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EFFECTIVENESS OF A PROGRESSIVE RESISTANCE TRAINING PROGRAM ON WORK PRODUCTIVITY AND MUSCULAR STRENGTH AMONG ADULT MALES WITH MENTAL RETARDATION

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EFFECTIVENESS OF A PROGRESSIVE RESISTANCE TRAINING PROGRAM ON WORK PRODUCTIVITY AND MUSCULAR STRENGTH AMONG ADULT MALES WITH MENTAL RETARDATION.

By

Lorenzo Parker

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ABSTRACT

EFFECTIVENESS OF A PROGRESSIVE RESISTANCE TRAINING PROGRAM ON WORK PRODUCTIVITY AND MUSCULAR STRENGTH AMONG ADULT MALES WITH MENTAL RETARDATION

By

Lorenzo Parker

This study was designed to investigate the effects of a 9-week progressive resistance-training program on work productivity and muscular strength among adult males with mental retardation (MR). Data were collected on: (a) work productivity using the simulated work tasks of hand-truck push and box stacking; (b) work productivity using "on-site" work tasks (assembly work, dishwashing, mail sorting, and custodian) in jobs that were held by the participants; and (c) muscular strength as determined by one repetition maximum lifts using Nautilus, Universal, and Icarian weight machines.

The research design used for this study was a single-subject ABA applied behavior analysis that was replicated for each of four adult males with MR age 25 to 29 years. The participants' performance levels were assessed once every week during the 5-week baseline, the 9-week treatment, and the 6-week retention periods. During the treatment period, participants were involved in a twice-a-week progressive resistance-training program using leg extension, leg curl, chest press, biceps curl, triceps extension, and abdominal curl weight-lifting exercises. Front-lying chest lifts using the participants' body resistance were used for strengthening back muscles. The 9-week intervention period was divided into 3 phases. The first phase lasted for a period of 2 weeks (4 sessions) and included 2 sets of 12 repetitions of each of the 6 strength-training exercises with low resistance of 30% to 40% of participants' 1-RM lifts. The second phase of the intervention lasted for a total of 3 weeks (6 sessions) and involved lifting 3 sets of 8 repetitions of each exercise with a moderate increase in the amount of resistance set at 50% to 60% of participants' 1-RM lift. The third and final phase of the lifting program was 4 weeks (8 sessions) and included 4 sets of 6 repetitions of lifting with an increased resistance of 70% to 80% of each participant's 1-RM lifts.

Data were collected and visually analyzed using the split middle technique. Visual analyses involved comparison of the participants' celeration and trend lines of the strength and work productivity data. Results indicated that participants showed improvements in both muscular strength and the simulated work tasks of box stacking and hand truck push. It was concluded that participation in a 9-week resistance-training program improved participants' muscular strength on the simulated work tasks. The results did not reveal significant improvements in productivity for the on-site work tasks as a result of increased strength. This may have been due to inadequate instrumentation for assessing productivity at participants' actual jobs. Recommendations for future studies are also provided.

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CHAPTER ONE

INTRODUCTION

Employment is important to the quality of life of adults with mental retardation (MR). There are numerous benefits to being employed for persons with MR. For example, Wehman (1993) indicates that being satisfied with employment, having monetary compensation, and obtaining opportunities for being productive at work can directly influence one's self-perceptions and financial and social freedom. Having a job and earning compensation allows individuals a chance to increase their quality of life by becoming more financially independent. Additionally, Serr, Lavay, Young, and Greene, (1994) mention that work provides intrinsic rewards, allows interaction with others, and provides opportunities to contribute to society as a whole. That is, if persons with MR are working citizens, they are able to provide financial support for themselves. This independence subsequently can lead to benefits for society.

Persons with disabilities, particularly those with MR, often are employed in jobs that require some type of physical or manual labor which involves the lifting or carrying of heavy objects (Barrett, 1978; Wehman, Kregel, & Seyfarth, 1985b). In conjunction, Williams (1977) stated that persons with MR are more likely to require physical rather than cognitive skills in their employment. These jobs may include task assemblers, warehouse workers, carpenters, janitors, maintenance workers, dock loaders, laborers, farm laborers, painters, restaurant workers, factory workers, bag persons in grocery stores, grounds maintenance worker, and dishwashers (Barrett, 1978; Wehman, Kregel, & Seyfarth, 1985a). In order for persons with MR to perform these tasks, they must have the necessary muscular strength and endurance. If this is the case, it is probable that some individuals with MR fail to get jobs or lose their jobs because they do not possess the necessary physical skills.

It is imperative that persons with MR be able to perform their job duties and still have energy to carry out activities of daily living. Zetts, Horvat, and Langone (1995) indicated "individuals with MR are disadvantaged when competing with the general population for jobs that require increased physical fitness and exercise performance" (p. 166). This statement may lead us to believe that having the necessary physical skills may enable persons with MR to do their jobs comparable to, if not better than their non-disabled coworkers.

Muscular strength and endurance are especially important for job maintenance for persons with MR especially those who jobs that require physical labor. Eichstaedt and Lavay (1992) noted that "lack of acceptance and of equal opportunity for persons with MR will always be an obstacle unless these individuals have the physical skill and motor ability to fit into the job market " (p.361). In addition, Bellamy, Rhodes, Bourdeau, and Mank (1986); Coleman, Ayoub, and Friedrich (1976); and Tomporowski and Hayden (1990) have indicated that persons with MR not only lack the cognitive and social skills, but also lack the motor skills, fitness, and consequently physical strength needed to perform the jobs in which they are employed. Therefore, enabling persons with MR to develop the necessary physical skills needed to obtain and keep jobs, and perhaps more importantly, to achieve a higher quality of life seems very important.

Researchers (Croce & Horvat, 1992; Pitetti, Climstein, Mays & Barrett, 1992; Pitetti & Tan, 1991; Reid, Montgomery, & Seidl, 1985; Schurrer, Weltman, & Brammell, 1985) have indicated that persons with MR also demonstrate low exercise and strength performance, and limited work capacity levels. In addition, Fernhall and Tymeson, (1987); Fernhall, Tymeson, and Webster, (1988); Montgomery, Reid, and Seidl, (1988); and Reid et al. (1985) have stated that persons with MR are characterized as having low fitness and strength levels as compared to the non-disabled population.

It can be assumed that participation in a resistance-training program may lead to an increase in muscular strength and fitness. This strength increase may assist persons with MR in maintaining jobs that are physically demanding. As with non-retarded individuals, improved strength and fitness allows for persons with MR to function throughout daily activities and become more productive at work (Combes & Jansma, 1990; Croce & Horvat, 1992; Rimmer & Kelly, 1991).

Current job training programs for people with MR do not address problems of strength and fitness. They often focus on teaching specific job training skills and acceptable work behaviors (Belfiore, Lim, & Browder, 1994; Rusch, Connis, & Sowers, 1979; Schutz & Rusch, 1982; Sowers, Rusch, Connis, & Cummings, 1980). More specifically, job training programs prepare individuals for completing job applications, interviewing, adjusting to work, and learning of specific tasks and skills (Coker, 1994; Montague & Lund, 1988; Szymanski & Danek, 1985). It also may be important for job training programs to place more of an emphasis on increasing strength, endurance, and the overall motor ability of individuals with MR in order that they may have the necessary stamina to complete various job skills. Tanner (1993) indicated that incorporating physical fitness and resistance exercise programs into the school curriculum of children and adolescents has the potential to make graduates more desirable in the work force. Progressive resistance training may be an effective way of increasing muscular strength and endurance among persons with MR. Participation in a weight training program is not only beneficial for improving muscular strength, health, and wellness, but it can also be fun and motivating.

If increased fitness and strength has beneficial effects for workers with MR, curricular and vocational programs that focus on preparing individuals for the work force could incorporate fitness and more specifically resistance training. Participation in a progressive resistance-training program is possible with minimal equipment and expertise. The rationale for research in this area is significant to determine if participation in a resistance-training program has the potential to enhance muscular strength and work productivity and consequently lead to improved health, quality of life, and job maintenance for individuals with MR. Therefore, there should be a sense of urgency among job training personnel and vocational-staff to properly prepare these individuals for employment in all work settings.

Purpose of the Study

This study was designed to investigate the effects of a nine-week progressive resistance-training program on work productivity and muscular strength among adult males with MR. Data were collected on: (a) work productivity using the simulated work tasks of hand-truck push and box stacking; (b) work productivity using "on-site" or actual work tasks in jobs that were held by the participants; and (c) muscular strength as determined by one repetition maximum lifts using weight machines.

Need for the Study

The need for this study is obvious given the rate of unemployment and underemployment of persons with MR, the concern for lowered work capacity among persons with MR, the impact to society of persons with MR being employed, and the limited research done regarding the relationship of weight training and work productivity. Each of these factors will be explored in this section.

Unemployment and underemployment. Underemployment and unemployment are major problems among persons with MR. Throughout the years, unemployment rates for persons with disabilities have been reported as high as 50% to 90% (Wehman, 1993). Some of the reasons offered for this high rate include the prevalence of cognitive deficits and a tendency to engage in unacceptable work behaviors such as being off task and or (provide and example of behaviors) In addition to the cognitive and behavioral aspects that limit employment, persons with MR may not possess the necessary motor ability, fitness, and consequently the physical strength, needed to keep jobs.

Concern for lowered work productivity. A related concern among persons with MR is low work productivity. It seems apparent that decreased work productivity would adversely influence employers' hiring and retention choices (Wehman, 1993). Minimized work productivity and lowered levels of strength and fitness also have the potential to negatively affect quality of life perceptions and self-esteem among persons with MR. Therefore, it may be important that persons with MR are prepared to take on the daily demands of employment. Participation in a resistance-training program may help workers with MR to increase their work productivity levels.

Societal benefits of employment for persons with mental retardation. Employment of persons with MR has a large impact on society. That is, being employed and earning an income may allow for financial independence rather than dependence upon various forms of public assistance. These persons will be tax paying citizens and contributing members of their community. This employment will also help reduce unemployment rates among persons with MR. Consequently employment for persons with MR will benefit local, state, and federal budgets and the overall economy (Wehman, 1993).

Limited research on work productivity and strength. The relationship between muscular strength and work productivity is not known for the population of people with MR. Hence, there was a need to determine if a positive relationship existed between muscular strength and work productivity for persons with MR. Results of this study will contribute to the body of knowledge on this topic. Past research on employment of persons with MR has focused on social, cognitive, and quality of life factors in addition to movement skills. For example, some of the variables studied included staff intervention (Wetzel & Taylor, 1991), analysis of body movements (Belfiore et al., 1994), visual feedback and ratio scheduling of pay (Martin & Morris, 1980), verbal reinforcement (Crouch, Rusch, & Karlan, 1984), quality of life (Sinnot-Oswald, Gliner & Spencer, 1991), jogging (Beasley, 1982), and dexterity test scores (Serr et al., 1994). However, recent research (Croce & Horvat, 1992; Zetts et al., 1995) is limited in examining weight training and its relationship to work productivity among adult persons with MR. To date no studies have researched the relationship that muscular strength has on both simulated and actual or "on-site" job tasks.

Furthermore, the results of this study can be used to help employers and potential employment or training sites to better prepare workers with MR for the job market. Service personnel and staff can emphasize the benefits of engaging in a progressive resistance-training program in order for persons with MR to endure the physical demands of a particular job and to become more productive workers. This study is significant because the results are beneficial for persons with MR who are employed in a variety of sheltered, supported, and competitive work settings.

There is a clear need for interventions that help people with MR to get and keep jobs. A strength intervention, such as the progressive resistance training used in this study, could help those persons with MR who need physical strength to perform their jobs. Designing a weight-training program is not too difficult, the equipment used can be minimal, and the cost is minimal. Lastly, the generalizability of the results from this study may provide additional empirical data on the effects of weight training for improving work performance among individuals with MR. The implications from this study will be important for persons with MR, as well as job training personnel and businesses that hire people with MR. It is important that persons with MR are prepared to handle the rigors of employment, especially job responsibilities which involve a higher level muscular strength, if they are to experience success in the workforce.

Hypotheses

The specific research hypotheses to be tested in this investigation include:

1. Participation in a progressive resistance-training program (leg extension, leg curls, chest press, biceps curl, triceps extension, and abdominal curl) will improve muscular strength and endurance among adult males with mild to moderate MR.

2. Participation in a progressive resistance-training program will improve work productivity of simulated job tasks (box stacking and box cart push) among adult males with mild to moderate MR.

3. Participation in a progressive resistance-training program will improve work productivity of on-site job tasks among adult males with mild to moderate MR.

Assumptions

The researcher was unable to obtain direct records of participants' intelligence scores. Therefore, it was assumed that parents, supervisors, and directors provided accurate information regarding participants' mental capacity. It was assumed that the participants had the mental capacity to follow verbal instructions, observe a model performance, and imitate demonstrations on the various lifting and work tasks. It was also assumed that participants tried their best when performing exercises and work tasks. The final assumption was that progressive resistance training helps persons with MR to increase muscular strength and endurance as it does for individuals without MR.

Limitations

1. The researcher could not control for participants practicing the simulated job tasks (box stacking and hand truck push) outside of the observation/testing periods. Practicing these tasks may create a learning effect causing variable productivity scores.

2. Participants in this study were selected from similar group homes, community housing, or family living environments in a rural or urban mid-western city.

3. Participants in the study were selected from different employment settings; therefore, different criteria were needed to measure on-site work productivity for each participant.

4. On-site work productivity records were obtained from participants' places of employment. The researcher accepted records of work productivity provided by the employer.

5. There were a small number (n=4) of participants in the study, which limited the nature of the statistical analysis.

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Definition of Terms

Competitive employment. Employment programs that have persons with developmental disabilities working alongside non-disabled coworkers in the regular job setting. There is usually minimal support from supervisors or job coaches needed in this environment.

Mental retardation (MR). "MR refers to substantial limitations in present functioning. It is characterized by significantly sub-average intellectual functioning, existing concurrently with related limitations in two or more of the following applicable adaptive skill areas: communication, self-care, home living, social skills, community use, self-direction, health and safety, functional academics, leisure, and work. MR manifests before age 18 " (Luckasson et al., 1992).

On-site job tasks. On-site job tasks refer to the actual jobs held by the participants used in this study. These tasks were performed in the employment setting and were not under the control of the researcher. On-site jobs for the purpose of this study consisted of a variety of tasks, all of which required some type of physical labor.

Progressive resistance training. "Progressive resistance exercise refers to the continual increase in the stress placed on the muscle as it becomes capable of producing greater force" (Fleck & Kraemer, 1987, p. 6). Exercises are designed to strengthen specific muscles by causing them to overcome a fixed resistance, usually in the form of a barbell, dumbbell, or weight machine (McArdle, Katch, & Katch, 1991, p. 461). In this study, progressive resistance training refers to a 9-week weight-training program. The program consisted of three phases with workloads at varying percentages (30% to 80%) of the participants' one-repetition (1-RM) lifts. Phase one (2 weeks) included lifts performed at 30% to 40% of 1-RM for 2 sets of twelve repetitions. Phase two (3 weeks) was done at 50% to 60% of participants 1-RM lifts for 3 sets of eight repetitions. Lastly, phase three (4 weeks) was 70% to 80% of 1-RM lifts for 4 sets of six repetitions.

Sheltered workshop employment. Sheltered work refers to employment programs that provide work for persons with various developmental disabilities in a setting that provides ongoing supervision. Participants receive compensation for the work they perform. Sheltered workshop employment often involves tasks such as assembly, mailing, collating, and packaging tasks.

Simulated work tasks. The simulated jobs used in this study were chosen by the researcher and closely resemble tasks found in typical job settings of individuals with MR (Barrrett, 1978; Shafer, Rice, & Metzler, 1989; Wehman et al., 1985a). The tasks included box stacking (e.g., weighted cardboard boxes were lifted to a table from the floor) and push cart with boxes (e.g., a two-wheel hand dolly was loaded with weighted boxes and pushed for a set distance). These tasks were modifications of those used by Zetts et al. (1995).

Supported employment. The Federal Register (1987; 1992) defines supported employment as "paid work in a variety of settings, particularly regular work sites, especially designed for handicapped individuals: (i) for whom competitive employment has not traditionally occurred; and (ii) who, because of their disability, need intensive ongoing support to perform in a work setting."

CHAPTER TWO

LITERATURE REVIEW

The literature related to muscular strength and endurance among persons with mental retardation (MR) indicates that these persons generally have lower fitness and strength levels than non-retarded persons (Croce & Horvat, 1992; Rimmer & Kelly, 1991; Reid, et. al., 1985). Low fitness levels may be a result of persons with MR not being afforded the opportunity to participate in consistent exercise programs. In addition, knowledge about the effects that muscular strength has on the employability of these persons is limited as well. Large amounts of money are spent on training programs to develop job skills for persons with MR. As mentioned previously, these programs tend to focus on work-related skills, but not on muscular strength and physical endurance. This literature review focuses on the importance of employment for persons with MR, the types of jobs commonly required by those persons, and lastly, several factors that relate to the strength and work productivity of persons with MR.

Importance of Employment for Persons with Mental Retardation

Employment for persons with MR is very important and can have a huge impact on their lives. As a matter of fact, Billions of dollars are spent each year on employment programs, vocational education, and special education for persons with disabilities (Wehman et al., 1985a). These programs train and place individuals who have various disabilities into jobs in order that they may become more economically and personally independent. However results of past research by The US Commission on Civil Rights (1983) has indicated that 50% to 75% of all persons in the United States with disabilities were unemployed in the mid 1980s. Others (Brickey, Browning, & Campbell, 1982;

Hasazi, Gordon, & Roe, 1985; Mithaug, Horiuchi, & Fanning, 1985; Patton, Bernie-Smith, & Payne (1990); Schalock & Lilley, 1986; Wehman et al. 1985a; and Wehman et al., 1985b) have conducted studies that also support claims of high unemployment, underemployment, or the failure to keep jobs. Furthermore, Jones, Ulicny, Czyzewski, and Plante (1987) proposed that there are limited opportunities in traditional employment for persons with disabilities, and that they are in constant competition with nondisabled workers. Smith (1981) surveyed 74 potential employers of persons with MR on their hiring concerns. The results indicated that 79% of the employers surveyed did not presently have any persons with MR working for them. These employers were concerned about factors such as hiring persons with MR because of lack of responsibility on the job, inappropriate social behavior, and inability to get along with other workers.

Much emphasis throughout society is placed on individuals being able to become independent and support themselves (Patton, Bernie-Smith, and Payne, 1990). Many people who are mentally retarded are able to have jobs if given the proper training, assistance, and opportunities. In conjunction, The Association for Retarded Citizens (ARC; 1994) stated the effects of MR varies among this population. About 87% of people with MR show mild to moderate deficits in learning new information and skills. As these persons get older and complete training, they are capable of performing a variety of jobs. The remaining 13% of people with MR have more pronounced deficits in learning; however, some can still become employed and demonstrate effective performance in certain jobs. Job assistance for persons with MR is common in many settings (workshop, sheltered, and competitive). The ARC (1994) recommends that a job coach "accompanies the individual with MR to the job to assist in the initial training period" (p. 1), especially during the initial stages of employment. The job coach offers recommendations on ways to accommodate the worker with MR. The goal is to have the job coach eventually be removed from the work setting and act as a consultant when needed. This strategy is important for persons with MR; however, it may not be sufficient. Persons with MR must continue to possess the necessary strength to perform their jobs. Consequently, progressive resistance training may be a way to increase their strength and provide the necessary endurance to further assist in their job independence.

Quality of life and job satisfaction. Goode (1990) states that quality of life variables are the same for non-disabled and the disabled. The quality of life variables involve a social construct that included interacting with others and could be attained by meeting the needs and responsibilities of individuals in the environment in which they live. Parent (1993) indicated the importance of choice, control, empowerment, and job satisfaction to the quality of life of persons with disabilities. Sinnott-Oswald, Gliner, and Spencer (1991) conducted a study to examine differences in perceived quality of life of two groups of adults with MR (n=30) from three different groups: (a) supported employment; (b) sheltered workshop; and (c) control group. The factors they used to define quality of life included environmental control, community involvement, and perception of personal change. An 18-item questionnaire was used and analyzed on a per-question basis. Results of this study indicated that participation in leisure activities, use of leisure time, self-esteem, activity involvement, mobility, perceptions of job skills, and increase in income were better for persons in supported employment settings as opposed to the sheltered workshop.

