An Empirical Assessment of a Home-Based Exercise Treatment Package for People with Severe Mobility-Related Disabilities Using a Changing Criterion Design: Two Studies

by

Dorothy E. Nary

Submitted to the Department of Applied Behavioral Science Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the doctoral degree in Developmental and Child Psychology
from the Department of Human Development and Family Life

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Chairperson Glen W. White, Ph.D.

_____
Deborah Altus, Ph.D.

_____
Stephen B. Fawcett, Ph.D.

_____
Jean Peterson, D.S.W.

_____
Jomella Watson-Thompson, Ph.D.

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The Dissertation Committee for Dorothy E. Nary
certifies that this is the approved version of the following dissertation:

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Glen W. White, Ph.D., Chairperson

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An Empirical Assessment of a Home-Based Exercise Treatment Package for People with Severe Mobility-Related Disabilities Using a Changing Criterion Design: Two Studies

Abstract

A single-subject changing criterion design was used in two studies to empirically assess a home-based exercise treatment package for sedentary participants with severe mobility-related disabilities. The independent variable in both studies included a behavioral contract, education, goal setting, self-monitoring, reinforcement, and contingent attention. Both studies enrolled 2 participants and used seated exercise programs on videotape to deliver the intervention. In study 1, participants incrementally increased their exercise to a mean of three 17-minutes sessions per week over 14 weeks. In study 2, participants increased their weekly exercise to five 20-minutes sessions per week, and five 35-minute sessions per week, respectively, over 16 weeks. The second study also incorporated objective data collected with motion devices to validate participant self-reports of exercise. These findings indicate that a home-based exercise treatment package can assist individuals with severe mobility-related disabilities to increase exercise minutes and sessions, to work toward recommended physical activity goals for all Americans of 30 minutes of moderate-intensity physical activity on most days of the week.

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Importance of physical Activity

Regular engagement in physical activity is important to achieve and maintain physical and mental health (e.g., Haskell et al., 2007). Physical activity is defined as "bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure" (U.S. Department of Health and Human Services [USDHHS], 1996, p.21). Evidence indicates that physical activity can improve functional capacity, reduce disease risk, strengthen the musculoskeletal system, and provide psychological benefits (e.g., Haskell et al., 2007). Yet, most U.S. residents do not engage in regular physical activity; in particular, people with disabilities are among the most sedentary groups in the U.S. population. This trend of inactivity and associated health problems results in lowered quality of life and limited opportunities for people with disabilities (USDHHS, 1996, 2005; Weil et al., 2002) and indicates the need for programs to promote adoption of regular physical activity (Heath & Fentem, 1997; USDHHS, 2005). The following sections further delineate this problem and provide context for two interventions.

Physical activity recommendations and prevalence of inactivity

The American College of Sports Medicine and the American Heart Association recommend that adults engage in moderate-intensity aerobic activity (e.g., walking, dancing, playing doubles tennis) for a minimum of 30 minutes on five days each week or vigorous-intensity aerobic activity (e.g., running, swimming laps, playing singles tennis) for a minimum of 30 minutes on three days each week (Haskell et al., 2007).

However, despite evidence of physical activity health benefits, U.S. inactivity prevalence is high. Behavioral Risk Factor Surveillance System [BRFSS] data from 2007 indicate that 35.5% of non-disabled respondents did not engage in the recommended amount of physical

activity per week (CDC, 2008). The BRFSS is a state-based system of health surveys begun in 1984 by the Centers for Disease Control and Prevention [CDC] to collect data on health risk behaviors, preventive health practices, and health care access primarily related to chronic disease and injury (USDHHS, 2010). This physical inactivity trend contributes to high obesity and related chronic disease rates, particularly for those living with disabilities. National Health Interview Survey [NHIS] data published in 2002 indicated that 24.9% of adults with disabilities were obese versus 15.1% of those without disabilities (Weil et al., 2002). Other researchers have also reported high obesity rates for people with disabilities (Froehlich-Grobe & White, 2004; Rimmer & Wang, 2005). Partly in response to the obesity problem, promoting regular physical activity has been designated as a national health priority and a leading health indicator in *Healthy People 2010* (USDHHS, 2000). These national health objectives have spurred development and implementation of health promotion activities, intervention programs, and policies at the state, county, and city levels, to increase population physical activity levels.

People with disabilities and physical activity

Some subgroups of the U.S. population are less active than others; people with disabilities are among the most physically inactive groups. BRFSS data from 2005 reveal that 26% of people with disabilities reported insufficient physical activity compared to 13% of nondisabled adults (CDC, 2007). BRFSS data has questionable validity because it is based on self-report, and also because it likely underestimates the inactivity prevalence of adults with disabilities because it excludes persons living in institutions, fails to sample persons with communication-related disabilities, and uses questions that were developed and validated for persons who do not experience disability (e.g., activities mentioned include brisk walking, bicycling, vacuuming, or running). However, it does provide recent population-level data on

physical activity levels in the US. Several researchers have noted the low physical activity rates of persons with disabilities as a population (Buchholz, McGillivray, & Pencharz, 2003; Durstine, et al., 2000).

Nonetheless, initial evidence indicates that people with disabilities experience similar physiological and psychological effects of exercise as nondisabled people do and can obtain similar health benefits. This was stated in *Physical Activity and Health: Report of the Surgeon General* (USDHHS, 1996) and continues to be confirmed for individuals with various mobility-related disabilities, including multiple sclerosis (Romberg, Virtanan, & Ruutiainen, 2005), osteoarthritis (Farrar & Mitchell, 2009), rheumatoid arthritis (Mats et al., 2009), and spinal cord injury (Stevens, Caputo, Fuller, & Morgan, 2008). In fact, physical activity engagement is especially important for this population to preserve functioning and independence. As noted in Heath and Fentem's (1997) seminal article on disability and physical activity from a public health perspective: "The importance of being able to walk a little farther, transfer in and out of a chair, or brush one's own hair cannot be overestimated" (p. 208). Thus, regular physical activity engagement by people with disabilities can produce tangible functional benefits, while infrequent or no physical activity engagement can lead to a downward spiral of deconditioning and physical inactivity, and exacerbate the limitations of the primary disability (Durstine et al., 2000). Many barriers, at the conceptual, policy, organizational, and individual levels have contributed to this health risk of physical inactivity. Additionally, lack of regular physical activity can also contribute to other health problems, called secondary conditions. Research indicates that secondary conditions can be more serious than primary disabilities, as described next.

Disability and secondary conditions

People with disabilities often experience secondary health conditions that diminish quality of life (Heath & Fentem, 1997; Rimmer, 1999). Secondary conditions are health problems that occur after a disability is acquired that negatively impact health and independence, and that are sometimes more debilitating than the primary disability (Brandt & Pope, 1997). Marge (1988) was one of the first to articulate the impact of secondary conditions on the health of people with disabilities. He emphasized that most secondary conditions are preventable; he and others stressed the need for health promotion programs to facilitate prevention (Marge, 1988; White, Gutierrez, & Seekins, 1996). Researchers report widely varied rates of secondary condition incidence, depending on the population and types of conditions queried, from an average of 4.7 conditions experienced over a two year period by adults with mobility limitations (Rasch, Magder, Hochberg, Magaziner, & Altman, 2008) to an average of 15 secondary conditions experienced annually by adults with injury-related disabilities living in Montana (Seekins & Ravesloot, 2000). Common secondary conditions for people with mobility-related disabilities include pressure ulcers, urinary tract infections, joint contractures, and joint pain, as well as psycho-social adjustment problems such as depression (Rasch et al., 2008; Seekins & Ravesloot, 2000). Rimmer and Shenoy (2006) reviewed randomized controlled trial data regarding the effect of exercise on three secondary conditions (i.e., deconditioning, fatigue, and pain). They concluded that the variety of methodologies, assessment tools, and exercise dosages made it impossible to develop evidence-based guidelines. Research is needed to better understand how exercise can prevent or mitigate secondary conditions.

Increasing population of people with disabilities

Attention to health promotion, and exercise in particular, for people with disabilities is especially important given this increasing population. U.S. Census data from 2000 indicates that about 19% (1 in 5) of the non-institutionalized U.S. civilian population over the age of five experiences some type of disability, and that the incidence of disability increases with age (Waldrep & Stern, 2003). U.S. Census data indicate that the population is aging, with 20% of U.S. residents expected to be 65 or older by 2030, up from 12% in 2000 (Bernstein & Edwards, 2008). It is particularly important in terms of both quality of life and health care resources to promote the health and productivity of the growing population of people with disabilities (Ravesloot, Seekins, & White, 2005). However, health promotion research and programming, as distinguished from medical or rehabilitation treatment, for people of any age living with disabilities are sparse, as described next.

Limited research on disability and health

In the last decade, increased emphasis has been placed on health promotion (Rimmer, 1999; Stuifbergen, Blozis, Harrison, & Becker, 2006) and increased physical activity (Durstine et al., 2000; van der Ploeg et al., 2004) for people with disabilities. *The Surgeon General's Call to Action to Improve the Health and Wellness of Persons with Disabilities* (USDHHS, 2005) emphasizes health promotion as a critical step toward increased community participation for people with disabilities. One of four goals in the *Call to Action* states that, "persons with disabilities can promote their own good health by developing and maintaining healthy lifestyles" (USDHHS, 2005, p.2). However, research in this area is limited. A small but growing body of research has begun to identify effective methods for promoting health (e.*g.*, Krahn, Putnam, Drum, & Powers, 2006) and regular engagement in physical activity (e.g., Froehlich-Grobe & White, 2004; Kosma, Cardinal, & McCubbin, 2005; Latimer, Martin Ginis, & Arbour, 2006; van

der Ploeg et al., 2006) for people with disabilities. This work is encouraging because people with disabilities as a group are heterogeneous, with diverse characteristics and abilities, requiring an array of accommodations and programs to promote the adoption of physical activity. In promoting a national agenda for research on disabilities and health, Krahn and colleagues (2006) emphasized that research should reflect the diversity of people with disabilities, including gender, culture, age, and the nature of the disability. For example, a 20-year-old person with spinal cord injury (SCI) might choose to engage in strenuous competitive sports, such as wheelchair tennis, while a middle-aged person with SCI might prefer a sport such as swimming which places less stress on overused shoulder joints. Conversely, a person with muscular dystrophy of any age might be unable to engage in strenuous activity, but might benefit from moderate physical conditioning using an arm cycle, or strengthening with small weights. Thus, three wheelchair users might have different physical activity abilities, needs, and preferences. Currently, there is insufficient research on approaches to promote the health of this diverse group of people with disabilities.

In particular, the physical activity literature lacks data on effective home and community-based physical activity programs for people with disabilities (White, Gonda, Peterson, & Drum, in press). Some research involving nondisabled populations indicates that participants who exercise at home have significantly better adherence than those who engage in community options (Cox, Burke, Gorely, Beilin, & Puddey, 2003; King et al., 1992). Also, pursuing physical activity in home and community-based settings have been identified as factors influencing sedentary individuals to become more active (DeBolt & McCubbin, 2004; Ransdell et al., 2003). Growth of the home fitness equipment industry provides additional evidence in support of high interest in home exercise (Pien, 2010).

Home and community-based exercise

Durstine and colleagues (2000) noted that home-based exercise may be especially helpful for people with mobility-related disabilities who often experience barriers to engagement in physical activity, such as exercise program costs (Rimmer, Wang, & Smith, 2008), lack of affordable and accessible transportation (Iezzoni, Killeen, & O'Day, 2006), and absence of accessible equipment in fitness facilities (Nary, Froehlich, & White, 2000; Rimmer, Riley, Wang, & Rauworth, 2005). Kehn and Kroll (2009) recently explored barriers to exercise participation for people with spinal cord injuries, adding reported high effort to gain only a low return on physical investment to the list of barriers confirmed in the literature. Other researchers have noted that lower-cost interventions involving educational materials and phone prompts may be appropriate and adequate to promote adoption of regular exercise for some populations. However, they note that people with disabilities may benefit from "professionally-delivered multidisciplinary home visits that could tailor treatment to the individual's motivational and psychological readiness to change and to adopt a physically active lifestyle" (Marcus, King, Bock, Borrelli, & Clark, 1998, p. 196). Still, a literature search revealed few interventions that provide sustained home-based exercise support for persons with mobility-related disabilities. Most studies begin with one or several sessions in a clinical environment and then discharge patients to the home or community to continue exercise on their own, with or without periodic phone monitoring and with follow-up visits to the clinical setting (Dawes et al., 2006; Olsen, Orngreen, & Vissing, 2005). Only a few studies have focused solely on home and community-based settings (e.g., Froehlich-Grobe & White, 2004; Keyser, Rasch, Finely, & Rogers, 2003). Given the many disability-related barriers to adoption of exercise that face this population, investigation of home- and community-based methods to promote adoption and maintenance of

exercise programs for people living with mobility-related disabilities is needed to establish an evidence base for practice.

Transition from rehabilitation to the community

In particular, there are no data on transition to community-based exercise after discharge from the clinical rehabilitation setting (van der Ploeg, van der Beek, van der Woude, & van Mechelen, 2004). This is important because typical inpatient rehabilitation stays have been shortened in recent decades. For example, the average inpatient rehabilitation length of stay for a person incurring a spinal cord injury was reduced from 98 days between 1973-1979 to 38 days in 2005 (National Spinal Cord Injury Statistical Center, 2010). Patients are likely discharged from rehabilitation while still adjusting to their newly acquired disabilities, and almost certainly before they have devised adaptive health promotion routines.

Given the lack of data on home- and community-based exercise for people with disabilities, research is needed to investigate effective programs to promote increased exercise for this population. The two studies presented in this paper investigate the effect of home-based exercise interventions using commercially-available videotaped seated exercise programs to facilitate adoption of regular physical activity by participants with mobility-related disabilities. These studies focus on a type of physical activity, exercise, defined as “planned, structured, and repetitive body movement done to improve or maintain one or more components of physical fitness” (USDHHS, 1996, p. 21), because the planned and structured nature facilitates measurement and because providing an accessible exercise opportunity may be helpful to individuals with mobility-related disabilities who experience barriers to usual exercise activities. The interventions relied on behavioral strategies found to be effective in promoting physical activity. They were identified both by a systematic review conducted by Kahn and colleagues

(2002) and a meta-analysis of patient education interventions to promote physical activity among chronically-ill adults (Conn, Hafdahl, Brown, & Brown, 2008). The behavioral strategies used in the exercise treatment package (i.e., behavioral contracting, education, goal setting, self-monitoring, and incentives) are described next.

Exercise treatment package components

Behavioral contracting. A behavioral contract is a written agreement between two parties that specifies a target behavior that one or both parties agree to engage in (Miltenberger, 2008). Behavioral contracts are frequently used in behavior change interventions. Neale, Singleton, Dupuis, & Hess (1990) used this tool in a 12-week aerobic exercise program to reduce cardiovascular risk, in which 41 participants fully met exercise goals specified in their contracts, and 21 others reported increased activity levels. Although the activity was self-reported, researchers reported that the level of contract adherence was significantly related to a decrease in heart rate during exercise at a six-month follow-up assessment. More recently, Gerber, Bloom, & Ross (2010) used a physical activity contract in a pilot study to promote increased activity among older adults. At four weeks, participants had significantly increased mean weekly physical activity minutes from a baseline of 172.2 to 305.5 minutes.

Education. Education regarding the importance of exercise and safe types of exercise has been cited in the literature as a need of persons with disabilities (Froehlich, Nary, & White, 2002; Stuifbergen & Becker, 1994). Pinto, Marcus, & Clark (1996) also identified lack of role models and lack of exercise knowledge as barriers for nondisabled women. Education may be especially important to individuals with disabilities or chronic conditions to counter traditional views that people living with disabilities are relegated to a “sick” role and therefore, incapable of physically active lifestyles. Additionally, people with disabilities likely encounter fewer exercise

role models in their communities, the media, etc., increasing the need for education regarding exercise for this population.

Goal setting. Goal setting has been defined as "the object or aim of an action, or that which one wants to accomplish" (Lee, Locke, & Latham, 1989, p. 299). Goal setting has been used successfully to establish new behaviors in a variety of organizational settings, including sport and exercise venues (Weinberg, 1994). West, Lagua, Trief, Izquierdo, and Weinstock (2010) emphasized collaborative goal setting, where researchers and participants negotiate mutually agreeable goals, in a study to promote dietary changes and physical activity among older adults with diabetes. This method may be particularly appropriate in working with people with severe mobility-related disabilities, as their knowledge of their own bodies and capabilities could be essential in setting realistic goals.

Self-monitoring. Self-monitoring requires an individual to create a record of a behavior to be changed, typically in a diary or on a website. This behavioral strategy has been shown to increase exercise frequency and to reduce exercise program dropouts (Neale, Singleton, Dupuis, & Hess, 1990). A meta-analysis of patient education interventions to increase physical activity among adults with chronic conditions found that, overall, self-monitoring resulted in significantly increased exercise (Conn, Hafdahl, Brown, & Brown, 2008). Self-monitoring via pencil and paper exercise logs has been used extensively in home-and community-based exercise interventions for various populations, including women with mobility-related disabilities (Froehlich-Grobe & White, 2004). While useful as a data collection method, the act of self-monitoring by completing exercise logs also serves as a prompt to observe behavior over time or participants to engage in activity. Cone (1978) distinguished between self-report and self-

monitoring, noting that the latter involved observing, recording and noting behavior change over time.

Incentives. Use of incentives involves providing rewards or reinforcement for practice of a desired behavior, or cessation of behavior that is undesired. Conn et al. (2008) noted reinforcement as an effective component of a variety of behavior change interventions. More recently, Harrington, Hollinghurst, Reed, Kay, and Wood (2010) used reinforcement in an exercise intervention for stroke survivors, and Larwin and Larwin (2008) used access to the internet and television as incentives in a single-subject study to increase physical activity of an adolescent.

Contingent attention. Providing attention to increase appropriate responses has been used frequently by researchers in classroom settings (Hall, Lund, & Jackson, 1968) and with patients with psychiatric disorders (Matson, Zeiss, Zeiss, & Bowman, 1980). Recently, contingent attention was a method included by Martens, DiGennaro, Reed, Szczech, and Rosenthal (2008) in a description of procedures in conducting *contingency space analysis [CSA]*, a method of identifying contingent relations from conditional probabilities. CSA is used in applied settings to determine consequences for problem behavior so that an effective treatment program can be devised.

These program components were used in two home-based exercise interventions conducted with individuals with severe mobility-related disabilities. The research question for study 1 is presented next.

Research Question

The primary research question was: What are the effects of a home-based exercise treatment package on the exercise frequency, duration, and intensity of participants with severe mobility-related disabilities?

Study 1

Method

Participants. Participants were individuals with various types of mobility-related disabilities who reported barriers to exercise participation. They were identified through the Kansas Physical Disability Waiver Program (PD Waiver). Case managers distributed study information to clients and obtained written permission for researchers to contact potential participants by phone.

Inclusion and Exclusion Criteria. To be included in the study, persons had to meet the following criteria: (a) be between 18-65 years, inclusive, (b) provide informed consent, (c) obtain written consent to participate from a personal physician, and (d) be able to self-report exercise accurately. Individuals were excluded if they (a) reported currently engaging in moderate or vigorous physical activity more than twice weekly, (b) experienced health conditions that precluded increased physical activity, (c) could not meet with the researcher weekly, (d) were unwilling to complete exercise logs, (e) were unwilling to sign a behavioral contract, or (e) did not own a television or computer on which they could play videotapes or DVDs. This study included two participants who are described next.

Ann, a 50 year old white female, used a wheelchair due to multiple health problems. She reported restricted movement and pain from orthopedic injuries suffered in a vehicular accident 10 years prior to study enrollment. She noted that this restricted movement due to pain caused her to gain weight and to move even less; she reported having a knee replacement but the pain

continued. She then developed diabetes, and began using a wheelchair for mobility. She continued to gain weight, which further restricted her movement and contributed to depression. Ann noted that these changes occurred gradually over a number of years, until she became morbidly obese; at that point, she said that it had been years since health care providers recommmended exercise to her. Ann did not reveal her exact weight but noted that it was over 300 pounds. Additionally, she reported experiencing psychological trauma from childhood.

Pat, a 46 year old white female, reported impaired mobility due to multiple sclerosis. She reported experiencing back problems and depression. She was able to walk but was concerned with progressively poor balance, and at times, used forearm crutches or a wheelchair to assist with mobility. She reported that she typically walked outdoors for exercise, but both balance problems and weather-related barriers, such as heat or slippery surfaces, frequently prevented her from exercising.

Setting. All activities, including exercise sessions and assessments, were conducted within participants' homes, specifically in the living room where their televisions were located.

Materials. Participants selected one videotape or DVD from several commercially available seated aerobic videotapes or DVDs for their use during the study. Details on the exercise programs used by participants are included in Appendix A. Each participant was given a digital kitchen timer to measure their minutes of exercise (Model # 201, Oster, Springfield Precision Instruments, Wood-Ridge, NJ). Participants were also were also given activity logs on which to record their data and a laminated copy of the Borg Scale, as noted below.

Independent variables. The exercise treatment package included five components that assisted participants to increase their weekly minutes of exercise (i.e., a behavioral contract,

education, goal setting, self-monitoring, incentives, and contingent attention). These components are described next.

Behavioral contracting. Both participants and the researcher signed a behavioral contract specifying activities each would carry out for the intervention (Appendix B), such as obtaining physician consent and setting incremental goals to increase exercise minutes/sessions (participants), and providing seated aerobic videos and visiting weekly to monitor participant progress (researcher).

Education. Participants were given a fact sheet from *Physical Activity and Health: A Report of the Surgeon General* (USDHHS, 1996) explaining exercise benefits for people with disabilities (Appendix C). The researcher discussed the information with participants during the first meeting and gave them copies for future reference. Additionally, each of the seated aerobic videotapes/DVDs provided active role models with mobility-related disabilities and briefly discussed the importance of regular aerobic exercise.

