AN ABSTRACT OF THE DISSERTATION OF

Heidi Isabel Stanish for the degree of Doctor of Philosophy in Human Performance presented on September 22, 1998. Title: Participation of Adults with Mental Retardation in a Voluntary Physical Activity Program.

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Jeffrey A. McCubbin

This study compared the effect of two sources of instruction and verbal encouragement on the participation of individuals with mental retardation (MR) in a 10-week physical activity program. Participants were 17 adult employees of a sheltered workshop (5 females, 12 males) ranging in age from 30 to 65 years. The program was offered at work 3 days per week and involved aerobic dance activities. Group engagement in moderate to vigorous intensity physical activity (MVPA) was systematically observed and was compared using a reversal design. Condition A involved an exercise leader plus an exercise video to deliver instructional cues and verbal promotion of participation. Condition B used an exercise video as the only source of instruction and verbal promotion. The exercise videos were designed specifically for the participant group to address the low fitness levels and limited ability to make activity transitions. Data indicated that, on average, a higher percentage of the group was engaged in MVPA when the leader-plus-video condition (A) was applied. However, the difference was not practically meaningful when the administrative ease and cost-effectiveness of videos are considered. Further, a considerable overlap of data points in the graphical analyses indicated that withdrawing the leader did not control exercise

behavior. Program attendance was variable but remained high over the course of the study. Group engagement levels were higher during the sessions with fewer participants, which suggested that a small group of highly compliant participants were more consistently on-task. Work performance was not negatively impacted when employees took time out of their workday to participate in physical activity. It is of importance that several participants continued to participate in the exercise program over the 4-week maintenance phase. This study provided a convenient, inexpensive method for adults with MR to independently participate in physical activity.

Participation of Adults with Mental Retardation in a Voluntary
Physical Activity Program

by

Heidi Isabel Stanish

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APPROVED:

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Major Professor, representing Human Performance

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Dean of Graduate School

I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

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Heidi Isabel Stanish, Author

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I have waited until the last moment to write this section of my dissertation because I finally have time to reflect on the past three years and acknowledge those who have helped me accomplish this wonderful task. Anyone who has come this far knows that a person cannot do it alone, but the quality of the experience is dependent upon the quality of those people who contribute to your success.

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CONTRIBUTION OF AUTHORS

Dr. Jeff McCubbin was directly involved in the design and analysis of the study. He also assisted in the writing and editing of the final manuscript. Christopher Draheim assisted in the data collection and was integrally involved in gathering evidence for reliability. Dr. Hans van der Mars provided direction regarding research design and the analysis of data.

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DEDICATION

This dissertation is dedicated to my family.
To the seven people who have supported, challenged, and encouraged me throughout my life. Without your love and influence I would not have the compassion to accept diversity nor the ability to study it. I love you all.
WDS, CFS, GDS, TWA, AA, NCP, and MTA.

PARTICIPATION OF ADULTS WITH MENTAL RETARDATION IN A VOLUNTARY PHYSICAL ACTIVITY PROGRAM

INTRODUCTION

The relationship between physical fitness and optimal health has been repeatedly documented in the scientific literature (Blair, Kohll, Paffenbarger, Clark, Cooper, & Gibbons, 1989; LaPorte, Adams, Savage, Brenes, Dearwater, & Cook 1984; Paffenbarger, Hyde, Wing, & Hsieh, 1986). Specifically, participation in regular physical activity can reduce one's risk for physiological and psychological diseases including coronary heart disease, diabetes, obesity (Haskell et al., 1992), and depression (Fletcher et al., 1992). The benefits of physical activity are no less significant for individuals with mental retardation (MR). In fact, higher rates of disease and secondary disabling conditions make participation in physical activity of critical importance for this segment of the population.

Persons with MR typically have lower levels of physical fitness than their peers without MR. Poor scores on measures of aerobic fitness (Fernhall et al., 1996; Fernhall, Tymeson, & Webster, 1988; Reid, Montgomery, & Seidl, 1985), muscular strength (Horvat, Pitetti, & Croce, 1997; Pitetti, 1988), and muscular endurance (Fernhall, 1993; Reid et al., 1985) have been reported in this population while the prevalence of obesity is high (Burkhart, Fox, & Rotatori, 1985). Possible explanations for the poor physical condition of persons with MR include low levels of activity and a lack of motivation to exercise (Eichstaedt & Lavay, 1992). Further, limited community-based opportunities for participation in physical activity likely contributes to the lower fitness scores. It is conceivable that the ability of persons with MR to perform daily living skills and physical work-related tasks is hindered by their lack of fitness. This is of importance since employment opportunities for this population are often physical in nature due to the limited cognitive abilities.

The positive response that individuals with MR have exhibited following training is promising for exercise programming. Pommering et al. (1994) reported that 10 weeks of aerobic exercise performed 4 days per week significantly increased the VO_2 max values of a group of adults with MR. Rimmer and Kelly (1991) examined the effects of a 9-week resistance training program on a similar sample. Results indicated that participation in the program 2 days per week led to improved strength levels as measured with a 1-repetition maximum. Exercise interventions have also proven useful for treating obesity in persons with MR. Significant reductions in body weight were observed in 5 adults with MR following participation in a 23-week walk/jog program (Schurrer, Weltman, & Brammell, 1985). The average decrease in body weight was 5.6%.

Although training studies have been effective for increasing physical fitness outcomes, experts recommend a shift in research focus. The call is for investigations of intervention strategies that *keep* persons with disabilities participating in physical activity, a goal far more broad than fitness (King, 1994; Pitetti & Campbell, 1990; Rimmer, Braddock, & Pitetti, 1996). This advice reflects the activity focus of the recently released Surgeon General's Report (Department of Health and Human Services, 1996). Only a few studies involving persons with MR have emphasized the process of becoming active over the product of physical fitness. Behavior modification strategies and/or reinforcement systems are commonly a major component of these intervention studies since it is accepted that persons with MR require extrinsic motivators to remain active. A token economy system was reportedly effective for increasing the stationary cycling time of adult women with MR (Bennett, Eisenman, French, Henderson, & Schultz, 1989). Participants were rewarded with tangible items such as food for pedaling a predetermined number of revolutions. Lavay and McKenzie (1991) reported that adult men with MR actively participated in a 12-week, supervised walk/run program when they set personal goals and were rewarded with outings for reaching them. In another study, 19 adults with MR were paired with a nondisabled exercise partner over an 18-week walk/jog program (Tomporowski & Jameson, 1985). Participants received verbal encouragement and assistance with pacing from their running partners. Results indicated that the program was effective for encouraging participants to increase the number of miles run each week and reduce their time to run each mile. Finally, verbal reinforcement and food were sufficient motivators to increase the exercise time of 6 youth with profound MR on a Stairmaster stepping machine (French, Silliman, Ben-Ezra, & Landrieu-Seiter, 1992).

While reinforcement systems are effective for stimulating persons with MR to participate in training programs, the behavior modification techniques embedded in the methodologies of these and similar studies involved high levels of supervision and/or tangible rewards. Therefore, the practicality of the interventions for use in community or integrated settings is limited. Although behavior modification and/or reinforcement are thought to be critical for motivating persons with MR to be physically active, research must begin to employ systems that are more functional in community-based programs. Few studies have examined the exercise behavior of persons with MR when only minimal compensation for participation was offered. Pitetti and Tan (1991) examined participation and adherence to a worksite stationary cycling program for adults with MR. Participants were supervised for safety purposes but no encouragement, prompting, or extrinsic reinforcement was provided. Not only was the 16-week program effective for increasing the cardiovascular fitness levels of the participants, but compliance to the program was acceptable with only 1 of 14 participants dropping out due to lack of interest. The effects of music and music videos on the time on task of 5 adolescents with profound MR exercising on a cycle ergometer has also been investigated (Owlia, French, Ben-Ezra, & Silliman, 1995). Both reinforcers were effective for increasing cycling time for all but one participant. A similar investigation examined television and verbal encouragement as motivators to encourage cycling behavior in a small group of adults with MR (Todd & Reid, 1992). The number of revolutions pedaled by participants increased when the audiovisual reinforcer was presented with verbal praise. The results of both studies have significant social validity due to the limited intrusiveness of the reinforcement strategies.

The importance of physical fitness as a significant indicator of health risk is well documented. However, before gaining fitness, an exercise habit must be acquired and maintained (Bennett et al., 1989). In order for persons with MR to independently engage in physical activity, proper programs must be developed with their best interests in mind. To date, the widespread exercise adherence research has neglected to study those segments of the population that are most sedentary including persons with MR (King, 1994). Adherence intervention studies have examined different exercise environments, program elements, and instructional methods and observed their effects on maintenance of participation. Instructional videotape is one method that has been examined to promote independent participation in exercise. The effectiveness of videotapes, which are typically used at home, has been variable in the general population. No studies have investigated the usefulness of exercise videotapes to increase the physical activity levels of persons with MR despite being a practical method to encourage participation.

The purpose of this investigation was to examine the level of active participation of adults with MR in a 10-week community-based physical activity program. Group engagement in moderate to vigorous intensity physical activity (MVPA) was systematically observed under two conditions that involved different sources of instruction and social reinforcement. In one condition (A), a live exercise leader plus an exercise video delivered instructional cues and verbal promotion of participation. The second condition (B) encouraged more independent engagement in activity and used an exercise video as the only source of instruction. Independent participation and adherence to the program were the main goals of the study. Therefore, the primary focus was to determine if the removal of the live exercise leader would have a negative impact on group engagement in MVPA. The long-term goal of the study was to develop a simple, inexpensive program for increasing the physical activity levels of adults with MR.

but examine their P.A level during program

METHOD

Participants

Seventeen adults with MR voluntarily participated in the study. All participants were employees at a sheltered workshop for individuals with MR and/or developmental disabilities. The group consisted of 5 females and 12 males with an average age of 42.6 years (range 30-65 years). IQ scores were not available. However, based on functional independence, 15 of the participants likely would have been classified as having mild MR while two participants had severe MR. The participants with mild MR were social and had the ability to verbally communicate. Further, they functioned independently in their personal and professional lives. The two participants with severe MR had limited verbal skills and were notably less independent in their daily activities. These two participants practiced daily living skills at work and did not perform the various production tasks as the other employees.

All participants were ambulatory. When interviewed informally, two of the participants reported having minor orthopedic impairments including sore knees and lower back pain. One participant had high blood pressure and one reported a heart murmur. Only one of the participants reported smoking on a regular basis.

According to staff records, 14 participants worked at the workshop 5 days per week while the other three worked at that site 2-3 days per week. The living arrangements of the participants varied. Five participants lived in group homes, nine lived independently in apartments, while three lived with a "foster" family.

In regard to participation in regular physical activity, two of the participants reported involvement in the Special Olympics program one night per week for one hour. One participant reported riding her stationary bicycle 5 days per week for 30 minutes during her favorite television program and another performed calisthenic-type exercises at home. Four of the participants rode their bicycles to work each day and one walked to work. Two participants took an aerobic dance class one night per week for 30 minutes. However, the class was discontinued half way through the present study. Four of the participants did not report any regular physical activity.

Participants were informed that participation in the study was voluntary and were required to sign a consent form (Appendix A). The consent form was read aloud to those participants who could not read or had difficulty understanding written directions. Participants were reminded on a regular basis that they were not required to participate in the exercise program and that they could stop at any time.

Experimental Design

This study used a reversal design to test for a functional relationship between exercise condition and engagement in moderate to vigorous intensity physical activity (MVPA). Reversal designs involve continuous measurement of behavior (dependent variable) during consecutive phases of an experiment (Heward, 1987; Watkinson & Wasson, 1984). A treatment (independent variable) is systematically applied, withdrawn, or manipulated, and the effects on behavior are examined. If the variation of treatment is linked with systematic changes in behavior, it can be inferred that the treatment produced the observed changes (Hersen & Barlow, 1976).

Reversal designs typically involve a baseline phase when the independent variable is absent. Data collected during baseline are used to establish a pretreatment rate of behavior that is compared to data in the intervention phase. However, this study used a variation of the reversal design and did not include a baseline condition. Instead, two exercise conditions were applied and withdrawn and their effects on engagement in MVPA were observed (Figure 1). One exercise condition (A) involved the combination of a live exercise leader and an exercise video to provide instructional cues and reinforcement to the participants. The second condition (B) consisted of an exercise video as the only source of instruction and reinforcement. Baseline for the present study would have involved the absence of instruction, prompting, and reinforcement to participants during exercise. Since there is some speculation that individuals with MR are typically not motivated to participate in exercise and may lose interest, it was more appropriate to initiate the program with a condition of maximal support (i.e. with a live exercise leader).

Exercise Leader plus Video Condition (A)	Video Only Condition (B)	Exercise Leader plus Video Condition (A)	Video Only Condition (B)
6 sessions	6 sessions	6 sessions	12 sessions

Figure 1 – Visual representation of reversal design and duration of phases

Since it was unclear how long the supervisors would welcome the program and how long the participants would be interested, the duration of the study was set a priori at 10 weeks. Therefore, the two exercise conditions were alternated in three, 2-week (6 sessions) phases and a final 4-week (12 sessions) phase to follow the reversal protocol (Figure 1). The extended final phase was included to examine short-term adherence to the program in the condition of minimal assistance.

Program Procedures

The exercise program was administered three mornings per week (Monday, Wednesday, and Friday) for 15-17 minutes. All sessions were conducted in a cleared area of the production room at the sheltered workshop. At 8:30 a.m., employees were informed that it was exercise time and they were given the choice to participate. Those individuals who did choose to exercise located a polyspot on the floor that delineated their personal exercise space. Those individuals who chose not to exercise used the time in their own way (e.g., watching the exercise group, working, reading, or talking to others). The format of each session involved approximately 4 minutes of static stretches to warm-up, 10 minutes of moderate intensity aerobic dance activities, and 1-2 minutes of stretching to cool down. Aerobic dance was shown to be an appropriate mode of exercise for individuals with MR (Barton, 1982). Also, considering the limited space and lack of equipment at the workshop, aerobics was very suitable for the participant group. The warm-up typically included neck and shoulder rolls, arm rotations, groin stretch, toe touches, and a trunk stretch. The aerobic component of the program consisted of gross motor movements and activities such as stationary jogging, hopping, jumping jacks, walking, marching, lunges, kicks, and knee bends. Finally, the cool-down involved two or three stretches similar to the warm-up. The exercise routines were developed specifically for the participant group following 12 pilot sessions when their movement abilities were determined. Simple routines involving easy transitions between activities ensured that participants were able to follow the movements and avoid frustration. Further, it was determined during the pilot phase that 15-17 minutes was an appropriate duration considering the exercise capacities and attention levels of the participants.

During the first 2 weeks of the program, the exercise leader-plus-exercise video condition (A) was applied. The video was similar to commercially available aerobic dance tapes and involved two instructors modeling all exercises while promoting participation through verbal instruction, encouragement, and praise to the participants. Videos were used in this study because of their ability to provide instruction without requiring a professional leader to be present. Five different exercise videos were developed for this phase of the study to reduce the potential for boredom with one routine. Each video involved the same male and female instructor while exercises varied slightly. The videos were filmed indoors with a portable video camera and a wireless microphone was used to ensure that instructions could be heard clearly. It should be noted that no background music was played on the exercise videos. In order to change the exercise music on a daily basis and to take into consideration participant preference, music was played on a tape player external to the television. It became evident during the pilot phase that participants did not use the rhythm of the music to follow the routine as is typical in exercise classes. Therefore, the playing of music externally was not a problem in regards to matching exercises with the beat of the music.