Sands and Kozleski (1994) examined the quantitative differences in quality of life factors between adults with (n=86) and without (n=131) disabilities. Subjects ranged in age from 18 to 70 years. The majority (61%) of the participants with disabilities identified their primary disability as MR, 13% as cerebral palsy, and 4% as head injury. Participants with disabilities were interviewed and administered the Consumer Satisfaction Survey (Temple University Developmental Disabilities Center, 1990). Non-disabled subjects completed a slightly modified version of the survey. This instrument was designed to evaluate consumer satisfaction and quality of life of individuals with developmental disabilities. The constructs of the survey were grouped into 6 categories, including: (a) services received; (b) satisfaction with those services; (c) independence / interdependence; (d) community activities; (e) productivity; and (f) needs for supports, services, and assistance. Results indicated that there was a significant relationship between presence of a disability and levels of participation in choice for life activities. That is, persons with disabilities had fewer choices than nondisabled individuals. Although all subjects were generally satisfied with their life, independence was low for individuals with disabilities (Sands & Kozleski, 1994).

Mehnert, Krauss, Nadler, and Boyd (1990) suggested that persons who are employed are more satisfied than those who are not employed. Thus, it is reasonable to assume that having and maintaining a job can lead to enhanced quality of life and offer personal satisfaction by fostering interpersonal relationships, psychological well-being, security, and independence (Parent, 1993).

Benefits of employment. There are numerous benefits of employment for persons with MR. Earning money and having a chance for advancement can improve self-esteem, social opportunities, and financial freedom, as well as the way that society views an individual (Wehman, 1993). Earning money and being satisfied with employment also may have a significant effect on a person's self-perception and quality of life. The jobs that are held by many persons with MR might seem less desirable than those held by persons without disabilities; however, they are a vital part of employment for this population. Although the jobs may be physically demanding, they allow individuals a chance to become socially accepted by family and community, make money, and become financially independent (Wehman, 1993). These factors can eventually lead to positive self-perceptions and improve quality of life.

Employers also experience apparent benefits when they hire people who are mentally retarded. The ARC (1994) stated that employers may be able to receive on the job training reimbursement from the ARC, the state's rehabilitation agency, or a local Job Training Partnership Act (JTPA) program. For some employers, tax credits from the Internal Revenue Service may also be available. Additionally, persons with MR usually are classified as loyal workers. They work hard and do what they can to please their employers. Hence many employers are usually satisfied with the performances of these individuals. Blanck (1993) conducted a survey to determine how satisfied employers were with their MR workers. Results indicated that the majority (96%) of the employers reported they were happy with work attendance. Others (78%) were pleased with the employees' dedication to work, and 95% indicated their employees with MR have lower turnover rates than nondisabled workers with the same type of jobs. Lastly, many of the employers were very satisfied with the employees' work productivity (59%) and initiative (58%).

Employment for persons with MR carries economic benefits for these persons as well as society as a whole. Wehman (1993) mentions that money earned by persons who are disabled goes back into the local and state economy. He further states "when combined with the taxes, it is apparent that significant reductions in the employment rate for persons with disabilities would quickly become a considerable benefit for state and federal budgets and the general economy" (p. 56). In addition, there are supplemental security income savings to be had as well. That is, persons with disabilities who can work and gain wages would not require as much of the supplementary income. Sylvestre and Gottlieb (1992) indicated, "persons with MR will become less dependent on government largesse and charitable organizations, and achieve a significant measure of economic independence" (p. 4).

Muscular Strength and Job Maintenance

Muscular strength and endurance has an effect on the ability of persons with MR to obtain and maintain jobs. It seems apparent that fitness, more specifically muscular strength, has the ability to effect productivity, job attendance, and the health of persons with MR who have physical tasks as their employment. Research by Barrett (1978), Wehman et al. (1985a, 1985b) has shown that persons with disabilities, particularly those with MR, are usually employed in jobs that require some type of physical or manual labor which involves the lifting or carrying of heavy objects. Some of the jobs may include task assembler, warehouse worker, carpenter, janitor, maintenance worker, loader on a dock, laborer, farm laborer, painter, busboy, factory worker, baggers in a grocery store, grounds maintenance, and dishwasher. The ARC (1994) listed several additional jobs that persons with MR have been successful in performing, such as animal caretakers, textile machine tenders, store clerks, nursery worker, messengers, cooks, hospital attendants, housekeepers, furniture refinishers, building maintenance workers, and grocery clerks. Smith (1981) added to this list mentioning, maintenance, kitchen worker, laundry worker, shoe repair, bus boy, production worker, farm worker, grounds keeper, mailroom clerk, mail delivery, and carpenter's helper jobs. Although the aforementioned jobs are physical tasks, there was no mention of persons with MR having the necessary strength to perform the jobs. The importance of strength for the jobs as suggested by these experts cannot go ignored.

It is well documented in the research literature that adults who are mentally retarded possess lower fitness and strength levels than persons who are not retarded (Beasley, 1982; Fernhall & Tymeson, 1987; Fernhall & Tymeson, 1988; Fernhall et al. 1988; Janicki & Jacobson, 1985; Pitetti & Tan, 1990; Pitetti, Jackson, Stubbs, Campbell, & Battar, 1989; Schurrer et al., 1985; Seidl, Reid, & Montgomery, 1987). Low fitness and strength performances, along with the current push toward more integrated working environments (supported employment), means that adults with MR may have a difficult time competing with nonretarded persons for jobs. Substandard strength and fitness levels of individuals who are MR may also lead to increased absenteeism in the work place as well (Cox, Shephard, & Corey, 1981; Cox, Shephard, & Corey, 1987).

Several researchers (American College of Sports Medicine [ACSM], 1990, 1991; Blair, Kohl, & Barlow, 1993; Blair, Kohl, & Gordon, 1992; Blair, Kohl, Gordon, & Paffenbarger, 1992; Debusk, Stenestrand, Sheehan, & Haskell, 1990; Fletcher et al., 1992; Gordon, Kohl, & Blair, 1993) have indicated that participation in physical activity is important in preventative health as well as disease prevention. Additionally, a report from the US Department of Health and Human Services (1996) details several benefits of participation in physical activity for persons with disabilities. The benefits include: (a) reduced risk of dying from coronary heart disease and having high blood pressure; (b) improved physical stamina for persons with chronic conditions; and (c) reduced likelihood of anxiety and depression and enhanced feelings of well-being. Persons who are healthy and free from disease may have better work attendance and increased productivity levels. Therefore, the importance of fitness and strength programs in the work force and the increase of work productivity is an important concern for employers.

Furthermore, job maintenance is important to the success of persons with MR in competitive employment as they are competing against people who are non-disabled. Therefore, having the necessary strength and stamina to complete the job tasks at hand is an important quality. It is important to determine more viable ways to prepare persons for the physical rigors of the work force. Improved stamina, less work absenteeism, and lower health insurance costs are benefits to being physically fit and healthy. Cox et al. (1987) mentioned that persons with MR often have a high rate of absenteeism due to illness and sometimes lack of job satisfaction. It is important to have stamina and energy to make it through a typical workday, making it apparent that some level of fitness and strength is needed to be successful and productive in the work force. The challenge will be for special education, vocational training, and job training personnel to focus on essential benefits of resistance training and the accompanying benefits to quality of life, of work productivity, and health and fitness for individuals with MR.

Strength Characteristics among Person with Mental Retardation

Persons with MR have the capacity to gain muscular strength and endurance by participating in consistent resistant programs. Zetts et al. (1995) investigated the effects of a progressive resistance exercise program (bench press, military press, leg press, leg curls, leg extensions, and biceps curl) on simulated work productivity (box stacking, hand truck push, and pail carry) for 4 men and 2 women with moderate to severe MR who ranged in age from 15 to 20 years. The equipment used included a Universal Gym, Icarian Fitness Leg Curl and Leg Extension machines, and free weight dumbbells. Strength was recorded using a Nicholas Manual Muscle Tester and a hand-held dynamometer. Data were analyzed by visual inspection for changes between baseline and intervention for each participant. Results indicated that strength increased from baseline to post intervention in all muscle groups for all participants. Simulated work productivity also increased for all participants during intervention, with the pail carry showing the lowest increase. However, the strength gains showed more of a significant increase than did work productivity.

A study by Rimmer and Kelly (1991) involved a progressive resistance training program for 24 adults (13 women and 11 men) with MR (IQ 40 to 70) ranging in age from 23 to 49 years. Participants completed a 9-week program using Nautilus equipment and a pull-up machine at a community-based exercise facility. Strength was measured using one repetition maximum lift (1-RM) on the following machines: leg extension, leg curl, pectoral deck, shoulder abduction, pull over, biceps curl, triceps extension, and pull up. The results suggested that participation in the 9-week resistance-training program improved the strength levels of persons with MR. The improvements were quite significant on all measures except the leg extension. It was also reported that participants seemed motivated to participate in the resistance-training program, suggesting that this type of program could be beneficial to persons with MR. These results further provide evidence of the importance that resistance training plays in the life of persons with mental retardation.

The findings of the previous studies are significant in that they used a variety of resistance equipment and settings, and/or each person had resistance training programs individualized specific to his or her strength. These results clearly indicate that persons with MR have the ability to participate in a fitness program and possess the ability to increase their muscular strength, endurance, and work productivity if given the opportunity.

Lastly, in a critical review of the literature, Moon and Renzaglia (1982) reported that persons with MR need systematic intervention strategies for leisure-time skills and physical fitness because they are not self-directed enough to know their options. Therefore, exercise programs should be monitored and simple enough so that persons with MR are motivated to participate. One such exercise program that could enhance participation of persons with MR is resistance training.

Strength Gains for Persons with Mental Retardation

Weight training can vastly improve the efficiency of muscles. The body's physiological responses to weight training and exercising are many. Hypertrophy and increase in strength are some of the responses that are sought by persons participating in weight training. The intensity, duration, and frequency of exercise determine the degree of improvement in muscular strength and endurance. Brzycki (1995) indicates that “each time t

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time the maximum number of repetitions are attained the resistance should be increased for the workout" (p. 39). Utilizing the principle of progressive overload is imperative in increasing strength. Overload involves placing additional stress on the muscles more than what they are accustomed to doing.

The key to progressive resistance training is to gradually increase the amount of weight lifted and the number of sets performed as the person's strength increases. Muscles respond better if the progression is challenging. Therefore, the increases in weight of progressive resistance training should be specific for the individual. Comparisons to others should not be of major concern, but the person should try to improve his or her previous performance (Brzycki, 1995). Therefore, weight is adjusted based on a person's maximal lift in one repetition or 1-RM. Lastly, participation in a progressive resistance-training program is a way of increasing strength and muscular endurance, and may result in reduction of risk for cardiovascular diseases (Fleck & Kraemer, 1988).

Past researchers have reported problems related to the inability of persons with MR to understand, maintain, and follow certain testing cadences or protocols. Fernhall and Tymeson (1987), Lavay, Reid, and Cressler-Chaviz (1990), and Rimmer and Kelly (1991) stress the importance of making sure that subjects are familiar with test settings. Although these concerns about following test or exercise protocols do exist, once these problems are overcome, persons with MR respond to exercise physiologically the same as nonretarded persons (Croce, 1990; Tomporowski & Ellis, 1984; Tomporowski & Jameson, 1985).

Fernhall (1997) indicated that exercise training for persons with MR is beneficial. Standard protocols are acceptable if low fitness capacities for this population are taken into consideration. Additionally, Fernhall (1997) recommends being aware of safety concerns, motivation, concentration, and understanding difficulties related to the task. Therefore the use of weight machines over free-weights are recommended because they are easier to use and control, and may present less of a safety hazard. Additional benefits were outlined by Rimmer (1996) who stated the following facts regarding muscle strength among persons who are MR: (a) body strength is valuable for recreation activities and activities of daily living; (b) good upper body muscles increase vocational opportunities; and (c) there is a relationship between good muscle strength and good performance of people with MR in industrial work settings (p. 2).

An increase in strength can lead to persons with MR having more vitality and endurance to make it through a typical workday. In addition, increased strength may improve the person's energy level so he or she may engage in other activities outside of the work place. There have been several studies that report on the benefits of weight training programs for persons who are nonretarded (Fleck & Kraemer, 1988; Kraemer & Fleck, 1988; McDonagh & Davies, 1984; Sailors & Berg, 1987). These studies have shown that resistance training can increase muscular strength and endurance and the ability to perform work. Only a few studies have looked at the effects of resistance training programs for persons with disabilities (Nordgren, 1971; Pitetti et al. 1992; Rimmer & Kelly, 1991; Zetts et al., 1995).

Muscular Strength and Work Productivity

There have been a few studies (Nordgren & Backstrom, 1971; Zetts et al., 1995) that looked at the effects that muscular strength and endurance have on work productivity. Serr et al. (1994) mentioned that the majority of jobs performed by persons with MR in workshop or competitive work settings involve the use of the hands. They perform assembly, lifting, cleaning, packaging, and various other tasks. A certain amount of strength is also required in these tasks. A study by Beasley (1982) looked at the effects of a jogging program, 5 days a week for 8 weeks, on cardiovascular fitness and work performance of 30 adults with mild to moderate MR who were employed in a workshop setting. Cardiovascular fitness was measured using posttest measures from Cooper's 12-minute Run-Walk Test (Cooper, 1968). Work productivity was measured by the amount of heat clip assembly tasks completed. Data analysis revealed a significant difference between the experimental and control group on Cooper's Test (Beasley, 1982). The experimental group had better fitness values and assembled more heat clips than the control group. An analysis of absenteeism indicated no significant difference between the two groups. However, the experimental group had a mean absentee rate of approximately one-day below that of the control group. Although this study provides encouraging results, it does not provide data on the importance of muscular strength in jobs requiring physical labor.

Croce and Horvat (1992) conducted research to determine the effects of a reinforcement-based aerobic and resistance exercise program on fitness and work productivity of three obese men with MR and low fitness levels. The behavior reinforcement involved a token system and was used to help with participant motivation.

Treatment effectiveness was evaluated on body weight, percent body fat (body composition), oxygen consumption (predicted max VO_2 in ml/kg/min), composite isometric strength (kg of force), and work productivity (pieces of work completed). Results from the analyses of a multiple-baseline-across–subjects-design indicated that participants improved from their baseline scores on cardiovascular fitness, strength, and work productivity measurements ($p < .05$). There were no significant differences for the body weight and body composition for the treatment and retention phases ($p > .05$). This study further indicated the importance of strength on work productivity.

Successful work experiences for both persons with and without MR depend a great deal on work productivity. Jobs such as assembly tasks and packaging involve persons being compensated for the amount of work they produce. Zetts et al. (1995) conducted a study to determine how a community-based progressive resistance-training program affected the work productivity of six adolescents with moderate to severe intellectual disabilities. The jobs used in the study were simulated and included box stacking, hand truck push, and a pail carry. The results indicated that there were increases in strength from the pretesting to the posttesting on all strength measures. In addition, the mean values of all work productivity tasks increased during the intervention stage. This study further indicated the positive effect that strength can have on work productivity, indicating its importance to persons with MR who have jobs that require physical labor.

Strength and endurance are especially important to perform job skills. More business and corporations are using resistance training and physical fitness as a possible enhancement of work productivity (Bernacki & Baun, 1984; Driver, 1992; Kaman, 1987; Shephard, 1986; Zetts et al., 1995). In addition, Bernacki and Baun (1984), Driver

(1992), and Kaman (1987) indicated that corporations are becoming more interested in including and stressing the importance of physical activity in the work place as a way of increasing employee work productivity. Therefore, being physically stronger may also enhance the individual's chances of obtaining and maintaining long term employment. Persons with MR should be prepared to take on this challenge and become physically stronger and subsequently more physically fit to perform on job tasks and improve their quality of life.

Lastly, Shephard (1994) states it best by indicating that, "perhaps the most important benefit that can be anticipated from a regular exercise program is enhanced quality of life" (p. 96). The effects of exercise are immediate and a person's life can be enhanced by as much as 10%. This provides more evidence for the importance of a consistent and sustained exercise program. Resistance training has the potential to produce the aforementioned effects.

Implications of the Literature for this Study

A review of the literature revealed that progressive resistance training has the potential to increase strength and possibly work productivity among persons with MR. It has been documented that a certain level of muscular strength is needed for persons with MR who work in jobs that require physical labor. Nine weeks has been shown to be a sufficient amount of time for persons with MR to experience noticeable strength gains using upper and lower body exercises. Participation in strength programs has improved work productivity for simulated work tasks; however; the data regarding its affect on actual job tasks is inconclusive.

Participation in a consistent resistance-training program has many ramifications for job maintenance and performance. Getting and keeping jobs and being productive at work is important for persons with MR. The significance of having a job to help enhance one's quality of life is paramount. The importance of improving the muscular strength and endurance of persons with MR has implications for job success and job maintenance. In addition, information from this study may offer guidelines to those who supervise work-training programs for persons with MR.

CHAPTER THREE

METHODS

The purpose of this study was to determine the effects of a weight training program on work productivity and muscular strength among adult males with MR. It was hypothesized that participation in a weight-training program would positively affect work productivity by increasing the amount of work completed on simulated and actual job tasks and improve the participants' muscular strength on one repetition max lifts.

Research Design

The design used for this study was a single-subject ABA applied behavior analysis design (Barlow & Hersen, 1984; Huck, Cormier, & Bounds, 1974) with four replications. The independent variable was a 9-week progressive resistance-training program. The participants' performance levels were assessed on the dependent variables once every week during the 5-week baseline (A), the 9-week treatment (B), and the 6-week retention (A) periods. During the treatment (B) period, participants were involved in a twice-a-week progressive resistance-training program.

The dependent variables were performances on a box-stacking task, a hand-truck push task, on-site work tasks, and selected muscular strength measures. Measurements across all A and B phases of the research design included: (a) work productivity using simulated work tasks of box stacking and hand truck push; (b) work productivity using on-site or actual jobs; and (c) muscular strength using leg extension, leg curl, chest press, biceps curl, triceps extension, and abdominal curl. In addition, participants performed front-lying chest lifts to strengthen the low back muscles. The chest lifts were a substitute for back extensions, because the back extension machine at one of the three workout sites was not in operation. Therefore, to maintain consistency within the treatment, chest lifts were performed because the exercise required the use of no equipment. No strength data were recorded on the back exercise. Table 1 provides a summary of the research design used for the study.

Participants were not engaged in strength training during the baseline period (A); however, their strength was measured once a week for the 5-week period. The participants indicated that they had not engaged in a strength-training program within the past three years. During the treatment period, participants lifted weights two days a week on non-consecutive days. The duration of each lifting session was approximately 2.0 to 2.5 hours. Table 2 shows an overview of the schedule used for the participants during the study. The independent variable was believed to be effective if the participants improved in composite strength and on the simulated and actual work tasks during the treatment period and then decreased during the retention period.

Justification for the Design

Reversal strategy designs are common in single-subject or small group studies. This design allowed for the researcher to conclude with a high degree of certainty that the treatment variable (resistance training program) caused changes in the dependent variables (work productivity and muscular strength) (Barlow & Hersen, 1984). The behavior of each participant was monitored weekly during the baseline and intervention phases of the study. These periodic observations allowed participants to serve as their own controls. The repeated measures conducted within this investigation also helped to establish experimental reliability in the scoring of work and strength outcomes.

Another justification for the use of this design is that it helped to control for several threats to internal validity (Huck, et al., 1974; Thomas & Nelson, 1996). Shavelson (1981) defines internal validity as "the extent to which the outcomes of a study result from the variables which were manipulated, measured, or selected in the study rather than from other variables not systematically treated" (p. 22). It should be noted that the nature of behavioral research designs being conducted in the "real world" setting could lead to some threats to internal and external validity.

Threats to internal and external validity were minimized whenever possible. Nevertheless, the following possible threats to internal validity were apparent for this study.

History. Threats due to history may have been a factor if participants performed lifting exercises outside of this study. To help control for this threat, participants were asked not to engage in lifting weights until completion of the study. The investigator asked parents/guardians, and group home supervisors to monitor participants so they did not participate in weight training during baseline or intervention periods. In addition, participants were asked to indicate on the health history form if they had previous weight training experience.

Maturation. Maturation was not a major threat to validity given that the total duration of this study was only 20 weeks. However, fatigue during testing sessions did represent a possible maturation threat. To help control for this variable, participants were given rest periods after each lift, as well as after each trial of the simulated work tasks during testing sessions. Hunger and thirst may have also been a problem.