Goal setting. This strategy was used to assist participants in increasing targeted activity levels as required by the changing criterion experimental design. During the intervention, goals of increased exercise minutes per session and/or sessions per week were re-negotiated by the researcher and the participant once a stable baseline was achieved for each condition (i.e., the previous goal).

Self-monitoring. Pencil and paper exercise logs were used in the current study to collect self-reported exercise data. These served as a permanent record of participants' exercise behavior, as well as a data collection tool (Appendix D). Participants were encouraged to keep their logs in a three-ring binder with other study materials.

Incentives. Participants in the current study were given long-distance phone calling cards in the amount of $3.00 for having a completed exercise log ready when the researcher visited each week. Provision of incentives was not contingent on exercise recorded on the log; it was provided for having completed the log.

Contingent attention. The researcher visited each participant weekly and provided encouragement to set and reach goals of increased exercise sessions and minutes. The visits were scheduled and conducted whether or not participants reached their goals for the previous week.

Dependent variables. Several measures were used to assess behavioral change and to demonstrate behavioral control (i.e., exercise sessions/minutes, exercise intensity, and stamina). These measures are described next.

Exercise sessions/minutes. These data were collected via weekly exercise logs that participants used for self-monitoring their exercise. The researcher prepared the log sheets with the participants' ID numbers and dates for each week of the intervention, including the orientation period (e.g., 5/10-5/16). These logs were provided to the participants at the start of the orientation condition. The logs had a column for each day of the week with space to record which videotaped program was used, the duration of the exercise session (e.g., minutes and seconds), and the intensity of the exercise (Appendix D). Additionally, a notes section allowed participants to provide information on occurrences that might have affected their exercise behavior for that week (e.g., illness, or extreme heat).

Exercise intensity. The modified Borg Rating of Perceived Exertion scale (Borg, 1982) was used to assess participants' exercise intensity (Appendix E). The range of the modified Borg scale is 0-12, with moderate to strong ratings in the 3-5 range. It is based on the physical sensations a person may experience during exercise, including increased heart rate, increased

respiration or breathing rate, increased perspiration, and muscle fatigue. Although it is a subjective measure, Borg (1998) asserts that a person's exertion rating may provide a good estimate of the actual heart rate during physical activity, and has been found to be valid and reliable (e.g., Skinner, Hustler, Bergsteinova, & Buskirk, 1973). The Borg scale is frequently used in exercise research. In the current study, participants were asked to view the Borg scale and to record a perceived exertion rating on their exercise log immediately after each exercise session.

Stamina. The Reach and Balance measure was devised for this study as a simple measure of aerobic conditioning, or stamina, that could be conducted by the researcher in participants' homes. It required participants to sit or stand 18 inches (or less depending on a participants' reach) from a door post and to reach as high and then as low as they could, continuously alternating up and down, for 30 seconds while maintaining their balance. These reach points were marked and measured, and then noted with a three inch round marker affixed to the wall, providing a range +/- 1.5 inches to the center point of upper and lower reach. Participants practiced with a 10 second trial, and then rested for at least two minutes before the trial. The researcher timed the trial with a digital timer (Oster, Springfield Precision Instruments, Wood-Ridge, NJ). When given the verbal signal "go," participants were asked to reach touch the upper and the lower disks repeatedly as fast as they could for 30 seconds, and then to stop when the researcher said "stop." Two trials using the participant's right arm were conducted with a two- minute interval between trials. After a three minute rest, the trial was repeated using the participant's left arm. The number of reaches for two trials on each side was averaged and this figure was noted in the results. The Reach and Balance measure was conducted at orientation,

mid-study, end of the study, and at the follow-up probe. Trials were recorded on videotape to allow inter-observer reliability assessment.

Experimental Design

This study used a single-subject changing criterion design (Hartmann & Hall, 1976) to assess intervention effects. This design requires baseline measurement of a single target behavior, followed by a treatment program implemented in a series of phases. Thus, each segment of the design serves as a baseline for the successive phase. When the targeted behavior change is achieved in each phase, experimental control is demonstrated. As noted by Hartmann and Hall, the changing criterion design facilitates achievement of incremental goals such as adherence to an exercise routine. In this study, stepwise increases in exercise session and/or minutes occurred as the program progressed. In the case of participants with mobility-related disabilities, this experimental design allows each participant to progress at his or her own pace and to regularly set new goals. Finally, the design permitted continuity of the experiment despite the possible interruption of physical activity regimens due to participant illness or secondary condition occurrence. This is particularly important for this population when, for example, a shoulder injury might preclude engagement in exercise until the injury heals. The changing criterion design has been used in other exercise interventions (e.g., Fitterling, Martin, Gramling, Cole, & Milan, 1988) but there is no evidence of its use in exercise interventions with people with mobility-related disabilities.

Procedures

Case managers of the Kansas Physical Disability Waiver program (PD Waiver), which provides services to persons with disabilities requiring personal assistance to prevent their institutionalization, informed clients about the study. These case managers asked interested

clients to sign consent forms giving the researcher permission to contact the clients. The researcher then sent a preliminary form (Appendix G) with a postage paid return envelope. The form included questions that asked participants to estimate their physical activity/ exercise during the previous two weeks, including type of activity, frequency and duration. One month before the intervention was scheduled to begin, the researcher phoned potential participants to assess initial eligibility and then scheduled in-home visits to: (a) explain the study, (b) confirm initial eligibility, and (c) show excerpts from several seated aerobic video routines that participants could choose from if they enrolled. Participants were also asked to sign a form requesting their personal physicians' medical permission to enroll in the study. Following receipt of physicians' permission by mail, the researcher visited participants to (a) provide education regarding the importance of physical activity for people with disabilities, (b) complete the consent form approved by the University of Kansas Human Subjects Committee-Lawrence (Appendix H), (c) conduct the initial Reach and Balance measure, (c) have the participant select a video exercise program and do a "practice session," (e) sign the behavioral contract, (f) provide instructions in exercise log completion, (g) provide a digital kitchen timer and demonstrate its use, and (h) set an initial goal of exercise minutes per week. Additionally, each digital kitchen timer was calibrated (e.g., checked against the researcher's wrist watch to ensure that it kept correct time). This calibration test was repeated during every fourth visit.

Participants were given printed exercise logs for the orientation and intervention weeks. Each log was prepared with the participant's study ID number and dates for each week of the intervention (e.g., 12/4-12/10). The logs contained spaces to record (a) the video exercise program they used, (b) their minutes and seconds of daily exercise, (c) the intensity of their exercise, and (d) any notes regarding their health or exercise patterns for that week. Each log

covered seven days, beginning with Monday and was prepared with participant ID and dates filled in. Participants were asked to begin completing the logs on the day of the visit to collect orientation data. The researcher visited three weeks later for participants to perform an exercise session. Soon after, participants began the intervention with three exercise sessions weekly. The researcher then made weekly visits to (a) collect participants' completed exercise logs and provide incentives as appropriate, (b) videotape a seated aerobic session as a probe, (c) review participants' progress on their goals and negotiate goal increases regarding session minutes, and (d) conduct the Reach and Balance measure at mid, post and follow-up points. The researcher also provided participants with copies of the exercise log collected on the previous visit, to provide an ongoing record of their exercise. Participants received a $3.00 prepaid phone card as an incentive for having the previous weeks' activity log completed when the researcher visited. (Note: the incentive was given for having the log completed, not for having exercised during the previous week.) The logs served as a data collection tool, and as a record of participants' exercise throughout the intervention.

Results

Program choices. Ann chose a program called "Seat-a-Robics Endurance," which provides a 30-minute seated aerobic workout lead by a female instructor who has paraplegia. Pat chose the program "Lisa Ericson's Seated Aerobic Workout", which provides a 50-minute seated aerobic workout, also led by a female instructor with paraplegia. Both programs are described in Appendix A. These programs feature five to seven participants, most with disabilities, exercising on video along with the instructor, to simulate the experience of participating in an exercise class. Both programs also provide a moderate aerobic exercise session with safety warnings (e.g., signs of overexertion) and suggestions regarding how to reduce (e.g., lift arms no higher than the

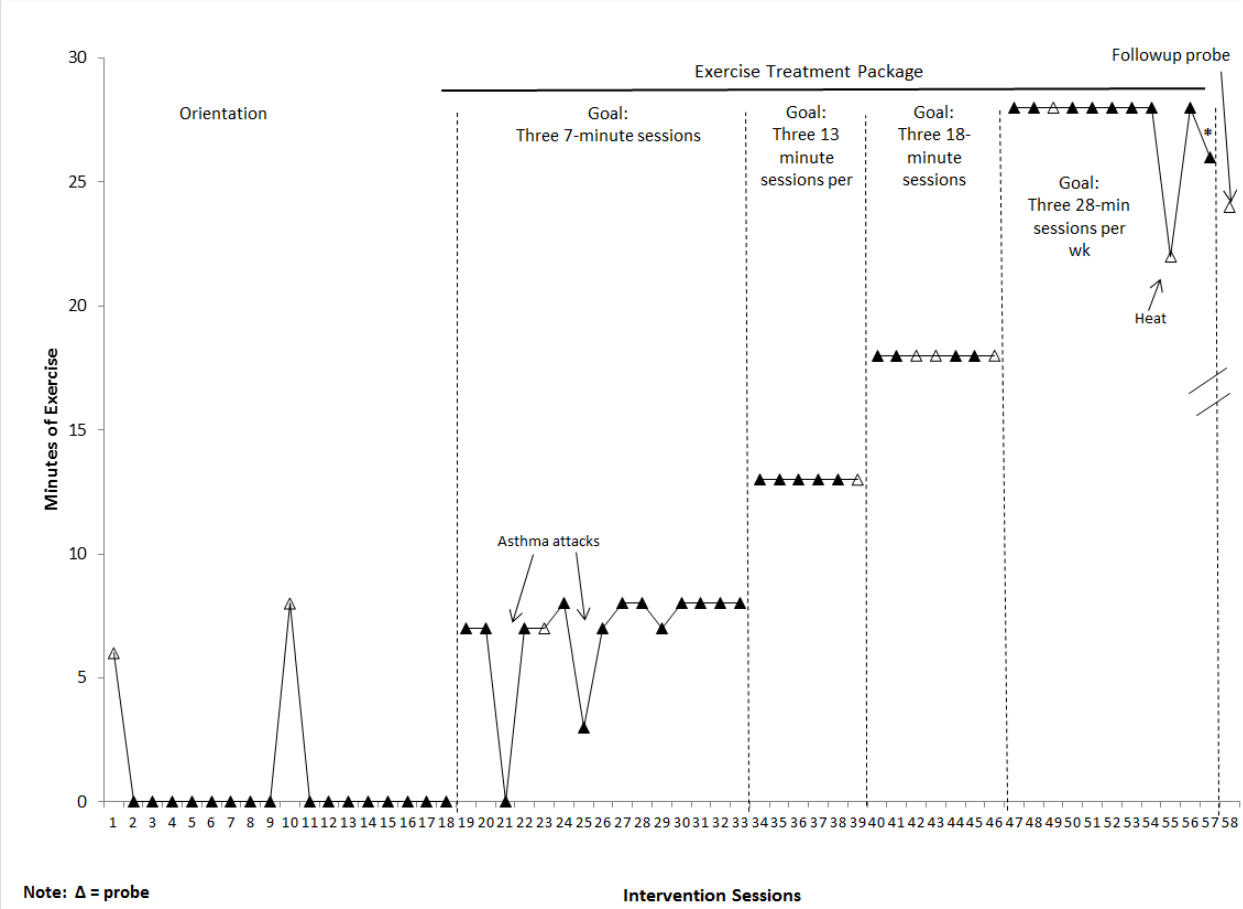
head) or increase (e.g., create resistance by using “punching” movements) the intensity of the movements.

Exercise sessions/minutes. Both participants set four goals of increased minutes of exercise sessions on a stepwise basis and these goal revisions were noted in additions to their behavioral contracts. Both participants achieved these goals based on their self-report exercise log data. Ann’s exercise log data will be presented first, followed by Pat’s data.

Ann tried her selected exercise program twice during the orientation period (sessions 1 and 10) and set an initial goal of three seven-minute exercise sessions per week for her program (Figure 1). She reported achieving this goal, with the exception of one day on which she did not exercise and another on which she exercised for only two minutes due to asthma attacks (sessions 21 and 25). She then agreed to increase her goal to 13 minutes per session (sessions 34-39). After two weeks (six sessions) at this goal, in which she reported meeting her goal of 13 minutes for three sessions per week, Ann agreed to increase her goal to three 18-minute sessions per week (sessions 40-46). After two and one-half weeks (seven sessions) of achieving this goal, she agreed to increase her goal to three 28-minute exercise sessions per week (sessions 47-57). She pursued this goal for 4 weeks with varied success, as she reported that high July temperatures fatigued her and made it difficult to exercise. She reported meeting her goal of 28 minutes during six sessions, but the remaining sessions were shorter, with one as low as 21 minutes and 28 seconds. Still, the mean number of minutes per session for this condition was 27 minutes and 14 seconds, not much lower than her goal of 28 minutes. However, for her July 31 session (data point 55), Ann expressed boredom with the video program she was using and insisted on switching to a different one. She used the different video for the remaining four

sessions and for the follow-up probe. During the follow-up probe, 11 weeks after the end of the intervention, Ann exercised for 24 minutes.

Figure 1. **Ann's Exercise Log Data**

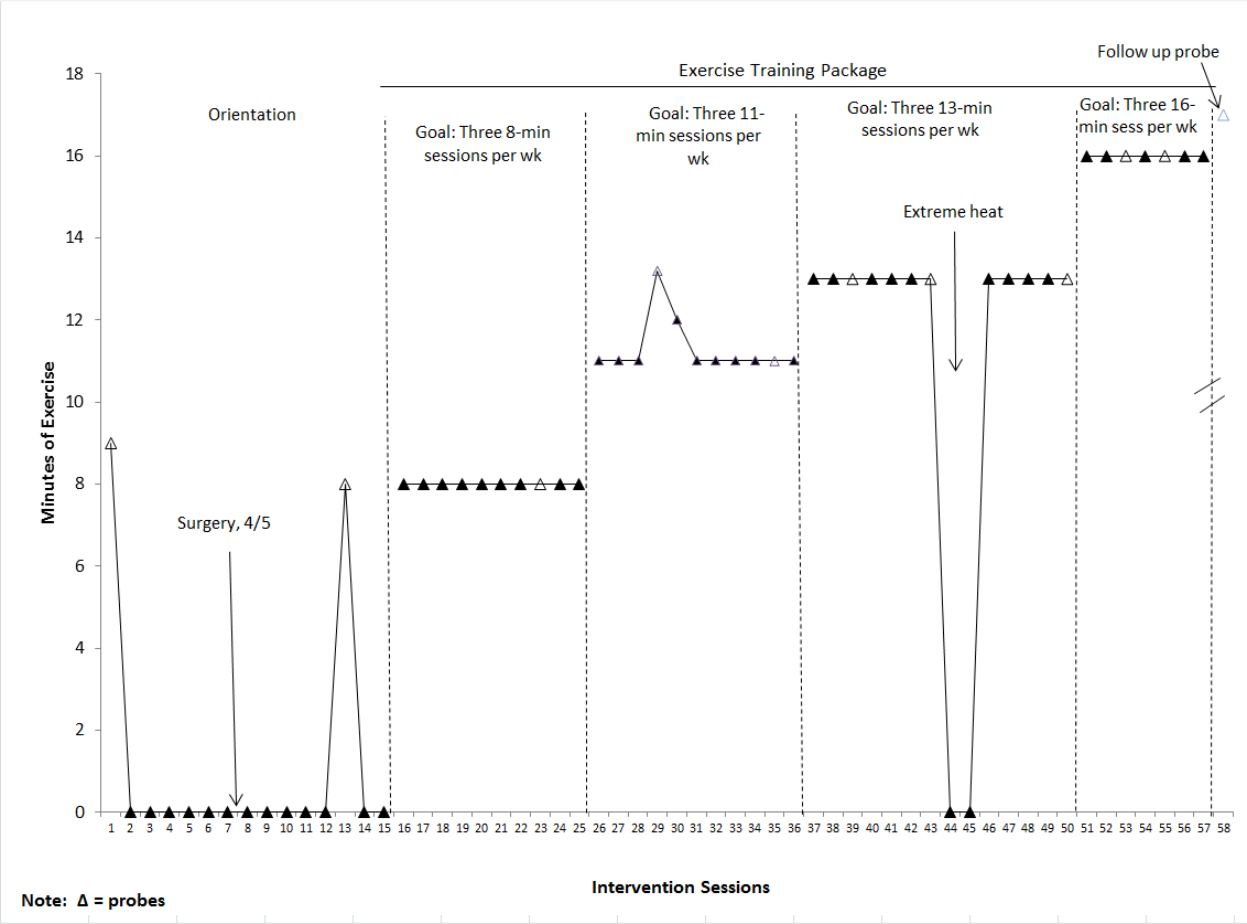


Pat performed two exercise sessions during the orientation period (sessions 1 and 13) in order to select a video program. She set an initial exercise goal of three eight-minute aerobic sessions per week. She worked at this goal for three weeks (Figure 2) (sessions 16-25). After one additional eight-minute session, she agreed to increase her goal to three 11-minutes sessions per week (sessions 26-36). She worked at this goal over a four week period (11 sessions). She then agreed to increase her goal to three 13-minute sessions per week (sessions 37-50). Pat maintained this goal over a period of almost five weeks (14 sessions), with the exception of two sessions that she skipped entirely due to the July heat. She then agreed to increase her goal to

three 16-minute sessions per week (sessions 51-57). She achieved this goal over a two week period (7 sessions), all at 16 minutes. During a follow-up probe eight weeks after the intervention ended, Pat exercised for 17 minutes.

Both participants had completed logs ready for each of the researcher's weekly visits; thus, they received all of the incentives that were made available as specified in their behavioral contract.

Figure 2. **Pat's Exercise Log Data**



Exertion. Participants recorded their exertion levels on exercise logs after each exercise session using the Borg RPE scale. Typically, their self-reported exertion levels decreased as the participants increased their exercise minutes. However, as the goals of exercise minutes increased with each condition toward the end of the intervention, their exertion levels were less

likely to decrease, as noted next. Participants' self-ratings of activity indicated that they were often working in the recommended range of moderate to strong activity (3-5 on the Borg Scale) or higher. Ann recorded an RPE between 3-5 for 21 (55.3%) of her 38 sessions; she rated the other 17 sessions (44.7%) in the strong to very strong range (6-11) (Figure 3). Pat recorded an RPE between 3-5 for 33 (82.5%) of her 40 sessions (Figure 4). She recorded one session in the weak range (3%) and the remaining six (15%) in the strong to very strong range (6-11).