During the leader-plus-video condition (A), the exercise leader was situated adjacent to the television, facing the participants. The leader imitated the exercises on the video and performed the routine with the group. Participants were instructed to watch either the exercise leader or the video and to follow their movements. The leader promoted participation by providing additional verbal encouragement and praise, and prompted the participants to stay on task. At the end of each session, the exercise leader congratulated the participants on their performance and gave each person a handshake or a high-five.

The exercise video-only condition (B) was applied during weeks 3 and 4. In this condition, no live exercise leader was present and a video was the source of instructional prompts and encouragement. The use of a video offered participants minimal support during exercise and was included as an instrument to stimulate independent participation. Again, several different exercise videos were created for use within this phase of the program to maintain variety. The same instructors were used in all videos and the routines were similar to those used in condition A. Once the participants were assembled in the exercise area, the investigator greeted them and the video was played on the television.

The absence of a live exercise leader during the video-only condition clearly would have resulted in less verbal promotion of participation. However, in order to ensure that the level of support remained similar across phases, the videos in condition B involved greater amounts of praise, encouragement, and prompting to compensate for the lack of a leader. Further, the observer (i.e., data collector) was always present and infrequently promoted participation through verbal cues when it appeared that participants were distracted or very unmotivated. At the end of each session, the observer gave each participant a handshake or a high five.

The results of a study using a reversal design are strengthened if the two treatments are alternated more than one time. If the relationship between treatments and behavior are replicated, then it can be stated with more confidence that the change in treatment is related to the change in behavior. Therefore, for weeks 5 and 6 the exercise leader-plus-video condition (A) was reintroduced. This condition was identical to the first two weeks of the study. Finally, the exercise video-only condition (B) was applied during weeks 7-10 and composed the second alternation of the reversal design. Since the priority of the study was to examine participation levels in an exercise program offering limited supervision and support, the final condition was extended to four weeks. Group engagement in MVPA over the final month of intervention provided valuable information regarding short-term adherence to the exercise program by participants.

The supervisors of the sheltered workshop were advised to verbally encourage employees to participate in the exercise program. Further, they were invited to join the exercise group at any time. However, supervisors were fully aware that participation in the program was optional and that employees were not to be persuaded to exercise.

As a means of examining the maintenance of behavior beyond the data collection phase, the exercise videos remained at the sheltered workshop for 4 weeks after the completion of the study. The principal investigator informed participants that the videos would continue to be played on Mondays, Wednesdays, and Fridays and that they could exercise if they wanted to. A work supervisor arranged the room and played the videotape while keeping a record of the number of participants who attended each physical activity session. Four probes were conducted to determine if group engagement in MVPA was maintained over the 4-week maintenance phase.

Data Collection

Physical Activity Engagement Data: The exercise behavior of interest consisted of group engagement in MVPA and was measured using selected components of the System for Observing Fitness Instruction Time (SOFIT). The SOFIT is a direct observation instrument designed to assess student physical activity levels, curriculum context variables, and teacher behavior in physical education classes (McKenzie, Sallis, & Nader, 1991). The component of the SOFIT that is used to assess physical activity levels was applied to the adult participants in the study.

The SOFIT uses a scale of engagement levels to estimate the intensity of an individual's physical activity. The scale includes five categories or codes. Codes 1-4 are associated with lying down, sitting, standing, and walking, respectively. Code 5 describes an individual who is very active, specifically, expending more energy than he/she would during ordinary walking. It has been demonstrated that heart rate does not elevate significantly until an individual performs at level 4 (walking) on the scale (Rowe, Schuldheisz, & van der Mars, 1997). Therefore, for the purpose of this study, MVPA was defined as 4 or 5 on the SOFIT activity scale. The validity of the SOFIT and the heart rate-MVPA relationship of the coding system was previously established in two studies (McKenzie et al., 1991; McKenzie, Sallis, & Armstrong, 1994).

The SOFIT involves group time-sampling every 20 seconds. This technique was employed to collect data on group engagement in MVPA. Every 20 seconds during the aerobic activity component of the exercise sessions, participants were observed and their activity levels were determined. This group time-sampling procedure involved listening to a prerecorded tape that cued the investigator to "scan" and "record" participant behavior. Specifically, each participant was coded as either engaged in MVPA (i.e. walking or expending more energy than walking) or not engaged in MVPA based on the SOFIT scale. The total number of participants engaged in MVPA at each 20-second time sample was recorded. The daily exercise behavior was expressed as a percentage of the entire group engaged in MVPA over all samples.

The aerobic component of the exercise routines was designed to involve approximately 10 minutes of MVPA. Therefore, if participants were actively imitating the video or the live leader, they were coded as engaged in MVPA. However, some participants had limited movement abilities, were less able to keep up with the video or leader, and/or had very low exercise capacities. The decision-making process regarding activity level was somewhat complicated in these cases. Through pilot work the investigator became well aware of participant abilities. Therefore, it was easier to determine if an individual was exercising at an intensity that constituted MVPA. Participants were most often given the "benefit of the doubt", and an apparent effort to follow along and actively participate was coded as MVPA. Interobserver agreement scores were calculated throughout the data collection process to ensure the accurate and reliable coding of behavior.

Work Performance Data Collection: The purpose of measuring work performance was to determine if taking time away from work time to exercise would significantly reduce productivity. Unfortunately, the work tasks were very inconsistent and employees often worked on different projects throughout the day. The work available was dependent upon contracts with other businesses and, at times, there was no work to do. Such variations in tasks made comparisons within and between participants very difficult.

Employees were paid on a per piece/pound basis so the work completed on a daily basis was recorded. The objective measure of work performance for the study was time (minutes) per piece/pound. On those weeks that contracts remained the same for individual participants, productivity on exercise days was compared to productivity on non-exercise days.

Verbal Promotion of Physical Activity Data Collection: Participation in MVPA was promoted verbally by the exercise leader and/or video. The amount of verbal promotion was comparable to that provided in a typical exercise class or on a commercial exercise video. Since the objective of the study was to stimulate independent participation in exercise without using tangible rewards, only social reinforcement was used to motivate participants. Any verbal cues, praise, prompting, or encouragement that were intended to increase or maintain participation in physical activity were considered verbal promotion. During the pilot phase, the amount of promotion required to keep the participants actively engaged was recorded. Therefore, the exercise videos were developed to involve approximately the same level of verbal promotion that was provided during pilot work. Further, participants clearly enjoyed the congratulatory high-five or handshake offered after each session so that was continued in the intervention phase.

In order to ensure that the amount of verbal promotion remained relatively constant across conditions, the exercise leaders were audio taped during each session. The tapes were analyzed to determine how frequently the leaders promoted participation in physical activity through verbal cues/comments. A 10-second partial interval recording system was used to collect the data (McKenzie et al., 1991). Specifically, during each 10-second time interval it was determined whether or not the leader verbally promoted participation. The total number of intervals that involved promotional cues/comments was calculated and expressed as a percentage of the total intervals in a session. All exercise videos were coded for the frequency of verbal promotion as well. This allowed for a comparison between the amount of promotion of physical activity between conditions.

Graphical Analyses

The data were graphed for visual analysis. The properties relevant to the visual analyses of the engagement level data included variability within and between exercise conditions, overlap between scores of adjacent exercise conditions, and changes in level between exercise conditions (Parsonson & Baer, 1990). The relative variability or stability of the data paths allowed for the determination of degree of control that the different exercise conditions had over group engagement in MVPA. The extent to which scores overlapped between the phases of exercise conditions gave an indication of how similar or different the conditions were in affecting engagement. Changes in level between conditions involved examining the vertical distance between the data paths.

Greater distances between the paths indicated greater differences in the effects of the conditions on the exercise behavior of interest.

Interobserver Agreement

Interobserver agreement (IOA) on engagement in MVPA was obtained on 31% of the exercise sessions. Data were collected live by the principal investigator and a trained graduate student. The observers were located far enough apart that neither could detect what the other was recording. Therefore, independence was achieved (van der Mars, 1989). Further, both observers listened to the same audiotape to ensure that cues to "scan" and "record" were heard at exactly the same time.

Interobserver agreement was calculated on a sample-by-sample basis for the duration of the exercise session (van der Mars, 1989). Perfect agreement was achieved when both observers coded the same number of participants as actively engaged at each 20-second time sample. To calculate IOA for each *20-second sample*, the following formula was used:

$$(1) \quad \frac{\text{Agreements}}{\text{Agreements + Disagreements}} \times 100 = \text{\% Agreement for sample}$$

The IOA for an *exercise session* was the average of all 20-second samples and calculated using the following formula:

$$(2) \quad \frac{\text{Sum (\% agreement for each 20-second time sample)}}{\text{Total number of samples}} = \text{\% Agreement for session}$$

Scores for IOA were also calculated for the frequency of verbal promotion data on 28% of the sessions across all phases of the study. The principal investigator and a trained graduate student were cued by the same tape to "listen" and "record" the verbal reinforcement provided by the exercise leader. Interobserver agreement for each session was calculated using equations 1 and 2.

RESULTS

The mean IOA score for the percentage of group engaged in MVPA data was 90% (range 85-94%). The mean IOA score for the percentage of intervals with reinforcement data was 93% (range 82-99%). The typical criterion of 90% or higher is regarded as acceptable when collecting data on behavior using direct observation (van der Mars, 1989). The levels of IOA were adequate to have confidence in the results.

Group Engagement in MVPA

Visual inspection of the data (Figure 2) revealed that the percentage of group engaged in MVPA was relatively stable within both conditions throughout all phases of the study. However, levels of engagement did differ between conditions.

During both leader-plus-video conditions (A) mean group engagement in MVPA was higher than during the video-only conditions (B) (Table). The difference in average engagement level between conditions A and B was 7% of the group over both reversals. There was a near replication of behavior across the first and second applications of each condition. Specifically, the application of a given exercise condition consistently resulted in a given level of group engagement in MVPA.

Although the withdrawal of the live exercise leader had a slight negative impact on the overall participation level of the group, the difference was small when considered in practical terms. An average of 11 participants attended each exercise session during the 10-week study. A 7% decrease in group engagement level with the video-only constituted one less person being physically active. Considering the significant

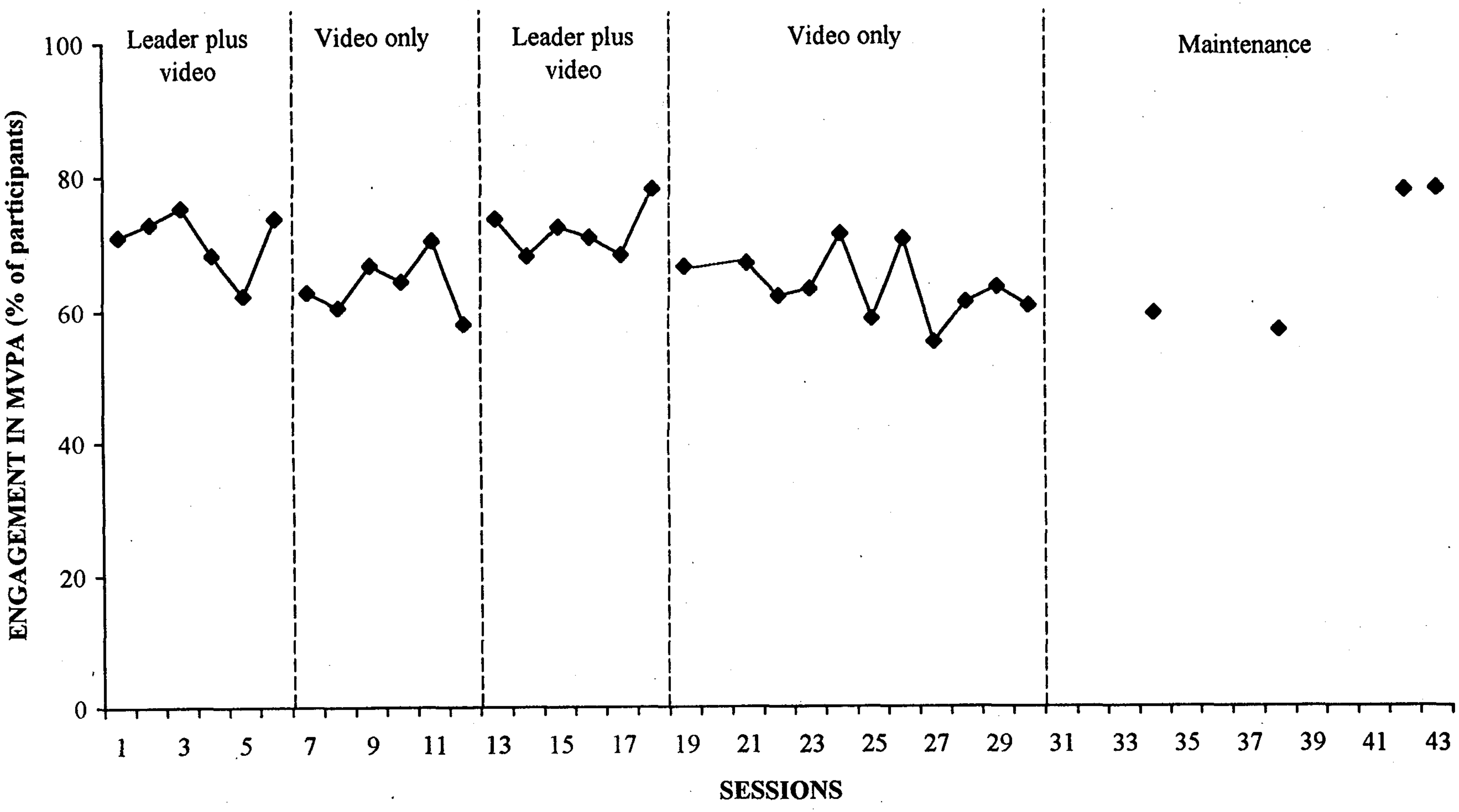

Figure 2 - Graphical display of percentage of participants engaged in MVPA. *no data collected on session 20

Mean Values for Engagement in MVPA, Reinforcement Provided, and Attendance

Weeks	Condition	Mean % of Group Enagaged in MVPA (range, stdev)	Mean % of Intervals with Reinforcement (range, stdev)	Mean % of Employees in Attendance (range, stdev)
1 - 2	video-plus-leader	71% (62 - 75, 4.7)	92% (90 - 94, 1.7)	78% (67 - 87, 9.7)
3 - 4	video-only	64% (58 - 71, 4.4)	90% (88 - 93, 2.0)	84% (71 - 93, 10.2)
5 - 6	video-plus-leader	72% (69 - 78, 3.7)	92% (87 - 98, 4.4)	84% (77 - 92, 6.2)
7 - 10	video-only	64% (55 - 71, 4.9)	91% (88 - 93, 1.9)	81% (64 - 92, 9.7)

administrative ease and cost-effectiveness of conducting the program with only an exercise video, the difference between conditions was not considered practically meaningful.

Despite the leader-plus-video treatment (A) resulting in slightly higher levels of engagement than the video-only (B), there was considerable overlap of data points between conditions. Overlapping data suggest that the type of exercise condition did not have full control over the behavior of interest. This provided additional evidence that the presence or absence of an exercise leader was not the sole determinant of participant activity level. It should be noted that there was less overlap between the second reversal of the leader-plus-video condition (i.e., third phase) and the second video-only condition (i.e., fourth phase). This may suggest that later in the study the exercise condition had more control over behavior.