Table 1

Summary of Research Design

	Duration	Treatment	Data Collection
Orientation	2 one-hour sessions	None	None
Baseline (A)	5 weeks	None	Box –stacking Hand-truck push On-site work tasks Muscular strength all measured once a week.
Treatment (B)	9 weeks	Progressive resistance training program with warm-up, multiple repetitions of 7 strength exercises, and cool-down	Box –stacking Hand-truck push On-site work tasks Muscular strength all measured once a week.
Baseline (A) Retention	6 weeks	None	Box –stacking Hand-truck push On-site work tasks Muscular strength all measured once a week.

Table 2

Overview of the Exercise and Testing Routine

Activities/Exercise	Duration (min)	Equipment
Meet in dance studio (Shane & Jacob) Meet in aerobic room (Jim) Meet in gymnasium (Bob)	5	None
Retrieve data and get sports drink or bottled water from cooler	5	Record sheet, pencil, sports drink or bottled water, cooler
Perform stretching exercises & warm-up (all sessions)	15-20	Padded exercise mat
Perform box stacking, hand truck push, & 1-RM lifts.(once a week on testing days)	40-50	Weighted boxes, hand truck, table 30" high, stop watch, cones (6), weight machines
Rest period (on testing days)[a]	5-10	None
Weight training (all sessions)	60-80	Weight machines
Cool down (all sessions)	5-10	None

[a]Additional rest periods were allowed as needed.

The investigator encouraged the participants to eat at least one to two hours prior to arriving at the testing site and provided water/sports drink during all sessions. Fatigue and hunger may have affected each participant differently; therefore, the investigator monitored this by periodically asking the participants how they felt.

Testing effects. Testing effects may have been a threat in this study. Participants may have been more motivated because the investigator and the assistants were present or because they were getting rewarded with verbal praise. To help control for this, participants had a chance to engage in practice sessions prior to participation in the study. This allowed the participants to become familiar with the testing site, and investigator to minimize the likelihood of testing effects. Furthermore, weekly baseline measures were taken on all participants prior to starting the intervention. Testing conditions were the same for all participants. In addition, the participants were required to have worked at their present job for a period of two months before they were allowed to take part in this study. This two-month period of time allowed participants to become familiar with their job tasks, thus decreasing the likelihood of threats due to testing effects of work outcomes.

Instrumentation. This seemed to be an unlikely source of invalidity because observations and those making the observations were consistent during the study. The instrumentation was not complex. For the box stacking and hand-truck push, testers used a stopwatch to assess the amount of time it took participants to lift eight boxes and push a hand truck for a distance of 160 feet. For the strength measures, the investigator had to add up the weight (in pounds) lifted by the participants on the various machines. The weight machines were not calibrated for this study. Proper positioning on the weight machines is simple, and each participant had assistance from the investigator. The investigator was the only person observing all participants throughout the study.

Selection bias. There was no selection bias because each participant served as his own control.

Mortality. This would have become a threat had participants dropped out of the study, or if any participant had a high absentee rate. The researcher attempted to control for mortality by keeping the participants motivated and giving them verbal praise each time they were present. Participants were also made aware of their attendance record. The researcher also carefully explained the study to the participants and their parents/guardians and mentioned the importance of completing the study. The parents/guardians made sure that the participants were at all exercise and testing sessions.

Statistical regression. The threat of statistical regression was not a concern because baseline measures were established and several measurements were taken prior to intervention.

External validity is defined as the extent to which the conclusions of a study can be generalized across populations other than the sample used in the study (Huck et al. 1974; Shavelson, 1981). External validity is typically controlled by selecting the participants, treatments, experimental situation, and tests to be representative of some larger population or "real life" (Thomas & Nelson, 1996). To minimize the risk of external invalidity, the researcher attempted to recruit participants who were representative of working class males with MR (see the section on participant selection and recruitment for more detail). The testing environments or tasks were similar to the "real world" setting in that the simulated tasks were similar to tasks participants may perform at their actual jobs. Lastly, the weight machines used are typical of those used at many community health club or fitness centers.

Participants

The eligibility criteria for participation in this study included: (a) males with mild to moderate MR; (b) chronological age of 25 to 40 years; (c) independently ambulatory, free from gross motor difficulties and medications that prohibit performance of physical work tasks, and relative good health; (d) signed medical release form; (e) no involvement in a weight training program during the past 12 months; (f) physical labor tasks as employment; (h) able to follow verbal directions (g) employed at current job for a minimum of two months; and (i) informed consent. The strict selection criteria were used to minimize the risk of injuries to the participants. For example, participants who were not in good health or who had gross motor difficulties were excluded because they might injure themselves while lifting weights or performing the simulated work tasks.

Recruitment of Participants

Participants were recruited from group homes and sheltered work sites in a Midwestern city in the United States. Potential sites for participants were identified by one of the researcher's dissertation committee members and the investigator. After potential group homes and job sites were identified, the researcher telephoned and visited those agencies approximately one month prior to the start of the study to recruit participants. The study was explained to the group home supervisor and job-site coordinators, as well as potential participants and their parents and guardians.

The description of the research study that was provided to potential participants and their parents and guardians included a complete description of the intervention and data collection procedures as well as the benefits and risks associated with participation. Individuals who were interested in participating in the study were asked to have their parents or guardians notify the investigator by telephone or email. The actual sample of four participants was randomly selected from the pool of given individuals (n = 5) who satisfied the selection criteria.

Informed Consent

The intervention and data collection procedures were explained verbally and were demonstrated in a videotaped presentation that showed an adult male performing the intervention and data-collection tasks. The actual consent procedures were also outlined in the video by the investigator. After viewing the videotape, the participants and their parent(s) or guardian(s) were given an opportunity to ask questions and were asked to sign the consent and assent forms (Appendix A). Verbal consent was obtained from the participants' job supervisors who recorded the on-site work productivity data. A copy of the consent forms approved by the Institutional Review Board at the investigator's university and signed by the participants is located in Appendix A.

Participant Sample

Participants included 4 males, aged 20 to 40 years, with mild to moderate MR, who resided either in group homes or with their parents or guardians. All participants were employed in jobs that involved some type of physical labor. Parents or guardians completed a demographic and health history questionnaire that requested information on the participant's living environment, gender, date of birth, history of injuries, and exercise habits (Appendix B). Information from this form was also used to help the researcher screen for eligibility criteria. The investigator relied on the information provided by parents, guardians, and participants to gain personal information about the participants' level of cognitive impairment and job history.

In addition participants were observed and assessed using the ABILITIES index (Simeonsson & Bailey, 1991). A copy of the index can be found in Appendix C. This instrument allowed the investigator to develop a profile of the participant's abilities in nine major areas including audition, behavior and social skills, intellectual functioning, limbs, intentional communication, tonicity, integrity of physical health, eyes, and structural status (Simeonsson & Bailey, 1991). The scale is commonly used for children however; the investigator used it with the participants in this study as reference to their functional ability. The investigator made all observations; however, parents were contacted if further clarification was needed. Participants' abilities ranged from normal to moderate in the nine categories. Adhering to the established criteria, no participant had any physical disabilities that would prevent them from performing the exercises used in the study. An overview of participants' scores on all components of the index is listed in Table 3.

The personal characteristic information that was provided in this study was voluntary. The investigator did not view any personal records of the participants. The names used in this study are not the actual names of the participants. Descriptions of the participants are provided in the subsequent paragraphs.

Shane. Shane is a 5'9", 124 pound, 25-year-old, Caucasian male who resides with his mother. His mother and job supervisors described him as having mild MR. He recently graduated from high school and now has a job at a sheltered workshop where he is responsible for assembly work. He also works at a local high school cafeteria where

Table 3

Summary of the ABILITIES Index Scores for all Participants

	Shane	Jacob	Jim	Bob
Audition				
Left	2.0	1.0	1.0	1.0
Right	2.0	1.0	1.0	1.0
Behavior	3.0	3.0	3.0	2.0
Social Skills	3.0	3.0	3.0	2.0
Intellectual Functioning	3.0	3.5	3.0	3.0
Limbs				
Hands				
Left	1.0	1.0	1.0	1.0
Right	1.0	1.0	1.0	1.0
Arms				
Left	1.0	1.0	1.0	1.0
Right	1.0	1.0	1.0	1.0
Legs				
Left	1.0	1.0	1.0	1.0
Right	1.0	1.0	1.0	1.0
Intentional Communication				
Understanding	2.0	3.0	2.0	2.0
Communicating	2.0	3.0	2.0	2.0
Tonicity	1.0	1.0	1.0	1.0
Integrity of Physical Health	1.0	2.0	1.0	1.0
Eyes (Vision)				
Left	1.0	3.0	2.0	1.0
Right	1.0	3.0	2.0	1.0
Structural status	1.0	1.0	1.0	1.0

Note. 1.0 = Norm; 2.0 = Suspected disability; 3.0 = Mild disability; 4.0 = Moderate disability; 5.0 = Severe disability; and 6.0 = Profound disability.

he washes dishes and performs general cleaning duties. At the time of the study he had been employed at his jobs for 5.5 years and 2.0 years respectively.

Jacob. Jacob is a 5'11", 190 pound, 26-year-old, Caucasian male who resides with his mother. His mother described him as having mild to moderate MR. Jacob is presently employed as a task assembler at a sheltered workshop and has held his job for approximately 4.5 years. In addition, Jacob works at local restaurant where he washes dishes and does general cleaning. He has been at this job for a period of 2 years.

Jim. Jim is a 5'10", 185 pound, 29 year old, African American who resides with his father. Jim's dad described him has having mild MR. Jim works as a mail sorter at a university in an urban area. He also stated that he lifts mailbags, boxes and packages, and prepares them for distribution to various buildings on the university campus.

Bob. Bob is a 5'8'', 137 pound, 25 year old, Caucasian male who resides with his mother and father. Bob's parents described him as having mild MR. He works at a local health club where he is responsible for cleaning the men's locker room and the weight machines in the aerobic fitness room. Bob has been employed at this job for 1.5 years.

Orientation Sessions

Prior to the baseline period, participants underwent two one-hour orientation sessions on the use of the weight machines and simulated work tasks (box stacking and hand truck push). The participants viewed a videotaped performance on the proper use of the Nautilus weight equipment, hand truck push, and box stacking, and practiced each task. The investigator assisted participants with performing the work tasks and positioning themselves onto the weight machines for lifting. To minimize the risk of injury while performing lifts, participants practiced with only one or two weight plates (an average weight of 10 to 20 lb per plate) on each of the six exercise machines. Upon the completion of practice in the weight room, participants were escorted to the gymnasium or aerobic studio to practice the simulated work tasks (box stacking and hand truck push).

Participants also viewed a videotaped performance of the hand truck push and box stacking simulated work tasks including: (a) proper lifting techniques for box stacking; (b) placement of boxes on the table; and (c) proper grip and push of the hand truck. For example, they were informed to lift with their knees, keep their back straight, and maintain a firm grip on the box being lifted and the hand truck handle.

A typical practice session for the work tasks involved participants performing two trials of lifting 8 boxes (10 pounds each) from the floor onto a table. Lastly, participants practiced pushing the hand truck twice around the perimeter of the gymnasium. The hand truck was weighted with two 25-pound boxes. The modest amount of weight of each box was done to provide for resistance and minimize the risk of injury. The practice sessions enabled the researcher to screen for potential problems and participant capability to perform the desired tasks measured in this study. The researcher was confident that participants understood the lifting tasks when they could perform each task independently on two consecutive trials with only verbal directions.

Test Administration

Participants were instructed to wear comfortable clothing (warm-up pants or shorts, and T-shirt or sweatshirt) that allowed them to move and bend freely during all testing sessions. Tennis shoes and socks were also required for safety. Participants were not able to wear any dangling jewelry or objects that interfered with the performance of the simulated work tasks or weight lifting exercises. All testing was done individually, however, there may have been other persons present in the facilities with the participants. Participants performed the lifting exercises before the simulated work tasks. Fluids and additional rest periods were provided as needed.

A typical testing session included: (a) arriving at the gymnasium; (b) stretching; (c) performing weight exercises; (d) resting for 15 minutes; and (e) performing the hand truck push and box stacking. Supervisors at the participant's job site assessed on-site work productivity. A more detailed description of testing can be found in the instrumentation section of this study.

Participants were verbally instructed and assisted if needed, to properly position themselves onto the weight machine to prepare for lifting. An appropriate weight was chosen close to, but below, the participant's maximum lifting capabilities to allow for warm-up. Participants were asked to lift the designated weight once and then lower it back to the weight stack. Weight was then progressively added to each machine in 2.5 to 10.0 lb. increments, depending upon the exercise being performed. The weight was added to the machine until maximum lift capability was achieved. Once the participant reached a weight that he could not successfully lift for one repetition, the weight amount preceding the unsuccessful attempt was considered his 1-RM lift. The data for all strength and exercise measures were recorded on the weight training work out form (Appendix B). Each participant received verbal praise and encouragement for motivation during all lifts. For example, the investigator said, "come on, you can lift it, try to do your best." When participants completed a successful lift, one of the comments from the investigator was "Great job buddy, way to go." The 1-RM lifts were done on an individual basis and each participant had the investigator present while he performed the lifts. It should be noted that at times there were more people than the participant and the investigator present in the weight room. The three sites used were open to the general public during many of the exercise sessions. The presence of others during testing did not seem to present a problem during weight training and testing.

Participants were allowed a maximum of four initial trials to reach 1-RM on each exercise. To minimize the risk of muscle fatigue, if 1-RM was not determined after the fourth trial, the participant moved to another machine that involved a different muscle group (Rimmer & Kelly, 1991). For example, if Jacob attempted the chest press and his 1-RM was not achieved within four lifts, he was not allowed a fifth trial, but had to move to the next exercise of leg curl. The participant could return to the chest press machine, where he had the unsuccessful attempt, after performing an exercise that worked a different muscle group. Participants were given a 3-min rest period between each exercise station. For the purpose of testing, participants performed the lifting exercises using the lower body muscle groups (leg extension, leg curl), then the upper body muscles (chest press, arm curl, triceps extension), and lastly the trunk muscles (abdominal curl and front lying chest lifts).

Baseline Measures of the Dependent Variables

A summary of the instruments used in this study, the variables they assessed, and the persons who administered the instruments are listed in Table 4. The job simulations used in this investigation were similar to those suggested by Zetts et al. (1995). These investigators measured social validity of the work tasks by having two local merchants,

Table 4

Summary of Instrumentation

Dependent Variable	Measurement Task Person	Responsible
Productivity		
Box Stacking	Timed stacking of eight 25 lb boxes	Investigator
Hand Truck Push	Timed pushing of hand truck loaded with two 85 lb boxes for a 160 ft distance	Investigator
On-site Task	Amount of work or assemblies completed - depends upon participant's job and ratings	Work Supervisor Job Coach
Strength		
Leg Extension	1 RM lift	Investigator
Leg Curl	1 RM lift	Investigator
Chest Press	1 RM lift	Investigator
Biceps Curl	1 RM lift	Investigator
Triceps Extension	1 RM lift	Investigator
Abdominal Curl	1 RM lift	Investigator
Front Lying Chest Lift	No data Collected (3 sets of 15 s)	Investigator

Note. All weights were added in 2.5 to 10 lb increments.

two vocational rehabilitation specialists, and a high school supported work trainer identify the job tasks as ones that are common for workers with MR. In addition, other researchers (Hughes & Wehman, 1992) have reported that the jobs identified (hand truck push and box stacking) for this study closely match those that are common for persons with MR.

Simulated Work Tasks

The simulated work tasks were performed in a gymnasium or fitness area near the participant's home. These tasks included timed stacking of eight 25-pound boxes and timed pushing of a hand truck loaded with three boxes totaling 85 pounds over a 160-feet distance. Data were recorded on the simulated work task performance sheet (Appendix B). To minimize the risk of injury from the lifting and pushing, all participants were required to wear a back support belt.

Box stacking. A total of eight cardboard boxes with dimensions of 17.5 x 11.5 x 10 inches were filled with papers and magazines to the weight of 25 pounds per box. The boxes used were constructed to hold 10 reams of paper. The contents of the boxes were secured and sealed with packaging tape to prevent spilling. Participants were timed using a stopwatch as they lifted the eight boxes one at a time from the floor to a table 30 inches off the ground. The boxes were positioned next to the table or a platform in four equal stacks (2 high). Participants had to walk no more than two feet to retrieve boxes from the floor. Participants were instructed not to stack the boxes any more than two high on the table. Each participant performed the box-lifting tasks three times, with a rest period of 5 minutes between trials. The first trial served as a practice trial. To prevent fatigue, the boxes used during the practice trial weighed only 15 pounds each. The results of the last two trials were recorded and averaged to determine the participant's score. If a participant dropped a box, he was instructed to pick it up and continue until the task was completed. This did contribute to the participants' score.

Hand truck push. Materials used were a two-wheeled hand truck and two cardboard boxes with a combined weight of 85 pounds (40 lb. and 45 lb.). Box dimensions were 17.5 x 11.5 x 10 inches. The boxes were filled with papers and magazines and stacked onto the hand truck. The contents of the boxes were secured and sealed with packaging tape to prevent spilling. The boxes were secured to the hand truck using packaging tape. Participants were timed as they pushed the loaded hand truck around a rectangular course 160 feet in perimeter. The course for the hand truck push was formed by placing cones in a rectangular formation measuring 20 feet by 60 feet. Participants performed the task three times, with the first trial serving as a practice trial. To prevent fatigue, the boxes on the hand truck during the practice trial weighed only 50 pounds. The averaged time of the last two trials served as the participant's score. If a participant dropped or tipped the hand truck, he was instructed to pick it up and continue until the task was completed. This trial did contribute to the participant's score. A rest period of 5 minutes was given between trials.

On-site Work Tasks

The "on-site" job tasks were performed at the participant's place of employment. Two of the participants had more than one job. Work productivity measures varied among participants. A description of participant's on-site jobs and the measurements taken can be found in Table 5. On-site job tasks were measured on the same schedule as the simulated job tasks and muscular strength. However, productivity information was obtained from job supervisors rather than the investigator. The investigator only visited the participants' job sites at the beginning and end of the study. Additionally, the investigator called some of the job supervisors to clarify requested work productivity data. It should be noted that the amount of work completed was kept on record and was made available to the investigator during his visits to the job sites. Participants' employers compensated them for the amount of work they completed. The investigator had no control over the working conditions, hours worked, or amount of work completed for the participant.

Muscular Strength Exercises

In this study, weight machines were used rather than free weights. The weight machines were chosen because of their availability, ease of use, and safety, as well as better control over exercise movements than free weights. Shane and Jacob used Nautilus machines (Nautilus Sports/Medical Industries, Deland, FL). Jim used both Nautilus and Universal machines (leg extension and leg curl). Lastly, Bob used Icarian machines for his weight training. The major muscles that were targeted included leg curls (hamstrings), leg extensions (quadriceps), chest press (pectoralis muscles of the chest), biceps machine (biceps of upper arm), triceps machine (triceps of upper arm), and abdominal machine (rectus abdominis). The lower back (erector spinae group) was strengthened using front lying chest lifts. More detailed descriptions of the specific exercises performed on the various types of equipment are listed below.

Table 5

Descriptions and Frequency of Data Recorded for On-Site Job Tasks

	Job Descriptions	Frequency of Data Recorded
Shane	Sheltered Work Shop Packaging Assembly Material handling	Data on hours worked and pay per hour were collected every two weeks.[a]
	High School Dish washer General cleaning (sweep, mop floor, take out garbage, wipe tables, cleaning, and painting lockers)	Weekly comments and rating scale of poor, average, good, and great.
Jacob	Sheltered Work Shop Packaging Assembly Material Handling	Data on hours worked and pay per hour were collected every two weeks.[b]
	Restaurant Dish washer General cleaning (wipe tables, sweep floor, take out garbage, clean restrooms) Assemble delivery boxes	Weekly comments and rating scale of poor, average, good, and great.
Jim	Mailroom at University Mail sorter Package mover (bags and boxes)	Weekly comments and rating scale of poor, average, good, and great.
Bob	Health Club Clean men's locker room Clean aerobic machines	Weekly comments and rating scale of poor, average, good, and great.