Figure 3. **Ann's Exertion Ratings**

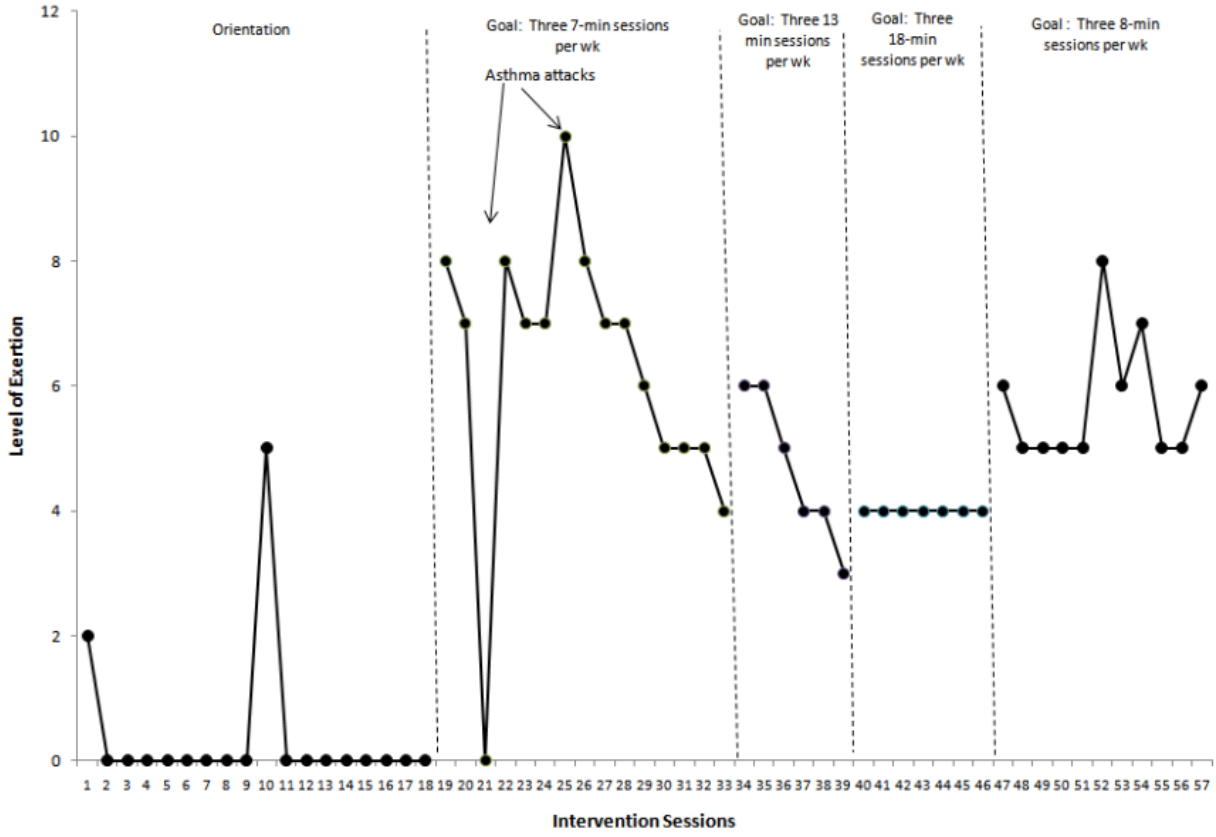
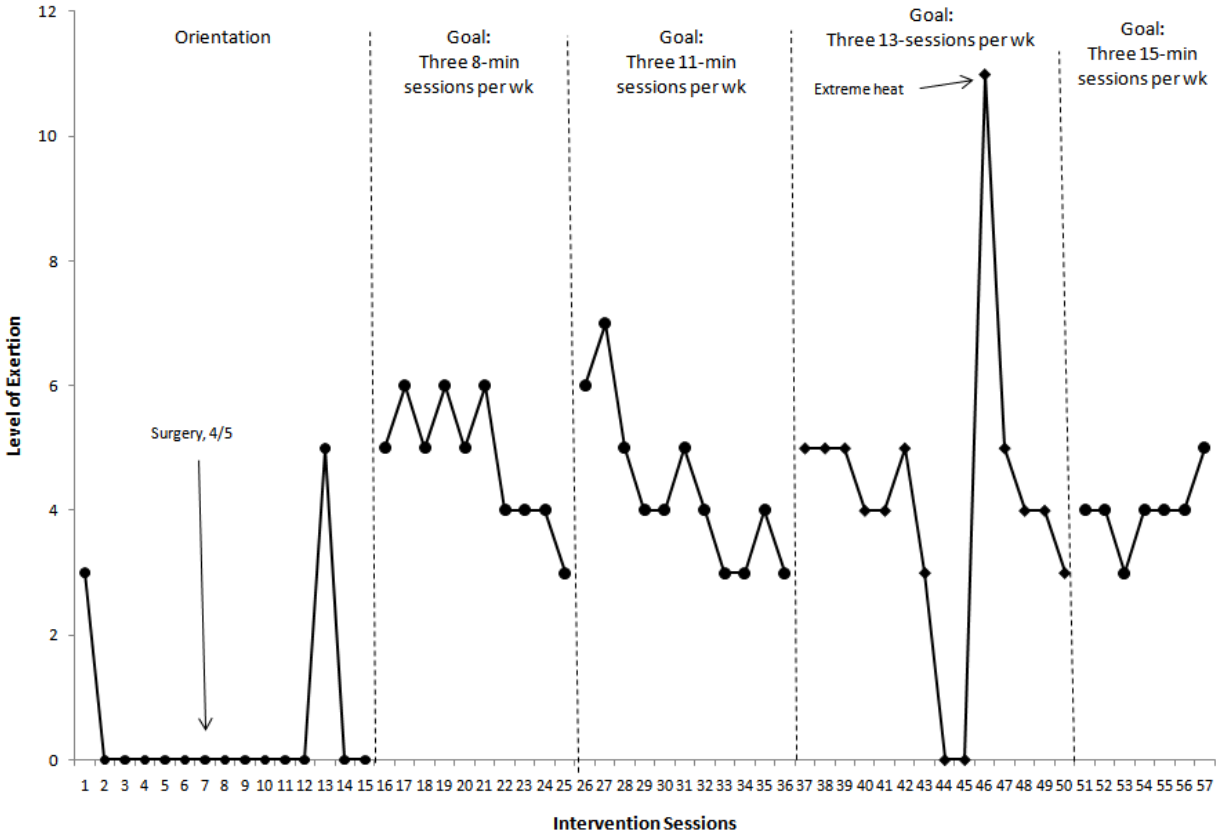


Figure 4. **Pat's Exertion Ratings**



Several of the participants' higher ratings were recorded when they reported experiencing asthma attacks (Ann) or negative effects of high atmospheric temperatures and humidity (Pat).

Stamina. The Reach and Balance measure results indicated that both participants had increased their aerobic conditioning, or stamina, by the post-intervention point. Ann increased her pre-intervention number of reaches by 27.3% on the left side (from 44 to 56 reaches) and by 30.4% on the right side (from 46 to 60 reaches) (Figure 5).

***Figure 5*. Ann's Stamina Test Data**

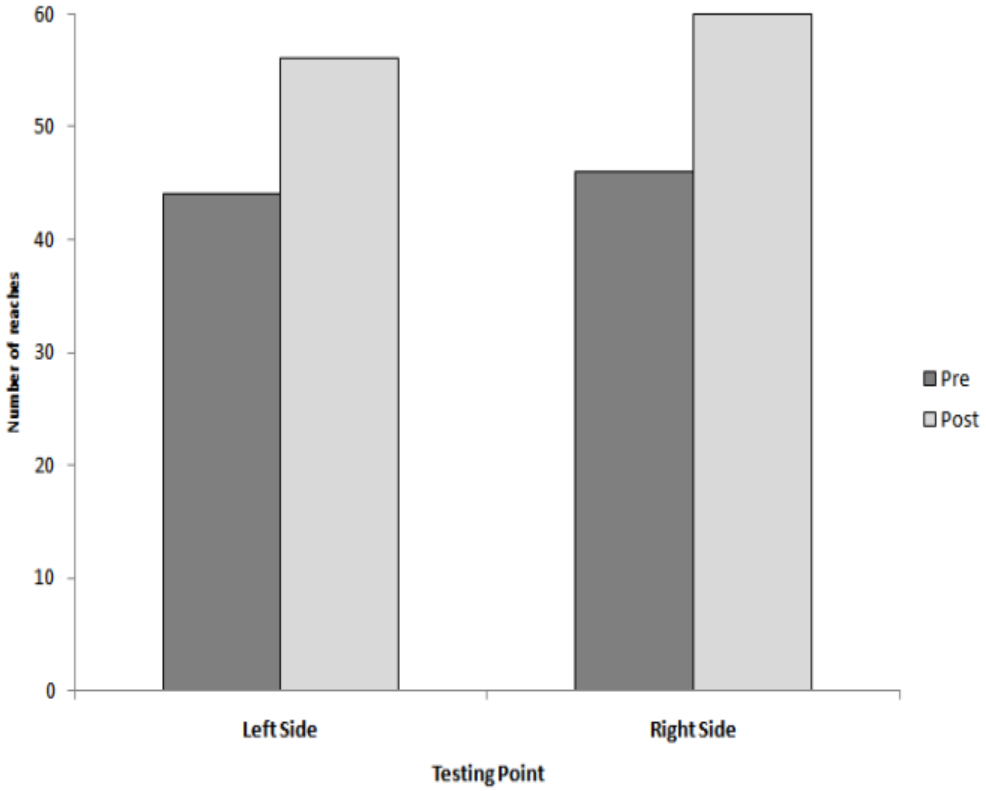
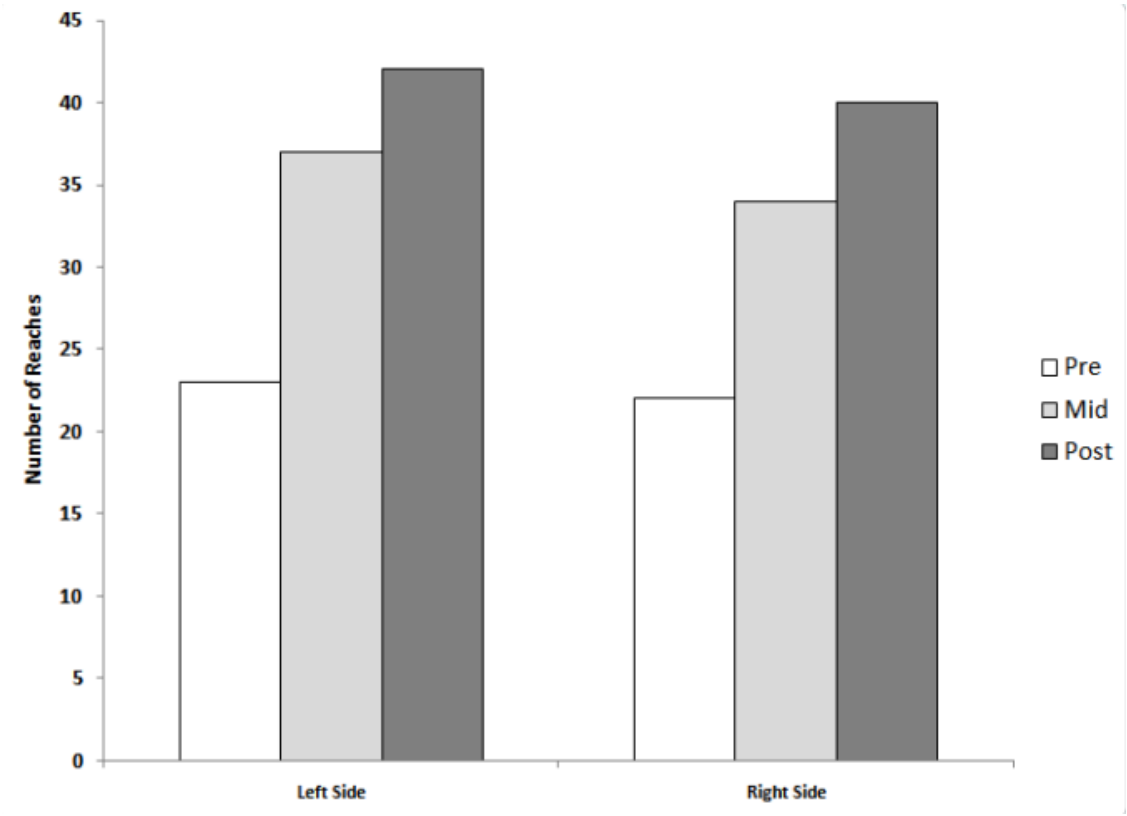
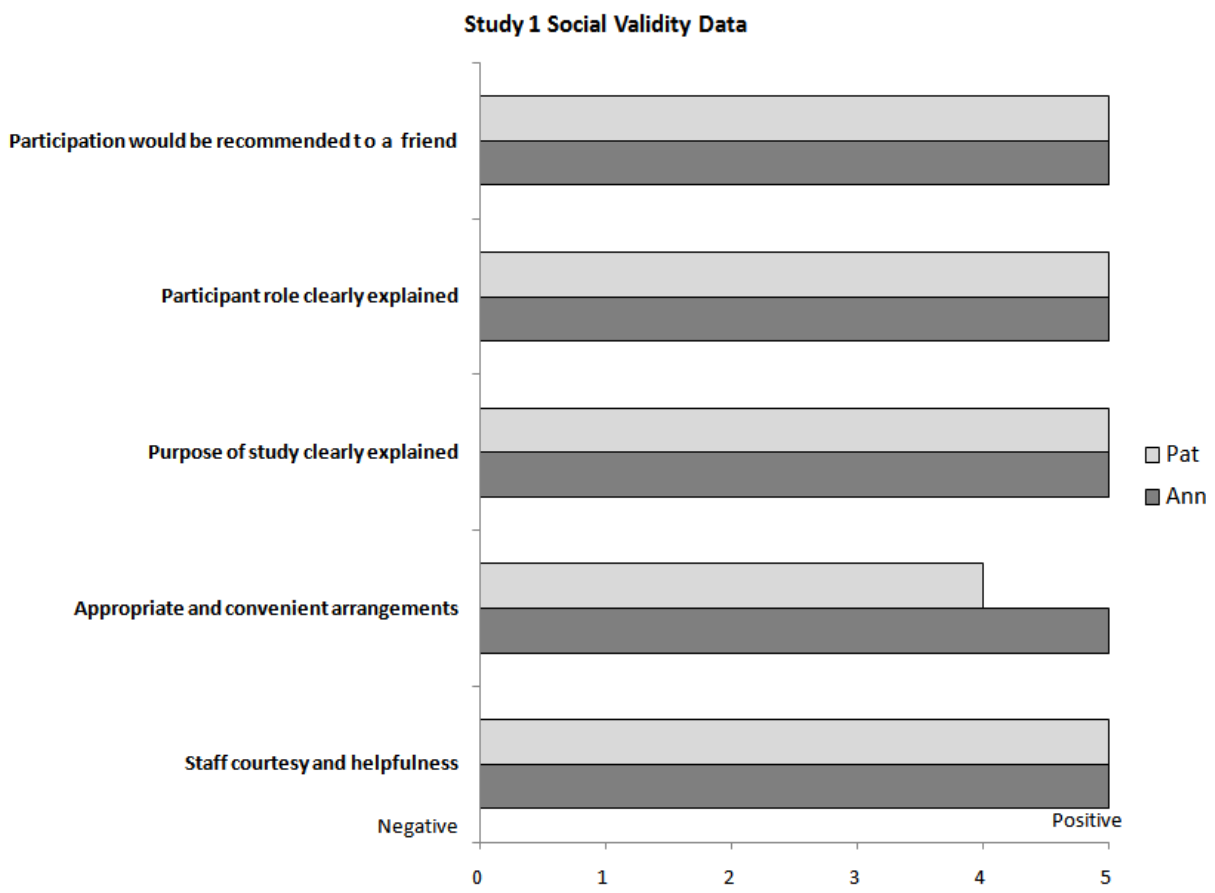


Figure 6. **Pat's Stamina Test Data**



Social validity. Both participants expressed satisfaction with the intervention procedures. . Both gave four of the five participant satisfaction issues the highest rating possible (Figure 7). Pat rated the question regarding appropriate and convenient participation arrangements as "4" while Ann rated it as "5." Additionally, Pat provided comments noting that the exercises took effort and were aversive at times, but that she was glad she kept to her goals and that "it is good to remember how good exercising made me feel afterward." She noted that this feeling would help her to continue with her exercise program. Ann provided comments noting that the staff was professional, courteous, and caring, and that she appreciated them coming on weekends several times to accommodate her schedule.

Figure 7. **Study 1 Social Validity Data**



Reliability

Exercise logs. Inter-observer agreement for exercise session minutes was calculated for the sessions that served as probes (i.e., sessions that were observed and videotaped by the researcher), and were calculated separately for each participant. Participants' recording of exercise minutes in their logs were compared with exercise minutes recorded by an independent observer who viewed permanent products (i.e. videotaped sessions) and timed them with the same type of kitchen timer used by participants. A variance of up to 1 minute (plus or minus 30 seconds) between participants' log entries and the observer's recorded time was regarded as meeting agreement. This variance allowance was based on observation of participants' difficulty in moving quickly to stop the timer when a session ended, and also to occasional errors in

stopping the timer or pushing the wrong button on DVD player remote when starting or stopping the tape or DVD. Percentage of inter-observer agreement was calculated by dividing the number of agreements by the sum of agreements and disagreements and multiplying that figure by 100.

For Ann's exercise logs, the agreement rate was 81.8% or 9 out of 11 sessions. Reliability could not be assessed for one session (data point 39) because the videotape that contained session data stopped while the reliability observer was viewing it and could not be repaired; however, the participant's log entry for that session agreed with the number of minutes of exercise recorded in the meeting record by the researcher. Still this session was recorded as a non-agreement. The other session that did not agree (data point 54) was off by over 1 minute; it was unclear why this occurred. For Pat's exercise logs, the agreement rate was 92.3%, or 12 of 13 sessions. For one session (data point 47), the participant recorded 13 minutes of exercise on the log but the reliability observer counted only 9 minutes and 21 seconds of activity on the tape. It appears that the researcher did not record the entire session, likely due to an error with the camera.

Stamina. Inter-rater reliability for the Reach and Balance measure was 100%, although reliability observers agreed to include some reaches not depicted on camera as they felt confident that the participant made the reaches, as noted above.

Discussion

The results of this study suggest that a home-based exercise treatment package for people with severe mobility-related disabilities may be effective in assisting these two participants to increase their exercise sessions and/ or minutes over a period of 12 or more weeks. A changing criterion experimental design demonstrated incremental increases in self-reported minutes of aerobic activity for both participants throughout the intervention. Additionally, follow-up probes

at 11 weeks for Ann and eight weeks for Pat indicated that participants could successfully pursue an exercise session of similar length in minutes to their last intervention session. The researcher videotaped at least one session in each condition as a reliability probe. Additionally, results of the Reach and Balance measure suggest that participants increased their level of aerobic conditioning between the pre-intervention and post-intervention points. Finally, the social validity questionnaire results indicate that participants were satisfied with the intervention and that they would recommend it to friends.

There are several study limitations. The sample size of two partcipants limits the ability to make generalizations based on this research. Use of a changing criterion single subject experimental design achieved the goal of demonstrating experimental control; however, this design did not contribute to generality of the study results. The study focused only on aerobic exercise, and excluded other types of physical activity, such as strengthening and lifestyle activity, which are more difficult to measure by self-report. Another limitation was reliance on self-reported versus objectively-measured exercise. Neither the self-report exercise logs nor self-reported exertion ratings provide objective evidence of exercise that characterizes robust research, as it is difficult to observe behavior such as exercise performed in uncontrolled community settings.

Another limitation is that the lack of medical consultation for participants with severe disabilties limited the researcher's ability of the researcher to promote more frequent goal increases and intense exercise to achieve greater physical conditioning. Although participants obtained their personal physician's permission to enroll in the study, these physicians did not make recommendations as to the amount or intensity of exercise their patients should pursue. Goals of increased exercise minutes and sessions were negotiated by the researcher and the

participants to minimize the possbility of over-exertion or injuries that manual wheelchair users can often experience. For example, the high prevalence of conditions such as shoulder overuse syndrome (Keyser, Rasch, Finley, & Rodgers, 2003) or rotator cuff tears (Akbar et al., 2010) required caution in promoting increased exercise minutes since both participants used wheelchairs some or all of the time, and experienced concurrent serious health conditions. Although the participants did not appear to be exercising as intensely as those recorded in the videos (e.g., study participants did not appear to be lifting their arms as high), the researcher refrained from encouraging them to work harder, but advised participants to exercise as intensely as possible based on their knowledge of their own personal capacity for exercise. Still, participants' self-reported exertion ratings indicated that they were often working in the moderate to strong exertion range (3-5 on the Borg scale).

While the Reach and Balance measure yielded some interesting outcomes, the administration of the measure did pose some challenges. In several trials, it appeared that Pat focused more on touching the designated spot versus performing the task as quickly as possible, despite several reminders from the researcher that both speed and accuracy were important. For this reason, the results may not represent her optimum capability. In one videotaped trial, the researcher did not position the camera properly and did not get the lower touch point in the camera for any of the reaches. However, reliability observers counted these reaches as touches, since they could see the participant reaching below the camera's view, and noted that the participant always touched the designated spot in other instances. Finally, the measure was not administered at all planned data collection points, as participants declined or postponed performing the measure times. At the mid-study point, Ann postponed the measure after performing her aerobic routine when the researcher visited, saying she was fatigued at that point.

Both participants also declined the measure at the follow-up point; the researcher felt that it was more important to record an endurance session rather than press for administration of the Reach and Balance measure at this point. Overall, while the Reach and Balance measure is a simple, unvalidated measure, it did indicate the possibility of increased conditioning in these participants.

Finally, while the use of video exercise programs appeared to facilitate increased exercise for participants, weekly home vists by the researcher, who uses a wheelchair, could have been a potential motivating factor as well. One participant, Ann, revealed that she owned a seated exercise video but reported using it only a few times several years before. She said that exercise videos were “boring” when used on their own, but knowing the researcher would be coming to collect her exercise log motivated her to keep working toward her goals. Thus, the researcher’s visits may have caused potential reactivity, resulting in higher exercise rates. However, it may also indicate that the structure of the program and the accountability it provided helped generate behavior change. Weekly participant visits also contributed to the cost of the intervention, in terms of researcher time and travel costs, making it less economical than other potential methods of contact and data collection, such as U.S. mail, phone or internet.

The study has several strengths. It was conducted in participants’ natural environments, rather than clinical settings, demonstrating its relevance and response to numerous calls by public health organizations to conduct community-based research to promote the health of persons with disabilities (USDHHS, 1996, 2005; Weil et al., 2002). Providing an option for home-based activity without the need for expensive adaptive exercise equipment was a realistic approach to the life situations of many people with mobility-related disabilities, who often have low incomes, transportation barriers, and limited access to fitness facilities and the high-tech

(albeit typically inaccessible) equipment that they house. The study participants were people with severe mobility-related disabilities, who are often screened out of other exercise studies. In fact, one participant, Ann, appeared to be a classic example of the downward spiral of deconditioning (Durstine et al., 2000) that contributes to increased immobility and disability. Ann's orthpedic injuries from a vehicular accident resulted in constant pain, which restricted her movement. This lead to less movement and she began to gain weight. She experienced depression and developed diabetes. This cycle of pain and increasingly limited movement contributed to her becoming morbidly obese over a number of years. The other participant, Pat, asserted that she did not want to become "lazy and fat" due to her diagnosis of multiple sclerosis, alluding to the "downward spiral" that she had observed in other people with this progressive and chronic condition.

The study empirically showed that a home-based program can assist participants to increase their weekly minutes of exercise and to adopt an important health-related behavior. While participants did not reach the current recommendations of 30 minutes of moderate activity on most days of the week (Haskell et al., 2007), they did incrementally increase their weekly minutes of aerobic activity. One participant, Ann, was exercising for 28 minutes per session by the end of the study, although only for three sessions per week. Starting with low-minute goals may be especially important for interventions promoting unsupervised, home-based programs in which participants' knowledge of their own abilities and limitations must be balanced with the goal of increased physical conditioning. This study also showed that commercially-available seated aerobic video programs can be effective in assisting persons with mobility-related disabilties to increase their physical activity levels. Since group exercise programs for this population are unvailable in many communities (USDHHS, 2005), video programs featuring

seated exercise routines that are accessible for people with mobility-related disablities can help to simulate the structure of group exercise. These programs can also provide some inexpensive variety to exericise programs for this population, as individuals could acquire several programs for use at different times. The need for variety was demonstrated by one participant who insisted on switching to a different program during the last weeks of the intervention due to boredom with the program she was using.