The final data points of the first three phases displayed marked changes in group engagement behavior. However, without more data points it is impossible to determine if there would have been a continued trend in the given direction. The 10-week time frame forced investigators to alternate conditions after days 6, 12, and 18, which is one limitation of this study.

Maintenance

Four probes were conducted (one per week) over the 4-week maintenance phase. The percentage of group engaged in MVPA declined following the second video-only condition. The average engagement level was 60% and 57% for the first and second weeks of maintenance, respectively (Figure 2). However, group engagement in MVPA increased over the final 2 weeks of maintenance with levels of 78% during both sessions when data were collected.

Attendance to the program remained high over the first 2 weeks of maintenance (mean attendance = 9.5 people) but dropped off over the course of the month. Records of attendance by the supervisor indicated that a core group of 7 participants continued to be physically active on all 3 exercise days while four others participated on a less regular basis.

Verbal Promotion of Group Engagement in MVPA

In order to rule out the amount of verbal promotion as a confounding variable that regulated group engagement level in MVPA, the percentage of intervals with promotional cues/comments was tallied and represented graphically in Figure 3. Visual inspection of the graphs indicates that the verbal promotion of participation remained very stable across both conditions throughout the study. Therefore, the amount of verbal support received from the leader and/or the video was not related to engagement levels. It is more conceivable that the *source* of verbal promotion was an influencing factor. The slightly higher engagement levels in the leader-plus-video condition (A) may have indicated that praise and encouragement from an exercise leader is more meaningful for reinforcing behavior than the exercise video only.

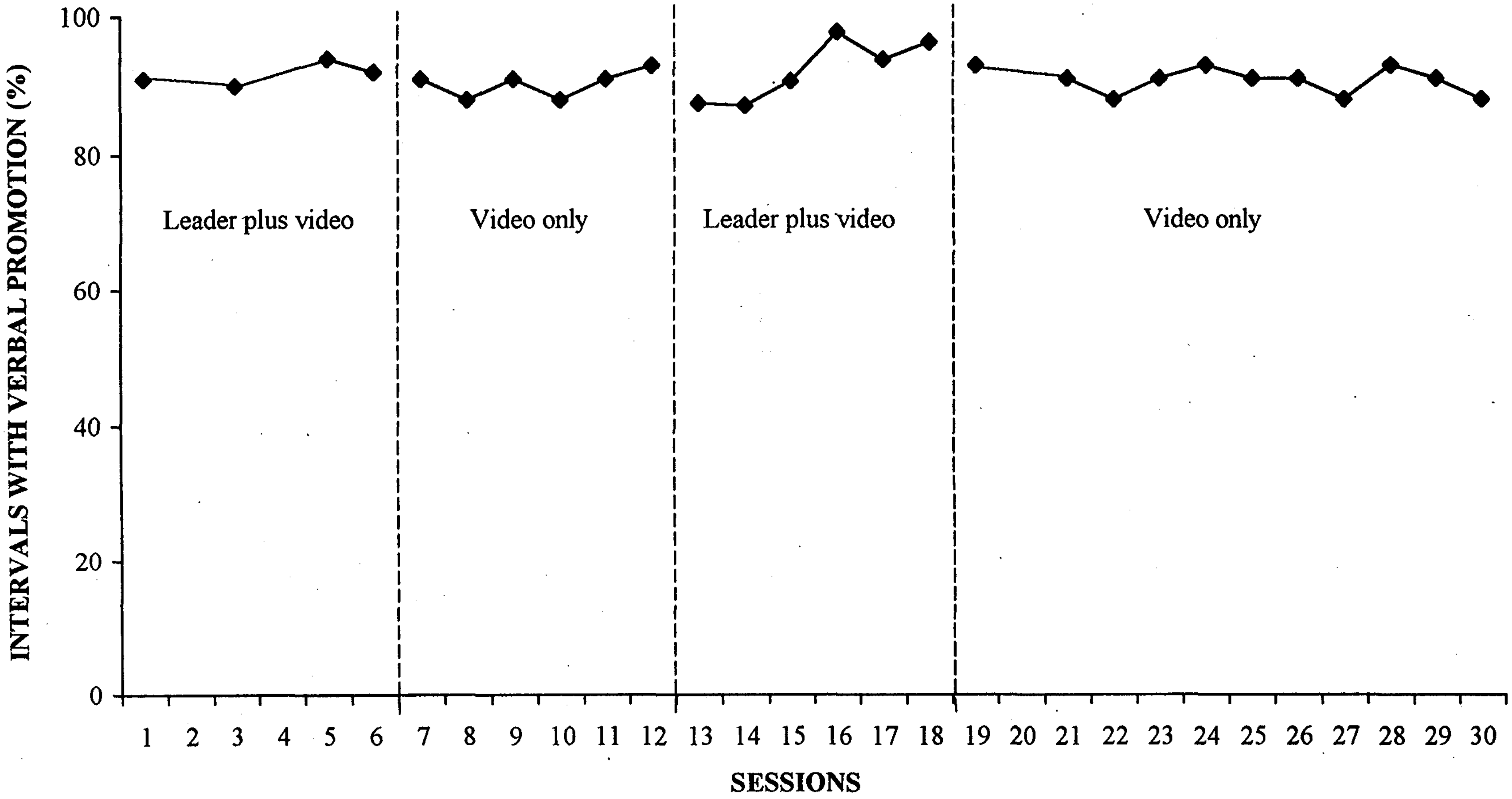

Figure 3 - Graphical display of percentage of intervals when verbal reinforcement was provided during each physical activity session. *no data was collected on sessions 2 and 4

Group Attendance in Physical Activity Sessions

The mean absolute attendance in the physical activity sessions remained relatively constant over the four conditions of the study. It should be noted that a core group of nine people consistently attended the exercise program while eight others participated on an irregular basis. If one of the "regulars" was absent it was typically a result of an uncontrollable influence as opposed to choice. Specifically, illness/injury, appointments, moving residence, and/or transportation problems caused a participant to be absent. One participant was away from work for 3 weeks due to difficulties at home, while another had back problems for approximately 2 weeks. The two individuals with more severe MR were among the core group of exercisers. Despite their regular attendance to the sessions, they typically did not actively participate in the program but only stood and watched the exercise video. This consistent pattern of behavior likely influenced group engagement levels.

Although all employees of the workshop were provided the opportunity to participate in the exercise program, some did not choose to do so. Therefore, a more relative attendance value was derived to provide further insight into the relationship between group engagement in MVPA and number of people present. The data represent the percentage of employees present at work on a given day who chose to be active in the exercise program. Employees who were required to perform duties during the time of the exercise program were considered unavailable and not included in the calculation of the percentage. It was noted that several employees did not participate in the program at all while others attended occasionally.

Based on visual inspection of the data (Figure 4), there appears to be a slight inverse relationship between the percentage of employees that participated in exercise and the engagement level of the group. Upon examining the first leader-plus-video condition (A), the lowest percentage of employees participated in session 3. The mean percentage of group engagement in MVPA was highest on that day at 75%. This association holds true for both applications of the video-only condition (B). Session 11 and session 23 had the lowest percentage of employees engaged in MVPA for the video-only condition (B). Group engagement level on these days was the highest at approximately 71%. Further, when the greatest percentage of employees participated over all condition applications, group engagement levels were notably low. It is likely that the individuals present during the sessions with low attendance were those "regulars" who consistently exhibited on-task behavior. Therefore, it was not surprising that engagement levels were higher during sessions when a low percentage of employees were present.

Anecdotal information was noted in the daily records to determine if any external variables could explain changes in exercise behavior. The type of music played, extent of supervisor involvement, day of the week, and any environmental changes or distractions were noted. Upon comparing the graphical data to the daily notes, it did not appear that any of the mentioned factors consistently influenced the group engagement level in MVPA.

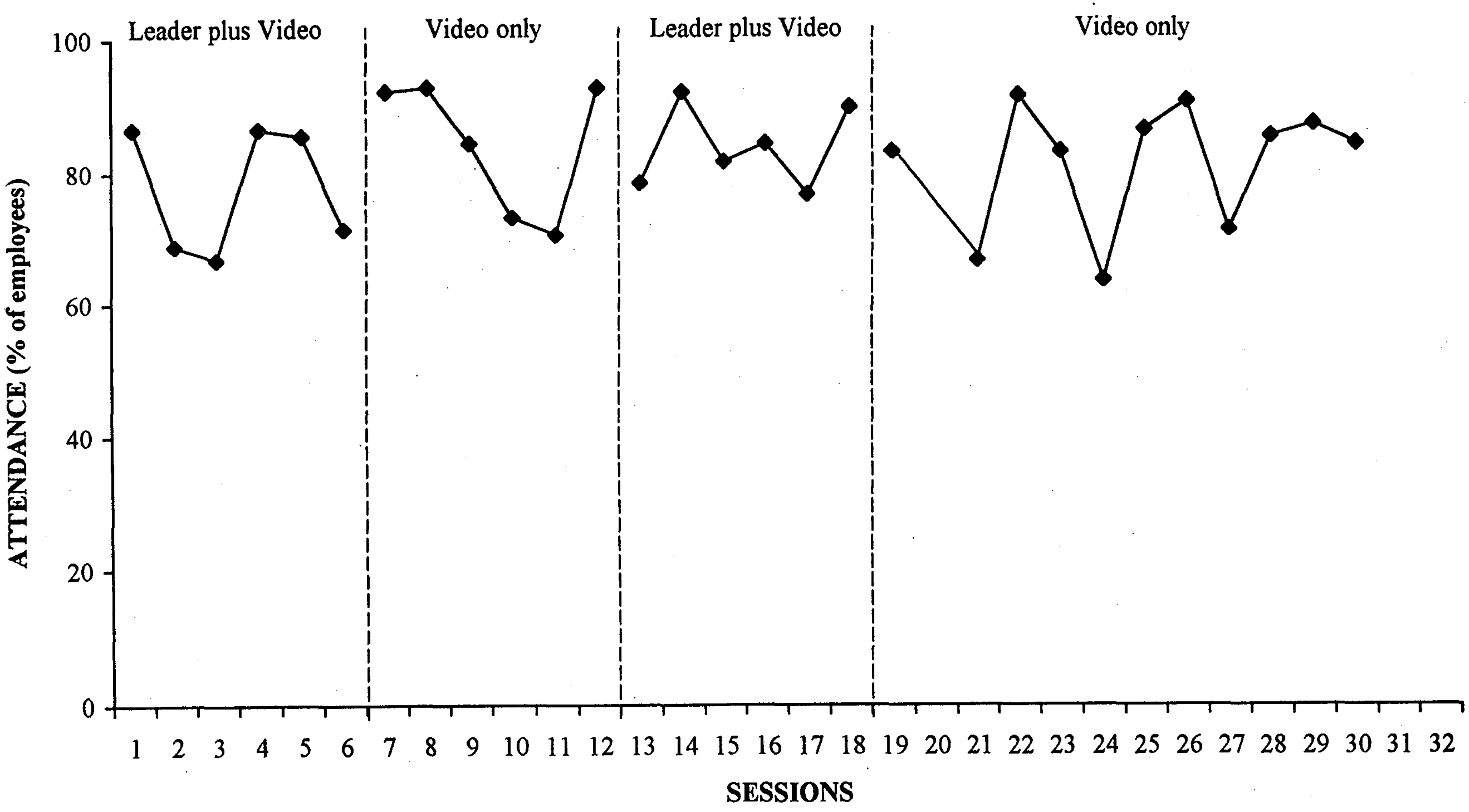

Figure 4 - Graphical display of percentage of employees attending each physical activity session

Work Performance

The purpose of including work performance as a secondary dependent variable was to determine whether or not daily productivity was affected by taking 15 minutes out of the workday to participate in the exercise program. This was difficult to monitor accurately as the tasks that participants performed at work were highly variable. Contracts with local businesses determined the type and amount of work available to the employees. Due to the inconsistency in tasks both within and between participants, the work performance data were presented through single subject graphical displays (Figures 5-10).

Work performance data were graphed over one month for 6 of the 17 participants. These subjects had relatively consistent tasks during that time and participated in a high percentage of the exercise sessions. The critical comparison was between work productivity on exercise days (Mondays, Wednesdays, and Fridays) versus non-exercise days (Tuesdays and Thursdays).

The work task for Participant #1 was to place labels on plastic bottles. Work performance was relatively stable across days and taking part in the physical activity program did not appear to negatively impact his productivity (Figure 5). Participant #1 labeled an average of 75.6 bottles/10 min on non-exercise days compared to 72.8 bottles/10 minutes on exercise days.

Participant #2 fed paper through a shredding machine. Work performance became variable toward the end of the month and there was a clear downward trend (Figure 6). Despite the lack of stability in data, Participant #2 was not consistently less