[a,b]Job descriptions varied and were dependent on the work contracts held from various companies. Examples included packaging nuts and bolts, toys, and tools, and assembling boxes.

Nautilus Equipment (Brzycki, 1995, pp. 86-98)

1. Leg extension (quadraceps). Sit down, place your feet behind the roller pad, with the backs of the knees against the end of the seat pad. There should be little, if any space between the buttocks and the back pad. Fasten the seat belt and hold onto the handles located on the side of the seat pad. Extend both legs smoothly as high as possible by pushing against the roller pads. Pause briefly at the end of the extension phase, then lower to start position in a controlled manner.

2. Leg curl (hamstring). Lie face down on the bench pad and place feet under roller pads with knees just over the edge of the bench. Lightly hold onto the handles on sides of the bench pad to prevent your body from moving. Curl legs and try to pull the heels as close to your buttocks as possible. Pause briefly at completion of the curl then lower the weight in a controlled fashion until the legs are fully extended back to the starting position.

3. Abdominal curl (abdominals). Sit in the machine. Locate the axis of rotation on the right side. Adjust the seat so that the axis of rotation is at the same level as the lower part of your sternum, or breastbone. Place ankles behind the roller pads. Rotate the shoulder pads to the most comfortable position. Rest your hands on your legs. Rotate the shoulders forward and down in an arc around the sternum as far as your range of movement allows. Pause during the crunch phase. Return to the starting position.

4. Double chest or arms cross (pectoralis). Adjust the seat height so that the front part of the shoulder is directly below the axis rotation. Sit on the seat and fasten the seat belt. Place the forearms against the arm pads and grasp the upper handles. The elbows should be slightly higher than the shoulders. Without moving the upper torso or the head away from the back pad, bring the elbows as close together as possible by pushing against

the arm pads. Pause briefly in the mid-range position and lower the weight under control to the starting position (arms apart) to get a good stretch.

5. Biceps curl (biceps). Sit down and place the feet flat on the floor (or on the bottom portion of the frame). Reach across the elbow pad and grasp the handles with the palms facing upward. Adjust the seat so the shoulders are slightly lower than the elbows. The elbows should be placed on the elbow pad in alignment with the axis of rotation. Curl both arms to the contracted or flexed position without moving the elbows or bending backward at the waist. Pause briefly during flexed position and then return the weight under control to the starting position.

6. Triceps extension (triceps). Adjust the seat so that the shoulders are slightly lower than the elbows. Place sides of hands on movement arms and elbows on the pad and in line with the axis of the cams. Position the hands on the wrist pads so that the palms are facing each other and the hands are open (i.e., fingers extended). Place the feet flat on the floor (or the bottom portion of the frame). Keep the elbows against the elbow pad and push the movement arms forward by straightening the lower arms. Pause briefly in the mid-range position and then lower the weight in a controlled fashion to the starting position (arms flexed).

Exercises with the Universal Weight Equipment (Brzycki, 1995, pp. 108-109)

1. Leg extension (quadriceps). Sit down, place the backs of the knees against the end of the bench pad and position the feet behind the roller pads. Lightly grasp the sides of the bench pad and lean back slightly. Extend the lower legs as high as possible by pushing against the roller pad. Pause briefly in the mid-range position and then return the weight under control to the starting position to obtain a proper stretch.

2. Leg curl (hamstrings). Lay face down on the pad and place the lower legs underneath the roller pads. Position the top of the knees just over the edge of the bench pad, not on the pad. Lightly grasp the support bars located on the sides of the bench pad. Pull the heels up as close to the buttocks as possible. Pause briefly in the mid-range position and then lower the weight under control to the starting position (legs fully extended) to allow for a good stretch.

3. Abdominal curl with lat pulldown machine (abdominals). Remove the straight bar and replace with rope grip handle. Sit down on the bench facing away from the machine. Grasp the rope part of the grip, just above the end stops. Place hands on side of head by the ears. While keeping hands by ears, slowly bend forward at the waist then sit back up while still holding rope by the ears. Repeat movements. Do not sit totally erect when performing exercises. This exercise was a modification by the investigator for abdominal curl.

Exercises with the ICARIAN Weight Equipment (Fitness Product International, Sun Valley, CA)

1. Leg extension 605 (quadriceps). Select appropriate weight. Adjust back pad so that the knees align with pivot point. Adjust the leg pad to rest comfortably above the foot over the ankle. Lightly grasp the handgrips on the side of the machine. Extend the legs upward with a slow controlled movement. Slowly return to start position.

2. Prone leg curl 606 (hamstrings). Select appropriate weight. Adjust leg pad to rest comfortably above foot. Align the knee with the pivot point and lay down in the prone position on the machine. Grip handles lightly. Curl legs upward, with slow

controlled movements keeping hips on the bench. Slowly return the weight to the start position.

3. Incline pectorial deck 405 (pectoralis). Select the appropriate weight. Adjust seat so arms are shoulder level. Press arms together with forearms, pause, and slowly return to start.

4. Camber curl 204 (biceps). Select the appropriate weight. Adjust seat so arms rest comfortably on pad and elbows align with pivot point. Grip handles with both hands and pull upward with a slow controlled movement. Slowly return to the start position.

5. Seated tricep 208 (triceps). Select the appropriate weight. Align elbows with pivot point. Grip the handles firmly and push forward.

6. Abdominal isolator 712 (abdominals). Select appropriate weight. Adjust start position to desired extension. Adjusts seat height so chest pad rests comfortably on upper chest. Place the feet on the footrest (select desired foot position by flipping foot bar). Push upper body toward knees with a slow, controlled movement. Slowly return to the start position.

To determine muscular strength, the participant performed one repetition maximum lift (1-RM) for each exercise. One repetition maximum lift referred to "the maximum amount of weight lifted one time with correct form during the performance of a predetermined weight-lifting exercise" (McArdle et al. 1991, p. 454). The 1-RM lifts comprised the composite strength scores for each participant. Composite strength was defined as the sum of the 1-RM lifts for each of the exercises performed per week.

Intervention

The intervention consisted of a 9-week weight-training program, two days a week. Participants performed the weightlifting exercises with a partner to simulate a typical setting for a fitness or health club. A typical intervention session included a warm-up, lifting, and cool-down period. Descriptions of the resistance training protocol, typical setting, and safety precautions used for this study are provided below.

Resistance Training Protocol

The 9-week intervention period was divided into three phases based on changes with weight percentages and the number of sets and repetitions lifted. The first phase lasted for a period of 2 weeks (4 sessions) and included 2 sets of 12 repetitions of each of the 7 strength-training exercises with low resistance (30% to 40% of their 1-RM lift). The second phase of the intervention lasted for a total of 3 weeks (6 sessions) and involved lifting 3 sets of 8 repetitions of each exercise with a moderate increase in the amount of resistance. Resistance was set at 50% to 60% of 1-RM lift. The third and final phase of the lifting program was 4 weeks (8 sessions) and included 4 sets of 6 repetitions of lifting with an increased resistance of 70% to 80% of each participant's 1-RM lift. (Appendix D).

The weight progressions were developed to place a progressive overload on the muscles to produce maximal strength gains. Atha (1981) has indicated that multiple sets are more effective for developing strength and muscle endurance than single sets. McArdle et al. (1991) mentioned that a load that is equal to 60% to 80% of a muscle's force-generating capacity (1-RM) is sufficient to increase strength. Although these percentages were established for persons without MR, the percentages have been shown to be effective for persons with MR (Rimmer & Kelly, 1991). The investigator looked at factors of fatigue, facial expressions, sets, and repetitions completed. Participants initially performed exercises at lower percentages of 1-RM (30%) because of low fitness levels and to minimize the risk of injury. Furthermore, the researcher attempted to start the participants out with a resistance that would be motivating and produce the most success.

Typical Intervention Setting

Each weight lifting period was approximately 1 to 1.5 hours long and consisted of 15-20 minutes of warm-up and stretching exercises, 40-60 minutes of lifting, and 5-10 minutes of cool down stretching exercises. Participants may have performed their lifting periods with others present in the workout facility. This was done because the facilities used were open to the public.

Warm-up. Each lifting period started with a warm-up session. Participants entered the building and reported to the gymnasium to collect their folders (which contained their exercise data) and prepared for warm-up. Participants jogged or walked once around the perimeter of the gymnasium (276 feet), stretched certain muscle groups (shoulder, back, groin, knees, and legs), and reviewed directions for performing the lifting exercises. Participants performed eight stretching exercises during warm-up. The exercises included: (a) anterior shoulder and posterior shoulder stretch; (b) double knee to chest and figure four for the lower back; (c) lunge and butterfly for the hip and groin area; and (d) the knee and legs, quadriceps stretch (standing), and hamstring stretch using the straight leg raise (Sudy, 1991). Each stretching exercise was performed for three repetitions and held for the duration of 5-7 s. Descriptions of the stretching exercises used are listed below (Sudy, 1991, pp. 287-289).

1. Anterior shoulder stretch. Grasp hands behind the back. Gently push arms upward.

2. Posterior shoulder stretch. Place left hand on right shoulder. With the elbow up and parallel to the floor, use the right hand to apply pressure above the elbow and toward the body. Repeat for right side.

3. Double knee to chest. On back, with knees bent, gently pull both knees toward chest, lifting feet off the floor, hold and relax. This exercise may also be done using one leg.

4. Figure four stretch. On back, with head down, flex right knee across the body and pull toward left shoulder. Repeat for left side.

5. Hip flexor stretch (lunge). Assume a lunge position, making sure front knee is directly over the foot and ankle. With weight supported by both hands, press hip toward the floor.

6. Groin stretch (butterfly). Sitting erect with soles of feed together, gently pull heels toward groin and press inside of knees toward floor.

7. Quadriceps stretch (standing). Using a wall or chair as support, reach back with the right hand and grasp right ankle. Be certain hips are forward and knees are adjacent to each other. Repeat on left.

8. Hamstring stretch (straight leg raises). On back, with knees bent and feet flat on floor, raise the right leg without lifting hips from the floor. Repeat on the left. Grasp the leg below the knee to increase the stretch.

Rotation through weight stations. The proper number of weight plates for each participant was placed on the weight machines by the investigator. Participants performed one set of the designated amount of repetitions on a particular exercise, then moved to the next exercise machine. Participants completed one set of all the exercises before beginning the second set. Exercises were performed in this order: leg extension, leg curl, chest press, biceps curl, triceps curl, abdominal curl, and back extension. Participants performed exercises for the lower body muscle before the upper body; therefore, the larger muscle groups were worked before the smaller muscles to prevent fatigue. Participants were allowed a 3 to 5 minute rest period before they proceeded to the next exercise machine.

Participants were not allowed to exceed the number of sets or repetitions (2 x 12, 3 x 8, and 4 x 6) designated for each phase of the intervention. Conversely, if participants could not perform all of the repetitions using the designated percentages of their 1-RM, they were verbally encouraged by the investigator to lift what they could. Verbal encouragement included such phrases as "good work, way to go," and "nice try, you will get it next time." Weight adjustments were made accordingly and noted on the performance data forms by the investigator or assistants.

Cool down. Each lifting period ended with a cool down session. Participants performed the same stretching exercises (shoulder, back, groin, knees, and legs) as in the warm-up. They turned in their folders and departed.

Safety Precautions

There were several safety precautions taken to minimize the risk of injury to participants while performing lifting exercises. The investigator is a certified instructor of first aid and cardiopulmonary resuscitation (CPR). Each participant had the opportunity to practice the lifting exercise prior to intervention. Participants were required to perform warm-up flexibility exercises before lifting. The investigator supervised or did all seat and weight adjustments. Participants had at least one day of rest between lifting sessions, and all lifting was done under supervision by the investigator. Each participant had an individualized program, and lifted a weight amount that was appropriate for his strength level. Muscles were trained from the largest to the smallest to minimize the risk of fatigue (Brzycki, 1995). Other safety precautions used with the participants included lifting the weight with slow, smooth, controlled movements; breathing naturally during lifts and not holding the breath; and taking a rest period between exercises (Brzycki, 1995; Sudy, 1991).

Data Collection Procedures

Data collection during the intervention phase was conducted to verify participation in the intervention. Therefore, each participant had the amount of weight lifted, the number of repetitions and sets required, and the machine used, recorded on his data sheet by the investigator. Data files of the lifts and muscles worked can be found in Appendix D. The investigator was also responsible for assisting and supervising participants with stretching and spotting on the lifting exercises.

Each participant was: (a) assigned a time to come to the weight room, become familiar with the weight equipment, and ask questions; (b) familiarized with the procedures for strength and work tasks measurements/observations by viewing a videotaped performance; and (c) assigned a time to be tested on muscular strength and work productivity tests. Observations for strength and on-site work tasks took place at local university gymnasiums and weight room or health club. The on-site work task was performed at each participant's place of employment. All transportation to and from data collection sites was the responsibility of the participant or parent/guardian.

Testing Schedule

Participants were tested once a week for a total of 20 weeks on strength and work productivity measures, with 5 testing occasions during the baseline period, 9 for the intervention period, and 6 during the second baseline or retention period. Due to time constraints, testing during the intervention was done on the days subjects were scheduled to weight train. To minimize the possibility of muscle fatigue due to overuse of muscles, especially with the lifting exercises, participants were given additional rest time. Participants needed approximately 85 to 100 min to complete the lifting exercises, 35 to 50 min for the simulated work tasks, and 15 to 30 min for rest periods, resulting in a total duration of 135 to 180 min per session.

The researcher encouraged participants to attend each testing and intervention session. If a participant missed a day, he was able to make it up on one of the days that regular testing was not scheduled. However, if a participant missed more than three testing sessions and could not make them up, he was excluded from the study. No participants were excluded from the study for excessive absences. After data collection, participants were provided with thank you letters, a record of their performances, and a certificate of participation. Letters of appreciation were sent to people who were instrumental in facilitating this study. Letters of recommendation were written for participants if requested by the participant or parent/guardian.

Testing Personnel

The investigator collected all data. The investigator helped to monitor participants during testing and intervention by setting the proper weight amounts, seat heights, and timing of the simulated work tasks. The investigator has had extensive experiences in working with persons who have MR. He has a master's degree in adapted physical education, and has taught adapted physical education for 12 years. Lastly, the investigator has lifted weights for several years and has taught several weight training courses at both the secondary and university levels.

Data Analyses

Data were analyzed by graphic presentation and visual inspection at the conclusion of each baseline and the intervention period. Calculation of the split-middle line to determine the celeration line of trend estimation and changes in level, variability, trend, or slope of trend line of the data points were of importance for strength and work productivity outcomes for each participant (Ottenbacher, 1986).

Visual Inspection of the Data

Visual inspection involves plotting the data on graphs and looking at the increases and/or decreases in scores for the various variables. More specifically, visual inspection involves analyzing changes in level, variability, trend, and slope of the graphed data points. Changes in level refer to the magnitude of the data (Bloom & Fischer, 1982). A change in level refers to the shift of a participant's performance from the end of one phase to the start of the next phase (e.g., from baseline to intervention) (Ottenbacher, 1986). Variability is the amount of change or fluctuation in the spread of scores in a series. Performance in the baseline phase should be stable to determine the effectiveness of the intervention. Changes in trends refer to direction in which the data pattern is moving. Changes in trend are usually associated with the presentation of the intervention. The final step of visual inspection involves the slope of the trend line across time.

Statistical Analyses

Statistical significance for the strength and work productivity was determined by analysis of the celeration line as suggested by Ottenbacher (1986). "The term celeration derives from the notions of acceleration and deceleration if the trend is ascending or descending, respectively" (Barlow & Hersen, 1984, p. 313). To determine the rate of changes in strength and work productivity scores due to treatment, each participant's performance was measured on several occasions over each testing/observation phase.

As suggested by Ottenbacher (1986) a trend or celeration line was computed for the baseline phase and extended into the other phases of the study. The extension of the celeration line was done to predict the data trend of the participant's behaviors. This celeration line is similar to the regression line or line of best fit in which a line is drawn through a set of data points on a graph in the direction of the trend or cluster of data points. If the proportion of data points were above or below the celeration line during treatment or observation phases from the baseline, this indicates change in the response to the treatment. A visual description of the celeration line using the participant's data is discussed in the result section of this study.

Rationale for Statistical Analysis. It should be noted that statistical tests are not usually used in applied behavior analysis research (Barlow & Hersen, 1984; Huck et al. 1974). Interpretation of the results is frequently done by graphic presentation and visual inspection. Barlow and Hersen (1984) and Wolery and Harris (1982) suggest that both visual inspection and statistical analysis should be considered to better investigate the changes that occur within and between experimental conditions.

For the purpose of this study, statistical analyses consisted of determining the slope, level of change, and the linear trend of strength and work productivity outcome data by incorporating the split middle technique. An explanation of calculating the split middle technique, as described by White and Haring (1980), involves seven steps and can be found below.

Calculation of the split middle line of trend estimation is based on the medians of two halves of the data series for which the trend line is being determined (White and Haring (1980).

1. Plot the data on semi logarithmic graph paper.
2. Count the datum points in the phase for which a trend line is being drawn, divide by 2, and add 0.5 to the quotient.
3. The final answer from Step 2 is used in Step 3. Count over from the left, beginning with the datum point nearest the ordinate, the number of datum points in the final answer of Step 2 and draw a hash line through the data series. If the answer from Step 2 were a whole number, such as 4, the experimenter would count over, from the left, that number of datum points and draw a hash line through the datum point equal to the whole number. This datum point is ignored in calculations of Steps 4 through 6. The result of Step 3 is a division of the data series into two equal sets (halves) of data.
4. For each equal set or half of data from Step 3, calculate the mid-date and draw a dashed vertical line through it. The mid-date is calculated by repeating the

process described in Steps 2 and 3 for each half of the data (for each of the two sets in the data series).

5. Calculate the mid-rate for each half of the data series and draw a horizontal dashed line through the mid-rate that intersects with the dashed vertical line through the mid-date. The mid-rate is calculated by counting the number of datum points in each half, dividing by 2, and adding 0.5 to the quotient.

NOTE: Frequently, when calculating the mid-date and mid-rate, the answer to calculations will not be a whole number.

6. Draw a straight line through the two sets of intersecting dashed lines at their point of intersection. This straight line is known as the quarter-intersect line.

7. Draw a line parallel to the quarter-intersect line that has 50% of the datum points on or above it and 50% of the datum points on or below it. The resulting line is the split-middle line of trend estimation.

This technique allowed analyses of present levels of performance in addition to predicting future performances. The split middle analysis is a process used to describe change in behavior rather than a way of determining statistical significance (Barlow & Hersen, 1984). Statistically significant change in behavior can be determined after the celeration line is calculated. This is done by computing the split middle slope of the baseline and the split middle slope of the intervention and looking at the level of changes that occur across those phases (Barlow & Hersen, 1984).

Decision Rule for Effective Intervention

It was hypothesized that the weight-training program would lead to improved strength and increased work productivity among the participants. The investigator also examined gain scores to further determine the effectiveness of the intervention on the measures of strength and work productivity. The mean of the baseline and intervention scores were compared to determine improvements in strength. The researcher considered the intervention to be successful if there were strength gains of at least 40 to 50 pounds in the mean composite strength of participant's 1-RM lifts exercises performed between the baseline and intervention phases of the study. The intervention was considered effective for the simulated work tasks if participants' mean time to completion to stack the 8 boxes and to push the hand truck the distance of 160 feet decreased by at least 6 to 8 s for each of the simulated work tasks. In addition, there was a positive treatment effect if the majority of the data points in the intervention phase fall on or above the celeration line for strength data and on or below the line for simulated work tasks indicating an improvement of scores from baseline data. The distance of the data points from the celeration line might also add to the level of significance.

For visual reference, the level and trend changes were also used to further determine the effectiveness of the intervention. Wolery and Harris (1982) indicated "an experimenter can conclude that a treatment is effective when the following situations exist concurrently. There must be either no changes or very minor changes within experimental conditions and a clear change in level, trend or both level and trend must occur when the treatment is introduced" (p. 447). More detailed data for on-site work productivity may be found in the results section of the paper.

Increased work productivity and positive comments from job supervisors were the criteria used to determine a successful intervention effect for the on-site jobs. On-site job productivity rates were dependent upon the specific jobs held. For example, assembly, packaging, and material handling jobs were evaluated on the amount of work participants completed for the indicated hours as detailed by the job supervisors. Pay rates varied for the various assembly and packaging jobs for two of the participants. The intervention effect for the cleaning tasks and mail sorting tasks were determined to be significant if the job supervisors reported positive comments or gave a rating of "good" or "great." It should be noted that data on on-site work productivity was difficult to obtain. However, the investigator attempted to interpret the data and comments given as accurately as possible. More detailed data for the on-site work tasks may be found in the results section of this study.