Nonetheless, study results suggest that seated aerobic programs on videotapes or DVDs can be used successfully as part of an home-based exercise treatment package for people with severe mobility-related disabilities. Given the lack of group exercise and sport programming for this population in most communities, and since transportation has been frequently reported as a barrier to community-based exercise, home-based programs using videotapes or DVDs can provide a useful alternative. Future exercise intervention research using this method with the addition of objective exercise measurement could contribute to the evidence base of scientific knowledge on exercise promotion for people with mobility-related disabilities. The next study replicates this intervention with the addition of accelerometer data to provide objective evidence of participants' exercise when the researcher was not present to observe. Study two also incorporates use of a heart rate monitor to collect comparison data on participants' heart rates before and after exercise, and several additional measures and procedures.

Study Two

This study empirically examines the effects of a home-based exercise treatment package for people with severe mobility-related disabilities. The research questions for this study are provided next.

Research Questions

The primary research question was: What are the effects of a home-based exercise treatment package on the exercise frequency, duration, and intensity of participants with severe mobility-related disabilities? An additional research question for study two was: Can data from an accelerometer (device that measures motion) be effective in providing objective data to validate self-reported exercise data? Background on additional dependent variables for study 2 are presented next.

Motion devices called accelerometers were used to generate objective data to supplement participants' exercise self-reports. The study replicates study 1, with the addition of additional measures and procedures as described above. These will be discussed in greater detail next.

Accelerometers are electronic motion sensors that are increasingly used as a direct measure of physical activity in community-based research (Napolitano et al., 2010; Prince et al., 2008). These event-recording devices are small and lightweight, similar to a wristwatch and can be worn on the waist, wrist or ankle; they are similar to a pedometer, although accelerometers use different technology and can measure movement other than steps. Accelerometers are programmed for start date and time by the researcher, and data are recorded in movement "counts" for a specified time interval (e.g., seconds or minutes). Devices can store up to 22 days of data for later downloading, providing a permanent record of movement over a specified time period. The reliability and validity of the devices are well documented (Ward, Evenson, Vaughn, Brown Rodgers, & Troiano, 2005). Numerous studies have established normative movement counts for nondisabled, ambulatory populations (Brage, Brage, Wedderkopp, & Roberg, 2003; Chen & Bassett, 2005; Metcalf, Curnow, Evans, Voss, & Wilkin, 2002) and ambulatory persons with stroke (Haeuber, Shaughnessy, Forrester, Coleman, & Macko, 2004). One study suggests that accelerometers worn on the wrist can distinguish between pushing speeds of wheelchair

athletes (Washburn & Copay, 1999). However, there are no published data examining the use of these devices to validate the self-reported movement of persons with mobility-related disabilities engaging in community-based seated aerobic exercise. Still, the accelerometers can provide a reliable record of movement for a specified time period.

Heart rate monitors are frequently used in research to collect heart rate data during exercise. The reliability and validity of these devices have been established, often by comparing output with that from EKG equipment (Seaward, Sleamaker, McAuliffe, & Clapp, 1990). Researchers continue to test heart rate monitors for use with various populations and for various types of physical activity (Kingsley, Lewis, & Marson, 2005).

Behavioral Risk Factor Surveillance System [BRFSS] questions were used to assess participants' pre- and post-intervention health status. The BRFSS is a state-based system of health surveys that generate data regarding health risk and other health related issues, particularly related to chronic diseases and injury (USDHHS, 2008) and questions devised for the survey generally have high reliability and validity (Nelson, Holtzman, Bolen, Stanwyck, & Mack, 2001)

The Barriers to Health Activities among Disabled Persons [BHADP] scale (Becker, Stuifbergen, & Sands, 1991) includes 16 items reflecting barriers to health activities based on previous barriers literature and by interviews of persons with disabilities. Internal consistency reliability testing resulted in a Cronbach alpha of .82, and the measure correlated highly with other attitudinal measure scores for a group of persons with disabilities (e.g., Sherer's General Self Efficacy Measure (r =.36) (Sherer et al., 1982), and the Stress Management (r = -.33) and Self Actualization Scales (r = -.36) from the Health Promotion Lifestyle Profile (Walker, Sechrist, & Pender, 1987).

Method

Participants. As in study 1, participants were individuals with severe mobility-related disabilities who experienced barriers to participating in exercise and were recruited through the Kansas Physical Disability Waiver Program. Case managers distributed study information to clients and obtained written permission for the researcher to contact potential participants by phone.

Inclusion and exclusion criteria. These criteria are the same as those used in study 1 and are described in detail on p.12.

Four participants enrolled in the study but two withdrew within the first three weeks. One who withdrew was a 30 year old male with balance problems due to a head injury, who declined to exercise with seated aerobic videotapes and said that he did not want to comply with the requirement to complete exercise logs. The other participant was a 28 year old female with multiple disabilities, including juvenile rheumatoid arthritis, who joined a gym just after the intervention started and began exercising regularly. The two participants who completed the study were assigned pseudonyms and are described next.

Lisa was 33 years old and a C-4-5 quadriplegic due to a congenital condition similar to cerebral palsy. She was able to move her arms but not her hands, and adapted activities by using her mouth (e.g., she wrote with a pen in her mouth.) She had earned a bachelor's degree, worked for a number of years, and at the time of the study, was a stay-at-home mother of two young children. She had been active in paralympic sport competition before her marriage, but had been inactive for the past five years. She wanted to engage in regular physical activity to increase her stamina.

Roger was 65 years old, and reported having arthritis and heart disease that required a pacemaker. His balance was unsteady and he had recently recovered from a broken hip resulting

from a fall. He had retired from a laborer's job, lived alone, had a personal care attendant for help in the home, and reported having completed the eighth grade. He ambulated independently in his apartment, but used a cane or walker in his apartment building and out in the community. He was interested in becoming more fit and increasing his energy level so that he could garden in a plot available at the apartment complex. During enrollment, he reported participating in a residents' exercise class held by staff in his housing complex; however, after the researcher participated in one of the classes and learned that it was held only once or twice weekly, she determined that this class was not sufficient in frequency or intensity to make him ineligible for participation in the exercise training package.

Settings and Equipment. All activities were conducted in the participants' homes. Roger lived alone in a two-room apartment on the fourth floor of a large public housing complex. Lisa lived with her husband and two children in a single-family home in the same city. As in the previous study, participants selected one seated aerobic videotape or DVD from several commercially available programs for their use during the study. Details on these exercise programs are included in Appendix A. Each participant was given a digital kitchen timer to measure their minutes of exercise (Model # 201, Oster, Springfield Precision Instruments, Wood-Ridge, NJ). Participants were also were also given activity logs on which to record their data and a laminated copy of the Borg Scale, as noted below. A Polar™ heart rate monitor (ModelS610i, www.polar.fi) was used to measure participants' resting and post-exercise maximum heart rates. Actigraph™ accelerometers (Model #GT7164) were used to provide reliability for participant's exercise self-reported exercise on logs (Actigraph, Pensacola, FL).

Independent variables. This exercise intervention package included components that would assist participants in developing an accessible home exercise routine over the course of

the intervention. These components included behavioral contracting, education, goal-setting, incentives, self-monitoring, and contingent attention. These components are described next.

Behavioral contracting. This component was used study 1 and is described on p. 13. A copy of the study 2 contract is presented in Appendix I.

Education. This component was used in study 1 and is described on p. 13.

Goal setting. This component was used study 1 and is described on p. 10.

Self-monitoring. This component was used in study 1 and is described on p. 15.

Incentives. This component was used in study 1 and is described on p. 15.

Contingent attention. This component was used in study 1 and is described on p. 16.

Dependent variables. Several measures were used to assess behavioral change and to demonstrate behavioral control (i.e., exercise sessions/minutes, exertion, heart/pulse rates, stamina, health assessment, and the Barriers to Health Activities for Disabled Persons [BHADP] scale). These measures are described next.

Exercise sessions/minutes. These data were collected via the weekly exercise logs similar to the logs used in study 1, with the addition of starting and ending times for exercise sessions, and starting and ending time for wearing an accelerometer. (Appendix J).

***Exertion*.** This measure was used in study 1 and is described on p. 14.

Heart/pulse rates. A heart rate monitor was used to assess exercise-related increases in heart rates during exercises videotaped as probes during researcher visits. However, since one participant, Roger, had a pacemaker, he declined to use the monitor. Instead, he was taught to measure his pulse, and was asked to record his pulse on his exercise logs at the start and end of exercise sessions.

Stamina. This measure was used in study 1 and is described on p. 15.

Health assessment. This measure was administered pre- and post-intervention and included six questions from the Behavioral Risk Factor Surveillance Survey that addressed exercise frequency, and physical and mental health.

***Barriers to Health Activities for Disabled Persons [BHADP*].** This scale was administered pre-and post-intervention to assess participants' disability-related barriers to engaging in exercise and other health promotion activities.

Experimental design. As in study 1, this study employed a single-subject changing criterion design (Hartmann & Hall, 1976) that facilitated incremental increases in physical activity sessions and/or minutes per week.

Procedures. The following sections contain descriptions of the procedures used to conduct the study.

Recruitment. The researcher obtained permission from the University of Kansas Human Subjects Committee-Lawrence campus to conduct the study. Participant recruitment began by asking case managers of the Kansas Physical Disability Waiver program (PD Waiver) to informed clients about the study, and to request that interested clients to sign contact consent forms giving the researcher permission to contact the clients. These forms were forwarded to the researcher. The researcher then phoned the clients to confirm interest in participation and to ask several screening questions regarding presence of a mobility-related disability, current engagement in physical activity, and willingness to obtain physician permission to participate. The researcher mailed interested participants a form to sign, allowing consent for the researcher to contact their physicians. When the signed consent forms were returned, the researcher faxed this information, and requested physician permission for their patients to participate in the study (Appendix L).

Enrollment. Upon receipt of physician permission, the researcher scheduled home visits for participant enrollment. A Participant Orientation/Training Checklist was used for fidelity purposes to ensure that all tasks were completed (e.g., signing consent forms, training in log completion, and demonstrating how to use the timer for exercise sessions) (Appendix M).

Equipment calibration. Digital kitchen timers were calibrated (e.g., checked against the researcher's wrist watch to ensure that it kept correct time) before being distributed to participants. This calibration test was repeated during every fourth visit. Also, each accelerometer was checked with a "sit test." Any data on the device was deleted, then it was set to collect data in data collection intervals of one second. The device was then left undisturbed overnight. Data were downloaded the next day to ensure that no motion "counts" had been recorded, indicating that the device was working properly. The heart rate monitor was purchased for the study and instructions indicated that no calibration was needed. Before the study began, the monitor was used by the researcher while exercising with an arm ergometer that had a small computer to measure pulse. Her pulse rate as measured by the ergometer computer and the heart rate monitor typically within 5 beats of each other during the session, providing some indication of reliability.

Weekly visits. Once participants had enrolled and the intervention started, the researcher made weekly visits to: (a) collect participants' completed exercise logs and provide incentives as warranted, (b) have participants put the heart rate monitor on five minutes before exercising and remove it after the session, (c) videotape a seated aerobic session as a reliability probe, (d) review participants' progress on their goals and negotiate goal increases regarding number of sessions and minutes, per session, (e) download accelerometer data and reset the devices to collect data for the next week, (f) conduct the Reach and Balance measure at scheduled points.

The researcher briefly reviewed exercise logs that participants had completed earlier, to inquire about any omissions or inconsistencies. Additional information regarding procedures for exercise log training and the conducting the Reach and Balance measure are provided next.

***Exercise log training*.** The researcher trained participants in completing exercise logs to facilitate consistent and reliable data collection. First, the researcher reviewed the blank log forms with the participants and provided a detailed instruction sheet that explained how to complete the logs (Appendix N). They also assessed participants' ability to complete the logs. Participants were given scenarios that contained descriptions of two wheelchair users' exercise session for seven days (Appendix O). They were given ample time to complete a blank exercise log for each scenario. The researcher used a 70-item score sheet to assess the accuracy and completeness of log completion (Appendix P). (Note: only page 1 of the score sheet is included as this document is repetitive.) If there were five or few errors, the researcher reviewed the incorrect items with the participant to ensure that he or she understood the correct way to record that item. If there were more than five errors, particularly if there were many different types of errors (e.g., omissions, placing info in correct spaces, using the Borg scale), the researcher reviewed the errors with the participant and explained how to make correct entries. The participant was then asked to complete a log based on a third scenario. The researcher then scored the third log, and reviewed any errors with the participant.

Pulse measurement. Because Roger was unable to use the heart rate monitor, he was trained to measure his pulse and asked to take this measurement just before and after his exercise sessions. He was instructed to use his index and middle fingers on his wrist to locate the pulse, and then to count for 15 seconds and to multiply the resulting figure by four. He practiced taking his pulse several times and the researcher took it directly after; the ratings were found to be the

same during several trials. Roger used his own calculator to multiply number of beats by four to obtain his beats per minute. His logs were altered manually to designate a space for him to record his pulse rates. Roger advised the researcher that he had been taking his pulse almost daily since he'd had his pacemaker inserted several years earlier, as he was interested to know what effect it had on his pulse rate.

Stamina measure. The procedures for this measure are described in study 1 on p. 15.

Data analyses. Following are descriptions of data analyses used for heart rate monitor data and accelerometer data.

Heart rate monitor data. Data from the heart rate monitor was downloaded to a computer after each use. Polar data analysis software was used to compile total minutes of data collection, and average, minimum, and maximum heart rates. These data are presented as a comparison between the minimum and maximum heart rates.

Accelerometer data. The purpose of collecting data with accelerometers in this study was to investigate any difference in motion "counts" between exercise hours and non-exercise hours, based on self-reports of when participants wore the devices during exercise and non-exercise times. The data analysis focused on this comparison and proceeded as follows. First, these data were run through an Excel macro that compiled hourly counts from minute counts. The data were then entered into a spreadsheet to facilitate comparison of exercise hours and non-exercise hours.

Figure 8. **Example of Spreadsheet Entry for Accelerometer Data Analysis**

*Date of exercise session	*Activity Type	*Start & End Time of Exercise Session	Hourly Slot Exercise Session	Accelerometer Counts for Exercise Hour	Accelerometer Counts for a Comparison Non-Exercise Hour	Hourly Slot of a Comparison Non-Exercise Hour	*Start & End Time that Accelerometer was worn
11/11	Intervention	10:40-10:55 a.m.	10-11 a.m.	85778	38189	9-10 a.m.	9 a.m. to 10:58 p.m.

*data from exercise log

The spreadsheet allowed the researcher to match accelerometer data with a) times that the participant reported wearing the device with b) hours in which the participant reported exercising. Motion counts from hours in which participants reported exercising were compared motion counts from a non-exercise hour on the same day. The hour before the exercise session was selected as the comparison non-exercise hourly slot; however, if the participant reported not wearing the accelerometer for the entire hour before the exercise hour, then the hour after the exercise session was selected for comparison.) Data collected under the following conditions were excluded: (a) days on which no exercise sessions or classes were reported, (b) days on which activity was recorded but the participant did not record the times that the accelerometer was put on and/or taken off, (c) days on which the exercise hour and a contiguous hour did not fall entirely within the hours the participant indicated wearing the device, and (d) days on which the participant reported wearing the device and performing activity but no or very low counts were recorded, indicating a possible programming error or device malfunction.

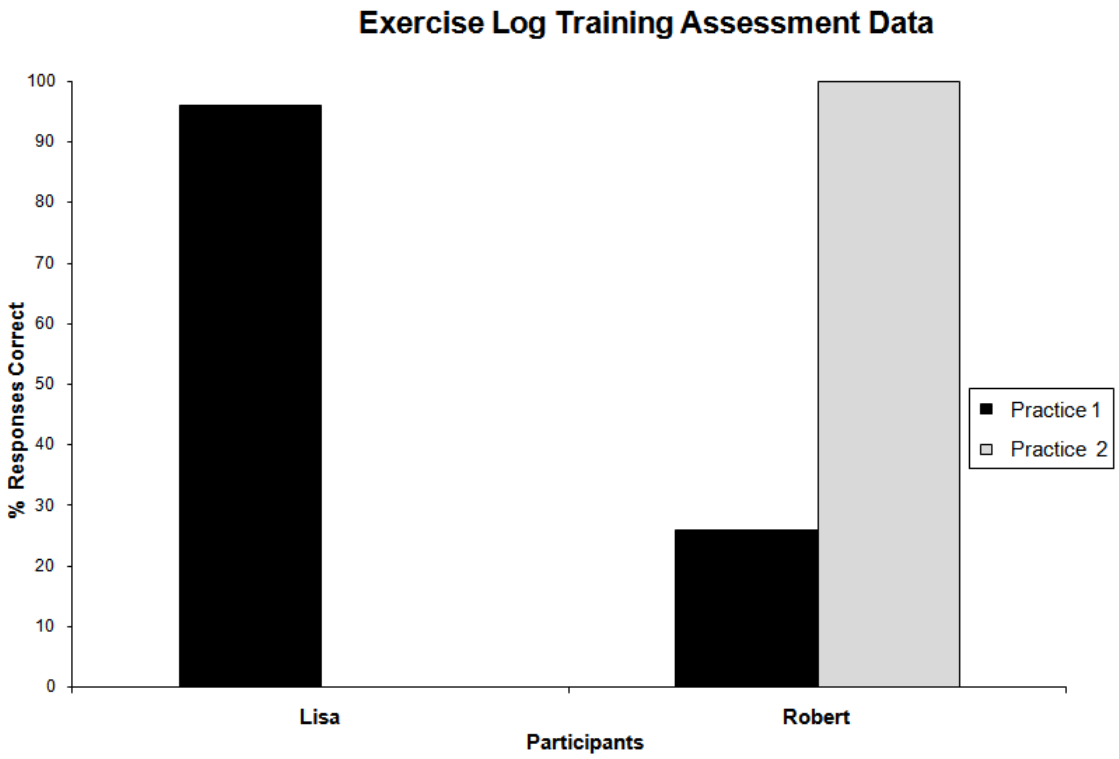
Results

Program choices. Lisa chose a program produced by the National Center on Physical Activity and Disability titled, “Exercise Program for Individuals with Spinal Cord Injuries: Paraplegia,” which provides a 30-minute seated aerobic workout with five wheelchair users. Roger chose,” Chair Dancing,” which provides a 40 minute seated workout with lead by a non-

disabled aerobics instructor who conducts the class in a seated position and a group of men and women in chairs. This program involves both arm and leg movements, such as kicks, which provides a more intensive workout. Descriptions of these programs are presented in Appendix A. Both programs provide a moderate aerobic exercise session with safety warnings (e.g., signs of overexertion) and suggestions regarding how to reduce (e.g., lift arms no higher than the head) or increase (e.g., create resistance by using "punching" movements) the intensity of the movements.

Exercise log training assessment. Results of the assessment are presented in Figure 9. Lisa accomplished the assessment in 15 minutes, with 67 of 70 items correct (95.7%). The researcher reviewed her three incorrect entries, which consisted of a slight error in calculating exercise minutes, and several omissions, and determined that the participant understood how to perform the task to criterion. Roger accomplished the assessment in 22 minutes; he completed 18 items correctly (26%), and made a variety of types of errors. The researcher reviewed the participants' logs with him, and compared them with example logs that had been completed correctly for those scenarios, to demonstrate a correctly completed log. Roger was then asked to complete a third log based an additional scenario. This time the researcher read the scenario to him while he completed the logs. Roger completed all items correctly on this additional log, and appeared to understand how to perform the task to criterion.

Figure 9. **Results of the Exercise Log Training Assessment**

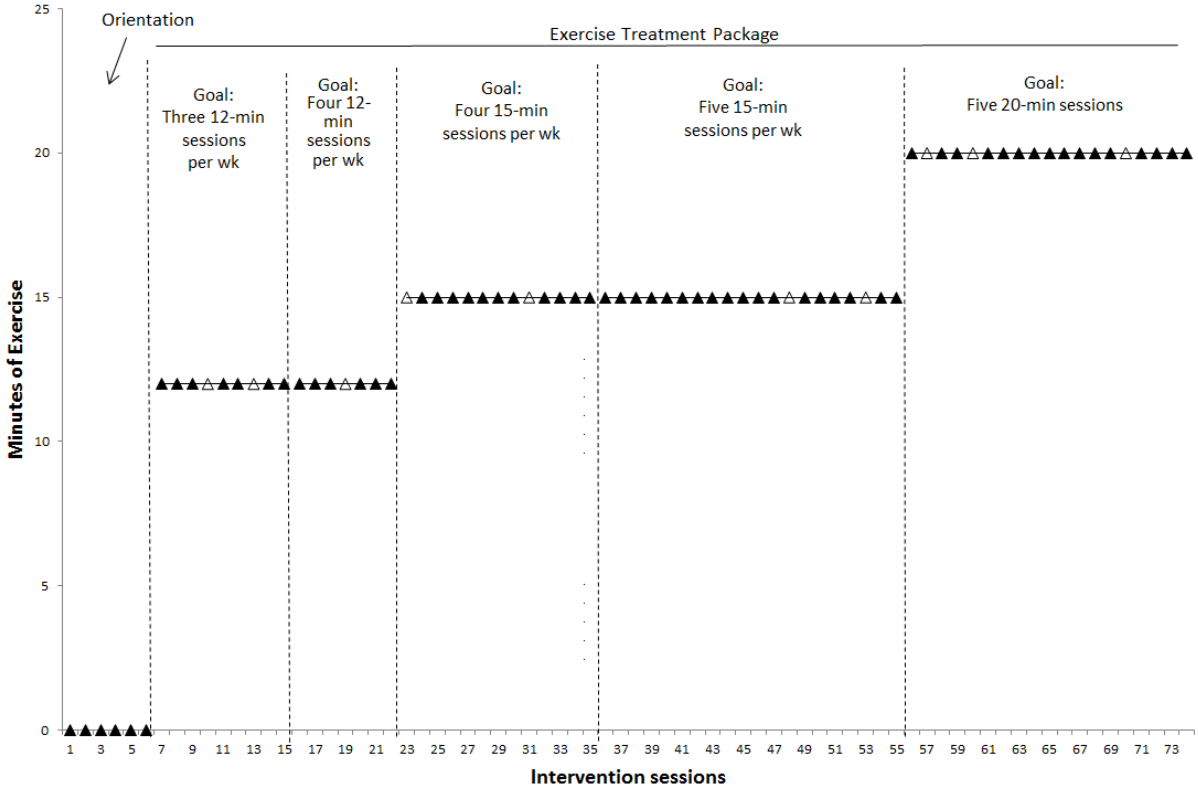


Exercise sessions/minutes. Lisa set five goals and Roger set four goals for exercise sessions per week and/or exercise minutes per session during the intervention. Based on their self-reported exercise log data, both participants achieved their goals. Lisa's exercise log data is presented next, followed by Roger's data.