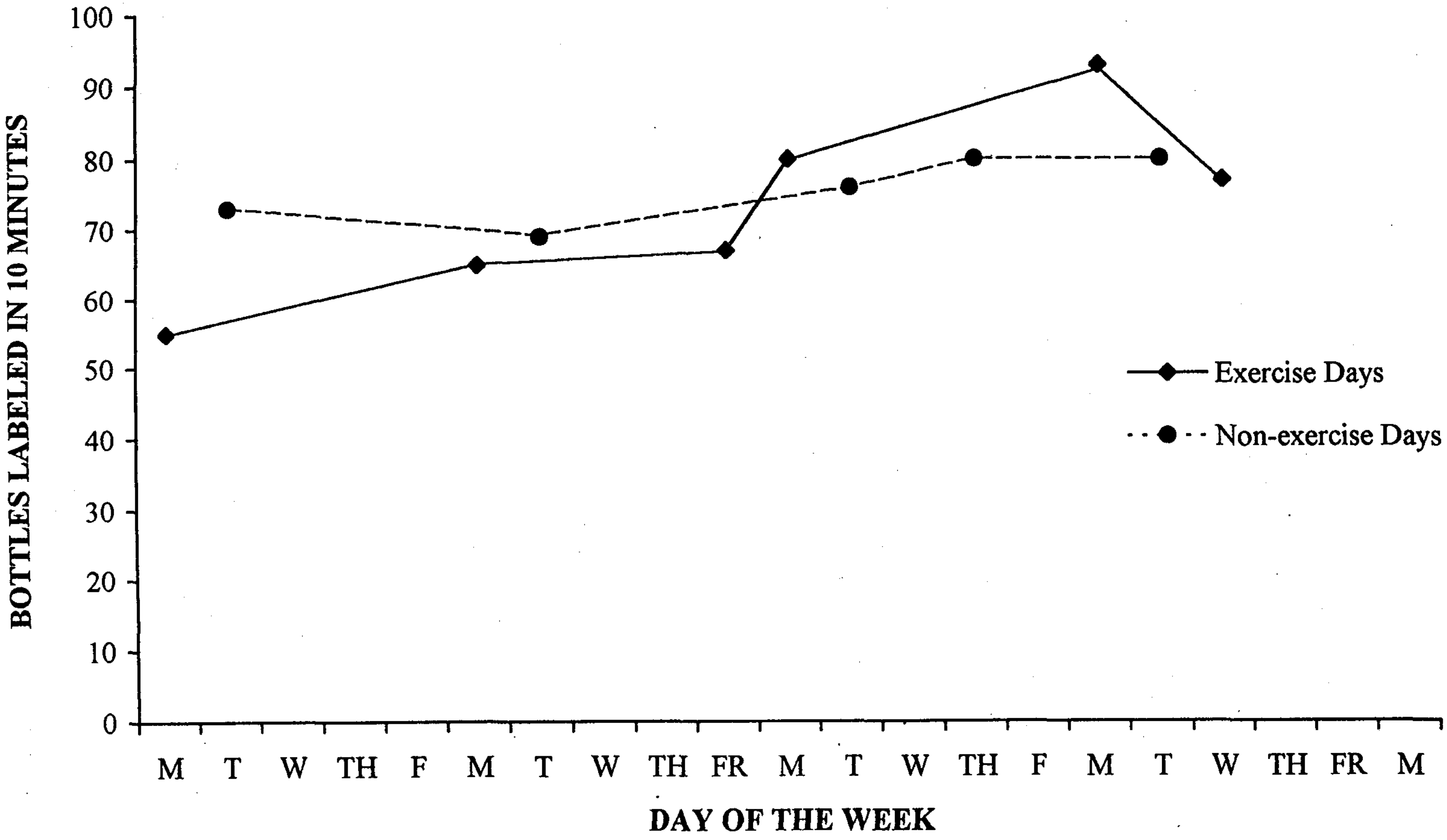

Figure 5 - Graphical display of work productivity data for Participant #1

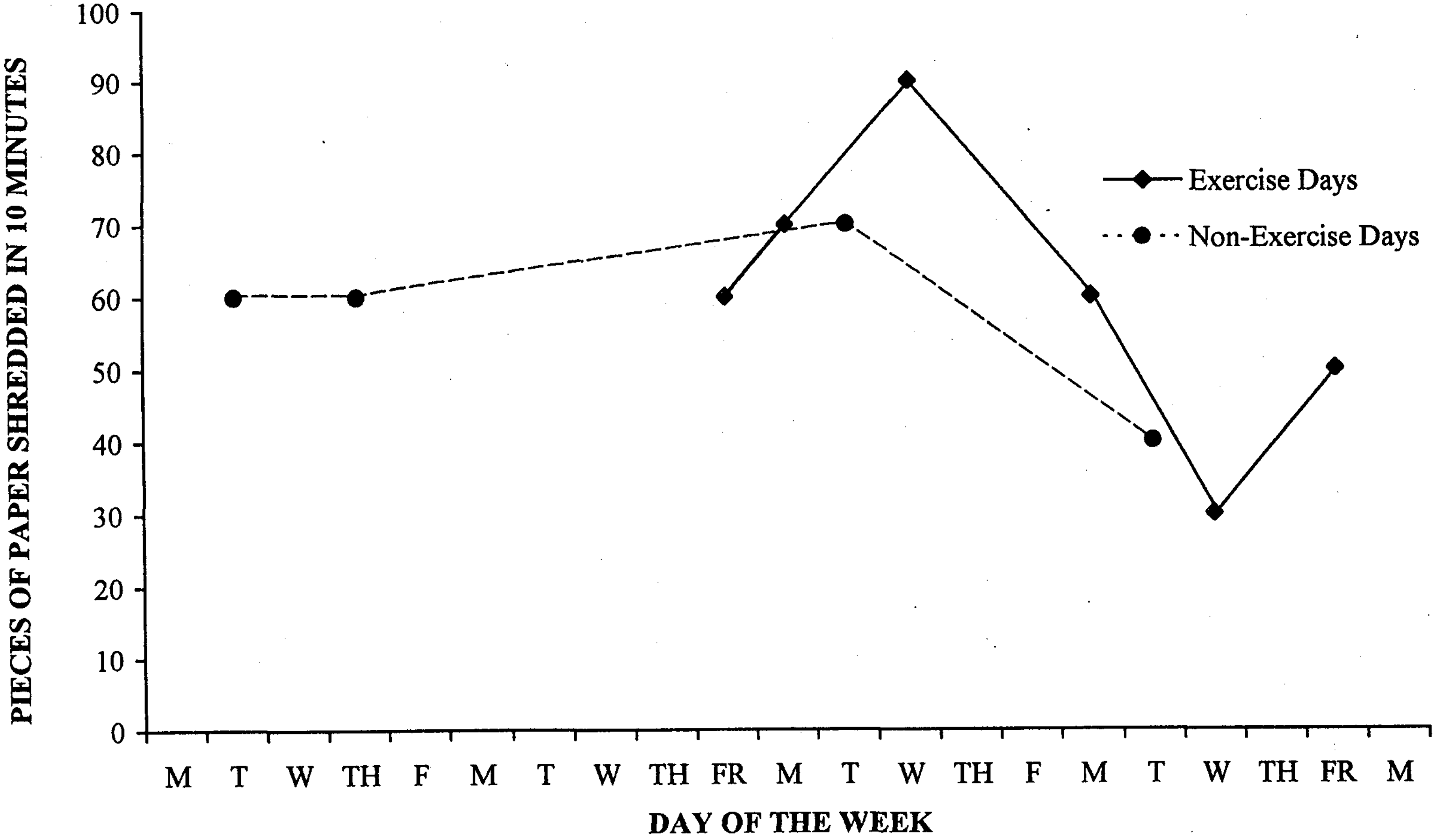

Figure 6 - Graphical display of work productivity data for Participant #2

productive on exercise days (mean = 60 pieces/10 minutes) compared to non-exercise days (mean = 57.5 pieces/10 minutes).

Work productivity for Participant #3 was highly variable and overall interpretation of data was difficult (Figure 7). However, there was no indication that her performance at work was negatively affected by her participation in exercise. In fact, over exercise days her mean productivity was 88 pieces of paper shredded/10 minutes, while on non-exercise days her average was 75 pieces/10 min.

Although there are limited work performance data for Participant #4 (Figure 8), it does not appear that the number of bottles labeled was inhibited by participation in exercise. The variability in scores especially on non-exercise days makes interpretation of scores difficult, however, mean productivity was 30.5 bottles/10 minutes on exercise days versus 29 bottles/10 minutes on non-exercise days.

Participants #5 and #6 also placed labels on bottles. Productivity was stable for Participant #5, and there was no evidence that taking the time to participate in the exercise program reduced the number of bottles labeled (Figure 9). In fact, her average performance on non-exercise days (76.1 bottles/10 minutes) was almost identical to that on exercise days (75.4 bottles/10 minutes). The average productivity scores provided some indication that Participant #6 was less productive on exercise days (87.8 bottles/10 minutes on exercise days; 96.8 bottles/10 minutes on non-exercise days). However, visual inspection of the data revealed variability and overlap of scores which suggests that the relationship was not consistent (Figure 10).