CHAPTER FOUR

RESULTS

The only hypothesis supported by the results of this study was the prediction that muscular strength would improve as a result of a resistance exercise program. Support for the hypotheses was based on score (strength or time to completion) improvements, level and trend changes, and celeration line scores for all of the participants, as outlined in the methods section. Each of the participants showed significant strength improvements of at least 20 to 40 lb in composite strength. Partial support was obtained for the hypothesis that performance of simulated job tasks would improve as the result of resistance exercise training. The hypothesis that performance of on-site job tasks would improve yielded non-significant results in relation to mean scores across phase, level and trend changes, and celeration line data. Table 6 provides a summary of the significance of the progressive resistance-training program for each of the dependent variables.

Hypothesis 1

It was hypothesized that participants would improve their strength. As expected, participation in the progressive resistance-training program did increase the muscular strength of all participants. The strength data support the first hypothesis that participation in a progressive resistance-training program would increase muscular strength and endurance in biceps curl, leg curls, leg extension, triceps extension, abdominal curl, and chest press exercises among the participants. The strength gains experienced were greater than expected by the investigator. Mean composite strength scores for each participant are listed in Table 7. Jacob showed the greatest overall improvement from baseline through intervention that continued into the retention period.

Table 6

Effects of the Intervention on Performance of the Dependent Variables

	Shane	Jacob	Jim	Bob
Trend/Level				
Strength	Increased 15 lb (5.2%)	Increased 0 lb (0%)	Increased 20 lb (5%)	Increased 20 lb (6%)
Hand truck	Increase 3s (8%)	Decrease .27 s (.8%)	Decreased 1 s (2%)	Decreased 3 s (7%)
Box stack	Increase .91 s (2.4%)	Decrease 6 s (14.4%)	Increase 2 s (5 %)	Decrease 2 s (4%)
On-site job[a]	No Data	No Data	No Data	No Data
Celeration Line				
Strength	Significant	Significant	Significant	Significant
Hand truck	NS	NS	NS	Significant
Box stack	Significant	Significant	Significant	NS
On-site job[b]	No Data	No Data	No Data	No Data

Note. Increases and decreases are based on the score for the final week of baseline and the first week of intervention for each dependent variable. ( ) = Percentages are listed for level changes based on the final week of baseline to the first week of intervention. Trend changes are based on the slope of the baseline compared to that of the intervention. NS = Non Significant and is based on the decision rule of the majority of data points in intervention being above (strength) or below (simulated work tasks) celeration line.

[a,b]No level and trend or celeration line calculations were made for the on-site job tasks.

Table 7

Mean Composite Strength Scores for Baseline, Intervention, and Retention

Participants	Phase of Study		
	Baseline	Intervention	Retention
Shane	292	352	485
Jacob	403	537	749
Jim	353	447	550
Bob	302	374	480

Note. Scores are listed in lb and represent the mean composite strength of participants' 1-RM lifts for all exercises (leg extension, leg curl, chest press, biceps curl, triceps curl, and abdominal curl). Scores are rounded to the nearest whole number.

Shane and Jacob demonstrated more baseline stability than did Jim and Bob. Comparisons of high and low baseline scores for each of the participants showed baseline variations of no more than 45 lb for composite strength. Shane demonstrated the least variance with 12.5 lb and Jim showed the greatest difference of 45 lb.

Figure 1 shows a visual comparison of composite strength scores for all participants during the baseline, intervention, and retention phases of the study. Jacob had the highest rate of increase throughout the study. Shane, Jim, and Bob showed similar rates of increase throughout all phases of the study. Additional comparisons of participants' composite muscular strength scores and raw data for each of the six exercises can be found in the data files located in Appendix D.

Level and Trend Changes for Composite Strength

Level and trend changes provided visual reference on the treatment effects of the progressive resistance-training program. Level and trend changes involve comparisons of the data patterns of the baseline and intervention scores, as mentioned in the methods section of this study. Three of the four participants experienced noticeable level and trend changes across baseline, intervention, and retention phases. The changes in level and magnitude of the trend lines for the data points of each participant are described for each participant.

Shane. Figure 2 shows that Shane had changes in both level and trend between the baseline and the intervention. Shane's strength scores for the final week of baseline and the first week of intervention were 290 and 305 lb respectively. Shane's scores during intervention show some variability; however, the trend line of the data points during this phase shows a projected increase in strength. There were also level and trend changes

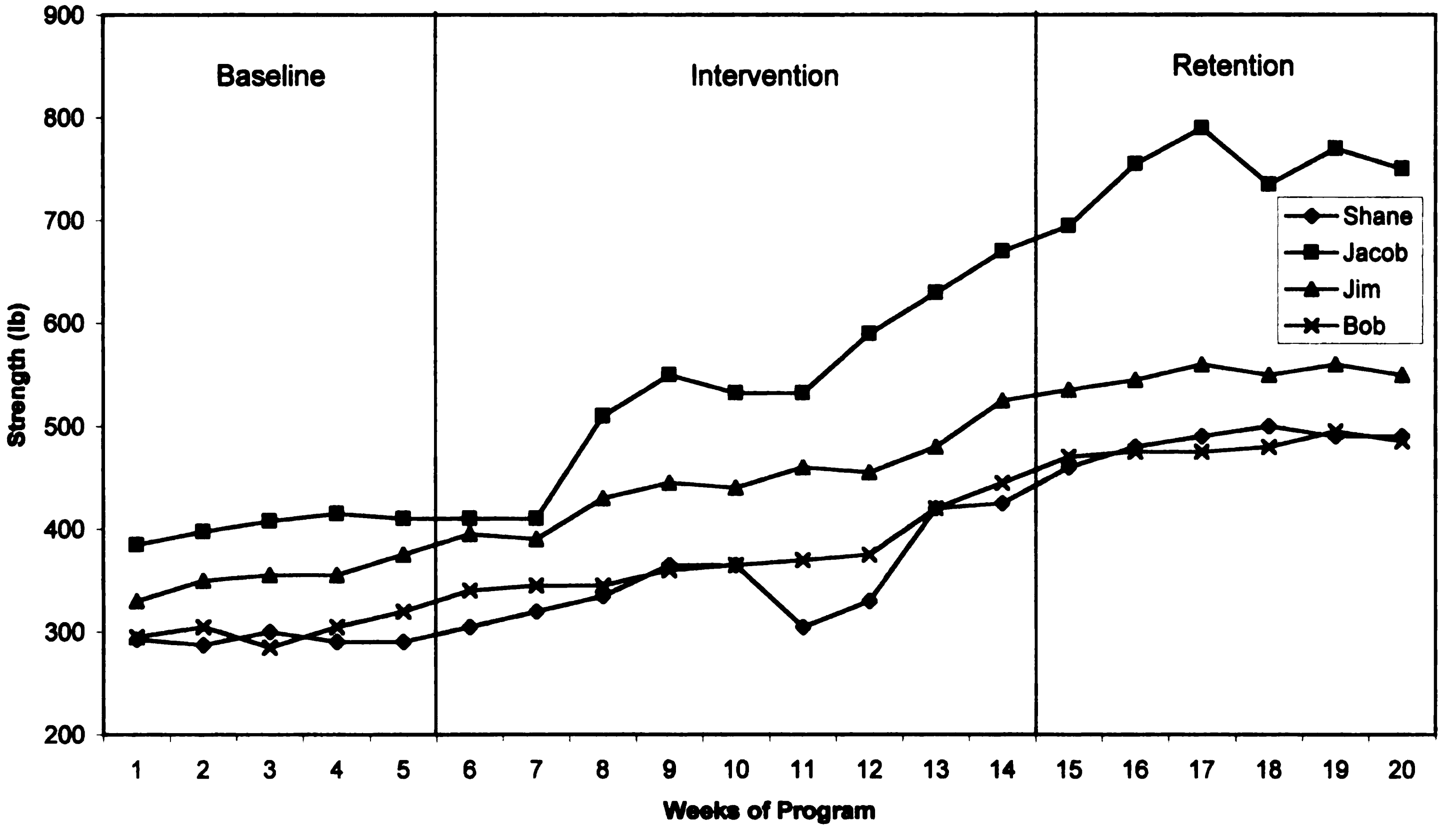


Figure 1. Comparison of composite strength scores for all Participants.

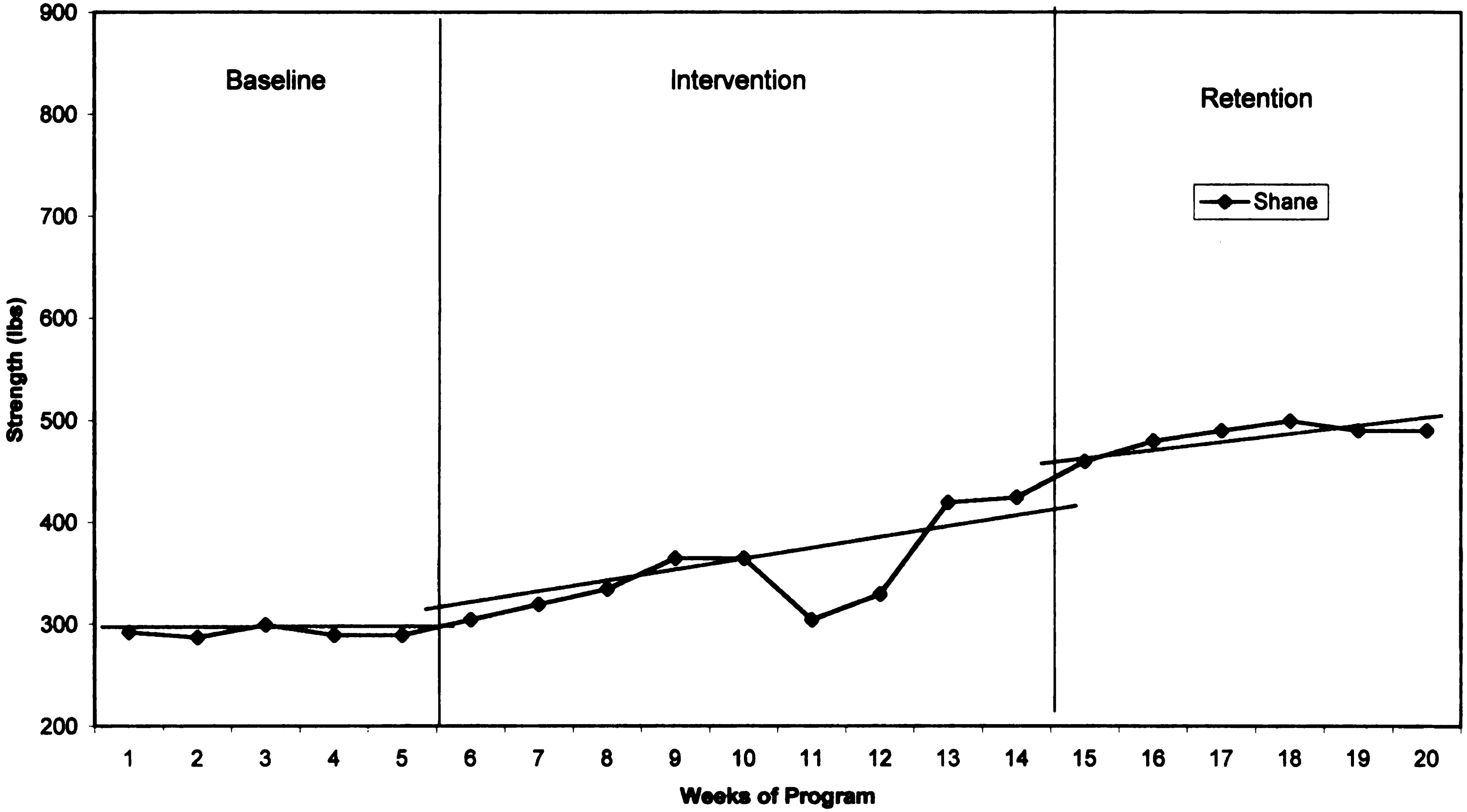


Figure 2. Shane's level and trend changes for composite strength.

recorded from the intervention to the retention phase. Shane's final strength measurement during intervention was 425 lb, and the first week of retention showed another increase with a score of 460 lb. It was shown that his strength continued to increase well into the retention phase. That is, the trend line data during this phase in on an ascending slope.

Jacob. There were minimal changes in level and drastic changes in the trend of the intervention data points (see Figure 3). Jacob's composite strength measure for the final week of baseline was 410 lb. This was maintained for the first two weeks of the intervention. In contrast, the trend of Jacob's strength scores during intervention shows a drastic upward slope with a projected increase in strength. His score during the final week of the intervention was 670 lb, which increased by 25 lb during the first week of the retention phase. The trend line for Jacob's scores during the retention phase shows an increase; however, it is not as drastic as in the intervention phase. His final composite strength score during the last week of the retention phase was 750 lb. It would be expected that Jacob's scores would begin to level off and decrease after the removal of the intervention.

Jim. Changes in trend and level of strength scores for Jim can be seen in Figure 4. Baseline to intervention scores showed little change in level and trend of the data series. However, there was an increase 20 lb across the two phases. Jim's final strength score during the baseline phase was 375 lb. His initial score during the first week of the intervention was 395 lb. The slight increase in level between the intervention and retention phase predicts a continual increase in strength scores. In addition, the trend line of the data for the retention phase shows an increasing slope; however, it is not as drastic

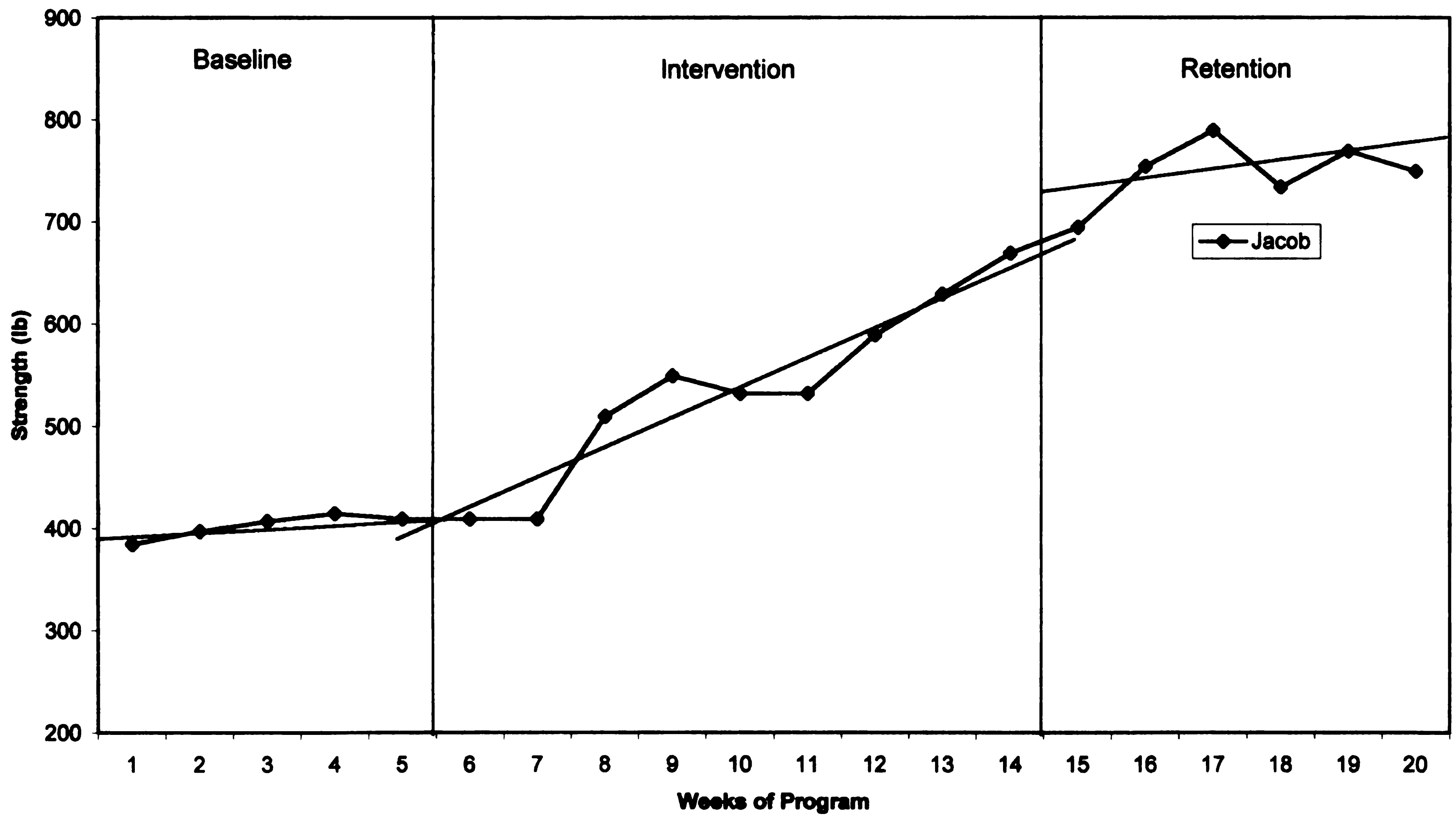


Figure 3. Jacob's level and trend changes for composite strength.

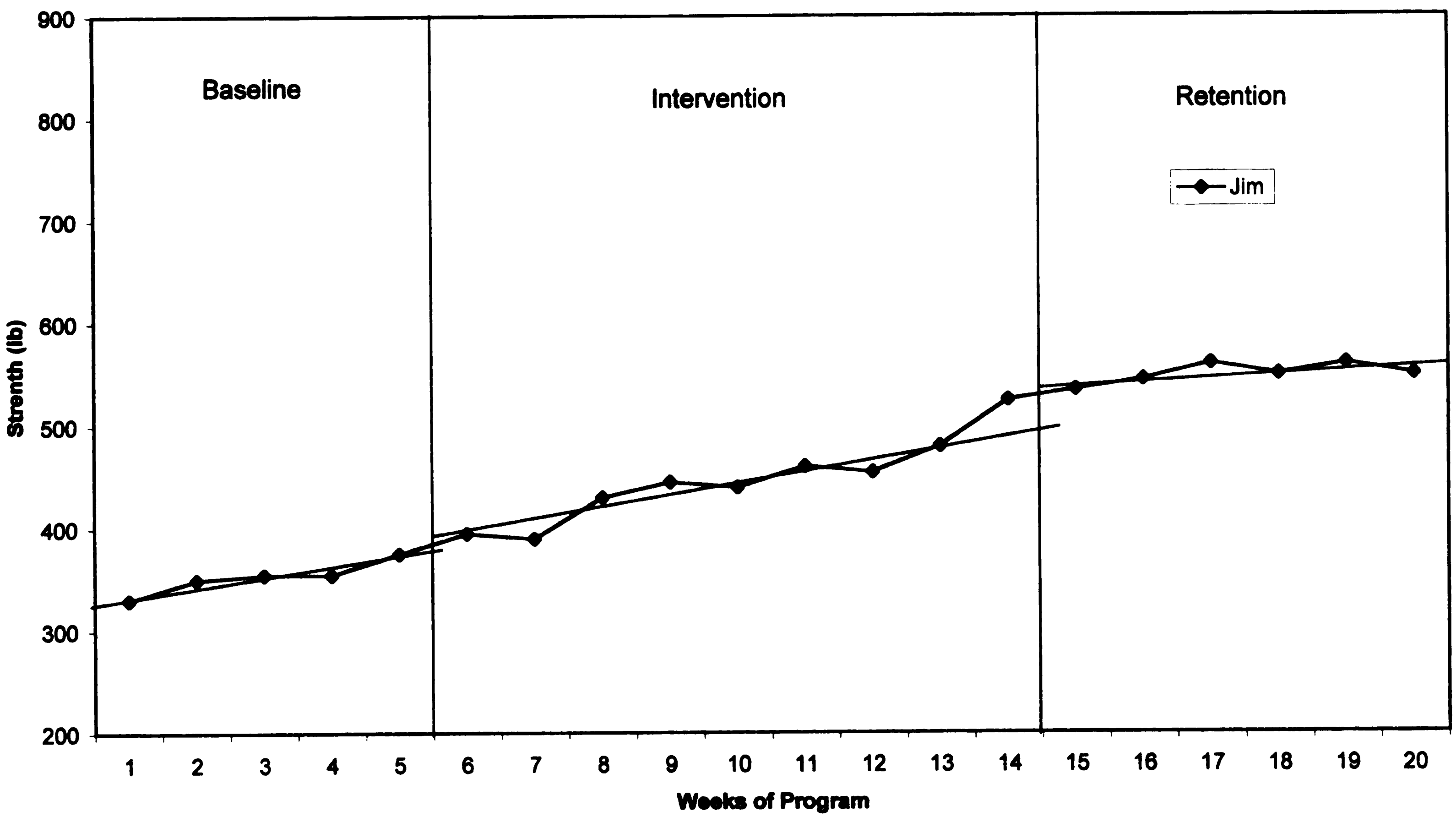


Figure 4. Jim's level and trend changes for composite strength.

as in the intervention phase. Jim's final score during retention was 550 lb, which was a decrease from the two previous weeks of the retention. It would seem from the data that Jim's strength was beginning to level off. This would be the expected outcome once the weight- training program was stopped.