Lisa set a goal of three 12-minute exercise sessions to begin her program (Figure 10). She reported achieving this goal over a three week period (sessions 7-15). She then set a new goal, increasing to *four* 12-minute sessions per week, and reached this goal over slightly less than two weeks (sessions 16-22). Next, she increased her goal to four 15-minute sessions per week, and reported attaining this goal over nearly 3 weeks (sessions 23-35). A new goal was set to five 15-minute sessions per week, and she met this goal over five weeks (sessions 36-55). Finally, her goal increased to five 20-minute sessions per week, which was achieved over a four week period

(sessions 56-74). Although Lisa said she became bored with her video program and tried a new one on December 6 (session 27), she switched back to her old one for the next session and used this program for the remainder of the intervention, stating that the old program was more motivating and had better music. She also said that she could accomplish more of the movements, despite her arm limitations due to quadriplegia.

Figure 10. **Lisa's Exercise Log Data**

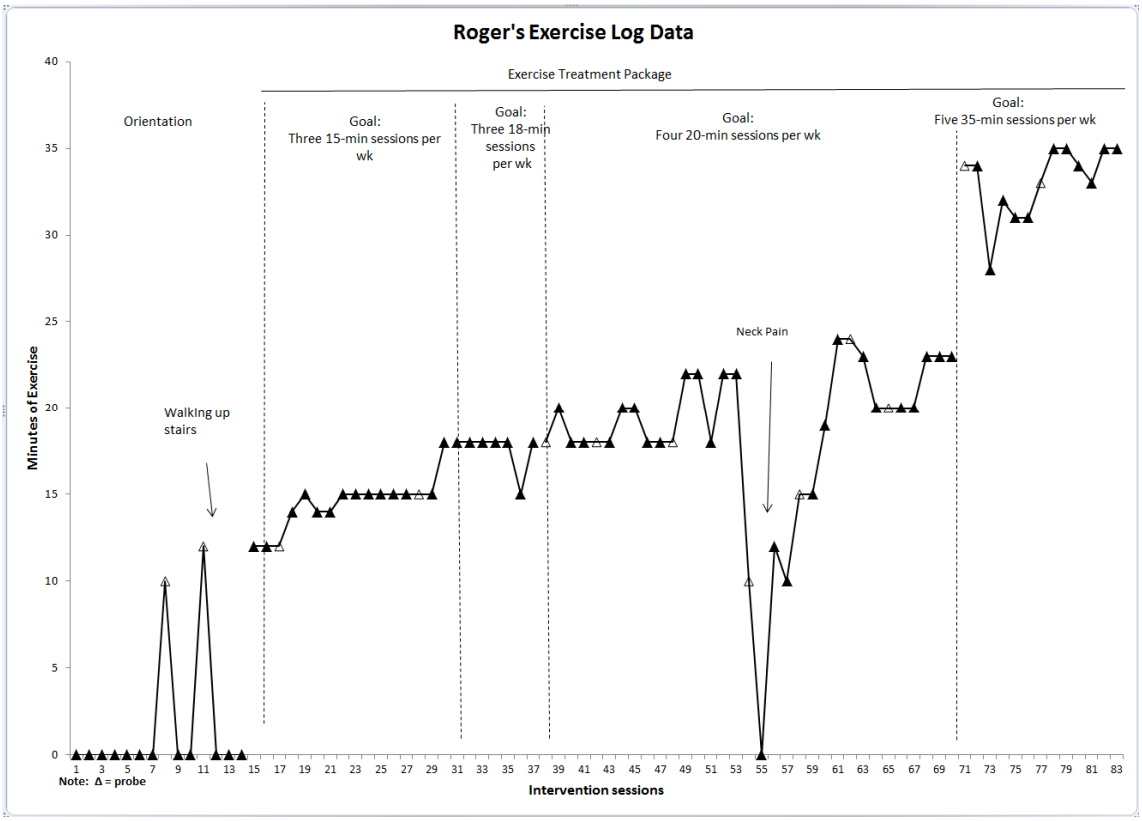


Roger's chart reflects data from several exercise sessions that occurred in the orientation period (Figure 11). He did 10 minutes of an exercise video to decide which one to use for his program (session 8) and then did 12 minutes of stair climbing in his apartment building three days later (data point 12). He acknowledged that the stair climbing "just about did him in" and

his self-described exhaustion after this activity is reflected in his exertion rating of “10” on the Borg scale, which will be described later.

Roger set an initial goal of three 15-minute sessions per week for his program. After four sessions with fewer minutes, he recorded one 15-minute session, then recorded two 12-minute sessions, and reached his goal with three weeks of three 15-minute sessions, ending with an 18-minute session (sessions 15-30). He then increased his goal to three 18-minute sessions per week, achieving this goal over a two-week period (sessions 31-37), with the exception of one 15-minute session (session 36). Next, Roger increased his goal to four 20-minute sessions per week. His performance at this rate varied, including some sessions at 18 minutes, some others at 22 minutes, with one missed session and some 10-12 minute sessions due to neck pain (sessions 38-70). However, he finished with three 23-minute sessions (sessions 68-70) and set a new goal of five 35-minutes sessions per week. He pursued this goal for several weeks at varied minutes (sessions 71-83); however, his mean session minutes for this condition was 33.08 minutes, performing six sessions in one week and seven sessions in the next week.

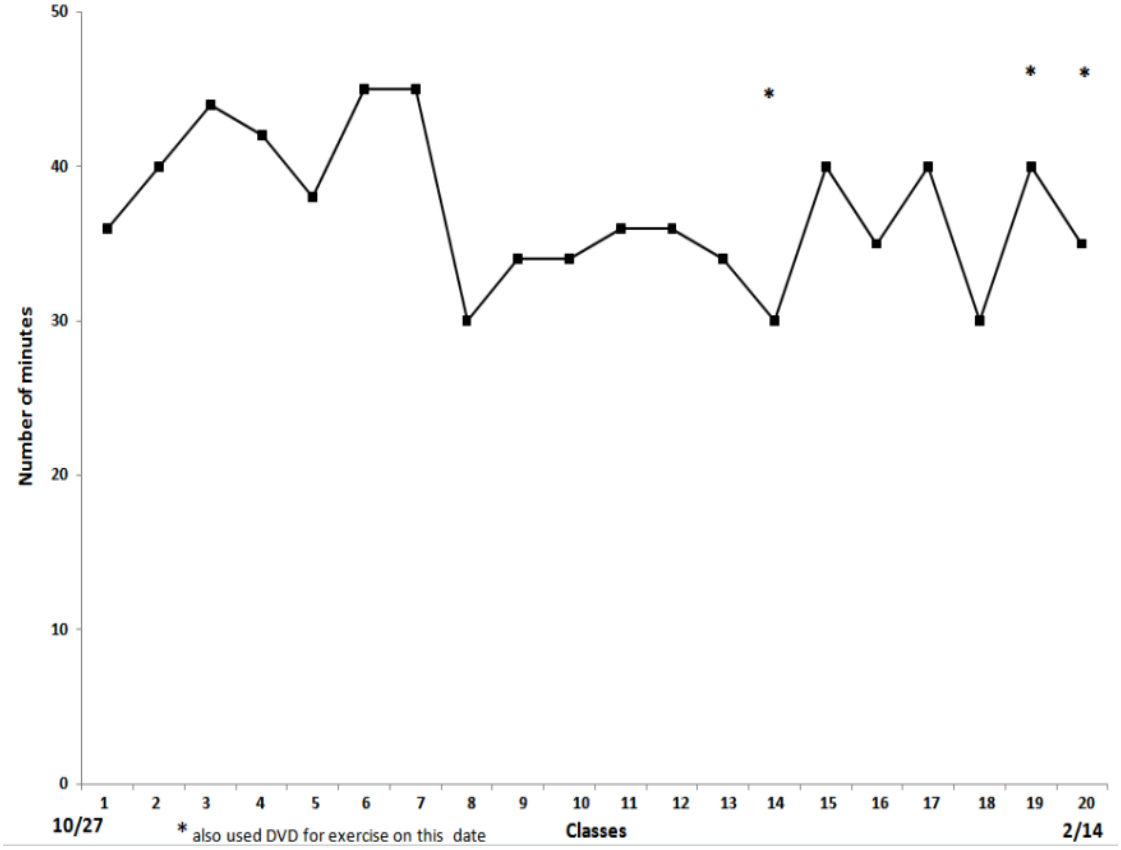
Figure 11. **Roger's Exercise Log Data**



Before and during the intervention, Roger reported attending an exercise class, referred to as the "residents' exercise class," conducted in the lounge area of his housing complex. Roger lived in public housing designated for senior citizens and younger people with disabilities on fixed incomes. The class was held once or twice weekly for 30-45 minutes, depending on staff availability. It was targeted to residents with a mean age of about 75 years. Participants sat for most of the exercise, but those who were able stood for some exercises while holding on to the back of a chair. The researcher observed and participated in one class, and found that the exercise was low impact. It was conducted in a leisurely manner, with the class purpose both socialization and exercise. For example, when a new person came late or appeared after having been absent from previous classes, participants often stopped for a few minutes so that they could welcome and converse with the newcomer. Roger said that he did not bring his timer to the

class, but recorded the number of minutes of the class in his intervention exercise log when he returned to his apartment. Roger also reported his class minutes and exertions ratings on his exercise logs. Over the sixteen weeks of the intervention, Roger participated in 30 residents' exercise classes, and toward the end of the intervention, participated both in his video sessions and the residents' exercise class on three days. Roger's accelerometer data for these classes is reported below.

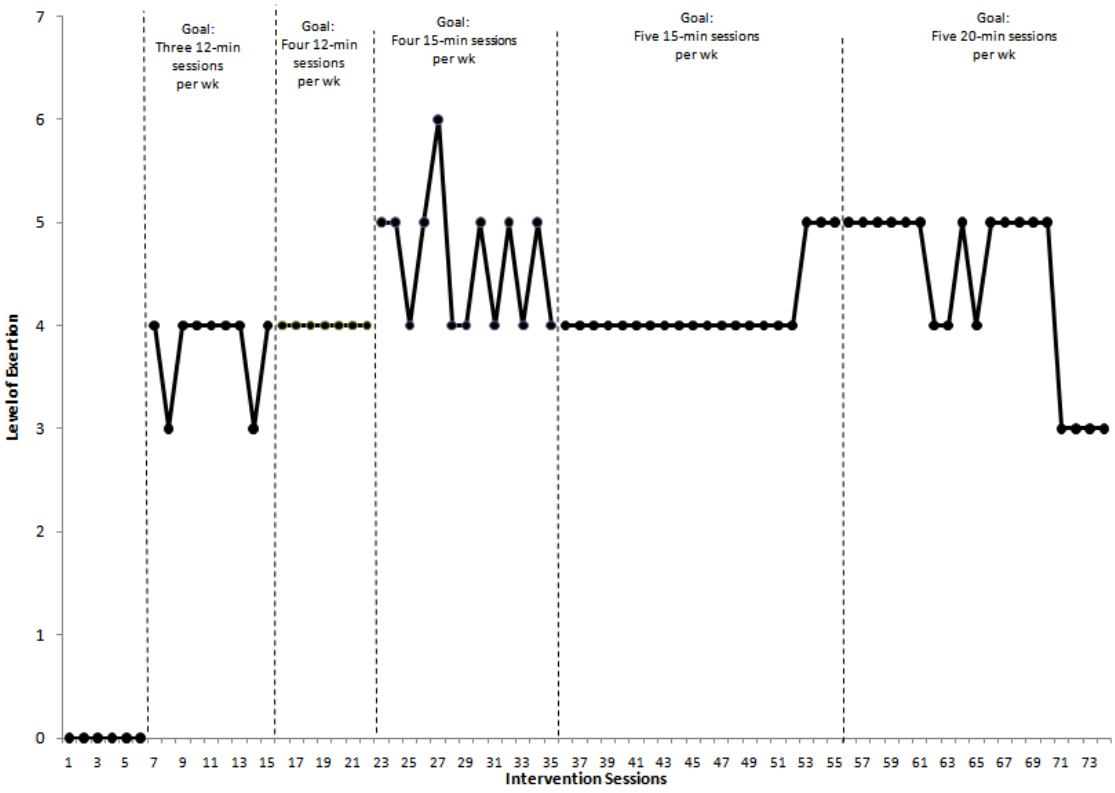
***Figure 12*. Roger's minutes of exercise in the residents' exercise class**



Exertion. Lisa's Rate of Perceived Exertion [RPE] ratings fluctuated but ended with lowered ratings for her last four sessions, indicating the possibility of increased conditioning (Figure 13). During her first condition (sessions 7-15), she reported consistently pursuing her

goal of three 12-minutes sessions per week, and consistently reported RPEs of four, indicating moderate to strong exertion, with the exception of two mid-condition sessions for which she recorded a lower RPE of three (sessions 8 and 14). For condition two (sessions 16-22), she reported RPE's of four for each session, although she had increased her exercise goal to four 12-minute sessions per week. For condition three (sessions 23-35), she steadily pursued her exercise goal of four 15-minute sessions per week; however, her RPE fluctuated between four and five with one rating of six (session 27). For condition four (sessions 36-55), she pursued a goal of five 15-minute sessions per week, and reported a RPE of four for each session, with the exception of the last three when she reported an increased rating of five (sessions 53-55) For the fifth condition (sessions 56-74), she pursued a goal of five 20-minute sessions per week and reported RPEs between four and five; however, she reported a lower RPE of three for the last four sessions (sessions 71-74). This may have indicated that she was becoming more conditioned as she pursued a regular exercise program.

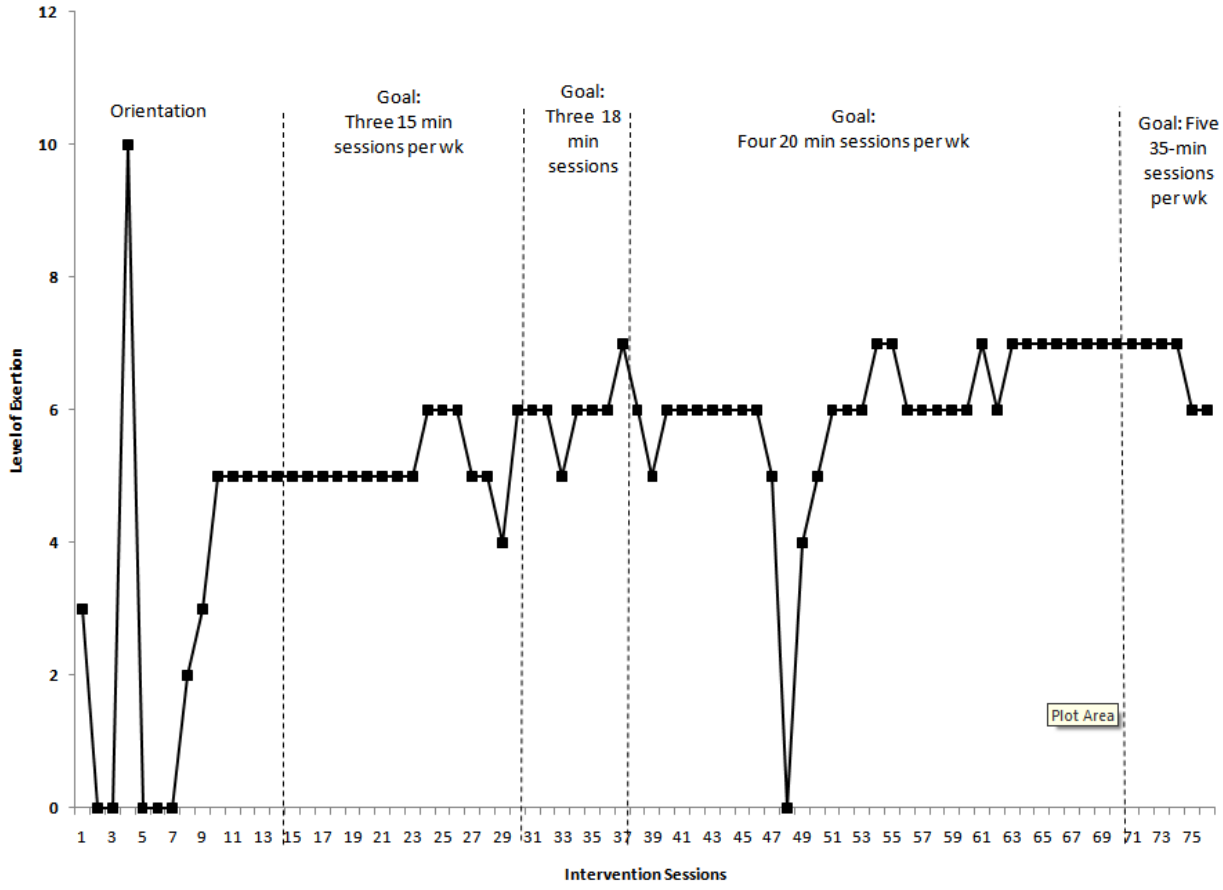
Figure 13. **Lisa's Exertion Ratings**



Roger's RPE ratings also fluctuated but may also have indicated eventual increased conditioning (Figure 14). For condition one (sessions 15-30), his RPE ratings rose from two to five as he increased his minutes of exercise to meet his goal of three 15-minute sessions per week (sessions 15-17). His RPE ratings remained at five for the remainder of that condition. For condition two (sessions 31-37), he reported RPEs between six and four, with no apparent pattern, although his minutes of exercise were fairly stable at 18-minute sessions. For condition three (sessions 38-70), with a goal of four 20-minute sessions per week, Roger's exercise minutes per session fluctuated from 10 to 23 minutes and he reported variable RPE ratings from five to seven as well. He reported neck pain during this condition, which caused him to miss one planned exercise session (session 55) and to shorten others. Finally, in condition four (sessions 71-83),

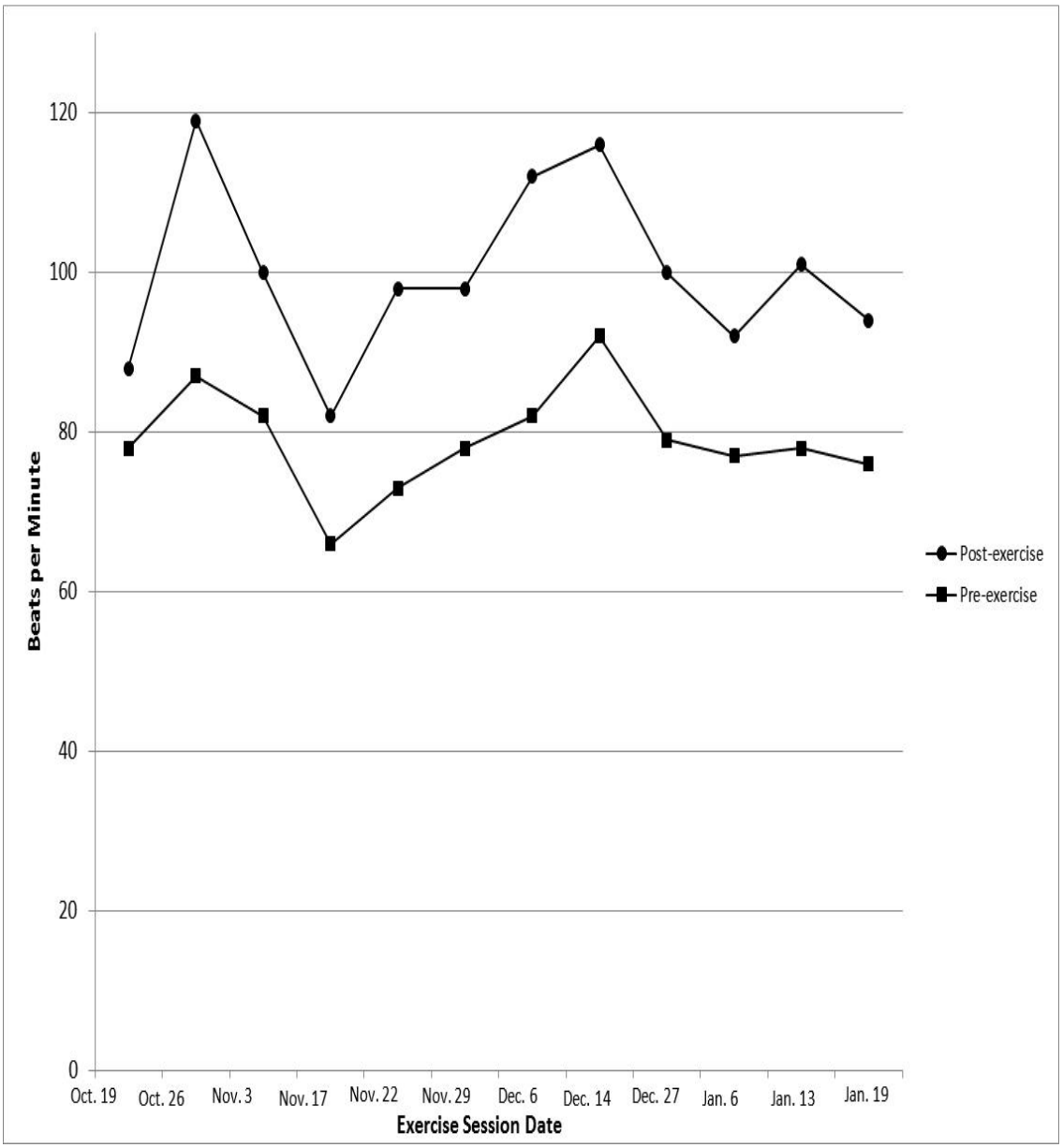
Roger set a goal of five 35-minute exercise sessions per week. His sessions ranged from 28 minutes to 35 minutes; however, he reported consistent RPEs of seven, with the two final sessions rated at six (sessions 82-83).