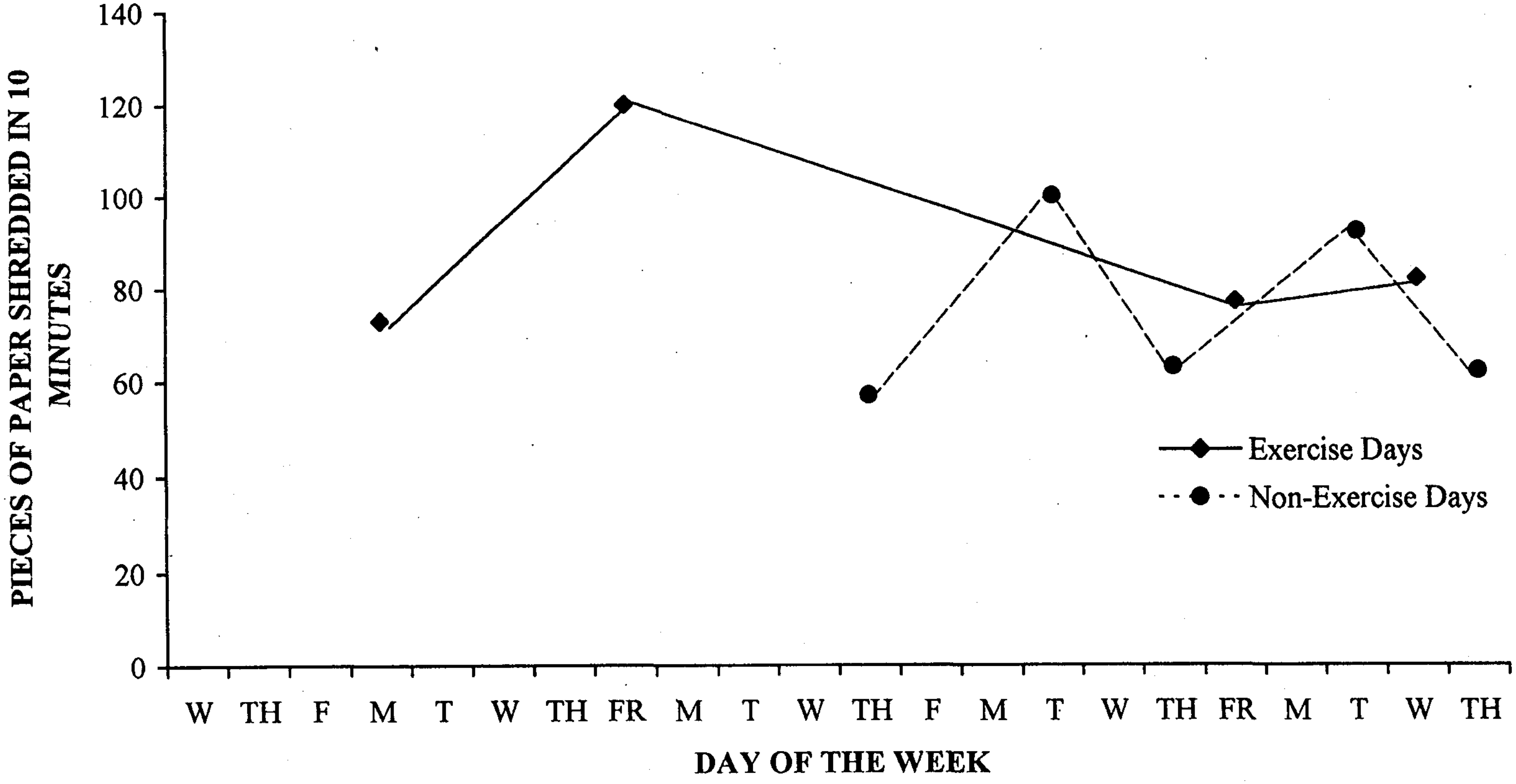

Figure 7 - Graphical display of work productivity data for Participant #3

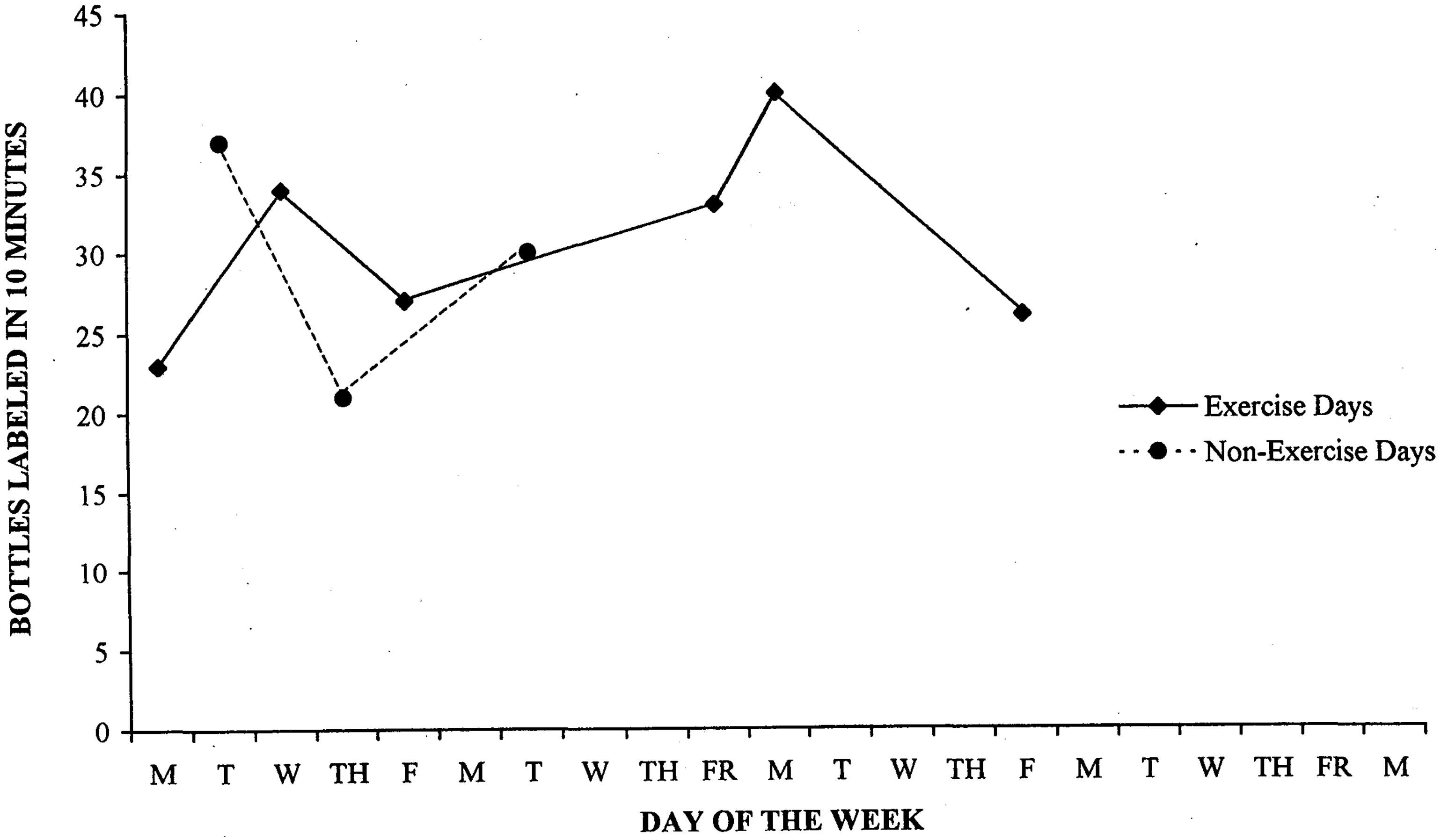

Figure 8 - Graphical display of work productivity data for Participant #4

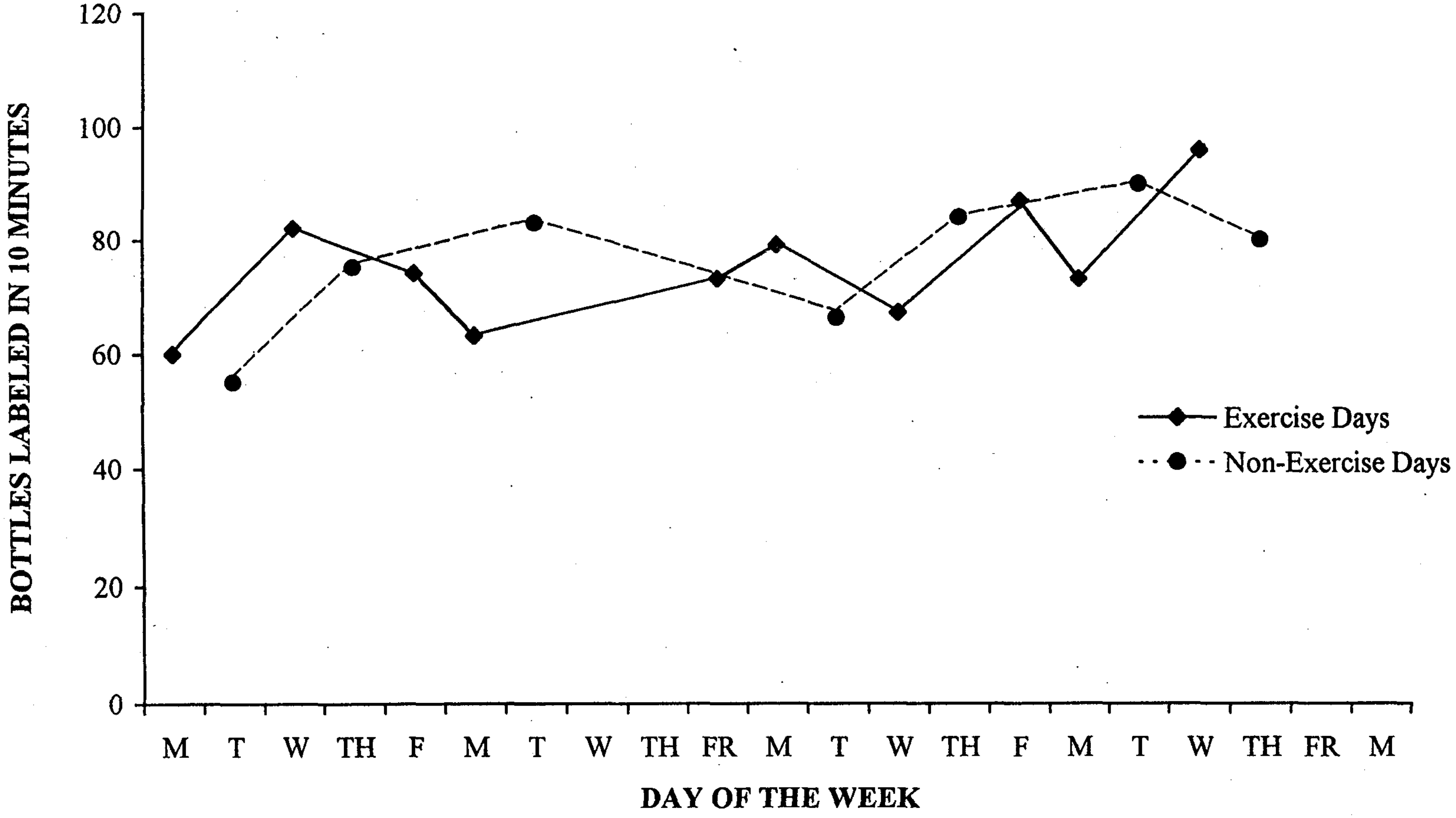

Figure 9 - Graphical display of work productivity data for Participant #5

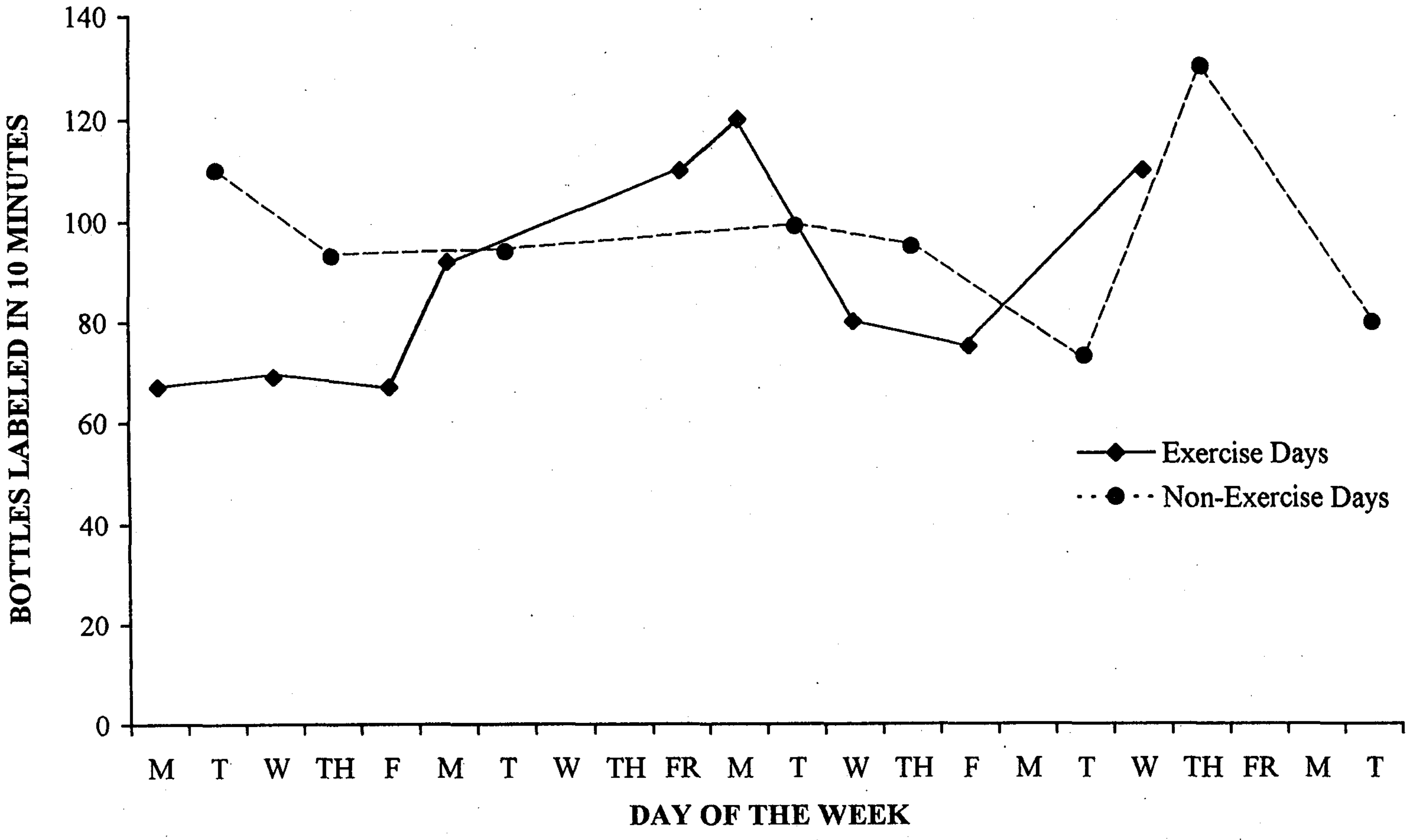

Figure 10 - Graphical display of work productivity data for Participant #6

DISCUSSION

There are significant data to illustrate that individuals with MR have low levels of physical fitness (Fernhall, 1993; Pitetti, Rimmer, & Fernhall, 1993). Although exercise training has proven effective for improving fitness scores in this population (Croce, 1990; Rimmer & Kelly, 1991; Pommering et al., 1994), very few studies have aimed to develop strategies that *keep* individuals with MR involved in regular, moderate intensity physical activity. It has been repeatedly suggested that people with MR are not intrinsically motivated to be physically active (Eichstaedt & Lavay, 1992). Therefore, most training studies have employed behavior modification techniques to promote active lifestyles in people with MR. Such techniques have commonly involved tangible rewards and high levels of supervision that reduce their practicality in community-based and/or integrated programs. A few studies have limited the amount of assistance and compensation provided to persons with MR when attempting to promote their active engagement in exercise (Tomporowski & Jameson, 1985; Pitetti & Tan, 1991; Todd & Reid, 1992). The results have provided some evidence that people with MR will voluntarily participate in physical activity without being afforded material rewards. This study aimed to evaluate the effectiveness of a convenient, inexpensive, and socially appropriate intervention strategy to stimulate the independent participation of adults with MR in physical activity.

The results of the present study were very encouraging. A major finding was that an average of 82% of employees at a sheltered workshop engaged in physical activity up to 3 days per week. Attendance and compliance to the program was good with a core group of participants who consistently engaged in activity and several others who participated on a less regular basis. Only three of the 17 participants dropped out of the program early on and did not ever re-join. They were not questioned about their discontinued participation. The timing of drop-out of the participants did not consistently coincide with condition A or B and there was no evidence that the removal of the leader caused their disinterest in the program. Other investigations have indicated that persons with MR will actively participate in fitness activities when given the opportunity (Bennett et al., 1989; Lavay & McKenzie, 1991). However, this study has provided unique results in that participants were not persuaded to exercise nor were they afforded rewards for their participation.

Of great importance to this study was that the removal of the live exercise leader only reduced the level of group engagement in MVPA by 7%. Wankel (1984) reported that support from program leaders in the form of verbal feedback was a key factor to adherence to exercise. Therefore, it was expected that the personal interaction with an enthusiastic leader during the leader-plus-video condition (A) might stimulate adults with MR to be considerably more active. There are three probable explanations to account for the small differences in group activity levels between the two conditions. First, the videos were developed specifically for the fitness/skill level of the group and involved personal feedback (i.e., used names of participants) making them more meaningful to participants. Participants enjoyed hearing their names on television and were personally acquainted with the leaders on the videos. It is difficult to speculate whether or not commercially available exercise videos would have been as effective. Second, the two exercise conditions may have been too similar to one another and participants may not have differentiated between the two. Since the same observer (i.e., data collector) was present during both conditions and exercise videos were also used in the treatments, the leader may not have had a significant impact on the exercise environment. The absence of a leader-only condition makes it difficult to accurately conclude the influence of the leader on the engagement level of the group. Third, it is possible that the employees enjoyed the social nature of the exercise program enough that the removal of the leader did not stifle their enthusiasm. The positive environment created by the up-beat music and the variety of exercise routines may have stimulated some participants to stay involved.

Although the differences in engagement levels between exercise conditions were small, it is possible that over the long term an exercise leader may be more effective for maintaining group participation levels. The power of a live exercise leader over a video is the leader's ability to target participants and provide direct reinforcement and/or assistance at the appropriate times. An exercise leader also has the ability to modify activities during a session so that participants get the most out of it. The practicality of a video over a leader must be weighed when making program decisions in light of the present results.

One of the most important observations made during the course of the program was that verbal praise, prompting, and encouragement were adequate to maintain the interest of most participants. In addition, the source of the verbal promotion (i.e., live leader or video) made only a small difference. It is possible that more employees would have participated had tangible rewards been offered. However, most participants exhibited high levels of motivation and enjoyment over the 10 weeks. These findings provide an argument that not all individuals with MR lack the initiative and motivation to be independently physically active. This is in contrast to suggestions published by Eichstaedt and Lavay (1992) and Reid et al. (1985). Tomporowski and Jameson (1985) used social approval and praise to reward a group of adults with MR for their participation in physical activity. The findings support their observation that participants were highly motivated despite the lack of extrinsic reward.

There were a number of other components of the study that may have acted to reinforce active participation in physical activity. Music has been shown to be a positive reinforcer that promotes motor performance and time-on-task in individuals with MR (Silliman & French, 1993). Further, television may be a useful tool to stimulate and/or maintain physical activity in this population (Todd & Reid, 1992). It should be noted that such forms of reinforcement are socially acceptable and age-appropriate and are commonly used in programs for nondisabled populations. Despite the possible external reinforcing influences, the aerobic activity itself appeared to motivate the participants to remain involved. Robison and Rogers (1994) reported that stimulus control strategies such as administering the exercise program at the same time each day, in the same setting, and with the same prompts may improve participant compliance. The program in the present study involved these behavioral strategies and they may have contributed to the high attendance and engagement levels.

It was of interest to determine if participants would continue to engage in physical activity using the video after the 10 weeks of data collection. A 4-week maintenance phase provided evidence that some participants continued with the program while others did not. It was not surprising to find that those 7 individuals who adhered to the program during maintenance were those who comprised the group of "regulars" over the 10 week investigation. In addition, the majority of those individuals reported being involved in some other regular physical activity. It is clear that the participants who continued to be active were those who already led active lifestyles. This supports the findings of studies on work-based programs that typically attract employees who are already active and not those who need it the most (Robison & Rogers, 1994).

The decline in engagement in MVPA observed over the first 2 weeks of maintenance may have been a result of reduced interest in the program. However, attendance remained high. Group engagement levels increased over the final 2 weeks of maintenance although attendance went down. The specific individuals who were present during the maintenance sessions likely accounted for these findings. Although the number of participants was less, those present exhibited on-task behavior. As is typically observed in nondisabled populations, the most motivated individuals adhered to the program and exercised continuously. Had this study employed a single subject experimental design and analysis the results may have been considerably different from those found.

There was anecdotal evidence that the study was successful in promoting active lifestyles and was beneficial to all involved. The director of the sheltered workshop perceived that employees looked forward to participating in the program and seemed more "ready to work" on exercise days. The participants clearly expressed excitement about the activity sessions and at times asked to participate more frequently. It should be mentioned that some of the supervisors also actively participated in the program on a regular basis. Toward the end of the study, participants offered unsolicited suggestions to improve the program. One participant brought in her own music tapes to play, while another proposed that we do some exercises on the floor with mats (e.g., pushups and situps). Several participants repeatedly asked to use a "Richard Simmons" exercise video. It is likely that such suggestions were indications of boredom with the program which was to be expected after 10 weeks. One participant did request a copy of the specially designed exercise video for use at home.

There are two limitations that must be taken into account when interpreting and applying the results of this study. Firstly, the order of treatments must be considered. Since the video-only condition (B) followed the leader-plus-video condition (A), it can only be concluded that the video was successful when preceded by a condition of greater assistance. It is possible that the video alone would not have been as effective as it was had a leader not been present at the beginning of the program to encourage initial participation.

Secondly, the presence of an observer during the video-only condition (B) may have prompted participants to be active. One disadvantage of direct observation is participant reactivity caused by observers being present in the environment (McKenzie, 1991). Pitetti and Tan (1991) reported a similar finding with a group of 14 adults with MR. Their results indicated that an observer was needed to escort participants to the exercise site and be present during the activity, but verbal encouragement was not provided. The findings of the present study offer evidence that people with MR will be on task when under minimal supervision. Exercise videos may be an appropriate alternative to leader-directed programs in that they provide instruction and verbal praise without a professional leader. However, the success of the video in this study may only be interpreted when the presence of an observer is considered.

Conclusions

In summary, a group of adults with MR willingly engaged in aerobic activity up to 3 days per week for 10 weeks. The results supported the use of specially designed exercise videos to encourage active living in this population. Further, participation in the activity program resulted in behavioral modifications for some participants in that several did continue to exercise at work for four additional weeks. It has also been demonstrated that some adults with MR are motivated to be physically active and that tangible rewards for participation may not always be necessary. As is typical in nondisabled populations, some individuals with MR may require greater amounts of reinforcement to adopt and maintain an exercise habit.

The workplace appears to be a convenient and accessible environment to provide adults with MR the opportunity to participate in a structured physical activity program. This study showed that taking time out of the workday to be physically active does not reduce productivity. The intervention program employed in this study could easily be administered in similar places of employment for adults with MR, as well as in residential centers, schools, and community recreation centers.

This study has provided one effective strategy to get people with MR to be independently physically active, which is the first step toward improving fitness. The most exciting finding is that the strategy involved an age-appropriate, socially-normative activity program that could easily be administered in an integrated, community-based setting.