Bob. The level and trend changes for Bob were minimal (see Figure 5). His scores for the final week of baseline and the first week of intervention were 320 and 340 lb respectively. The slope of the trend line for the intervention shows an increase in scores with a greater magnitude than the baseline trend line. There is little variability in intervention scores. Bob's score of 445 lb during the final week of intervention was his highest for that phase. The change in the level from the intervention to retention showed an increase of 25 lb. The magnitude of the trend line during the retention phase is similar to that of the intervention phase, which indicates that Bob's strength continued to increase. His final score during the retention phase is 485 lb. Bob's results should be interpreted with caution due to some variability in his baseline scores.

Celeration Line for Composite Strength

Celeration line projections allowed the investigator to predict the trend of the scores after the baseline scores have been established. As with the level and trend, calculation of the celeration line produced varying results. Table 8 provides a summary of the data points above the celeration line. The majority (5) of the intervention scores should be on or above the celeration line to be classified as a significant change. In addition, the distance of the intervention points away from celeration line may also add to the significance of the results. That is, the data points above and farther away from the celeration line are higher than that closer to the line for composite strength data.

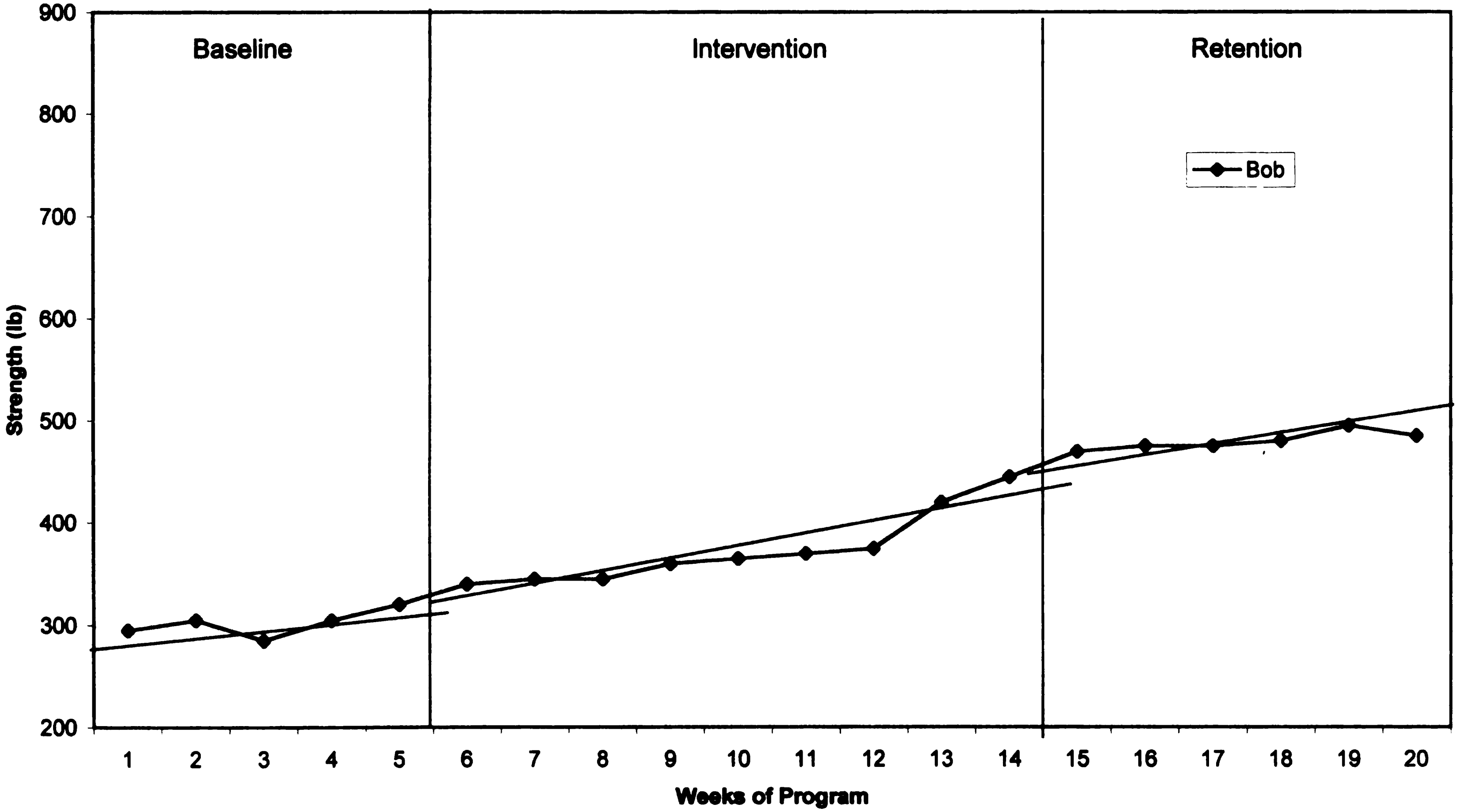


Figure 5. Bob's level and trend changes for composite strength.

Table 8

Number of Points On or Above the Celeration Line for Composite Strength

	Intervention (Maximum 9 data points)	Retention (Maximum 6 data points)
Shane	9	6
Jacob	9	6
Jim	9	6
Bob	9	6

Shane. As seen in Figure 6 all scores during the intervention phase were above the celeration line. This is a good indication of a positive treatment effect of the resistance-training program. Some of the composite strength scores increased as much as 100 lbs. or more during the intervention. Weeks 6 and 7 of the intervention phase showed some variability in scores (305 and 330 lb respectively). Retention scores for Shane were also well above the celeration line. Retention scores for Shane continually increased for the first 3 weeks of that phase, and then started to level off by the end of the phase.

Jacob. Figure 7 shows that all intervention scores were either on or above the celeration trend line. This would indicate a possible treatment effect by the progressive resistance-training program for strength. The highest score for Jacob during the intervention phase was 670 lb. In addition, his strength continued to improve after the intervention had ceased. The highest score received throughout the course of the study was 790 lb on the third week of the retention phase. Jacob improved in strength by an average of 355 lb from baseline through the retention phase.

Jim. As illustrated in Figure 8, all scores during the intervention phase were close to or above the celeration line. Jim's predicted strength gains from the celeration line and actual strength gains were relatively similar. His actual strength was slightly higher. Variability of scores throughout the intervention was virtually non-existent. There was a steady increase in strength with more significant gains coming during the end of the intervention and into the retention phases respectively. There was an increase of 195 lb from the lowest baseline score (330 lb) to the highest intervention score (525 lb). Although not as high as the previous participants, analysis indicates a significant treatment effect due to the intervention.

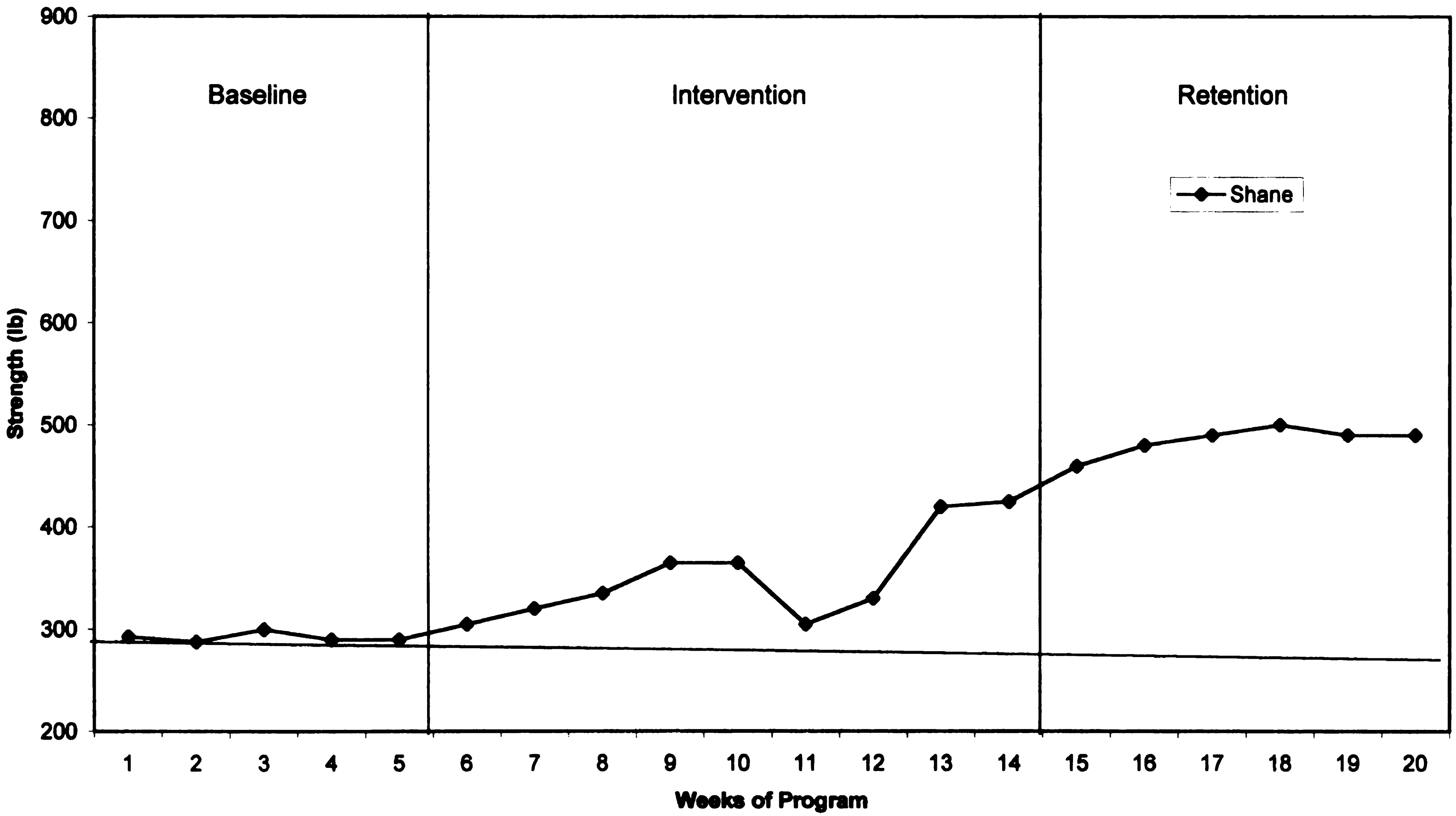


Figure 6. Celeration line for Shane's composite strength.

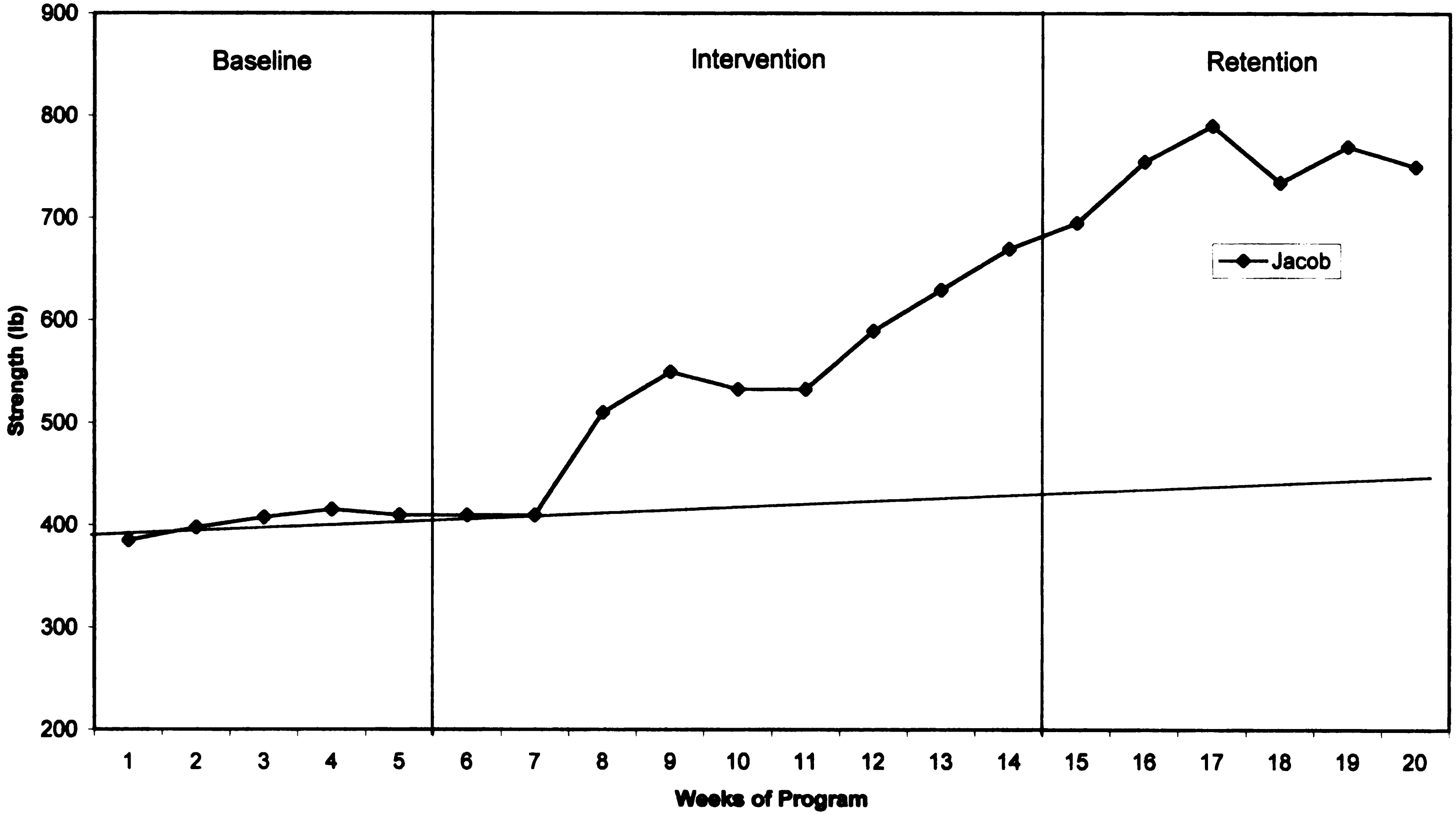


Figure 7. Celeration line for Jacob's composite strength.

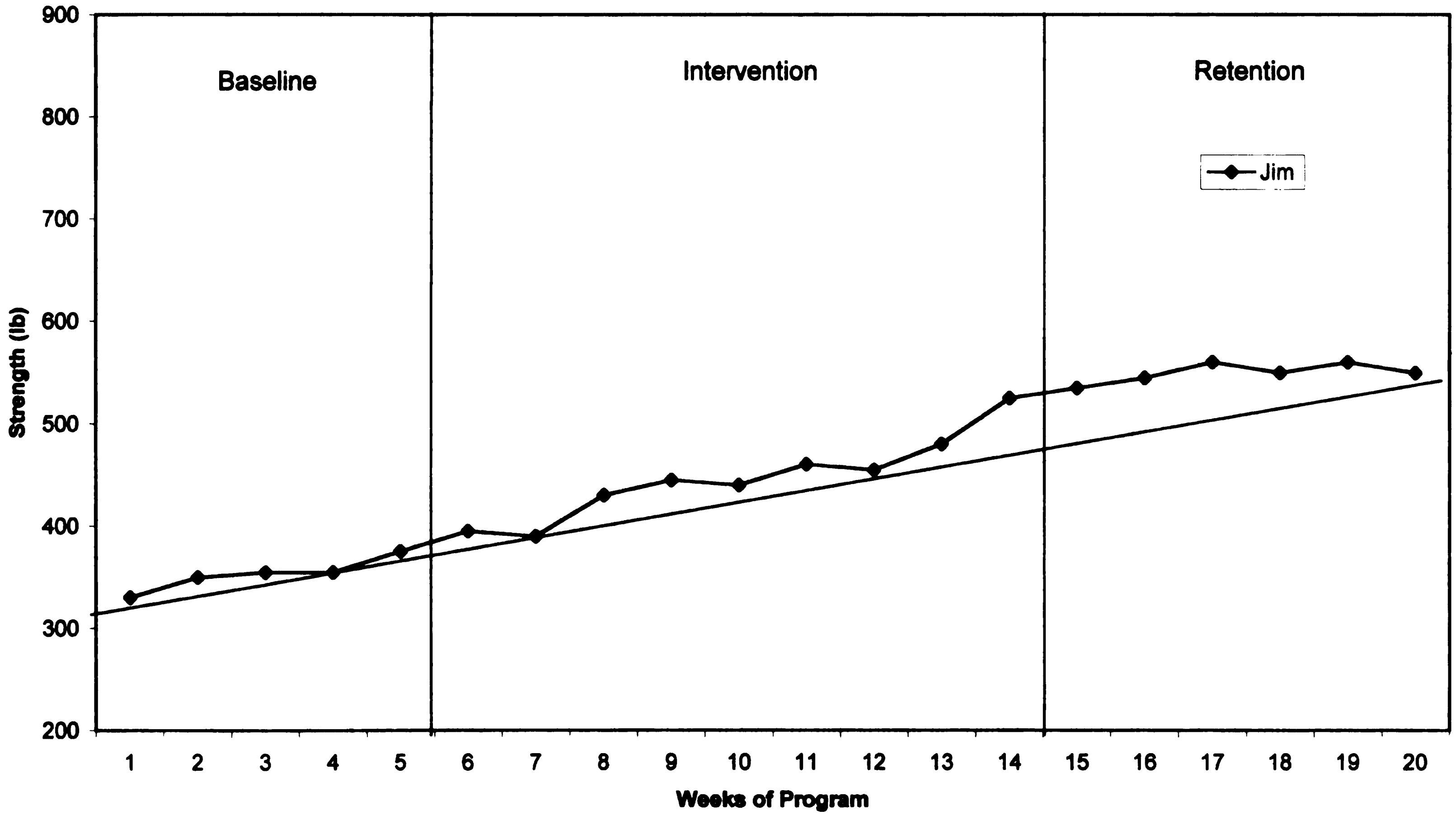
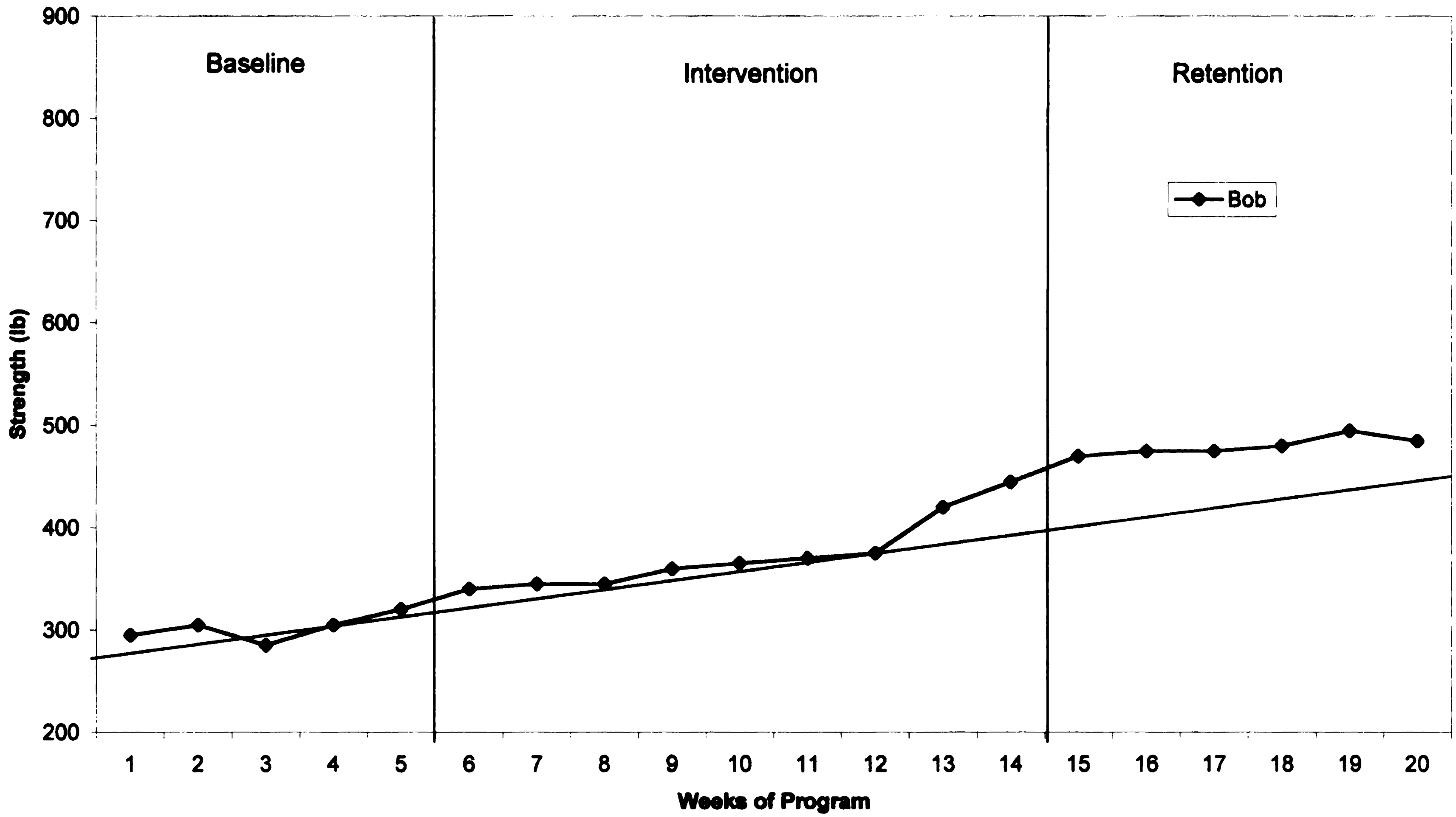


Figure 8. Celeration line for Jim's composite strength.