Figure 14. **Roger's Exertion Ratings**



Heart/pulse rates. Lisa wore the heart rate monitor during 12 of her exercise sessions when the researcher was present (Figure 15). These data are presented as empirical evidence of an increased heart rate after exercise. Overall, her heart monitor data appears to correspond with her heart rate as measured before exercise. Her pre-exercise mean heart rate was 70 beats per minute, increasing to a post-exercise mean heart rate of 100 beats per minute.

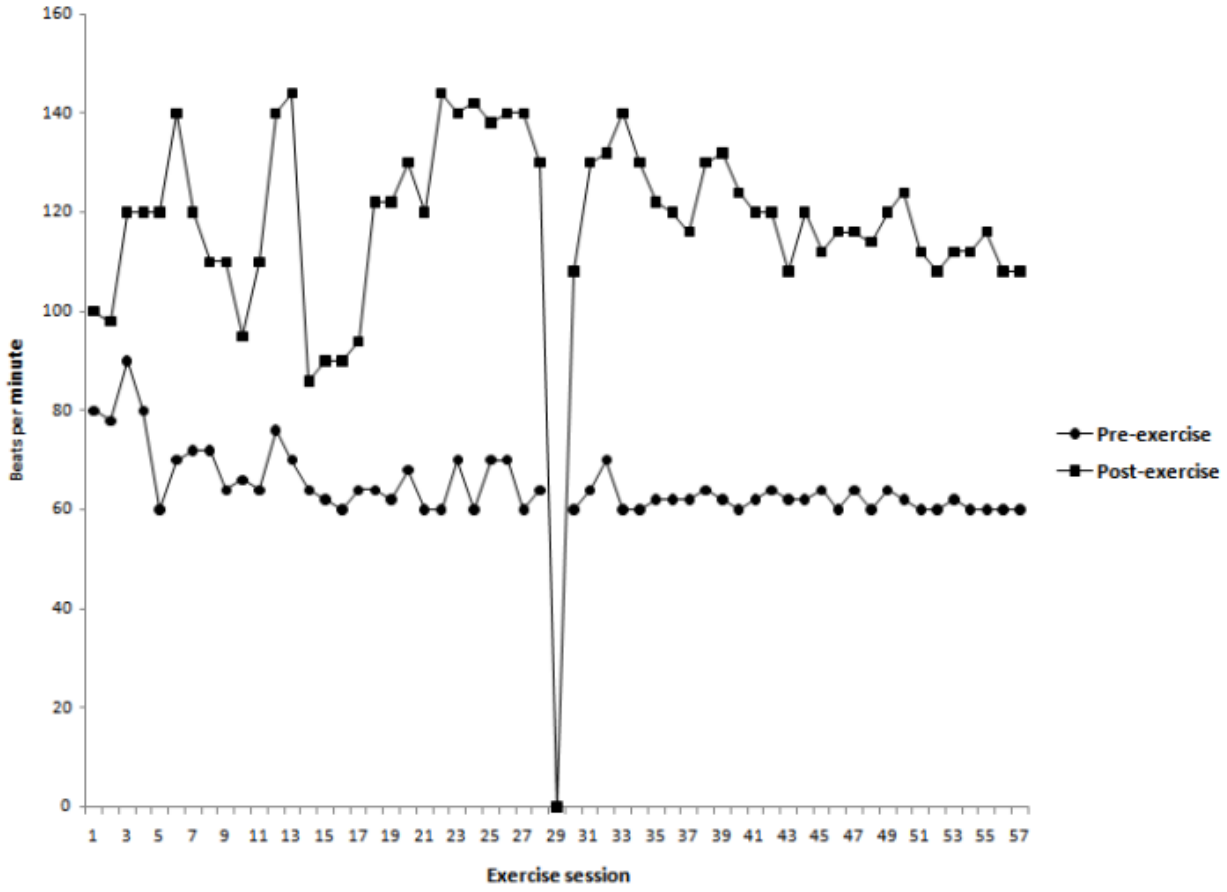
Figure 15. **Lisa's pre- and post-exercise heart rate data for 12 exercise sessions showing increased heart rates after exercise.**



Roger self-reported his pre-and post-exercise pulse rates in lieu of using the heart rate monitor (Figure 16). These subjective data are presented as empirical evidence of increased pulse rates after exercise. Roger used his wrist watch to measure his pulse before and directly after his exercise sessions and his pulse rates on his exercise logs for 56 exercise sessions. Overall, data show variations of about 10 beats per minute in his pre-exercise pulse and relatively highly

variable post-exercise pulse rates from a low of 86 to a high of 144. His mean pre-exercise pulse rate was 64.9 and his mean post-exercise pulse rate was 119.4.

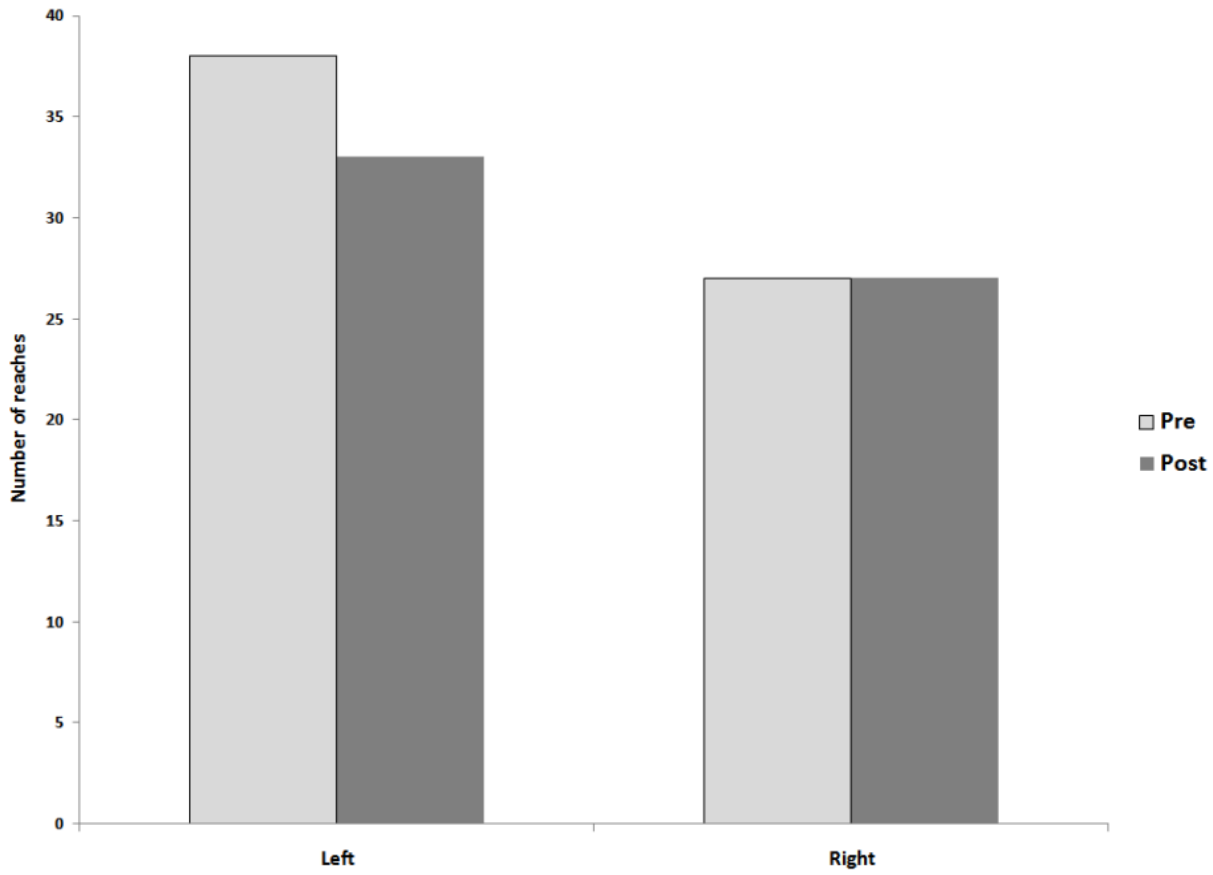
Figure 16. **Roger's self-reported pre- and post-exercise pulse rates for intervention sessions**



Stamina. The Reach and Balance measure was administered at the pre- and post-intervention points**.** Because of the almost identical results from two trials in study 1, only one trial at both the pre-and post-intervention points was conducted for study two. Lisa's performance declined from 38 pre-intervention reaches to 33 post-intervention reaches on the left side, a decline of 15.2% (Figure 17). Her pre- and post-intervention results for her right side were exactly the same, 27 reaches. Because Lisa's arms were contracted due to her disability, she used her elbows instead of her hands to touch the wall for the trial. Therefore, she had to be positioned much closer to the wall to allow for a shorter reach. However, this accommodation

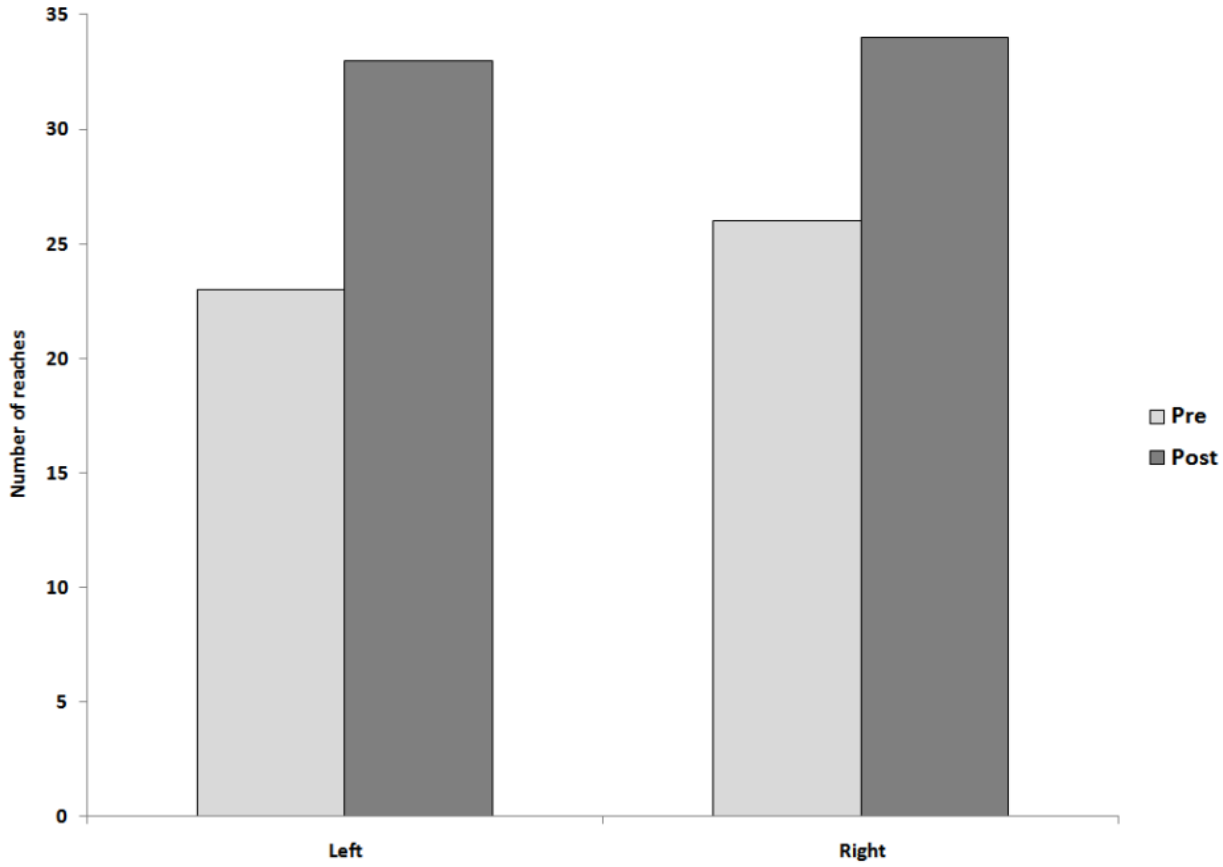
appeared to simulate the same level of exertion as other participants expended experienced in completing the trial.

Figure 17. **Lisa's Stamina Test Data**



Roger showed improvement at the post-intervention point on his left side, increasing his reaches from 27 to 33 (22.2%) and on his right side, from 24 to 34 reaches (41.7%) (Figure 18). As with Pat in study 1, Roger seemed to focus more on accuracy than speed, and so, his performance may not represent his optimum capability.

Figure 18. **Roger's Stamina Test Data**



Health assessment. Both participants reported that their general health increased from good to very good from the pre- to post-intervention points, and that they were exercising more regularly. Results of this assessment are presented in Table 1.

Table 1

Results of Study 2 Pre/Post Health Assessment

	Lisa		Roger	
	Pre	Post	Pre	Post
How long since you last exercised regularly?	**Over 5 yrs**	**Less than 1 month**	**Never**	**Less than 1 month**
General health	**Good**	**Very good**	**Good**	**Very good**
How many days during the last 30 days was your physical health not good?	**3**	**3**	**0**	**0**
How many days during the last 30 days was your mental health not good?	**1**	**1**	**2**	**0**
How many days did poor physical or mental health keep you from your usual activities?	**1**	**3**	**2**	**0**

Barriers to Health Activities for Disabled Persons data. Overall, results from this measure indicated that participants reported that their barriers to health activities decreased from the pre- to post-intervention point. One exception was that Lisa reported "never" being "too tired" on the pre-test, but reported experiences this barrier "sometimes" on the post-test. These data are presented in Figures 19 and 20, respectively.

Figure 19. **Lisa's Barriers to Health Activities for Disabled Persons Data**

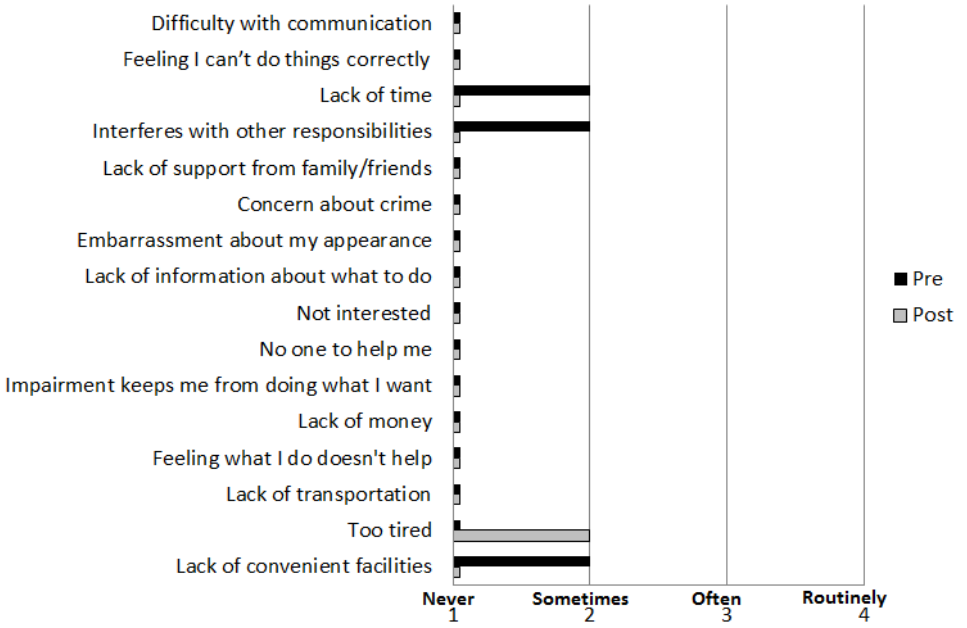
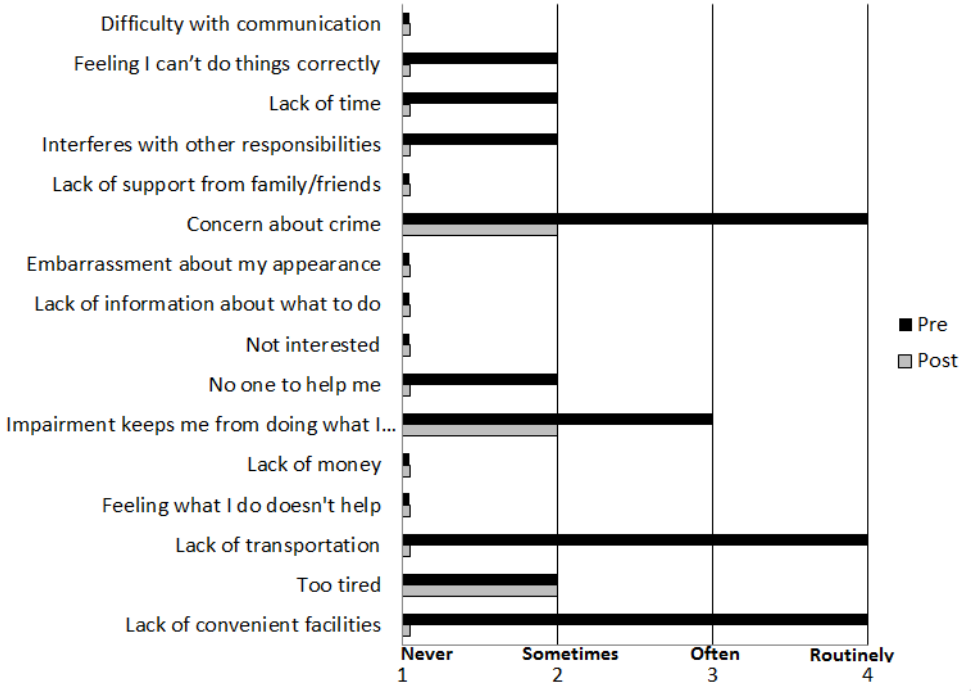


Figure 20. **Roger's Barriers to Health Activities for Disabled Persons Data**



Social validity. Participants were asked to complete an eight-question survey at the intervention end. The questions addressed participants' positive and negative experiences of the

intervention, participant outcomes, and whether participants would recommend the program to others. A summary of the responses is presented in Appendix Q. 19. Lisa completed the survey herself, but Roger asked the researcher to record his responses. Overall, participants reported positive experiences regarding the intervention. Both reported that they would recommend the program to a friend.

Reliability

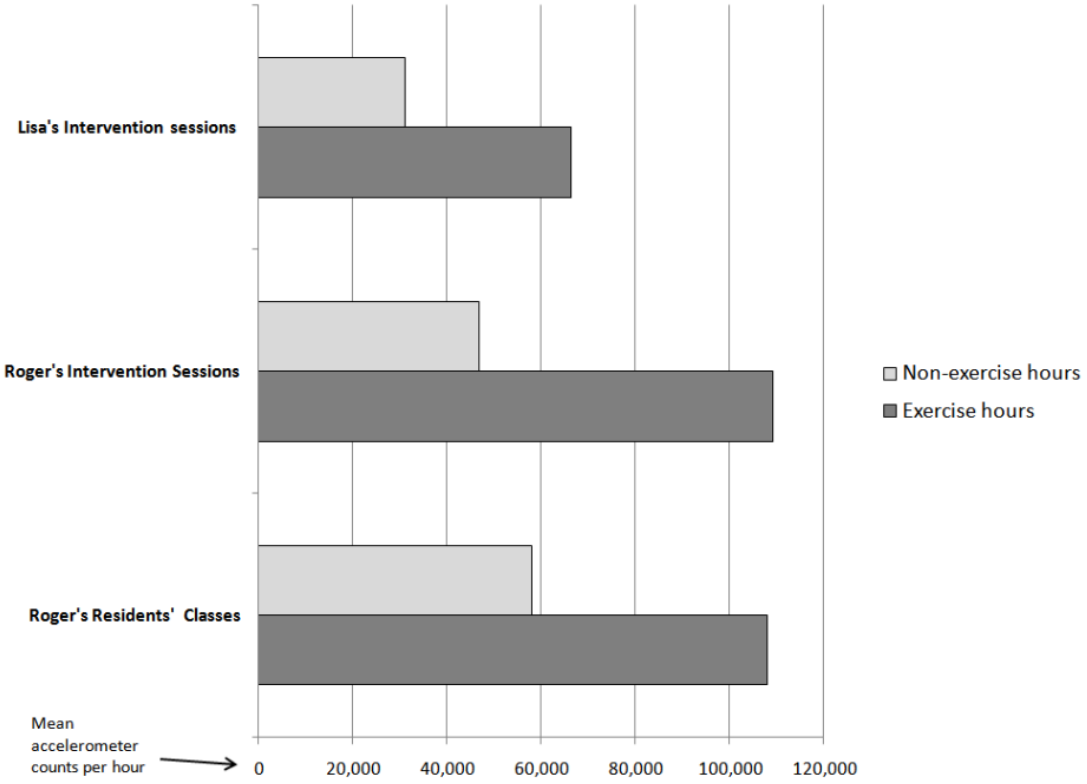
Exercise log data. Inter-observer agreement for exercise session minutes was calculated for the sessions that served as reliability probes (i.e., sessions that were observed and videotaped by the researcher, and were calculated separately for each participant. Participants' recording of exercise minutes in their logs were compared with exercise minutes recorded by an independent observer who viewed permanent products (i.e. videotaped sessions) and timed them with the same type of kitchen timer used by participants. A variance of up to 1 minute (plus or minus 30 seconds) between participants' log entries and the observer's recorded time was regarded as agreement. Reasons for this variance included participants' difficulty, walking or moving a wheelchair quickly, to stop the timer when a session ended, and also to occasional errors in stopping the timer or pushing the wrong button on the DVD player remote when starting or stopping the tape or DVD. Percentage of inter-observer agreement was calculated by dividing the number of agreements by the sum of agreements and disagreements and multiplying that figure by 100. For Lisa's exercise logs, the agreement rate was 84.6%, or 11 out of 13 sessions. For Roger, the agreement rate was the same, 84.6%, or 11 out of 13 sessions. Lack of agreement for some sessions occurred both to participant error (briefly stopping during the session without stopping the timer) or researcher error (failing to start the camera on time when a knock on the door occurred and the participant had begun exercising and asked the researcher to respond to it).