Recommendations for Future Study

This study should be considered the first step in a line of research. Several important questions have resulted from the present investigation that could be addressed in future studies. Issues to be examined include: a) the determinants of exercise adherence in individuals with MR, b) the type/amount of reinforcement that is effective for stimulating less motivated individuals with MR to be physically active, c) the effect of providing choice of activity on engagement level and adherence, d) the specific health benefits, other than fitness, of participation in habitual physical activity in this population, and e) the effect of employee-directed physical activity programs on engagement levels in adults with MR. Future studies could also manipulate program variables (i.e. frequency, intensity, and duration) and environment (e.g. home based program) to develop programs that are most appropriate for individuals with MR. It is critical that future research keeps the best interests of the population in mind and strives for findings that can be translated into efficient and effective health practices.

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APPENDICES

APPENDIX A

INFORMED CONSENT

TITLE: **PARTICIPATION OF ADULTS WITH MENTAL RETARDATION IN A VOLUNTARY PHYSICAL ACTIVITY PROGRAM**

PRINCIPAL INVESTIGATORS: Dr. Jeff McCubbin and Heidi Stanish

I understand that;

1. I am being asked to exercise for 30 minutes on three mornings each week when I come to work at Open Door. This program will last for 10 weeks.

2. The exercise program is part of a study that Heidi is doing at Oregon State University.

3. I will be watched by Heidi when I exercise and she will write down how I do it.

4. If I ever have any questions about the exercise program I can ask Heidi.

5. I don't have to start exercising if I don't want to. If I ever want to stop exercising or quit the exercise program all together, I can do that without losing anything.

6. My name will not be used if Heidi ever shares the information from the exercise program with anyone else.

I understand what I am asked to do and want to participate. If I have any questions about the exercise program I can call Heidi at 737-3402 or Dr. Jeff McCubbin at 737-5921. For any other questions I can call Mary Nunn at 737-0670.

______________________________ ________________

Participant's Signature Date

______________________________ ________________

Witness' Signature Date

APPENDIX B

REVIEW OF THE LITERATURE

The purpose of this review of the literature is to provide an overview of published research in the area of physical activity and fitness for individuals with disabilities. Specifically, the review will detail fitness and training studies that have involved individuals with MR. Strategies that have been used to stimulate participation in exercise will also be examined. The strengths and shortcomings of past research will be described while suggestions for further investigation will be explained. The background provided by the review will develop a rationale for the present study.

Physical Activity, Physical Fitness, and Health

Numerous studies evaluating the association among physical activity, physical fitness, and health have been published in the scientific and epidemiological literature (Blair et al., 1989; Haskell et al., 1992; LaPorte et al., 1984; Paffenbarger et al., 1986). Within these reports there is substantial evidence to support the hypothesis that sedentary lifestyles increase the risk of morbidity and mortality from a number of chronic diseases. The most convincing evidence for a causal relationship exists for coronary artery disease, hypertension, colon cancer, obesity, functional capability, and non-insulin dependent diabetes mellitus (Blair, 1993). Psychological benefits have also been linked to regular exercise although studies are somewhat fewer in number. Measures of depression, well-being, anxiety, and self-efficacy have all been examined and display correlations to levels of participation in physical activity (Fletcher et al., 1992). The significant public health burdens of sedentary living habits have been well established and have fostered much of the research surrounding physical fitness and disease.

Powell and Blair (1993) provided quantitative estimates of mortality attributable to inactive lifestyles. Using the epidemiological construct of population attributable risk (PAR), they estimated the number of deaths due to coronary heart disease (CHD), colon cancer, and diabetes that were consequences of insufficient physical activity. The authors used a compilation of observational studies, pathological reports, and experimental studies to establish the causal relationship between sedentary living and certain public health burdens. Calculations revealed the overall PARs in 1988 were 35% for CHD, 32% for colon cancer, and 35% for diabetes mellitus. It should be noted that participation in regular, vigorous physical activity would be required for these percentages of deaths to have theoretically been prevented. Results of the calculations indicated that 21,800 deaths from CHD, colon cancer, and diabetes mellitus could have been prevented that year if 50% of the sedentary people had engaged in at least irregular physical activity. In addition, had half of the irregular exercisers become regular, 41,800 of the deaths could have theoretically been prevented. Despite these remarkable estimations and the growing evidence to support physically active living to benefit health, residents of the United States (US) remain predominantly sedentary (Blair, 1993).

To estimate the prevalence of inactivity and to identify differences among various groups in the US, the Center for Disease Control and Prevention (CDC) analyzed data on leisure-time physical activity from the 1991 Behavioral Risk Factor Surveillance System (BRFSS) (Center for Disease Control and Prevention [CDC], 1993). Respondents of the random telephone survey were questioned on the frequency, intensity, and duration of activities and were categorized as: 1) no physical activity, 2) irregular physical activity only, 3) regular but not intensive activity, or 4) regular and intensive activity. A sedentary lifestyle was defined as no or irregular leisure-time physical activity. Overall, 58.1% of people were classified as sedentary, and 29.8% reported no leisure-time physical activity at all. The prevalence of inactivity was inversely related to income and education, but positively correlated to age. It is apparent that relatively few individuals in the US are taking advantage of the health-protecting effects of regular exercise.

The concerns of public health professionals and exercise scientists regarding the nation's sedentary habits and increased risk for chronic disease, have prompted research on the determinants of exercise behavior (Sallis & Hovell, 1990). Investigators have claimed that the identification of exercise predictors could ultimately be used to enhance the effectiveness of exercise intervention programs. King et al. (1992) summarized the literature on known determinants of physical activity participation in adults. The review examined the influence of personal characteristics, knowledge, attitudes, and beliefs, psychological/behavioral attributes and skills, program/regimen factors, and environmental factors on exercise behavior. Age, education, race, gender, and body composition were identified as important demographic variables for predicting participation in exercise. It was revealed that self-efficacy, perceived access to facilities, perceptions of health, and attitudes toward exercise all correlate with exercise participation levels. The environmental factor most consistently identified as an exercise determinant is social support from friends and family. Program-related variables such as exercise intensity, program flexibility, participation fees, and the complexity or convenience of activity regimen may all influence exercise participation levels.

Interestingly, there is some evidence to indicate that the determinants of exercise behavior in children and adolescents differ from those of adults. A recent review identified motor skills, body composition, socio-economic status, and parental encouragement as predictors of participation in physical activity for youth (Sallis et al., 1992). It should be noted that the majority of these studies focused on the determinants of scheduled, vigorous leisure-time physical activity and there is limited data available on the factors related to light and moderate intensity activity. The importance of this differentiation should be considered when reviewing exercise studies in light of the recent shift in emphasis from fitness standards to physical activity levels.

There has been an accumulation of knowledge that indicates that light to moderate intensity physical activity can lead to improved health. In 1984, LaPorte et al. reviewed the epidemiological research surrounding physical activity, cardiovascular disease (CVD), and health. The authors challenged the traditional perspective that physical fitness is a necessary condition for overall health and protection against cardiovascular disease. They proposed that high levels of physical activity may or may not produce fitness and that the two should not be considered synonymous. The review reported evidence that physical fitness may not have a strong link to subsequent heart attack risk when compared to physical activity. It was also stated that studies have identified high activity groups who did not achieve adequate intensity to increase fitness but had reduced health risks. In addition to this relatively new information about exercise intensity, the results of a recent study have stimulated thought regarding exercise duration. DeBusk, Strenestrand, Sheehan, and Haskell (1990) compared the effects of a single, 30 minute bout of moderate intensity exercise to three, 10 minute exercise bouts on functional capacity. Participants in both exercise groups showed significant increases in maximal oxygen consumption (VO2 max) after the 8 week intervention. Therefore, multiple short bouts of exercise throughout the day are significant to invoke a training effect. Although a direct measure of physical fitness was the dependent variable in the study, the results have been applied to current perspectives on physical activity and health status. It has been stated that the accumulation of moderate intensity physical activity throughout the day is adequate to reduce the risks for several chronic diseases (Pate et al., 1995).

A group of experts was brought together by the CDC and the American College of Sports Medicine (ACSM) to develop a public health message regarding physical activity (Pate et al., 1995). Physical activity was defined in the paper as "any bodily movement produced by skeletal muscles that results in energy expenditure". Exercise was presented as a subset of physical activity defined as "planned, structured, and repetitive bodily movement done to improve one or more components of physical fitness". With this in mind, the authors reported on epidemiological studies and experimental investigations that have demonstrated that low levels of habitual physical activity and low levels of physical fitness are associated with increased all-cause mortality rates and risks for chronic diseases. Further to outlining the percentage of the population that currently leads a physically active life and the determinants of exercise behavior, the authors provided specific physical activity recommendations for adults. In order to attain the health benefits associated with physical activity "every US adult should accumulate 30 minutes or more of moderate intensity physical activity on most, preferably all, days of the week". This recommendation has come to be known as the Lifetime Physical Activity Model (LPAM) and differs significantly from traditional exercise prescriptions (Corbin, Pangrazi, & Welk, 1994).

A 1990 ACSM position paper provided guidelines for exercise prescription for the healthy adult which involved 20-60 minutes of continuous aerobic activity, at an intensity of 60-90% of maximum heart rate or 50-85% of VO_2 max, 3-5 days per week (ACSM, 1990). In addition, moderate intensity resistance training 2 days per week was recommended to improve muscular strength. It is very likely that this Exercise Prescription Model (EPM) provides most of the disease benefits observed with increased physical activity. However, the ACSM guidelines may have intimidated some potential exercisers and contributed to the current low participation rates in physical activity.

An updated position stand by the ACSM outlined the recommended quality and quantity of exercise for developing and maintaining physical fitness in healthy adults (Pollock, Gaesser, Butcher, Despres, Dishman, Franklin, & Garber, 1998). The specific values for frequency, intensity, and duration of exercise are similar to those in the 1990 stand. However, a noticeable modification to the more recent publication is the further definition of the relationship between physical activity and health versus fitness. It was acknowledged that lower levels of activity than recommended may reduce the risk for certain chronic diseases and yet may not be adequate to improve fitness values. Further, the authors claimed that significant health benefits are achieved by going from a predominantly sedentary existence to a minimal level of physical activity. It is evident that those experts who traditionally researched and advocated the EPM are now encouraging the public to simply "do more".

Physical Fitness and Individuals with Disabilities

There are a number of population subgroups at the forefront of the sedentary existence observed in North American society. In many cases, the most inactive individuals are those who are at high risk for disease and could benefit most from positive lifestyle modifications (King, 1994). Despite a lack of data on the daily physical activity patterns of persons with cognitive and/or physical disabilities, it is generally accepted that this segment of the population is less active than the "general", nondisabled population (Compton, Eisenman, & Henderson, 1989; Rimmer et al., 1996). A sedentary lifestyle may be of even greater concern for persons with disabilities for a number of reasons. Firstly, inactivity may compound the effect of a disability itself and lead to a further reduction in independence (Heath & Fentem, 1997). Secondary disabling conditions such as diabetes, stroke, and arthritis that are faced by individuals with physical impairments may be minimized through participation in physical activity (Compton et al., 1989). Secondly, participation in physical activity has the potential to reduce the stigma associated with disability, enhance the normalization process, and increase the daily interaction among persons with and without disabilities (Eichstaedt & Lavay, 1992). Exercise and sport opportunities may also raise the expectations associated with this population by others and by persons with disabilities themselves. Finally, the maintenance of a physically active lifestyle would increase the ease at which persons with disabilities perform daily activities. It is evident that the predominance of inactivity in persons with disabilities is a major public health issue, however, this segment of the population is consistently being ignored when public health goals are being developed and in research studies.

The Americans with Disabilities Act has defined a disability as "a physical or mental impairment that substantially limits one or more of the major life activities" (Public Law 101-336). Findings of the 1992 National Health Interview Survey showed that 15% (37.7 million) of the noninstitutionalized US adult population report having a disability (LaPlante & Carlson, 1996). In Great Britain, the Office of Population Censuses and Surveys revealed that the prevalence of disability among adults in 1988 was 10% (5 million) (Martin, Meltzer, & Elliot, 1988). Persons with disabilities clearly represent a large portion of the population in North America and throughout the world. Furthermore, as the population grows older the number of individuals with disabilities will likely grow exponentially (Rimmer et al., 1996). In recognizing this growing prevalence of disability, it is important that increased rates of participation in physical activity become a public health priority to assist in the maintenance of independence and improve the quality of life of persons with disabilities.

Physical Fitness and Mental Retardation

Cognitive disabilities may include mental retardation, mental illness, autism, traumatic brain injury, or others. Mental retardation (MR) refers to "significantly subaverage general intellectual functioning existing concurrently with deficits in adaptive behavior and manifested during the developmental period" (American Psychological Association [APA], 1990). The three key components to this definition should be clarified. Firstly, The American Association on Mental Retardation (AAMR) defines "significantly subaverage intellectual functioning" as an IQ of 70 or below on a standard measure of intelligence (AAMR, 1992). Further, a person with MR can be classified as either mild or severe depending upon their adaptive skill level. "Adaptive behavior" is defined in an MR terminology manual as "the effectiveness or degree with which an individual meets the standards of personal independence and social responsibility expected for age and cultural group" (Grossman, 1983). Pitetti et al. (1993) state that those attributes generally fall under maturity, learning capacity, and social adjustment. The American Association on Mental Retardation more recently clarified adaptive skill areas as: communication, self-care, home living, social skills, community use, self-direction, health and safety, functional academics, leisure, and work (AAMR, 1992). Finally, the manifestation of MR during the "developmental period" is generally considered to be from conception to 18 years of age.

Participation in physical activity is equally, if not more, important for the wellness of persons with MR. In addition to the health benefits associated with an active lifestyle, daily activities work skills may be performed more easily when minimal fitness is maintained. Adults with MR often have greater amounts of leisure time following graduation from school than nonretarded adults (Eichstaedt & Lavay, 1992). Therefore, it is critical that regular physical activity becomes a component of their lives in order to keep persons with MR from spending their free time in a sedentary way. Social interaction and the maximization of independence can also be enhanced through participation in physical activity, and substantiates the need for opportunities in this special population.

Pitetti and Campbell (1991) raised two further important public health issues: the earlier onset of old age, and the higher mortality rate of persons with MR compared to the general population. The authors suggested that the rate of decline of the physical capacities of persons with MR is significantly faster than that of persons without. The results of one study demonstrated that there is an earlier onset of CVD in older adults with MR compared to their nonretarded peers (Janicki & Jacobsen, 1984). A review article reported that 50-60% of elderly individuals with MR are institutionalized compared to only 5% of the general population, and that life expectancy may be directly related to activity among persons with profound MR (Fernhall, 1993).

Implications on Work Performance: In addition to the health and social benefits of participation in physical activity for individuals with MR, their vocational development may also depend upon their ability to be physically active (Beasley, 1982; Coleman, Ayoub, & Friedrich, 1976; Lavay, Reid, & Cressler-Chaviz, 1990; Rimmer & Kelly, 1991). Through the deinstitutionalization process, people with MR have become valued and productive members of the work force. Being employed affords individuals with MR the opportunity to contribute to the community and may positively influence self-esteem.