Bob. Extension of the celeration line for Bob's strength scores shows a predicted increase in strength scores (see Figure 9). Bob's baseline scores show some variability with an upward trend of the celeration line. Although all scores during the intervention are above the celeration line, the majority of them are closer to the celeration line than for the other participants. Bob experiences an acceleration of composite strength the last two weeks of the intervention. This is an indication that the actual rate of increase is similar to the predicted rate. Intervention scores show some variability in scores with the last two weeks showing increases of 420 and 445 lb respectively. Scores in the retention phase were further from the celeration line than for the intervention, indicating still more increases in strength after stopping the intervention.

Percent Performance Changes for Strength

Percent changes are outlined in Table 9 for each lifting exercise across baseline and intervention and baseline and retention phases. Increases in strength among exercises ranged from 5% to 65% between baseline and intervention to 26% to 138% between baseline and intervention. Jacob showed the greatest increase from baseline to retention with an increase of 113% on the leg extension exercise. Conversely, Bob received the lowest overall percent change from baseline to retention on the leg curl exercise. Overall percent changes were positive for all participants. The improvement in strength may be due to the progressions used in the study. The gradual changes in the amount of weight lifted allowed for optimal and safe muscle increases. Additionally, participants worked out two days a week. They were not accustomed to this type of regime and their muscles responded positively.



<u>Figure 9.</u> Celeration line for Bob's composite strength.

Table 9

Percentage Change in Mean 1-RM Scores for Strength Data for Each Exercise

	Shane	Jacob	Jim	Bob
Exercises				
Leg Extension				
Baseline (B)	76.0	124.0	96.0	80.0
Intervention (I)	96.7	191.1	121.1	101.7
Retention (R)	158.3	265.0	165.8	158.3
% Change B-I	27.2	54.1	26.1	27.1
% Change B-R	108.3	113.7	72.7	97.9
Leg Curl				
Baseline (B)	38.0	64.0	51.0	3.0
Intervention (I)	40.0	67.8	53.9	45.0
Retention (R)	51.7	95.0	64.2	47.5
% Change B-I	5.3	5.9	5.7	21.6
% Change B-R	36.1	48.4	25.9	28.4
Chest Press				
Baseline (B)	80.0	74.0	96.0	79.0
Intervention (I)	87.8	101.1	113.3	96.7
Retention (R)	106.7	145.0	125.0	110.8
% Change B-I	9.7	36.6	18.0	22.4
% Change B-R	33.4	95.9	30.2	40.3
Biceps Curl				
Baseline (B)	39.0	47.0	43.0	34.0
Intervention (I)	48.3	55.0	54.4	44.4
Retention (R)	50.0	80.0	65.0	55.0
% Change B-I	23.8	17.0	26.5	30.6
% Change B-R	28.2	70.2	51.2	61.8

Table 4

Exercis

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Table 9 (cont'd).

	Shane	Jacob	Jim	Bob
Exercises				
Triceps Extension				
Baseline (B)	31.0	43.0	35.0	37.0
Intervention (I)	38.9	57.8	57.8	40.6
Retention (R)	53.3	75.8	65.0	52.5
% Change B-I	25.5	34.4	65.1	9.7
% Change B-R	71.9	76.3	85.7	41.9
Abdominal Curl				
Baseline (B)	28.0	51.0	32.0	35.0
Intervention (I)	45.6	64.4	46.1	45.6
Retention (R)	66.7	88.3	65.0	55.8
% Change B-I	62.9	26.3	44.1	30.3
% Change B-R	138.2	73.1	103.1	59.4

Note. The baseline, intervention, and retention scores are listed in lb. Baseline, intervention, and retention percent changes are calculated based on the means of each respective phase.

Visual inspection of the data for composite strength shows that participation in the progressive resistance exercise program produced increased composite strength for all participants. The rate at which participants increased varied. Two of the four participants' actual rates of increase were consistent with their predicted rate from extension of the celeration line. Three of the four participants showed strength increases prior to participating in the intervention. Although strength improvements were evident, results from participants with unstable baselines should be cautioned.

<u>Hypothesis 2</u>

Results of the simulated work tasks provided partial support of the hypothesis regarding work productivity of hand truck push and box stacking task. The investigator expected all participants to have sizeable improvements in completion times. All participants showed some improvement in their mean scores for both the hand truck push and box stacking tasks from baseline through intervention. Level and trend changes among the baseline, intervention, and retention phase varied among participants. The celeration line results were significant (only for Bob with the hand-truck push and Shane, Jacob, and Jim with the box stacking tasks. Additional comparisons and raw data of participants' mean hand truck push and box-stacking scores can be found in the data files located in Appendix D. Additional level and trend changes and celeration line results will be described for the simulated work tasks to provide for further interpretation.

<u>Comparison of Participants' Hand Truck Push Scores</u>

Score comparison shows varying levels of significance among the participants. Mean scores for the hand-truck push are listed in Table 10. The mean time to completion varied for each participant, with Shane and Jacob having the lowest (fastest) mean scores

Table 10

Mean Scores for Time to Completion of the Hand-Truck Push

	Time to Completion in Seconds)		
Participants			
	Baseline	Intervention	Retention
Shane	37.01	31.94	30.22
Jacob	38.68	31.29	30.34
Jim	49.87	43.89	38.92
Bob	45.66	38.26	33.53

Note. Scores are rounded to the nearest whole number in the text. Scores represent the participants' mean productivity scores measured by time to completion.

during the intervention. However, Jacob and Bob showed the greatest improvement from baseline to intervention with improvements of about 7.4 s each.

Figure 10 shows a comparison of hand truck push scores for all participants. Visual inspection shows baseline variability and slopes that are not level for Shane, Jacob, and Jim. That is, each of the data series within baseline illustrates a downward rather than a horizontal trend. The most noticeable change in baseline scores occurred between Shane and Jacob who showed score decreases of 5.4 and 5.2 s respectively during the last week of baseline. These changes may be due participants becoming more familiar with the tasks as the weeks progressed. Further visual inspection of Figure 10 illustrates that all participants showed improvements in their completion times during intervention. The rate of those improvements and the magnitude of the data series also varied for each participant. By viewing the slope of the data series, it can be observed that scores for Jim and Bob show the greatest rate of improvement during the intervention phase.

Level and Trend Changes for the Hand Truck Push Task

The level changes across baseline, intervention, and retention phases were relatively minor for all participants on the hand truck push. The trend of the data series on the other hand showed more noticeable changes across the three phases. Descriptions of those changes for each participant are detailed below. As mentioned previously, the level and trend changes involve comparing the baseline and intervention data. In addition the researcher also described the change in the intervention to retention phase.

Shane. Hand-truck push scores for Shane showed small change in level of the data across the baseline and intervention phase (see Figure 11). His score during the final week of baseline and the first week of intervention was an increase of 2.8 s. Shane

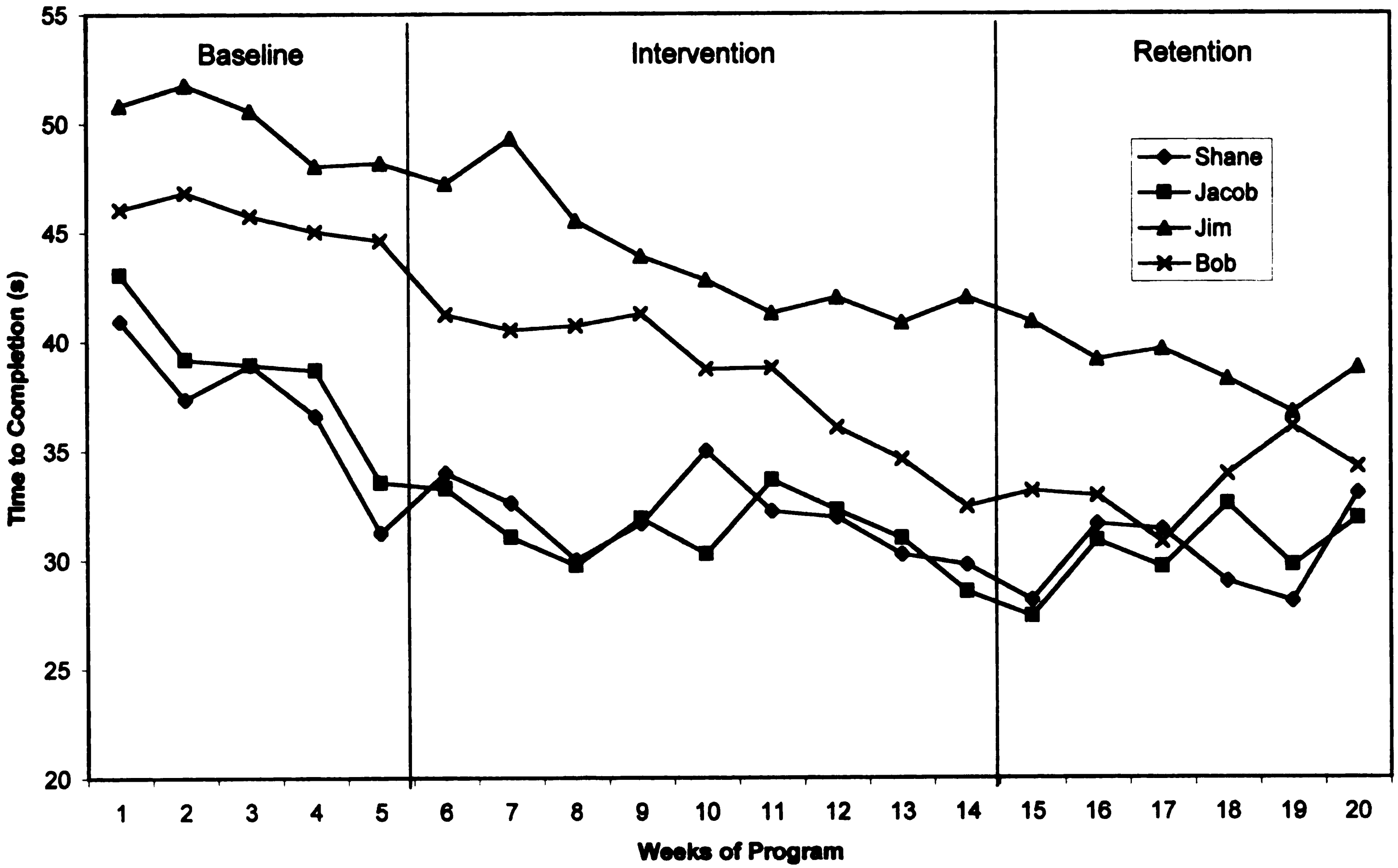

Figure 10. Comparison of hand truck push scores for all participants

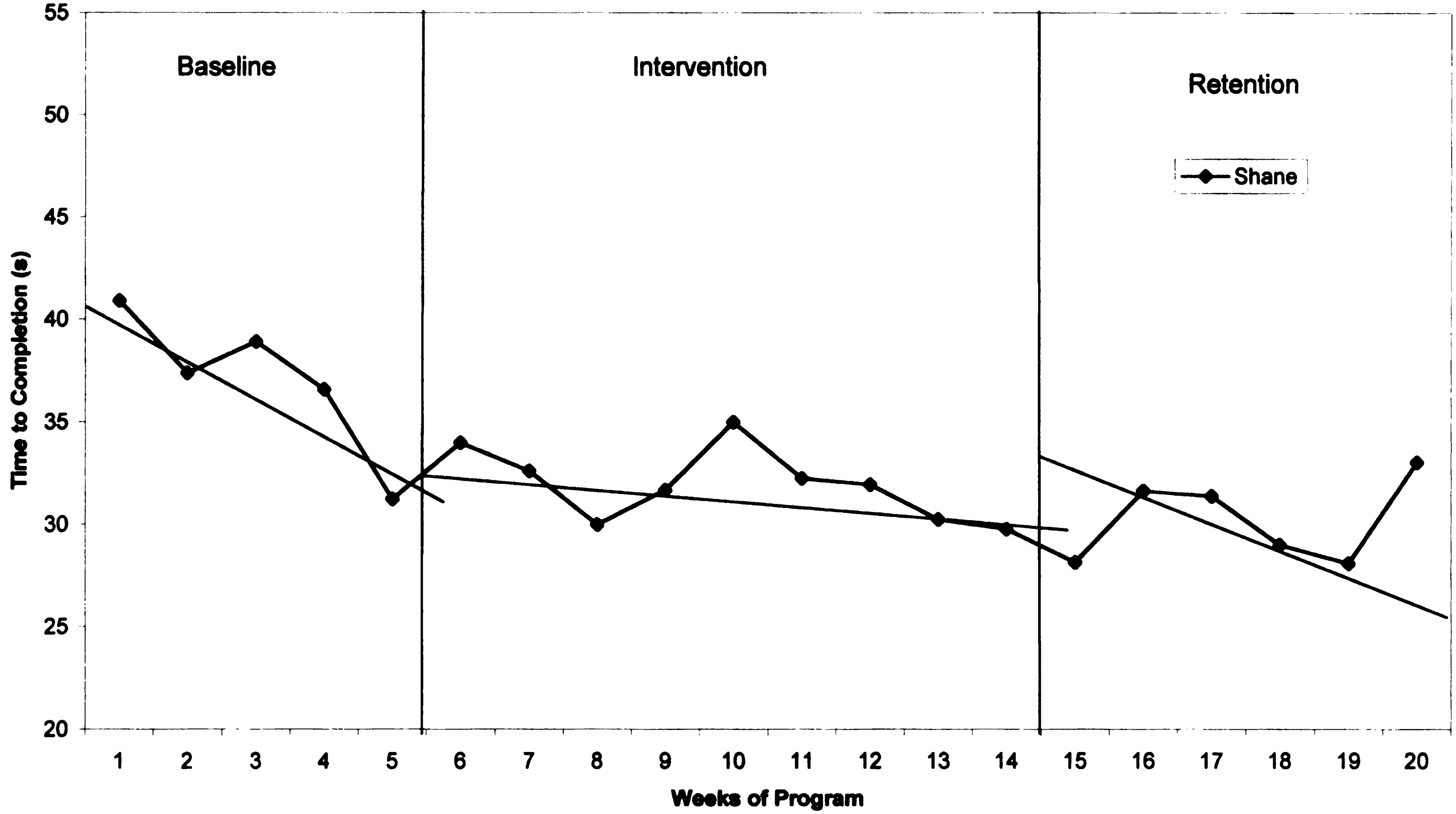

Figure 11. Shane's level and trend changes for hand-truck push scores

demonstrated a more dramatic change in the slope of trend line between baseline and intervention. The trend of the data for Shane's intervention scores seems to level off more than shown in baseline. In addition, scores from intervention to retention showed more variation in the trend of data than level. Shane's score in the last week of intervention was 29.8 s, and his score during the first week of the retention phases was 28.2 s.

Jacob. The level and trend changes for Jacob showed mixed results (see Figure 12). The trend of the data pattern for baseline predicts decreasing scores. There was minimal change in level of the data pattern from the end of baseline to the start of intervention. That is, Jacob's score for the last week of baseline and his first week of intervention was 33.5 and 33.3 s respectively. The slope of the intervention data series is not as prominent as for the baseline trend. There is no major change in level between the intervention and retention phases. However, there is an increasing trend of the retention data points.

Jim. There were no drastic changes in level and trend of Jim's score between baseline and intervention phases (see Figure 13). His score for the final week of baseline and the first week of intervention was a difference of 1 s. In addition, the trend of the data series for intervention was similar to that of the baseline phase. Jim's score during the first week of retention was 40.9 s; this was a 1.1-s decrease from the final week of the intervention phase. The trend of the data for the retention phase, as with the intervention, shows a descending pattern.

