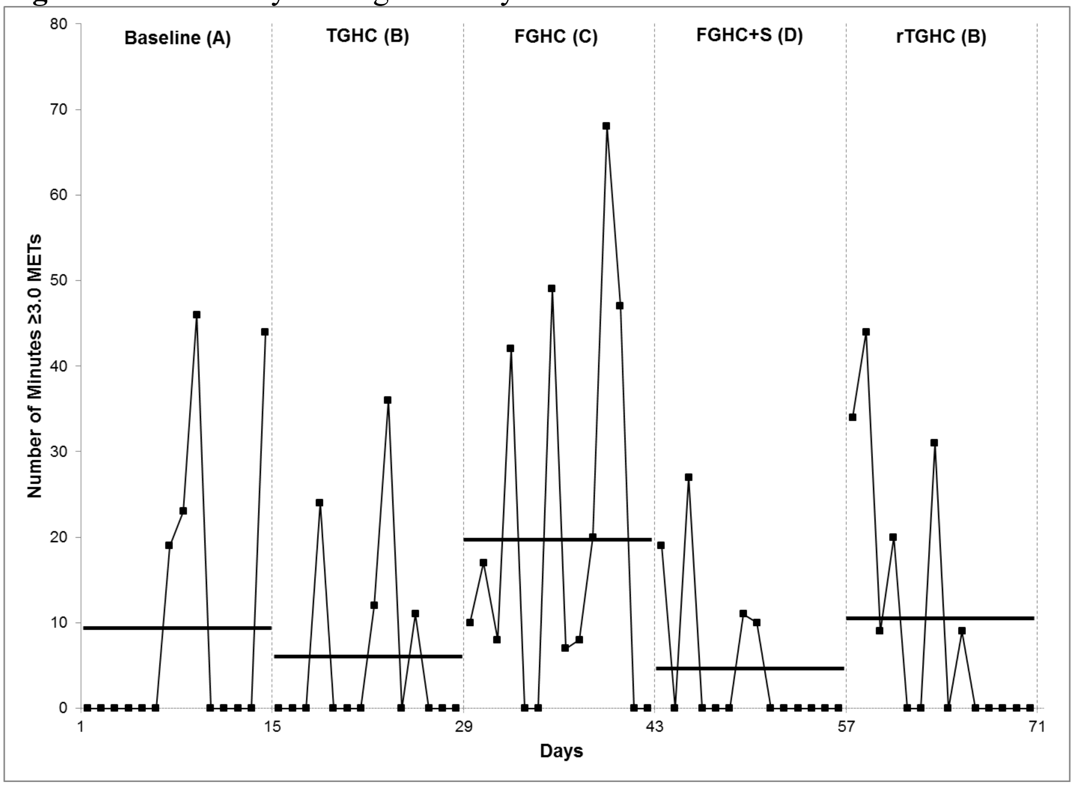


Figure 21. P707 Daily Average Activity Minutes

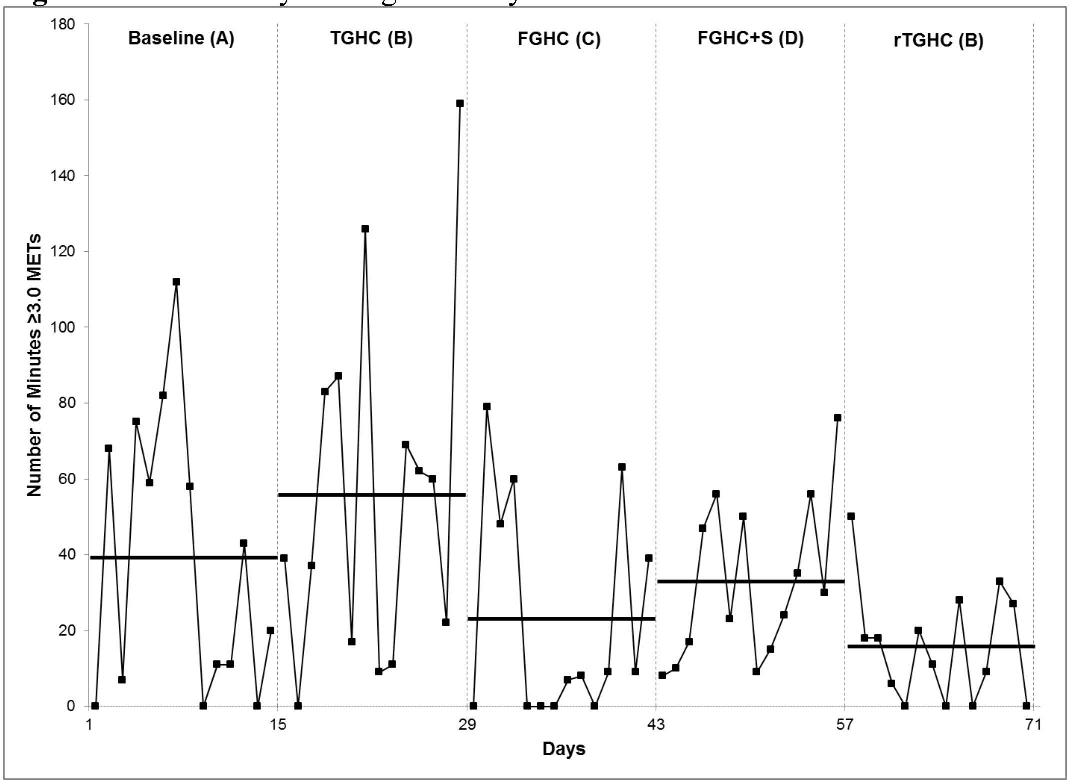


Figure 22. P708 Daily Average Activity Minutes