The employment opportunities available for persons with MR are often physical in nature due to their limited ability to perform cognitive-oriented tasks (Bundschuh & Cureton, 1982; Coleman et al., 1976; Croce, 1990). Jobs involving janitorial work, light physical labor, assembling goods, cooking, and cleaning are typical for this population. Very low levels of physical fitness would lead to early fatigue and an inability to perform productively at work. Therefore, it is necessary that persons with MR have the ability to sustain low intensity physical activity for extended periods of time. Further, in order for persons with MR to be competitive in the job market, they will be required to demonstrate that they have the physical abilities to perform the work-related tasks.

An understanding of the potential vocational, health, personal, and social benefits associated with exercise for persons with MR has prompted considerable research examining the fitness status of both children and adults in this population. The majority of studies have focused on one component of health-related fitness and compared the scores of individuals with MR to their nondisabled peers. Unfortunately, the results of such studies consistently indicate that persons with MR have very low levels of fitness.

Cardiovascular Fitness: The majority of field and laboratory studies that have included children with MR reported lower levels of cardiovascular fitness (CVF) when compared to nonretarded peers. Maksud and Hamilton (1974) found VO_2 max values of approximately 39 ml/kg/min for 10-13 year old boys with MR, while 48.0-56.0 ml/kg/min was the accepted average range for typically developing males of the same age. Bar-Or et al. (1971) also reported VO_2 max values of boys with MR as significantly lower than age-matched boys without MR. Overall, the laboratory studies provided evidence that the CVF levels for children with MR were 20-40% lower than their nonretarded peers.

Laboratory studies involving adolescents reported CVF levels anywhere from 10-45% below expected values (Fernhall et al., 1988). The largest data base in the earlier studies was collected on adults (Reid et al., 1985). This substantial study evaluated the CVF of 220 adults with MR using a step test that predicted VO_2 max. The estimated values predicted poor aerobic conditioning when compared to nonretarded adults. Three laboratory investigations also reported VO_2 max values of 25.0-28.0 ml/kg/min for adults with MR. Such inferior values are cause for great concern.

More recent investigations substantiate the evidence of low CVF levels in this population found in the earlier studies. Cressler, Lavay, and Geise (1988) determined the test-retest reliability of four submaximal oxygen uptake test protocols for 15 adults with MR. Results revealed mean CVF scores ranging from 26.5-44.0 ml/kg/min on the re-test of each protocol. Three of the tests estimated mean VO_2 max scores of less than 30.0 ml/kg/min while a modified step test predicted values above 40.0 ml/kg/min. Fernhall, Tymeson, and Webster (1988) evaluated the concurrent validity of the 1.5 mile and 300 yd run for adults with mild MR. The reported mean VO_2 max value of 28.1 ml/kg/min was 25-35% lower than that expected for nonretarded adults. Further, the 1.5 mile run times did not even fall within the range of poor cardiovascular conditioning on the norms for nonretarded people. A 1989 study (Fernhall, Millar, Tymeson, & Burkett, 1989) evaluated the CVF of 38 adolescents and adults with MR. Again, the maximal oxygen consumption test revealed values far lower (mean score of 25.3 ml/kg/min) than those typically reported for nonretarded adolescents and adults.

The most recent investigation on the CVF of individuals with MR was a multi-center, retrospective study of 111 participants (Fernhall et al., 1996). Authors analyzed VO_2 max data that had been collected using a walking treadmill protocol that was proven valid and reliable for use with this population. Participants were classified as either MR or Down syndrome (DS). DS is a genetic disorder that is one of the major causes of MR in the United States (Winnick, 1995). The classification of participants was required because persons with DS commonly have heart abnormalities, pulmonary hypoplasia, muscle hypotonia, or other conditions which may limit cardiorespiratory capacity (Winnick, 1995). The VO_2 peak values for all participants were low compared to cited norms for the nonretarded population. Mean peak values ranged from 22.2-32.7 ml/kg/min for the entire sample (includes males and females, DS and MR). It should be noted that the participants with DS exhibited lower peak VO_2 and peak heart rate scores than the participants with MR but not DS.

Several review articles have qualitatively examined the research on cardiovascular fitness in persons with MR (Compton et al., 1989; Fernhall et al.,1988; Fernhall, 1993; Pitetti et al., 1993). These papers have implied that past fitness studies have included some methodological shortcomings such as small sample size and fitness tests that were not validated. However, it has been consistently concluded that persons with MR have low fitness levels compared to their nonretarded peers.

Muscular Strength and Endurance: Although CVF is commonly accepted as the most important component of health-related fitness because of its impact on heart disease, muscular strength and endurance are also of importance for persons with MR. Positive associations have been found among work performance, level of independence, and muscular strength for this population (Nordgren & Backstrom, 1971). Fernhall (1993) reviewed field and laboratory research on the muscular fitness of children and adults with MR. Overall, studies involving children indicated that those with MR exhibited inferior sit-up and pull-up performance than their peers without MR even with modifications for their lower ability levels. Reid et al. (1985) tested 220 adults with MR on the Canadian Standard Test of Fitness (CSTF) protocol which included grip strength, 60 second sit-ups, and 60 second push-ups. The male group of 20-29 year olds (n=66) had mean values of 47.6 kg, 12/min, and 12.7/min on the grip strength, sit-ups, and push-ups, respectively.

According to the CSTF percentile norms for nonretarded persons, the males in this group were considered "poor" or "below minimum". The female group of 20-29 year olds (n=44) performed equally poorly and means were inferior to nonretarded adults of similar age. The investigation also revealed that performance decreased with age for push-ups and sit-ups, but the mean grip strength value for females was higher in the 30-39 year olds.

The studies that have employed laboratory tests of muscular strength and endurance have produced somewhat conflicting results. Pitetti, Climstein, Mays, and Barrett (1992) reported that the isokinetic knee flexion and extension values of adults with MR were markedly inferior compared to nonretarded adults. However, another study by one of the same authors (Pitetti, 1990) found that adults with MR displayed expected isokinetic knee flexion and extension strength. One of the most recent investigations on muscular fitness compared the isokinetic torque, average power, and flexion/extension ratios of the elbows among adults with MR, DS, and nonretarded adults (Horvat et al., 1997). The participant group without MR had significantly higher elbow flexion and extension average power and peak torque than the other two groups. The findings of the study provide further evidence that adults with MR, including DS, have lower levels of muscular strength and endurance than nonretarded adults.

Body Composition: The health implications of excessive body fat and the stigma associated with being obese as well as mentally retarded have stimulated research on body composition. Three review articles (Burkhart et al., 1985; Fernhall, 1993; Pitetti et al., 1993) provide an in-depth discussion of the research surrounding body composition and MR. Burkhart and colleagues (1985) concluded from their early review that: 1) there is a greater incidence of obesity among females with MR than males, 2) a higher proportion of persons with mild MR are obese than those with severe MR, and 3) incidence of obesity generally increases with age. In addition, the authors reported the high prevalence of obesity in the MR population was a result of their poor physical conditioning as opposed to eating behavior or personality characteristics (e.g. anxiety and self-concept). A comprehensive investigation by Kelly, Rimmer, and Ness (1986) measured body composition in 553 institutionalized adults with MR. The study found that 45.2% of the males and 50.5% of the females were classified as obese. The results also showed that participants with a higher IQ (i.e. mild MR) were more obese than those with a lower intellectual level (i.e. severe MR). These results were in conflict with the earlier conclusion made by Burkhart et al. (1983). Rimmer and co-workers (Rimmer, Braddock, & Fijiura, 1993) studied the type of living arrangement (institution, community-based intermediate care facility, family, or group home) and incidence of obesity among adults with MR. Approximately 28% of the males and 59% of the females in the study were classified as obese which was higher than the statistics reported for the nonretarded population (19% of males and 28% of females). The lowest percent body fat values for the male and female groups were from the institutional setting, and the highest values were from the family and intermediate care facility for the males and family setting for the females. Once again, it was found that participants with severe MR were significantly less obese than participants with mild/moderate MR. Both reviews suggested that low levels of physical activity and poor eating habits are a major cause of the disproportionate number of obese adults with MR.

There is no evidence to suggest that the low level of physical fitness observed in persons with MR is linked to some genetic characteristic of MR. Investigators have put forth possible explanations for the poor conditioning of this population. Firstly, there are a number of difficulties associated with the assessment of physical fitness in persons with MR that may contribute to the reported low levels. The validity and reliability of fitness measurements for this population are at times questionable and have not been established in some studies (Cressler et al., 1988). People with MR may have difficulty understanding a task involved in a testing protocol which clearly affects the construct validity of the test. In addition, people with disabilities, including MR, typically have a high variability in day-to-day performance (Eichstaedt & Lavay, 1992). The majority of published studies have only collected fitness data one time which may not be reflective of a true score. Secondly, less opportunity for participation in planned physical activity on a regular basis may contribute to the low fitness levels observed in persons with MR (Combs & Jansma, 1990; Montgomery, Reid and Seidl, 1988; Rimmer et al., 1996; Tomporowski & Jameson, 1985). Limited community-based exercise programs and poor transportation services to and from available facilities exacerbate the problem. The lower physical activity level of persons with MR is the most legitimate yet concerning explanation for their inferior fitness scores. Another related concern to training individuals with MR is the difficulty in keeping them motivated to participate in activity (Combs & Jansma, 1990). It seems that this segment of the population is not intrinsically motivated to be active and factors such as weight loss, risk for CVD, and increased energy levels do not inspire them (Eichstaedt & Lavay, 1992).

Training Studies in Mental Retardation

It seems evident that sedentary lifestyles due to limited opportunity for planned physical activity and/or poor motivation may be the strongest predictors of the low fitness scores observed in persons with MR. A series of studies have investigated the effects of aerobic, resistance, and mixed training regimens on the fitness values of adults with MR. In addition, a few studies have examined the effects of training on vocational performance in this population. The reported findings provide evidence that physical training can induce fitness changes in persons with MR.

Cardiovascular Fitness: A 9-month mixed exercise intervention was administered to three groups of adults with MR and the effects on CVF were observed (Tomporowski & Ellis, 1985). The program consisted of circuit training, running, and aerobic dance. Post treatment treadmill tests indicated that 17 of 19 participants significantly improved their VO_2 max scores during the course of treatment. Schurrer and coworkers (1985) examined the effects of an optional, supervised 23-week walk/jog program on the VO_2 max scores and behavior patterns of five adults with MR. The VO_2 max was measured using a treadmill walking protocol. The major finding of the study was that participants improved VO_2 max values by an average of 36-43% following training. Furthermore, significant losses in body weight were observed.

More recent training studies involving aerobic exercise confirmed earlier findings. Croce (1990) used a multiple-baseline across subjects design to study the effects of exercise and diet therapy on the body composition and CVF of 3 obese men with MR. The exercise intervention involved aerobic activity for 1 hour, 5 times per week, and lasted 14-20 weeks. Following treatment, a mean increase of 29.8% in VO_2 max was found as well as a mean decrease of 19.3% in body fat. Participants had very low VO_2 max levels prior to the intervention which may explain the remarkable improvements. Upon questioning the appropriateness of the fitness assessments and exercise methodologies used in previous studies, Pitetti and Tan (1991) examined the effects of a minimally supervised 16-week training program on the CVF of adults with MR. Pretraining peak VO_2 evaluations were conducted on both a cycle ergometer and a treadmill. Participants were accessed at their sheltered workshop 3 times per week and given the option to exercise on a stationary bicycle for 25 minutes. A significant increase (16%) in peak VO_2 was found for the assessment conducted on the treadmill but not on the cycle ergometer. The effect of a 10-week aerobic exercise program on the CVF, body composition, and flexibility of 14 adults with MR was studied by Pommering et al. (1994). Participants exercise from 20-30 minutes on a stationary bicycle or a rowing machine 4 times per week. The results supported the findings of previous training studies in that significant increases in VO_2 max values were observed. It should be mentioned that a similar study of the same duration provided conflicting results with no significant changes in VO_2 max found for 14 adults with DS (Millar, Fernhall, & Burkett, 1992). The authors explained their findings by reporting that individuals with DS may not respond to exercise training in a conventional manner.

Muscular Strength and Endurance: Training programs aimed at improving muscular strength for individuals with MR have been very successful. One of the first published experimental studies on resistance training programs for adults with MR was conducted by Rimmer and Kelly (1991). Twenty four adults with MR were randomly assigned to an experimental or control group and 1-repetition maximum (1-RM) was used for pre- and posttest measures of strength. The participants in the experimental group performed 3 sets of 15-18 repetitions of resistance exercises on a Nautilus machine. By the third set, participants were lifting 70% of their 1-RM. The program was performed 2 times per week for a total of 9 weeks. The experimental group displayed a significant increase in strength on 5 of the 7 exercises after completing the resistance training program. Improvements in upper body measures ranged from 42-121%, while lower body measures increased from 42-52% over baseline. The significant strength increases observed in just 9 weeks is an important finding considering the relationship between vocational productivity and muscular fitness in this population.

Suomi and colleagues (Suomi, Surburg, & Lecius, 1995) evaluated the isokinetic strength of 22 men with MR before and after a 12-week training program using hydraulic resistance equipment. Sessions were conducted 3 times per week. A Musculoskeletal Evaluation, Rehabilitation and Conditioning Systems Dynamometer was used to assess the total work and peak torque of knee extension and hip abduction for both limbs. The strength trained participants (i.e. experimental group) exhibited significant isokinetic strength gains ranging from 25-177% for total work measures on both tests. Significant increases of peak torque on the hip abduction tests were also reported (50% increase for right hip and 82% increase for left hip). Although the training studies on muscular fitness are fewer in number than those for CVF, the available results appear conclusive.

Body Composition: An early review by Staugaitis (1978) reported on the research which investigated weight reduction and maintenance for persons with MR. The data surrounding appropriate programs to control weight in the MR population was very limited at that point in time, and continues to be somewhat scarce. Foxx (1972) used social reinforcement to incur weight loss in an obese female with MR. Praise and weekly visits to a "canteen" were used as rewards for losing weight, and after 42 weeks the participant lost 33% of her preexperimental weight. Another study which involved behavioral therapy procedures and self-monitoring (Foreyt & Parks, 1975) reported significant weight loss in both male and female adults with MR. In addition, a 29 week follow-up found that participants had continued to lose weight. Upon reviewing the literature, Staugaitis (1978) offered several recommendations for the development of a weight control program for persons with MR including: periodic weighings, exercise, positive reinforcement, and weight reduction goals.

A multi-component behavioral program was developed to reduce the weight of females with MR (Jackson & Thorbecke, 1982). Twelve overweight females were randomly assigned to a control or experimental group. The mothers of the experimental group met 7 times with a behavior modification specialist who instructed them on the components of the weight loss treatment (i.e. food monitoring, exercise, reinforcement). The experimental group members also attended 6 sessions with the specialist who taught them about appropriate eating behaviors and a healthy diet. The findings showed that the individuals in the experimental group lost significantly more weight during the treatment weeks than did the control group. In addition, follow-ups conducted at 3, 6, and 12, weeks post treatment revealed that experimental group members had continued to lose more weight. Norvell and Ahern (1987) further evaluated the effectiveness of behavioral weight loss programs for adults with MR. Thirteen employees at a sheltered workshop participated in a 10-week program which involved food regulation and nutrition education. Study results demonstrated that the experimental group lost and average of 2.0 kg compared to a loss of .15 kg for the control group. It should also be noted that weight loss was maintained after 3 and 6 months of follow-up.