However, each of the four non-agreements was less than 60 seconds difference between the participant's log entry and the reliability observer's data.

Accelerometer data. For Lisa, data from 38 intervention exercise sessions were analyzed; these sessions included two data points in condition one, seven in condition two, eight in condition three, thirteen in condition four, and eight in condition five. The mean accelerometer count for intervention exercise session hours was 66,214 ct/hr, or 2.1 times higher than the count for non-exercise hours (31,190 ct/hr).

For Roger, data from 17 intervention exercise sessions were analyzed; these sessions 0.one in condition four. The mean accelerometer count for intervention exercise hours was 109,066 ct/hr, or 2.3 times higher than the count for non-exercise hours (46,794 ct/hr). Accelerometer data from Roger's participation in the residents' exercise class was also analyzed. The mean count for class hours was 107,914 ct/hr, or 1.9 times higher than non-class hours (58,025 ct/hr). These data reflect that the mean self-reported minutes of the residents' exercise classes included in the analyses was 40 minutes, and the mean self-reported minutes of the intervention exercise sessions included in the analyses was 19 minutes, or less than half of the class minutes. This, the higher mean counts for residents' classes are likely to the fact that the classes are longer in minutes than the intervention sessions.

Figure 21. **Mean accelerometer counts for exercise and non-exercise hours – Lisa and Roger**



Stamina. Inter-observer reliability for the Reach and Balance measure was 100% for both participants. Although Lisa's performance was somewhat difficult to assess, as she was using her elbow rather than her hand to touch the wall, both the researcher and reliability observer recorded the same number of touches when viewing the videotape.

Discussion

The findings of study 2 suggest that a home-based exercise treatment package for people with severe mobility-related disabilities can be effective in assisting them to increase their exercise sessions and/ or minutes over a period of 16 weeks. As in study 1, a changing criterion experimental design was used to demonstrate incremental increases in self-reported sessions and minutes of exercise throughout the intervention. Data collected via participants' self-report exercise logs was validated by accelerometer data showing increased movement during hours

when participants reported exercising. The addition of exertion ratings, data from a heart rate monitor, self-reported pulse rates, and an stamina measure provide secondary data to support the notion that participants' behavior changed positively (i.e., that they set exercise goals and reached them during the intervention phase). Using an event recording device that produces permanent records to collect objective data regarding exercise in home- and community-based settings represents an innovative empirical method of measuring an important health-related behavior in uncontrolled settings. These devices allow researchers to study exercise behavior without setting restrictions on participants' exercise locations and schedules, facilitating the integration of exercise into their individual schedules and routines.

While the pre- and post- intervention BRFSS health assessment questions did not show many changes, it is notable that both participants reported their general health improved from good to very good on the post-test. BHADP results indicated that participants experienced fewer barriers to participating in health activities at the intervention end. Roger's concern about crime (a factor on the BHADP) dropped from being a routine concern to one he experienced only sometimes. He reported that his impairment kept him from doing what he wanted only sometimes, versus often. His BHADP results also showed that several barriers he experienced routinely (i.e., lack of transportation and lack of convenient facilities) were never experienced by the end of the intervention. Lisa reported that she never experienced lack of time, interference with other responsibilities, and lack of convenient facilities as barriers, even though she reported experiencing them sometimes before the intervention. Her report that being too tired sometimes, versus never being too tired for health activities before the intervention, may have resulted from her increase to five exercise sessions per week at the end of the study. Overall, this 16-week exercise training package produced positive health benefits for both participants.

Limitations. The study has a number of limitations. As in study 1, the research results have limited generalization, due to the small sample. Use of a changing criterion single subject experimental design achieved the goal of demonstrating experimental control; however, this design did not generality of the study results. However, the participants were of different sexes, and represented different life stages, with one at retirement age and the other in her mid-thirties. They also represented diversity in their disability types, with Roger experiencing several aging-related conditions (i.e., arthritis, hip replacement, and heart disease) and Lisa experiencing quadriplegia from birth. These participant characteristics, coupled with those of study 1 participants, indicates that the home-based exercise treatment package may appeal to a broad range of persons with mobility-related disabilities.

Another limitation is the focus on aerobic exercise only, excluding other types of physical activity, such as stretching and strengthening, that are also important to overall health. Aerobic activity is more easily pursued independently with a video; also, stretching and strengthening would require more safety training, and likely involve transferring from the wheelchair to other surfaces.

As in study 1, the participants obtained their physicians' permission to enroll in the study and pursue a program of moderate exercise. However, the physicians did not make recommendations regarding specific exercises their patients should or should not do. This caused the researcher to be cautious about prompting activity increases, and to fully involve the participants in decisions regarding goals for frequency and duration of exercise sessions. As a result, the participants did not increase goals as regularly as the researcher thought they could have. On the other hand, the shared decision-making encouraged participant ownership of their programs, and may have encouraged program survival, although this was not assessed.

The researcher intended that participants would develop an exercise routine that would be sustained after the study ended. She suggested to participants that planning to exercise at a specific time each day might be helpful. In response, Roger talked about exercising before he showered every day, as part of his personal care routine. Lisa mentioned that exercising after her children left for school each weekday would be help her to develop a routine. However, both participants' log data revealed that they exercised at a variety of times of the day with no discernible pattern. Still, this might demonstrate their determination to pursue their scheduled sessions to meet their goals no matter what else was on their calendar on a particular day.

A more serious limitation is the lack of follow-up data. The researcher had planned to conduct a follow up probe 8-12 weeks after the intervention end. However, both participants were experiencing life situations that caused them to decline further involvement in the study. Lisa missed the last session due to a brief hospitalization for respiratory issues, and upon recovery, began volunteering at her children's school on a regular basis and did not feel that she could take time for more researcher visits. Roger confided that his son was being released from prison and would be staying with him for a while and preferred not to have any other activities on his agenda at that time. Under these circumstances, the researcher did not push to schedule follow-up visits. Twelve weeks after the intervention ended, the researcher forwarded two blank exercise logs with postage paid envelopes to the participants, asking them to complete and send them back. Unfortunately, there was no response. The lack of follow-up data limits confidence regarding the survival of participants' exercise programs after the researcher withdrew. Fading researcher involvement over period of several months might have improved both studies.

Strengths. A major strength of this study is that it assisted individuals with severe mobility-related disabilities to engage in an important health behavior. It assessed an affordable

and accessible option for individuals who face numerous barriers to engaging in exercise. The exercise videos/DVDs also provided active role models with disabilities, both leading the exercise and participating in the on screen "classes." Several participants commented that they liked seeing wheelchair users in the programs. Pat commented early on, "this shows that disabled people can be healthy."

Another study strength is that it was conducted in participants' natural environments. There are few published studies promoting exercise adoption for this population, although more research is being conducted as health disparities receive more attention (USDHHS, 2005). Much of the exercise research focused on people with disabilities examines the physiological effects of exercise. It typically involves exercise sessions in rehabilitation settings, followed by home exercise recommendations with limited or no assessment of adherence (e.g., Thomas et al., 2002). Yet, a habit of regular exercise is difficult for anyone to establish (Sweeney, Taylor, & Calin, 2002) and likely even more so for a population that faces additional disability-related barriers.

Use of accelerometer data to provide reliability for self-report exercise data was another study strength. While it is not unusual for community-based exercise studies to use logs or diaries to collect data, fewer use portable event recorder devices that produce permanent products as evidence of movement. The use of accelerometers in physical activity research is increasing as the technology improves and the devices become more affordable. Still, there is scant data on normative values or "counts" for participants who do not ambulate. Thus, it was not possible to compare the study 2 participants' counts with normative data from other studies. Additionally, participants in this study wore the devices on their wrists for seated exercise, which consists mainly of arm movements. However, Roger used an exercise videotape that included leg

movements as well as arm movement. Wearing the device on his wrist likely did not capture his leg movement, and therefore, did not provide a complete account of his movement. It is possible that his hourly counts would have been higher if he had worn multiple devices. Still, comparing exercise hour counts with non-exercise hour counts provided convincing data (exercise hour counts more than doubling non-exercise hour counts) that participants' activity had increased in this study. Accelerometers allowed the researcher to use collect data unobtrusively in participants' natural environments.

This study was also strengthened by efforts to ensure the quality of the primary data through participants' self-reports via exercise logs. Participant training to complete the exercise logs allowed the researcher to better understand participants' needs. For example, watching Lisa complete the practice logs with a pen in her mouth prompted the researcher to ask if electronic logs completed by computer might be helpful, since Lisa advised that she used her computer daily. The participant declined this accommodation; however, it prompted a discussion about how to position the timer in a way that would make it easier for her to push the buttons to time her exercise sessions. The training also made the researcher aware of Roger's limited literacy, and the need to review written materials with him in detail. This knowledge facilitated Roger's record keeping, and resulted in few errors on Roger's logs throughout the intervention. In fact, both participants seemed proud to present their completed logs to the researcher each week, and typically pointed out their increased activity. Both kept copies of the logs that were returned to them in their binders, and Roger reported showing them to his personal care attendant to show how his minutes of exercise were increasing over time. Thus, training the participants in log completion appeared to contribute both to effective data collection and interest in self-monitoring.

It is notable that one study participant was exceeding the recommendation of a minimum of 30 minutes of moderate-intensity activity on five days each week (Haskell et al., 2007) at study end. Roger had set a goal of five 35-minute sessions of moderate-intensity aerobic activity per week by the end of the 16-week intervention. He did not always exercise for thirty-five minutes during these weeks, but most of his sessions were over 30 minutes in length. Additionally, he was participating in the residents' exercise class on some days that he was also performing his intervention exercise routine. Roger's average RPE for the residents' exercise classes was 4.45, while his average RPE for the intervention sessions was 5.78, which may indicate that the intervention sessions were better suited for his desire for increased conditioning. About two weeks before the intervention ended, Roger commented during the researcher's visit that "I think I'm getting addicted to exercise!" During the following two weeks, he either performed his intervention routine for an average of 33 minutes per session, or attended the residents' exercise class on most days of the week. However, on three days, he both did his intervention session and attended the class. He also commented that he tried to work harder in the class, such as raising his legs higher during leg lifts. For the first 14 weeks of the exercise training package, his recorded a mean RPE of 3.92 for the residents' exercise class; however, for the last two weeks of the exercise training package, his mean RPE for the residents' exercise class rose to 5.57, perhaps supporting Roger's assertion that he was working harder. It may also suggest that the effect of the intervention were generalizing to the residents' exercise class.

Although the other participant in study 2 and those in study 1 did not achieve the recommended level of moderate intensity physical activity, their efforts to increase their exercise activity to three 18-minutes session per week (Ann), three 16-minute sessions per week (Pat) and five 20-minute session per week (Lisa) represent a significant increase of activity for each of

them. Their achievements are impressive, given the disability-related barriers to exercise that they faced, and the low physical activity rates of the U.S. population.

This study did not aim to facilitate social support for participants' exercise in their natural environments. Still, it appears that participants may have obtained social support on their own. Lisa mentioned that her children had become accustomed to seeing her exercise, and would ask if she wanted them to put the tape in the VCR for her. She said that she liked setting a good example for them, that "exercise is important for everyone." Roger reported that his personal care attendant exercised with him three times during the intervention, and that she sometimes asked how his program was going. These occurrences may indicate that participants and their significant others valued the behavior change and sought support in their own environments to support its maintenance.

Implications for future research

Both studies add to the body of knowledge regarding exercise adoption for people with severe mobility-related disabilities, and suggest that an exercise intervention can effect increased exercise engagement for this population, to generate other positive outcomes. The dependent variable in the second study suggested outcomes of improved general health (i.e., health assessment), increased physical conditioning (i.e., Reach and Balance Test, increased heart and pulse rates) and reduced barriers to health activities (i.e., BHADP) for participants. These positive outcomes, in turn, may have contributed to other participant benefits, such as increased community participation. However, it was not within the scope of these studies to assess these distal outcomes.

Secondary conditions were not tracked or measured in either study. Surprisingly, participants across both studies reported missing few exercise sessions due to health related

issues (e.g., neck pain, asthma, reaction to heat and humidity), and on several occasions they reported exercising for fewer minutes than their goal but still tried to pursue their scheduled sessions. Also, they rarely reported health-related issues on their exercise logs and the researcher was asked on only one occasion to postpone a visit due to illness. This might reflect participants' ability to pursue exercise in the convenience of their homes, and still have the structure of a goal-driven program. Still, multiple studies provide evidence that secondary conditions greatly impact the activities, including exercise, of people with disabilities (e.g., Seekins & Ravesloot, 2000). White, Gonda, Peterson, and Drum (in press) reported results of several health promotion studies that included physical activity and assessed the impact on participants' secondary condition outcomes. Three studies reported a reduction in secondary conditions, one reported no significant differences, and a fifth study reported an increase in several secondary conditions. Data from an ongoing randomized controlled exercise trial for wheelchair users indicates frequent reports of a wide range of health events, including many that would likely be classified as secondary conditions (e.g., urinary tract infections, and shoulder or wrist pain) (K.Grobe, personal communication, September 27, 2010). Thus, inclusion of secondary condition surveys in both study 1 and study 2 might have yielded useful data regarding how secondary conditions affect exercise habits of people with mobility-related disabilities. These data could be particularly informative in understanding how to craft exercise programs for people with disabilities at the personal and community levels. For example, registering for a six-week seated aerobic exercise class or for six sessions of home-based personal training might not attract members of this population if there is a reasonable chance that an injury might cause them to miss several of the sessions. A program with a flexible schedule might be more financially appropriate and result in better enrollment.

Research to promote exercise adoption for people with mobility-related disabilities should explore ways to facilitate increases in this vital health behavior. Participants in both studies appreciated having video programs that depicted people in wheelchairs exercising. It appeared that role models with disabilities were as important as the accessible exercise that they were presenting. This may be important because members of this population seldom see images of people in wheelchairs or with walkers exercising in the popular media, or in public health messages. Systematically assessing the impact of role models with disabilities could add to the exercise adoption evidence base for this population.

Research is needed to investigate social support for exercise in natural environments for people with disabilities. Roger reported both discussing his progress with his personal care attendant [PCA] and exercising with her for several sessions. Investigation of how PCAs might be trained as “personal trainer/assistants” might both facilitate in-home support for exercise and other healthy behaviors, and provide a career advancement opportunity for people working in this field. Similarly, exploration of family members’ role in providing social support for exercise is needed. This research should address the specific needs that this population might have (e.g., providing assistance with transfers to equipment, changing in and out of workout clothing, and strapping hands and/or feet to equipment pedals)

Investigation is also needed regarding the role of variety in adopting and maintaining a physically active lifestyle. Both studies indicated that some participants desired a program change after using a videotaped program for 10-12 weeks. It appeared that they wanted to use the same one long enough to master the movements and become comfortable with it, but then desired some variety. Currently, there are insufficient seated aerobic programs available to provide variety for people with mobility-related disabilities who want to exercise regularly.

Creation of "training" videotapes that provide 10 minute increments of activity with several minutes of warm-up and cool-down minutes could provide structured programs that individuals could use on their own gradually build up minutes of exercise. Additionally, options such as Wii™ exercise video game equipment are already gaining attention and recommendations among people with disabilities on list serves (http://www.apparelyzed.com/forums/topic/12428-exercises-for-wheelchair-users/). Researchers are currently studying the role of these video games to improve balance and reduce falls among older adults (J. Rowland, personal communication, September 8, 2010). Research on integrating these commercially available, accessible exercise programs into home exercise routines could provide the convenience, accessibility, and affordability that people with disabilities need. Delivery of video exercise programs over the internet is another possibility that could give participants the experience of being in a "class" with other participants for accessible exercise in the convenience of their own homes.

Conclusion

The urgent need for effective physical activity/exercise interventions for people with a variety of disabilities has been recognized (Rimmer, Chen, McCubbin, Drum, & Peterson, 2010; USDHHS, 2005). Yet, many members of this population struggle to find ways to integrate accessible exercise into their weekly routines and to enjoy the physical and mental health benefits of exercise that many Americans take for granted. On a larger scale, civil rights legislation such as the Americans with Disabilities Act is less meaningful if people with disabilities do not have sufficient health to take advantage of increased opportunities for community participation, again emphasizing the importance of exercise adoption and maintenance. The two studies described in this paper demonstrate strategies to use behavioral

methods in promoting home-based accessible exercise for people with severe mobility-related disabilities. Empowering this population with research-based tools to promote their own health through home-based exercise will likely increase both physical conditioning and the social benefits of increased health.

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Appendix A

Video/DVD exercise program descriptions

Descriptions of Seated Aerobic Programs on Video/DVD

1. ***Seat-A-Robics***
   Producer: Daria Alinovi
   Year: 1993
   Instructional video on fitness for people with physical disabilities and seniors. Must have some use of upper extremities. Instructor and class participants are all people with disabilities. “Endurance” consists of warm-up, aerobic conditioning and cool down. Covers monitoring resting and target heart rates, safety tips, and adaptive exercises for people with disabilities and older adults.
   (no website)

2. ***Exercise Program for Individuals with Spinal Cord Injuries: Paraplegia***
   Producer: Collaboration of the Christopher & Dana Reeve Paralysis Resource Center, the National Center on Physical Activity and Disability, and the Rehabilitation Institute of Chicago
   Year: 2004
   NCPAD presents ***"Exercise Program for Individuals with Spinal Cord Injuries: Paraplegia"***
   This video is funded by the Christopher & Dana Reeve Paralysis Resource Center and developed in conjunction with the Rehabilitation Institute of Chicago and the National Center on Physical Activity and Disability. It is designed for individuals with paraplegia, and features a 25-minute aerobic segment, as well as strengthening, and flexibility segments for a well-rounded exercise program. Warm-up and cool-down exercises are also included. This video is available in DVD and VHS formats. Closed captioning feature is available for both formats.
   www.ncpad.org

3. ***Lisa Ericson’s Seated Aerobic Workout Video***
   Producer: Lisa Ericson
   Year: 1996
   Lisa’s seated aerobics video is an easy to learn series of choreographed movements of the body performed while seated, for both disabled and able-bodied individuals. Each video comes with an instructional booklet which includes important fitness information and 100 pictures of some of the actual movements. The video focuses on calorie/fat burning and weight loss, cardiovascular strength, muscle strength, improvements in flexibility, toning and shaping the body, stress relief and a sense of overall well-being.
   http://www.seatedaerobics.com/video.html

Descriptions of Seated Aerobic Programs on Video/DVD (cont.)

4. ***Chair Dancing: A New Concept in Aerobic Fitness®***
   Producer: Jodi Stolove
   Year: 1991
   Chair Dancing is a fun and convenient way to get aerobic exercise and improve muscle tone and flexibility. You'll do the cha-cha, the can-can, a tap dance, and much more while seated comfortably on a chair. Originally scored music and up-beat choreography make Chair Dancing the fitness program you'll look forward to doing regularly. Three exercise levels show you how to adapt the program to your current fitness ability. You'll continue to be challenged as your endurance improves. When you exercise the Chair Dancing way, you'll enjoy aerobic fitness like never before.
   http://www.chairdancing.com/

Appendix B

Study 1 Behavioral contract

Physical Disability Waiver Project Physical Activity Study
Contract between Participants and Researchers

Participant

I, _____ agree to participate in the Physical Activity Study of the Physical Disability Waiver Project through the Research and Training Center on Independent Living (RTC/IL) at KU.

I agree to:

- Obtain my medical providers consent to participate in the study.
- Complete a written questionnaire at the start and end of the study.
- Complete a fitness test at the start, midpoint, and end of the study.
- Participate in developing an adaptive physical activity routine that is achievable for me and will be based on a videotaped seated aerobic exercise program.
- Set goals regarding number of sessions and number of minutes per session each week, and increase these goals as I become more conditioned, in collaboration with the researcher.
- Record accurate information about my exercise level on a log during specified weeks before the program has started and during each week of the program as instructed by research staff.
- Begin the program when requested by research staff.
- Follow the program to the best of my ability for 12 weeks.
- Carefully monitor my body's response to increased physical activity, stop the activity, and if needed, seek medical attention if I feel that I am having physical problems due to the activity.
- Agree to be visited in my home each week for 60-90 minutes by research staff, be videotaped performing my physical activity routine, review my physical activity goals each week, and provide my completed activity log for the previous week to the researcher at each visit.

Researchers

We agree to support _____ (referred to as the participant) in increasing his/her physical activity level by participation in the Physical Activity Study of the Physical Disability Waiver Project through the RTC/IL at KU.

We agree to:

- Reimburse the participant $10 each time he/she completes a written questionnaire.

- Assist the participant to develop an adaptive physical activity program that is achievable for him/her, and uses videotaped seated aerobic programs.

- Review materials that explain components of the program in detail, as well as information about the importance of physical activity for persons with disabilities as well as safety issues.

- Train the participant to record information about physical activity on the activity log at the start of the study, and provide feedback on log completion once the program has begun.

- Provide a seated aerobic videotape that the participant chooses.

- Advise the participant when to begin the program, and be available to assist with demonstration of the program.

- Visit the participant in his/her home each week for 60-90 minutes at a time that is mutually convenient, and videotape performance of the aerobic program. Review the participants progress toward goals, negotiate increased goals as appropriate, and collect the activity log for the previous week. Provide prepaid phone cards as incentives when the previous week's log had been completed.

- Provide a toll-free phone number and be available by phone on a timely basis to respond to questions and concerns expressed by the participant.