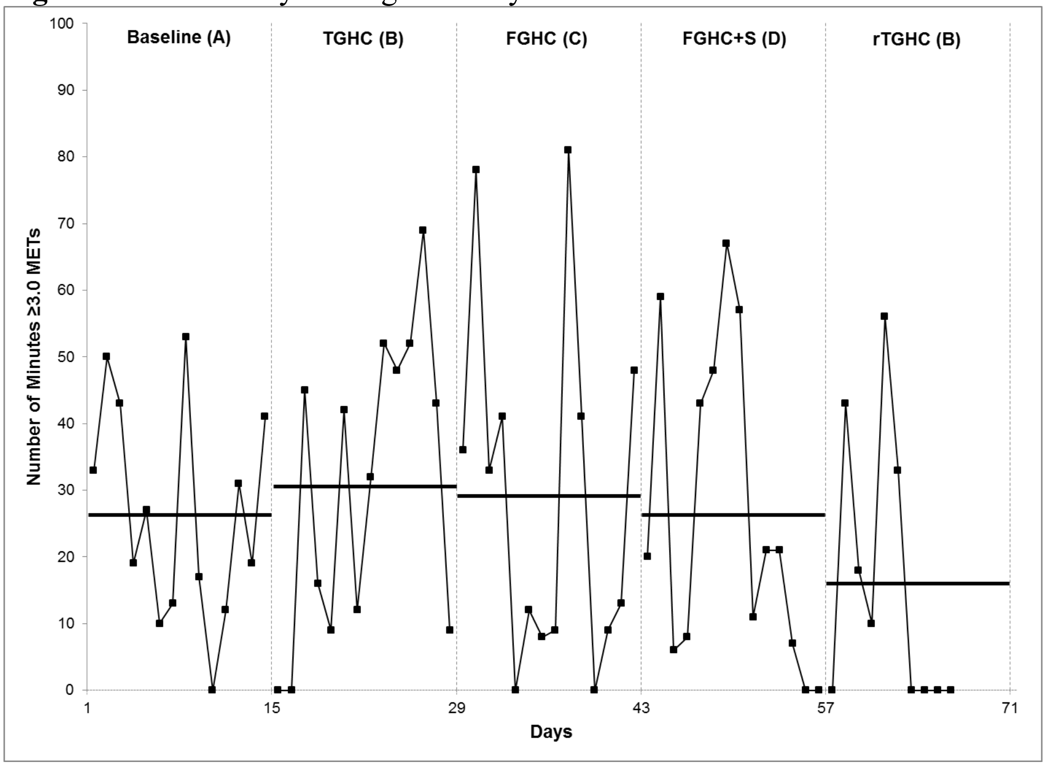


Figure 23. P712 Daily Average Activity Minutes

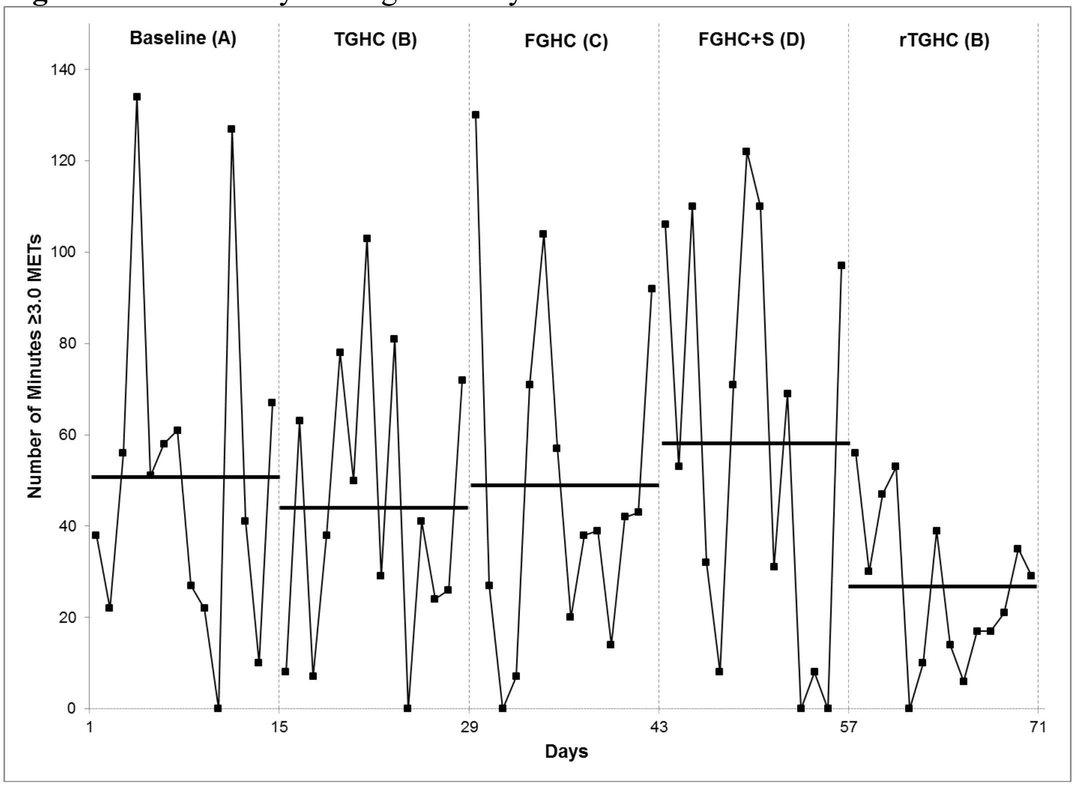


Figure 24. P713 Daily Average Activity Minutes