Behavioral approaches to weight reduction for persons with MR appear to be effective and in some cases may also lead to maintenance. Exercise interventions have also proven useful for treating obesity. As previously mentioned, Schurrer et al. (1985) showed a large reduction in body weight after a 23-week walk/jog program. The average change in body weight was -5.6% for the five adults with MR who participated in that investigation. In Croce's study (1990), the mean percent body fat decreased from 35.4% to 28.5% after 14-24 weeks of exercise training. Finally, data by Pitetti and Tan (1991) revealed that females with MR significantly decreased their percent body fat after 16 weeks of training, but the male participants did not.

A recently published meta-analysis outlined the effects of exercise on the health-related fitness of individuals with an intellectual disability (Chanias, Reid, & Hoover, 1998). Twenty-one studies were involved in the analysis that examined the effect sizes for cardiovascular endurance, muscular strength and endurance, flexibility, and body composition. Large and statistically significant effect sizes were demonstrated for cardiovascular and muscular endurance which provides evidence that exercise has a considerable training effect on these components of fitness. It was concluded that the low levels of endurance observed in persons with MR can be reversed with training. A moderate effect size was demonstrated for muscular strength. The small database on muscular strength in this segment of the population was thought to partly account for the smaller effect. Finally, the effect size calculated for flexibility was small but still statistically significant. No significant effects were demonstrated for body composition. The authors concluded that the length of cardiovascular and muscular endurance programs influenced outcomes while program type and frequency were predictors of effects in strength and flexibility studies, respectively.

Work Productivity: Beasley (1982) studied the effect of an 8-week jogging program on the CVF, rate of absenteeism, and work productivity of 15 adults with MR. The Cooper 12-minute run/walk test was employed to measure aerobic fitness, and work performance was measured by participants' rate of production on the assembly of heat clips within a 20 minute time period. Following the exercise intervention, the experimental group performed significantly better on the fitness test than the control group. Further, the experimental group increased their rate of production of heat clips by 11.5% more than the control group. No significant difference was found between the two groups on rate of absenteeism. The authors concluded that a general aerobic conditioning program is effective for causing increases in fitness and work productivity.

Zetts, Horvat, and Langone (1995) conducted an investigation to examine the impact of a weight training program on three work behaviors. The resistance program was individualized for each participant but involved three progressions: 2 sets of 12 repetitions with low resistance, 3 sets of 8 repetitions with an increase in resistance, and 4 sets of 6 repetitions with a further increase in weight. Once a subject could exercise without strain at the first level, they progressed to the next protocol. The simulated work tasks which were which were pre- and post-tested included: timed stacking of 25 pound boxes, timed pushing of a hand truck which held an 85 pound box, and timed carrying of 25 pound pails. The exercise intervention was effective in increasing productivity on all three tasks by 6-75%. Furthermore, the resistance program also lead to improvements in strength as measured by the Nicholas Manual Muscle Tester. Gains up to 160% were reported following the intervention.

It is apparent that persons with MR typically demonstrate improved health-related physical fitness and work productivity when they participate in structured exercise programs. Although such findings are valuable, the majority of training studies have limited application to exercise programming. The aim of training studies is to determine if a given exercise mode, intensity, frequency, and duration is effective to increase fitness values in a given population. Therefore, it is not surprising that the adoption and maintenance of an exercise habit is not of great importance in such investigations. It is uncommon for training studies to include follow-up periods that examine behavior change or to consider closely if the exercise program could be administered following the intervention. As previously mentioned, physical fitness no longer appears to be necessary to receive the health benefits of exercise (Pollock et al., 1998). Experts have repeatedly acknowledged the worth of training studies but recommend that research strive to develop and test strategies that keep individuals with MR involved in regular physical activity (Pitetti & Campbell, 1990; Rimmer et al., 1996).

Exercise Adherence and Motivation

It is well known that the benefits of physical activity are only obtained and maintained if participation is sustained over the long term (ACSM, 1998). With that in mind, it is not surprising that exercise adherence has become a commonly researched concept in the field of exercise science (Leith, 1990). A number of review articles have attempted to detail the determinants of exercise adoption and maintenance (Dishman, 1982; Dishman & Buckworth, 1996; King, 1994; King et al., 1992). Recommended intervention strategies to improve compliance to exercise are typically included in such papers. However, despite the wealth of information on exercise adherence, approximately 50% of individuals who begin an exercise program drop out in within the first 6 months (Leith, 1992). Short-term adherence (i.e. weeks or months) measures may be slightly higher but are still thought to be poor.

King et al. (1992) summarized the typical intervention strategies used in the field of exercise science to increase participation in physical activity. The role of the physician was identified as important to promote physical activity especially for populations who are at high risk for disease. Institutional/societal level interventions such as federal support for safe, accessible facilities, reduced insurance rates for physically active people, or incentives for school-based programming to increase activity, have all been proposed but not widely used. Activity interventions as components of larger scale programs (i.e. smoking cessation, weight reduction) may also be effective.

Robison and Rogers (1994) also reviewed the literature on exercise adherence and provided some recommendations for promoting participation in physical activity. They concluded that the individuals at greatest risk for dropping out of exercise programs are those who are overweight, smokers, and those who lack social support for their changes in lifestyle. Several behavioral strategies to improve adherence to exercise were also proposed. Stimulus control, which is the manipulation of cues to prompt physical activity, appears to have a positive influence on adherence. In addition, consequent control in the form of reinforcement or punishment for adherence or non-adherence has been effective in impacting exercise behavior. Personal goal setting, incentives, contracts, and competition have all been applied to exercise compliance with varying degrees of effectiveness. The review stated that group programs that involve social reinforcement from exercise leaders in a convenient setting are ideal for promoting participation.

Dishman and Buckworth (1996) substantiated the recommendations made by Robison and Rogers (1994) in their synthesis of the moderating variables associated with participation in physical activity. Interventions aimed at increasing participation in physical activity appear to be more effective when certain variables are involved. The use of behavior modification strategies such as reinforcement or contracts has been effective for increasing participation. In addition, interventions involving low intensity, short duration physical activity have higher rates of participation compared to generic exercise prescription.

It is evident that adherence to an exercise program may be dependent upon a number of variables. Determining why a person may or may not adhere to a program would assist in the understanding of exercise motivation (Leith, 1990). The concept of exercise motivation has not been clearly defined but it is understood that all people are motivated to perform (or not perform) by different things. All of the intervention strategies mentioned previously have included techniques to increase the motivation of exercise in the hopes of increasing compliance. Goal setting, rewards, social support, contracts and other methods have had varying degrees of effectiveness for improving compliance.

There is a significant amount of research that has investigated the exercise behavior of individuals with MR. Studies have typically examined the time-on-task (Bennet et al., 1989; French et al., 1992; Owlia et al., 1995; Pitetti & Tan, 1991), total distance run/walked (Combs & Jansma, 1990; Lavay & McKenzie, 1991; Tomporowski& Jameson, 1985), or physical work output (Caouette & Reid, 1991; Todd & Reid, 1992) of participants. Although the majority of these studies have focused on increasing participation in exercise as opposed to adherence, they all employed strategies for motivating participants. In fact, the primary aim of studies on exercise behavior in persons with MR has commonly been to test the reinforcement/behavior modification program itself. This is a result of the repeated claim that persons with MR do not have the intrinsic motivation or self-direction to exercise. An interesting point to consider is that such claims have not been empirically proven but are often based on observations during training studies and general assumptions about the population. However, since it has been shown that the "general" population has difficulty adopting and maintaining an exercise habit, it seems reasonable to assume that the same problem may exist in that segment of the population that has MR.

Bennett et al. (1989) examined the effects of a token economy on the exercise behavior and CVF of 3 adult women with DS. If the participants pedaled a predetermined number of revolutions on a cycle ergometer during an exercise session, they were given tokens that could be exchanged for items they wanted. Food, music, games, and make-up were used as rewards. Findings indicated that exercise duration and number of revolutions pedaled increased during the intervention when the token economy was administered. A token economy system was also effective for improving the fitness and work productivity of 3 obese men with MR (Croce & Horvat, 1992). A combined resistance and aerobic exercise protocol was conducted 5 days per week at the sheltered workshop where the participants were employed. The work task involved screwing jar lids on plastic jars and placing them in a cardboard box. Total number of boxes filled (12 jars per box) per 6-hour work day was the work productivity measure. Participants were given social reinforcement in the form of verbal praise when they were actively participating in exercise. In addition to verbal reinforcement, tokens were awarded to subjects when they reached or surpassed a predetermined exercise criterion. Tokens were exchanged for preferred tangible items chosen from a reinforcement menu. Subjects showed modest improvements in work productivity from 7.12-10.8% with the implementation of the token economy.

Combs and Jansma (1990) offered a reinforcement package to 5 adult males who were dually-diagnosed with MR and an emotional disturbance. Social reinforcement was provided after participants performed each fitness activity which included a weight routine and cardiovascular training. If an individual completed the entire sequence of activities for the day, he received a tangible reinforcer such as food or gum. Trips to fast food restaurants were used as rewards for active participation over 5 days, while more expensive gifts were offered for completion of the study duration. All participants demonstrated improvement on 3 fitness parameters (sit and reach, 12 minute run, and maximum sit-ups/minute) over the course of the 6-week training period and there was no mention of drop-out. A similar study lasting 12 weeks in duration involved a token economy system with dually-diagnosed adults (Merriman, Barnett, & Jarry, 1996). The aim of the study was to induce fitness changes through participation in a 45 minute aerobic and weight training program 3 days per week. Again, the reinforcement system proved effective for improving fitness scores. Although exercise behavior was not measured per se, it seems likely that participants adhered to the program since they exhibited fitness gains.

Investigations have also examined the effects of auditory stimulation and audiovisual reinforcement on the exercise behavior of persons with severe MR. Physical work output during a 15 minute bout of cycling on a stationary ergometer was measured when three types of noise were a consequence of exercise (Caouette & Reid, 1991). Meaningless noise (i.e. pink and white) had no positive influence on the work output of participants. However, contingent musical stimulation was effective for significantly increasing the work output of participants. The authors concluded that persons with severe MR must find the music to be enjoyable in order for it to be reinforcing on a continuous motor task. Owlia et al. (1995) investigated the influence of audio (cassette tapes) and audiovisual (music videotapes) reinforcers on the time-on-task performance of adolescents with profound MR. The exercise mode used in the study was stationary bicycling. The data revealed that cycling time was longer with the presentation of audio or audiovisual reinforcers compared to a baseline phase without reinforcement. Only one participant did not respond positively to the reinforcers and it was suggested that either his lack of interest in the program or the inadequate strength of the reinforcement accounted for the difference. For the remaining participants, the audio and audiovisual reinforcers were equally effective for increasing time on task. Television and verbal encouragement were used to increase the number of revolutions pedaled by a group of adults with MR on a stationary bicycle (Todd & Reid, 1992). Participants were asked to pedal for 15 minutes at a given workload. With the exception of a baseline phase, a television program was played as soon as exercise began. Further, a staff member provided verbal encouragement every 30 seconds to help motivate participants. The number of revolutions increased considerably during the intervention phase of the study compared to baseline. When the workload was increased, pedaling behavior was either maintained or increased which supports the effectiveness of the reinforcement. The withdrawal of the television and verbal encouragement resulted in a decrease of revolutions pedaled.

Lavay and McKenzie (1991) developed a systematic and progressive run/walk program to enhance CVF levels of 5 men with MR. Exercise sessions were conducted for 1 hour, 3 times per week for 12 weeks and participants were assigned a training partner to monitor pulse rates and provide external motivation. Participants could also earn privileges such as going out to dinner if they reached goals. Distance criterion goals (number of laps) were set every two weeks and were based on baseline data. All participants met or exceeded criterion goals for 92% of the sessions. It should be noted that during weeks 9 and 10, participants walked or ran without a training partner and still exceeded criterion goals. Tomporowski and Jameson (1985) paired participants with MR with a nonretarded adult who was responsible for maintaining their walk/run pace during an 18-week program. Participants gradually increased the number of miles run each week and displayed a systematic decrease in the time to run each mile. No extrinsic rewards were offered to participants but the staff reinforced appropriate exercise behavior through social approval and praise. It was reported that the participants exhibited a high level of motivation during the exercise sessions and concluded that people with MR will perform aerobic exercise with minimal prompting or external rewards.

The number of steps taken and exercise time on a Stairmaster was the exercise behavior of interest in an investigation by French et al. (1992). Six youth with profound MR were divided into two groups and received either verbal reinforcement only or verbal reinforcement plus food for actively stepping on the machine. Participants participated 7 days per week for 5 weeks. All but one participant increased exercise time and number of steps taken during the intervention phase over baseline. The one participant was in the verbal only group. The authors noted that verbal reinforcement was almost as effective as verbal reinforcement plus food for increasing duration of exercise. Therefore, they suggested that verbal reinforcers should be used initially in exercise programs since they are more natural while primary reinforcers (i.e. food) be used only as a last resort.

Summary

In summary, individuals with MR have inferior fitness levels compared to their nonretarded peers. It is likely that limited opportunities for engagement in regular physical activity accounts for the poor scores observed in this population. Exercise training has been very effective for improving the fitness of individuals with MR, however, studies have focused on the fitness product as opposed to the acquisition of an exercise habit. The examination of participation in, and adherence to, activity programs is critical for changing the sedentary lifestyles typically lead by persons with MR.

The results of the above exercise studies strongly suggest that it is possible to motivate individuals with MR to actively engage in exercise for an extended period of time. However, the strategies used to modify and/or reinforce behavior would be difficult to translate directly into practice. Many of the studies involved a level of supervision that would tax the time constraints of the staff who work with individuals with MR in a variety of settings. Furthermore, the rewards offered to participants were in some cases expensive and unnatural. In an integrated, community-based program adults with MR would not be awarded food or trips to the movies for participating in exercise. Another condition of research that restricts translation to practice is the type of exercise equipment used. It is unlikely that many persons with MR have access to a Stairmaster or a stationary bicycle at their residence or place of employment.

It is critical that research begins to provide workable guidelines for exercise adoption and maintenance. The limitations associated with having MR mean that physical activity programs must be designed with special considerations such as lack of transportation and access to facilities, possible restricted mobility, limited capacity to understand and follow directions, and especially low levels of physical fitness. The aim of any program should be to induce a lifestyle modification through the maintenance of exercise behavior over an extended period of time. In that regard, a specially-designed physical activity program, administered in the accessible work environment, and requiring limited or no supervision, equipment, or extrinsic reinforcers would be in the best interest of the participants.

APPENDIX C

OFFICIAL APPROVAL FROM OREGON STATE UNIVERSITY INTERNAL REVIEW BOARD

INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN SUBJECTS

OREGON STATE UNIVERSITY

COPY

Report of Review

TO: Jeffrey McCubbin, ExSS

COPY: Heidi Stanish

RE: Participation of adults with mental retardation in a worksite physical activity program (proposed modification, dated 02/02/98, to an application approved on 01/16/98).

The referenced proposed modification to a previously approved project was reviewed under the guidelines of Oregon State University's Committee for the Protection of Human Subjects and the U.S. Department of Health and Human Services. The committee has **approved** the modification.

Any additional change to the protocol or informed consent form that is not included in the approved application as modified must be submitted to the IRB for review and must be approved by the committee before it can be implemented. Immediate action may be taken where necessary to eliminate apparent hazards to subjects, but this modification to the approved project must be reported immediately to the IRB.

Redacted for privacy

Date: 02/04/98

Warren N. Suzuki, Chair
Committee for the Protection of Human Subjects
(Education, 7-6393, suzukiw@ccmail.orst.edu)