Signatures

_____	_____
Participant	Date
_____	_____
Researcher	Date
_____	_____
Researcher	Date

Appendix C

Fact sheet from *Physical Activity and Health: A Report of The Surgeon General* for participant education

A Report of the Surgeon General

Physical Activity and Health

Persons with Disabilities

KEY MESSAGES

- Physical activity need not be strenuous to achieve health benefits.
- Significant health benefits can be obtained with a moderate amount of physical activity, preferably daily. The same moderate amount of activity can be obtained in longer sessions of moderately intense activities (such as 30–40 minutes of wheeling oneself in a wheelchair) or in shorter sessions of more strenuous activities (such as 20 minutes of wheelchair basketball).
- Additional health benefits can be gained through greater amounts of physical activity. People who can maintain a regular routine of physical activity that is of longer duration or of greater intensity are likely to derive greater benefit.
- Previously sedentary people who begin physical activity programs should start with short intervals of physical activity (5–10 minutes) and gradually build up to the desired level of activity.
- People with disabilities should first consult a physician before beginning a program of physical activity to which they are unaccustomed.
- The emphasis on moderate amounts of physical activity makes it possible to vary activities to meet individual needs, preferences, and life circumstances.

FACTS

- People with disabilities are less likely to engage in regular moderate physical activity than people without disabilities, yet they have similar needs to promote their health and prevent unnecessary disease.
- Social support from family and friends has been consistently and positively related to regular physical activity.

BENEFITS OF PHYSICAL ACTIVITY

- Reduces the risk of dying from coronary heart disease and of developing high blood pressure, colon cancer, and diabetes.
- Can help people with chronic, disabling conditions improve their stamina and muscle strength.
- Reduces symptoms of anxiety and depression, improves mood, and promotes general feelings of well-being.
- Helps control joint swelling and pain associated with arthritis.
- Can help reduce blood pressure in some people with hypertension.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Chronic Disease Prevention and Health Promotion
The President's Council on Physical Fitness and Sports

The President's Council on Physical Fitness and Sports

What Communities Can Do

- Provide community-based programs to meet the needs of persons with disabilities.
- Ensure that environments and facilities conducive to being physically active are available and accessible to people with disabilities, such as offering safe, accessible, and attractive trails for bicycling, walking, and wheelchair activities.
- Ensure that people with disabilities are involved at all stages of planning and implementing community physical activity programs.
- Provide quality, preferably daily, K–12 accessible physical education classes for children and youths with disabilities.
- Encourage health care providers to talk routinely to their patients with disabilities about incorporating physical activity into their lives.

For more information contact:

Centers for Disease Control and Prevention
National Center for Chronic Disease Prevention and Health Promotion
Division of Nutrition and Physical Activity, MS K-46
4770 Buford Highway, NE
Atlanta, GA 30341-3724
1-888-CDC-4NRG or 1-888-232-4674 (Toll Free)
http://www.cdc.gov

The President's Council on Physical Fitness and Sports
Box SG
Suite 250
701 Pennsylvania Avenue, NW
Washington, DC 20004

Appendix D

Study 1 Exercise log

Participant: Week:


Physical Activity Log


Endurance

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
☐ No activity	☐ No activity	☐ No activity	☐ No activity	☐ No activity	☐ No activity	☐ No activity
Video:	Video:	Video:	Video:	Video:	Video:	Video:
Duration:	Duration:	Duration:	Duration:	Duration:	Duration:	Duration:
Intensity:	Intensity:	Intensity:	Intensity:	Intensity:	Intensity:	Intensity:
DFMS:	DFMS:	DFMS:	DFMS:	DFMS:	DFMS:	DFMS:

Notes

Appendix E

Modified Borg Rating of Perceived Exertion scale

Rating of Perceived Exertion

Rate the combined intensity of these symptoms due to exercise:

- Muscle fatigue and discomfort
- Shortness of breath
- General exhaustion

Rating	Descriptor	Intensity
0	Nothing At All	No Intensity
0.5	Extremely Weak	Just Noticeable
1	Very Weak	
2	Weak	Light
3	Moderate	
4		
5	Strong	Heavy
6		
7	Very Strong	
8		
9		
10	Extremely Strong	Strongest Intensity
11		
•	Absolute Maximum	Highest Possible

Appendix F

Study 1 Participant satisfaction questionnaire

Physical Disability Waiver Project Home Physical Activity Study

Participant Satisfaction Questionnaire

1. Project staff who worked with me were courteous and helpful.

Dissatisfied				Satisfied
1	2	3	4	5

2. Arrangements for my participation were appropriate and convenient.

Dissatisfied				Satisfied
1	2	3	4	5

3. The purpose of the study was clearly explained to me.

Dissatisfied				Satisfied
1	2	3	4	5

4. My role in the study was clearly explained to me.

Dissatisfied				Satisfied
1	2	3	4	5

5. I would recommend participation in a similar project to a friend.

Dissatisfied				Satisfied
1	2	3	4	5

Additional comments on any aspect of your participation:

Thank you!

Appendix G

Study 1 Preliminary interest form

1

Date:

Name _____

I am interested in participating in a physical activity program that is tailored to my physical abilities and starts early next year.

(If no, please end here and mail form back to us. If yes, please continue.)

We would like to know about your physical activity patterns during the last few weeks. Please answer honestly --- We are most interested in an accurate picture of your activity level. By physical activity, we mean some type of movement that increases your heart rate, strength, flexibility, stamina, etc. or simply makes one of your Activities of Daily Living easier to accomplish. Physical activities may include walking, wheeling, light aerobics, stretching, strengthening, flexibility exercises, relaxation exercises, yoga, swimming, etc. If you don't have any activities to list, that's OK!

We are looking for **estimates** – Give us your best guess!	Activities	Frequency (Times per week)	Duration (How many minutes each time)
Week 1			
Week 2			

We would also like to know what some goals of a physical activity program might be for you. These might be some simple everyday activities that you can't do as well as you would like or not at all, but think that a physical activity program might improve. For example, some people might want to be able to reach higher, to wheel farther without losing their breath, to put shoes or other clothing on more easily, or to walk out to their mailbox.
Please list any personal Goals that you can think of:
(**example**: to be able to wheel out to the front Yard and pick up my newspaper from the lawn each morning)

Appendix H

Study 1 participant Consent Form

PARTICIPANT CONSENT FORM

Home Physical Activity Program

The Research and Training Center on Independent Living at the University of Kansas wants to protect people who participate in research. The following information is provided for you to decide whether you wish to participate in the present study. This study is being conducted to help people with physical disabilities increase their physical activity levels. You should be aware that even if you agree to participate, you are free to withdraw from the study at any time without penalty. Withdrawal from the study will not affect your benefits from SRS in any way.

Although this study will involve a non-strenuous physical activity program, there are some risks associated with any increase in physical activity, such as muscle soreness, fatigue and other health issues. Your individualized program might include stretching exercises, strengthening with light hand weights, and/or a videotaped light exercise program. We cannot guarantee that participation in this project will be beneficial to you, however, other research has shown that engaging in physical activity can improve health. We assure you that any personal information shared with us will be kept strictly confidential to the extent allowed by law. Your name will not be associated in any way with the study findings. If you would like additional information concerning this study before or after it is complete, please feel free to contact me by phone or mail. You will be given a copy of this consent form.

I agree to participate in the Home Physical Activity Program that is being conducted by the University of Kansas. I have been fully informed about the activities that will be involved and about the procedures involved in gathering data for the study. I understand that I will need to obtain written permission from my physician in order to participate.

I have been informed that participation is voluntary and that the program will last four months. I understand that I will be provided with information and some modest exercise equipment to participate and that I will be expected to report my activity on a weekly basis throughout the intervention. I understand that there will be no cost to me to participate in the program or to obtain the materials and equipment, which I may keep when the program has ended. I understand also that I will be paid $10 for completing surveys at the end of the program.

Glen W. White, Ph.D.
Principal Investigator
RTC/IL, University of Kansas
4089 Dole Center
Lawrence, KS 66045
785-864-4095

By signing this, I certify that I am at least 18 years old and agree to participate in the research project described above. I have received a copy of this consent form and I understand that I will be compensated at the end of this project.

NAME DATE

Appendix I

Study 2 Behavioral contract

Health in Motion Study
Contract Between Participants and Researchers & Activity Plan

Participant

I, _____ agree to participate in the Health in Motion Study conducted by the Research and Training Center on Independent Living (RTC/IL) at KU.

I agree to:

- Participate in an adaptive physical activity routine that is achievable for me, will include progress toward a self-set physical activity goal, and may incorporate exercising with commercially available videotaped routines, as appropriate, provided by the research staff.
- Increase my minutes/days of activity as agreed to in this document, including regular updates of it.
- Begin the activity program when agreed upon with the research staff.
- Follow the program to the best of my ability for the next ten weeks.
- Meet with the researcher each week at a mutually agreed upon date and time.
- Wear a wristwatch-like device called an accelerometer periodically during the study as requested by researchers, and return the device for downloading of data on schedule (for example, weekly).
- Agree to be videotaped performing my exercise session once weekly, or less, and meeting with the researcher as requested.
- Record accurate information about my physical activity sessions on an activity log during each week of the study as instructed, and give these logs to the research staff each week.
- Agree to participate in a test of functioning at the start and end of the program.

Health in Motion Study
Contract Between Participants and Researchers & Activity Plan

- Agree to complete written measures at the start and end of the program.

- Agree to complete two weeks of activity logs six weeks after the end of the program.

- If I pursue my physical activity at one or more fitness centers, advise researchers of this and collect "activity cards " from the facility each time I use it and give these activity cards to researchers along with my activity logs.

- Monitor carefully my body's response to increased physical activity, and, if needed, stop the activity and seek medical attention if I feel that I am having physical problems due to the activity.

- **Researchers**

The Health in Motion study staff agree to support _____ (referred to as the participant) in increasing his/her physical activity level by participation in the Health in Motion Study of the Research and Training Center on Independent Living (RTC/IL) at KU.

We agree to:

- Assist him/her to develop and document an adaptive physical activity program that includes progress toward some personally-identified activity goals.

- Review the participant manual in detail, covering components of the program, as well as information about physical activity for persons with disabilities and safety issues.

- Train participants to record information about physical activity levels on an activity log at the beginning of the study, and provide feedback in the form of progress charts each week.

Health in Motion Study
Contract Between Participants and Researchers & Activity Plan

- Provide, at a minimum, one aerobic videotape or DVD if requested for the participant's individualized physical activity program.
- Advise the participant when to begin his/her physical activity program, and be available to assist with implementation and/or demonstration of the program.
- Facilitate weekly individual meetings with participant, for information sharing, problem-solving, and social support throughout the study.
- Provide incentives, in the form of grocery store gift certificates, as rewards for completing weekly activity logs.
- Provide incentives, in the form of fitness equipment or other agreed upon items periodically for meeting activity goals and setting the next goal.
- Provide incentives, in the form of tokens that can be redeemed for a check at the end of the study, for wearing an accelerometer during some or all weeks of the study.
- Be available by phone on a timely basis to respond to questions and concerns expressed by the participant.

Activity Plan

	Days of week Activity to be performed	**or**	**Number of sessions per Week**	**# of minutes per session**
Goal 1				
Goal 2				
Goal 3				

Health in Motion Study
Contract Between Participants and Researchers &
Activity Plan

Goal 4

Goal 5

Signatures

_____	_____
Participant	**Date**
_____	_____
Research Staff	**Date**
_____	_____
Research Staff	**Date**

Appendix J

Study 2 Exercise log

Participant: RB Week: 12/7-13


Physical Activity Log



	Sunday 12-11	Monday 12-2	Tuesday 12-3	Wednesday 12-7	Thursday 12-8	Friday 12-9	Saturday 12-10	Notes
	☐ No activity	☐ No activity	☐ No activity	☐ No activity	☐ No activity	☐ No activity	☐ No activity	
Activity 1:	DVD-2	DVD-2	Debby	DVD-1	DVD-1	DVD-1		
Total Min:	19	20	30	18	15	18		
Start Time:	9:58	3:40	1:35	2:15	3:55	2:30		
	✓ am _ pm	_ am ✓ pm	_ am ✓ pm	_ am ✓ pm	_ am ✓ pm	_ am ✓ pm	_ am _ pm	
Finish Time:	10:16	[illegible]	2:05	3:23	4:10	2:49		
	✓ am _ pm	_ am ✓ pm	_ am ✓ pm	_ am ✓ pm	_ am _ pm	_ am ✓ pm	_ am _ pm	
Exertion:	6	6	5	5	4	6		
Pulse-begin:	76	70	64	64	66	64		
Pulse: end:	148	144	110	110	95	110		

Actigraph

On:	9:40	3:30		1:15	1:00		
Site:	LW	LW		LW	LW		
Off:	10:25	8:00		4:30	5:00		
On:							
Site:							

Appendix K

Study 2 Participant contact permission form

Date: _____

I give permission for staff members of the Research and Training Center on Independent Living (RTC/IL) at the University of Kansas to contact me regarding my possible participation in the Health in Motion research study.

Name:_____

Signature: _____

Appendix L

Study 2 Physician consent form

Health in Motion Physician Permission Form

Patient name: _____ Date of Birth (if needed): _____

I hereby authorize release of pertinent information, as requested above, to Dot Nary, Health in Motion Program, RTC/IL, University of Kansas for up to 18 months from the date below.

Patient Signature _____ Date _____

Dear Physician,

The patient named above has enrolled in *Health in Motion*, a self-directed physical activity program conducted by the Research and Training Center on Independent Living at the University of Kansas (RTC/IL). This program will provide information and structure for participants' self-selected aerobic activities, in order to establish regular engagement in physical activity as lifelong health promotion behavior.

We request your signature stating that moderate physical activity is not medically-contraindicated for this individual.

Physician signature _____ Date _____

Type name here _____Phone _____

Address _____

_____

For more information on *Health in Motion*, please contact Dorothy E. Nary, M.A., RTC/IL at 864-4095.

Appendix M

Study 2 Participant orientation/training check list

Participant: _____ **Date:** _____

Participant Orientation/Training Checklist

Category	Task	Completed?	Notes
Consent	A. Present & review form		
	B. Have participant sign it		
	C. Give copy to participant		
Data Collection	A. Review exercise fact sheet (education component)		
	B. Conduct exercise log training		
	C. Review reinforcers		
	D. Give accelerometer to participant and explain purpose and when he/she should wear it		
	E. Give timer to participant and demonstrate how to use it		
	F. Conduct reach and balance test		
Program	A. Have the participant select a video program and try it out		
	B. Ask participant to begin completing logs tomorrow		
Other	A. Provide contact information and ask participant to call with questions or problems		

Appendix N

Study 2 Participant exercise log instructions

Completing your Activity Logs

Your activity logs are a very important part of this program. Most importantly, they will provide a record of your increasing levels of physical activity for your own use, as you try to adopt a healthier way of life. The logs will show how often you engage in physical activity, for how long, and how hard you work each time. The logs will also help us to know if you are increasing your physical activity levels to meet the goal you set.

Please remember to follow your physical activity plan! You should be reporting physical activity that is included in your plan, and/or is

- longer than 5 minutes
- continuous

Instructions:

- Please record information about your physical activity on a separate activity log for each week of the program. You will receive a new dated log (for example, Sunday, 10/9/05 to Saturday, 10/15/05) at your meeting with Dot each week. Also, at the start of the program you will be given several undated logs.

- Please record your minutes of activity right away, or as soon as possible after you finish your activity, in order to provide as accurate information as possible. Remember, the only information that is useful to us is accurate information about whether or not you have followed your physical activity program.

- Please use the timer provided to you to measure your activity sessions in minutes accurately and easily using these instructions.

Please record the following information in your activity log:

Activity 1	The type of activity that you engaged in. Examples might be seated aerobics or walking.
Total Min	The total number of minutes of this activity session. Be sure to subtract the minutes of any interruptions, and rests longer than 15 seconds. If you exercise for part of a minute, please round up to the next minute if it is 30 seconds or more, and round down if it is 30 seconds or

	less. For example, if you exercise for 2 minutes and 35 seconds, round down up to 3 minutes. Note: Please record sessions of 5 minutes or longer. For example, if you take a walk that lasts longer than 5 minutes, you should not record this on your log.
Start Time	The time you began this activity: hour and minutes.
Finish Time	The time you ended this activity: hour and minutes.
AM/PM	Please check whether you STARTED your activity in AM or PM.
Intensity 1	The number for the rating that best describes your level of physical exertion for this activity session, after referring to the Borg Scale in this manual.
Actigraph Log	If you have been asked to wear the Actigraph during a specific week, please record the days you wore it and the times during the day when you put on the device, the body part you put it on (wrist) and the times that you remove the Actigraph from your body. For example, you put the Actigraph on in the morning, take it off to shower, and then put it back on after getting dressed. Record the times underneath the appropriate day and make sure to indicate AM or PM.
Notes	Please record any helpful information about your activity for the week. For example, travel or illness might be reasons why you didn't reach your activity goal. Feeling energetic might be a reason why you engaged in more activity than you'd planned.

- If you engage in more than one type of activity on a specific day, please be sure to record it in the section labeled Activity 2.

- Please record the actual time you spent engaging in activity. Remember to record number of minutes spent in activity, not number of minutes the videotape was running or the time you arrived at the fitness center. For example, if you do aerobic activity for ten minutes and then stop for five minutes to answer the phone, **remember to** subtract those five minutes from the total time of your activity session.

- Also, please remember, that on days you don't engage in activity, you need to check the "No Activity" box.

- Remember to turn in your completed logs each week at the meeting or by mail.

- Don't hesitate to call Dot at 785-864-0562 if you have any questions about the logs. If she's not there and you leave a message, she will call you back!

Appendix O

Study 2 Exercise log training scenarios

Revised 9/05

Health in Motion

Practice Scenarios for Activity Log Training

Mary

1. Mary is a wheelchair user. She used her arm cycle on Friday from 11:30 AM to 12:05 PM. She didn't stop during that time period. When she finished using the cycle, she was a little short of breath and felt that the activity had a strong effect on her. On Friday afternoon, she met a friend at the high school track. Her friend started walking and Mary started wheeling at 4:00 PM. They walked, talked, and wheeled for 15 minutes (Mary brought her timer in her pocket). Because they were moving slowly, Mary wasn't very tired afterwards and didn't feel that she worked too hard—she felt that the activity had a very weak effect on her.

2. Mary used her arm cycle again on Sunday from 7:55 to 8:20 AM. She felt the session had a moderate effect on her.

3. On Tuesday, Mary wasn't feeling so well, but she still kept her promise to herself to exercise. She used her arm cycle from 9:15 to 9:35 AM. She felt the workout had a strong effect on her and felt she had to end it earlier then she'd planned.

4. Mary hadn't planned to exercise on Thursday, but she wanted to make up the minutes she'd missed on Tuesday. She used her arm cycle from 8:15 AM to 8:50 AM, and felt that the workout had a strong or heavy effect on her.

Daniel

1. Daniel to the pool on Friday and got into the pool at 1:50 PM. After stretching and saying hello to some folks he knew, he treaded water from 2:05 to 2:25 without stopping. When he finished, he felt the effort had had a strong effect on him.

2. Daniel used an aerobic exercise video on Sunday. After starting at 1:30 PM, he exercised for 5 minutes, answered the phone and talked for 5 minutes, and then exercised to the video for 20 minutes without stopping. When he finished, he felt the workout had a very strong effect on him.

3. On Monday, Daniel walked his dog from 5:30 to 5:42 PM. He felt that the walk had a strong effect on him.

Appendix P

Study 2 Exercise log training score sheet- page 1

Participant: Form completed by: Date:

Health in Motion

Score Sheet for HIM Activity Log Training – Practice Scenarios

#	Scenario	Item	Entry in Practice Log			Notes
			Correct	Incorrect	N/A	
1	Mary	Friday activity 1- No activity				
2		Friday activity 1 description				
3		Friday activity 1 – Total min				
4		Friday activity 1 - Start time				
5		Friday activity 1 - End time				
6		Friday activity 1 – AM or PM				
7		Friday Activity 1 - Intensity				
8		Friday activity 2- No activity				
9		Friday activity 2 - description				
10		Friday activity 2 – Total min				
11		Friday activity 2 - Start time				
12		Friday activity 2 - End time				
13		Friday activity 2 – AM or PM				
14		Friday Activity 2 - Intensity				
15		Saturday– No activity				
16		Sunday – No activity				
17		Sunday activity 1 - description				
18		Sunday activity 1 – Total min				
19		Sunday activity 1 - Start time				
20		Sunday activity 1 - End time				
21		Sunday activity 1 – AM or PM				
22		Sunday Activity 1 - Intensity				
23		Monday - No activity				
24		Tuesday – No activity				
25		Tuesday Activity 1 - description				
26		Tuesday Activity 1 - Total min				

Appendix Q. Study 2 Social Validity Data

Study 2 Post-Intervention Questionnaire Responses			
		Roger	Lisa
1.	How would you rate your overall experience with the Health in Motion program? (ratings from 1-5 with 5 as most positive)	5	5
2.	What did you like most about the program?	Don't have to leave home I can do it	All video participants have a disability
3.	What did you like least about the program?	Ending	Having to stop exercising at a certain time
4.	Would you suggest any changes to the program based on your experience with it?	Different DVDs would make it more fun (variety)	Allow more freedom with how long participants exercise per session
5.	Have you noticed any benefits related to your participation in the program?		
	a. Physical?	Endurance picked up	Healthier; lengthier time between illnesses
	b. Emotional	Mind is more clear, feel better about myself	None
	c. Social	I talk with other residents about my program	More energy
	d. Other	Leg exercise has helped	None
6.	Are there activities you plan to pursue now that you couldn't do before? If so, what activities?	May start walking up and down steps Will try gardening in the spring	Helps maintain weight
7.	What kind of incentives or motivators might you use to continue the program?	Will use logs	Money
8.	Would you recommend this program to a friend? (ratings from 1-5 with 5 as most positive)	5	5