Bob. As illustrated in Figure 14, there was not a major level change between the baseline and the intervention or between the intervention and the retention phase. Bob's score for the last week of baseline and the first week of intervention showed a 3.4-s

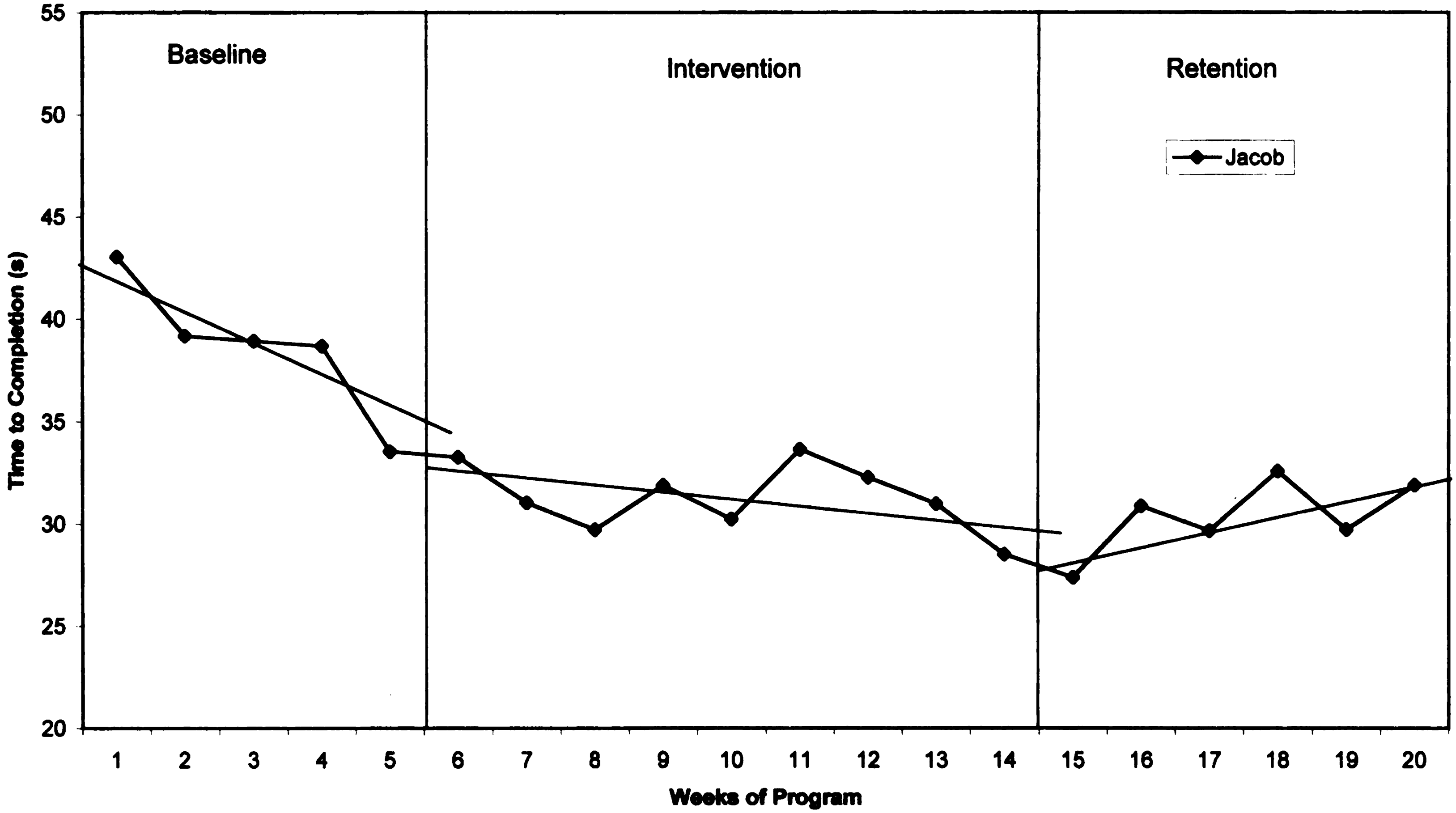

Figure 12. Jacob's level and trend changes for hand-truck push

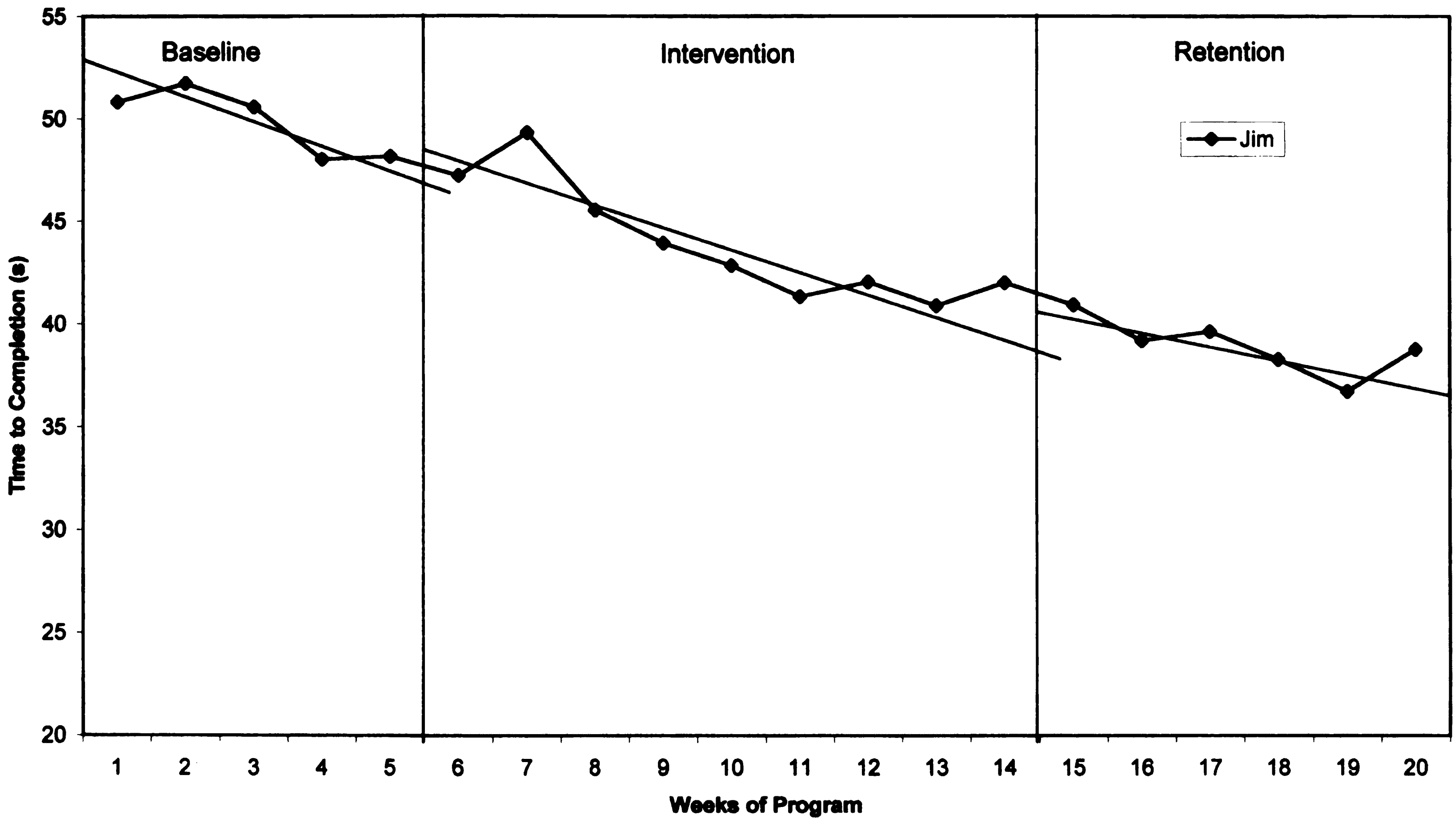

Figure 13. Jim's level and trend changes for hand-truck push scores

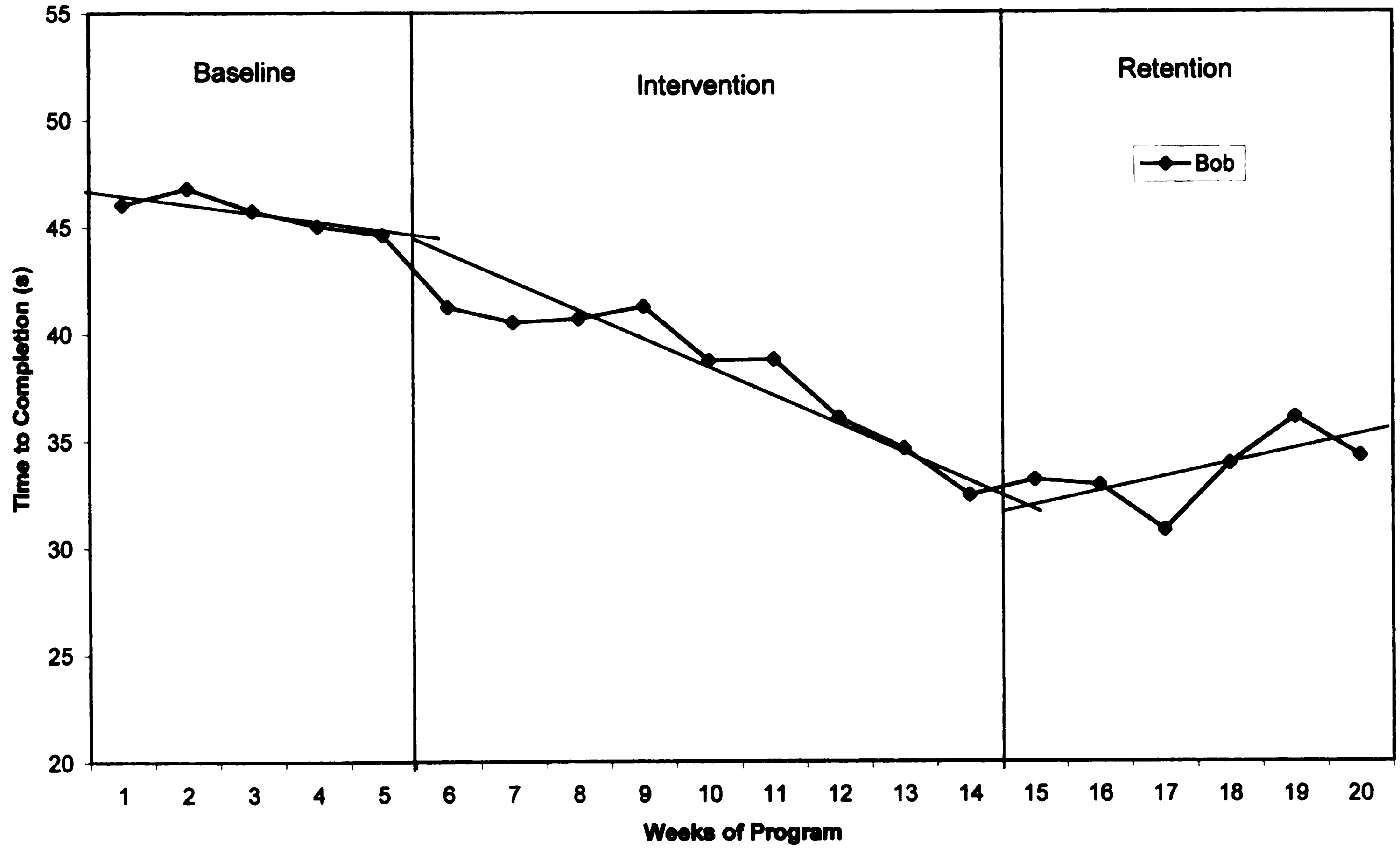

Figure 14. Bob's level and trend changes for hand-truck push scores.

difference. The trend of the data during intervention has more of a descending slope than the trend of baseline scores. Bob's time to completion score during the final week of intervention was 32.4 s. His score increased by .80 s for the first week of the retention phase. There was also a change in the trend of the data pattern for the retention phase with the scores showing an ascending pattern. This trend was similar to Jacob's retention scores and is the desired effect when the intervention is removed.

Celeration Line for the Hand Truck Push Task

Table 11 shows the number of hand truck push data points that fall on or below the celeration line. Points that fall below the celeration line in the intervention phase show a significant rate of improvement from the baseline phase. As with the strength data, the distance of the intervention points away from celeration line may also add to the significance of the results. That is, the data points below and farther away from the celeration line are better than those closer to the line for simulated work productivity data.

Shane. None of Shane's intervention phase scores fell below the celeration line. The trend of the celeration line shows predicted decreases in time taken to complete the hand truck push (see Figure 15). The actual decreases in time to completion were not as the celeration line predicted. The celeration line forecasted a more drastic change in scores than what Shane achieved. Although scores do show improvements throughout intervention, the rate of those improvements is not considered significant because the completion times recorded during the intervention phase were above the celeration line. For significance to occur, more than half of the scores in the intervention phase have to fall below the celeration line extended from baseline.

Table 11

Number of Points On or Below the Celeration Line for the Hand-Truck Push Task

	Intervention (Maximum 9 data points)	Retention (Maximum 6 data points)
Shane	0	0
Jacob	6	6
Jim	0	0
Bob	9	6

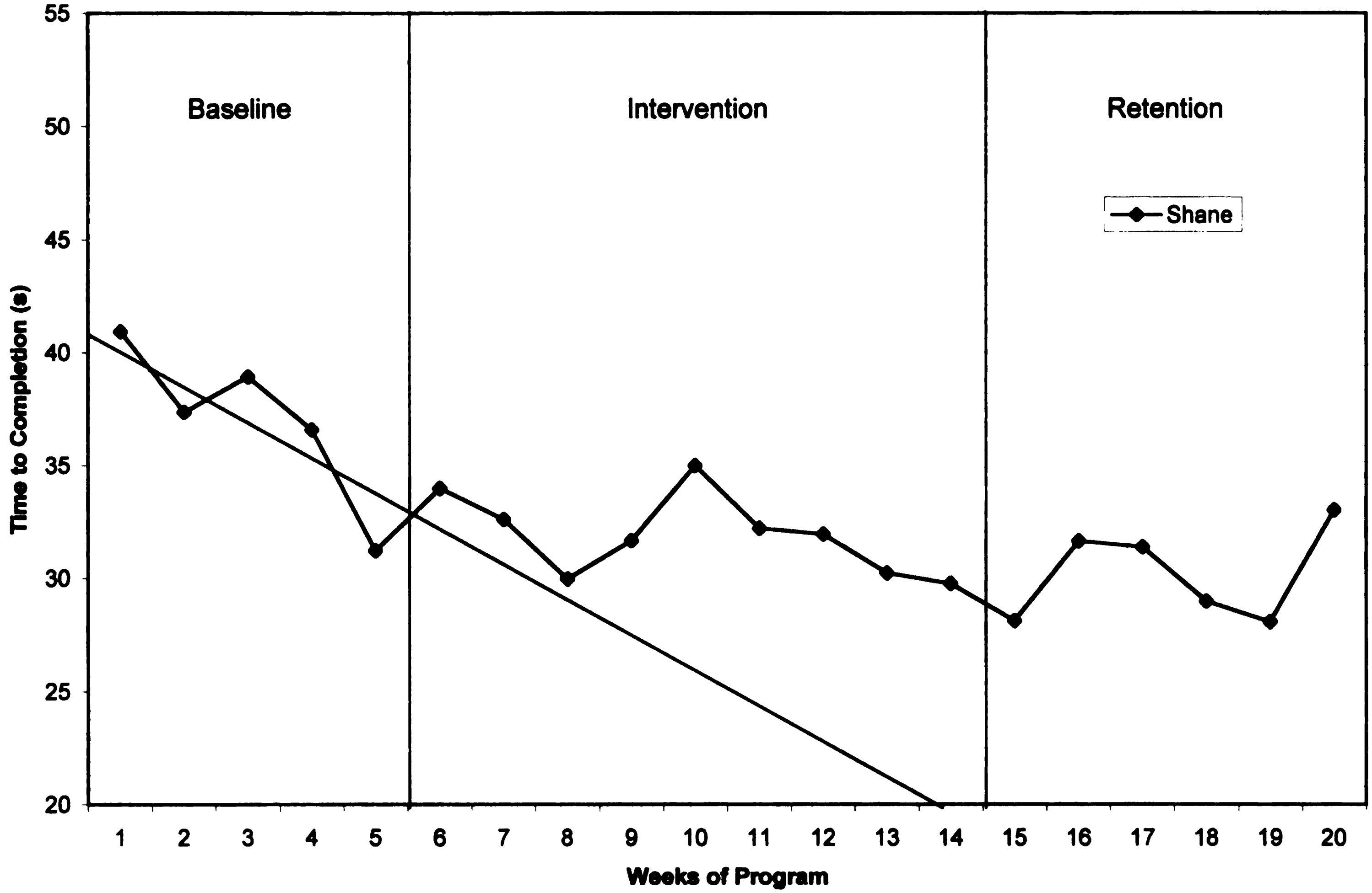

Figure 15. Celeration line for Shane's hand truck push scores.

The peak (lowest time to completion score for Shane during the intervention phase was 30 s, which was recorded during week 8 of that period. His high score for the intervention phase was 35 s, which was recorded on week 5 of the intervention.

All retention scores were above the celeration line. In addition, the scores for this phase are further away from the celeration line than in the intervention phase. The highest score for Shane during the retention phase was 33 s, which was recorded during the final week of the study. It is expected that the scores during the retention phase would be higher than in the intervention phase.

Jacob. As illustrated in Figure 16, the majority of Jacob's intervention scores are above the celeration line. Jacob's final baseline score was 33.5 s, which was a decrease of 9.6 s from the first week of baseline. However the introduction of the weight-training program caused the scores to level off, and the slope of the data series is not as extreme as predicted in the baseline. The peak score for the intervention phase was 28.5 s, which was achieved on the final day of intervention. This score was a 14.6 s improvement for from the first week of baseline. All data points in the retention phase also are above the celeration line.

Jim. No significant treatment effect was observed for Jim. Analysis of the celeration line in Figure 17 shows all of his data points were above the celeration line. The data series had at least half of his score close to the celeration line during the intervention phase. Jim's highest scores during the intervention phase were 49.3 s on the second week and 47.2 s recorded on the first week. As expected, scores in the retention phase are further away from the celeration line than those in the intervention. Jim's high score throughout retention was 40.9 s during the first week. His best time or lowest score was

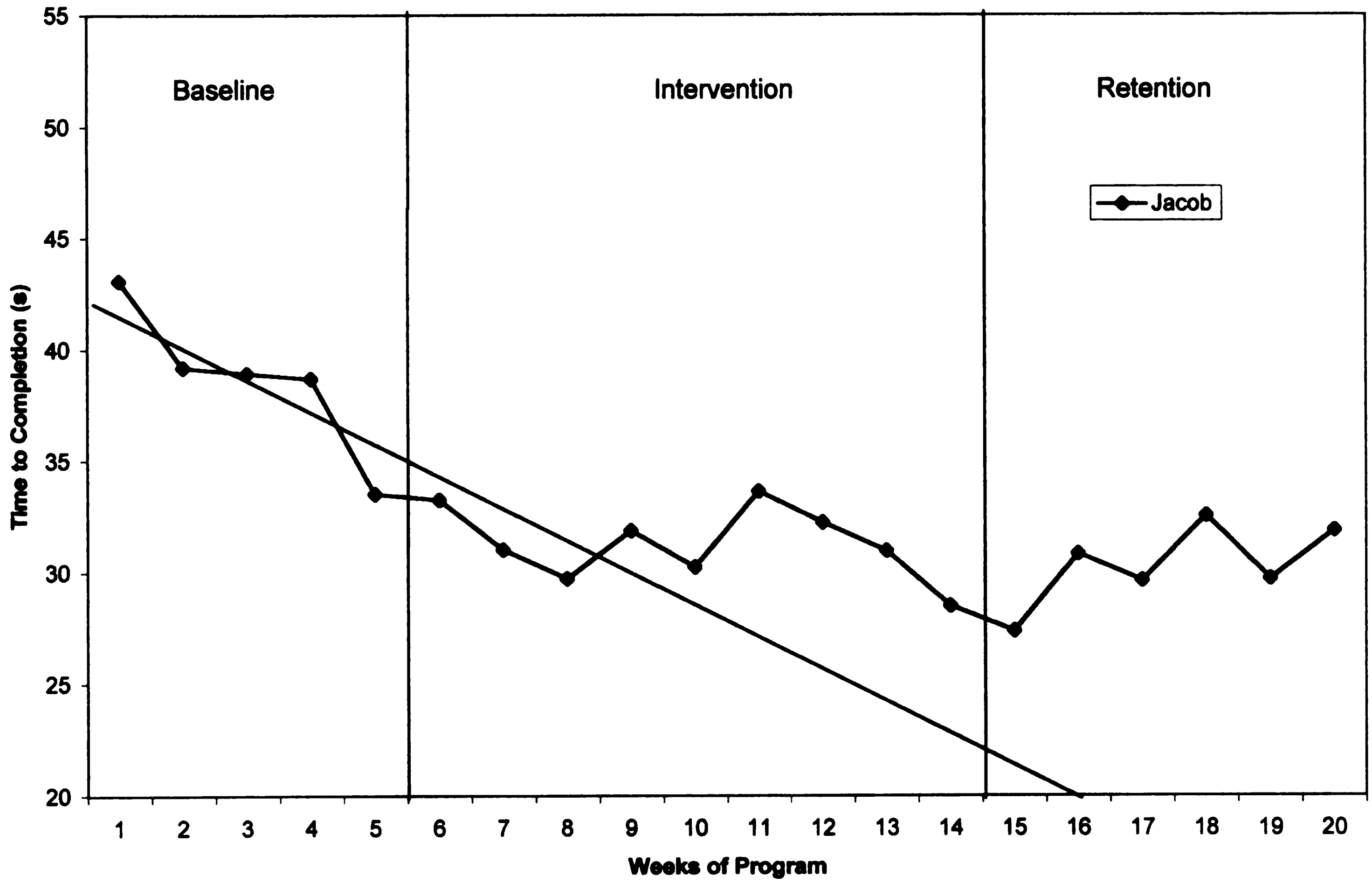

Figure 16. Celeration line for Jacob's hand truck push scores.

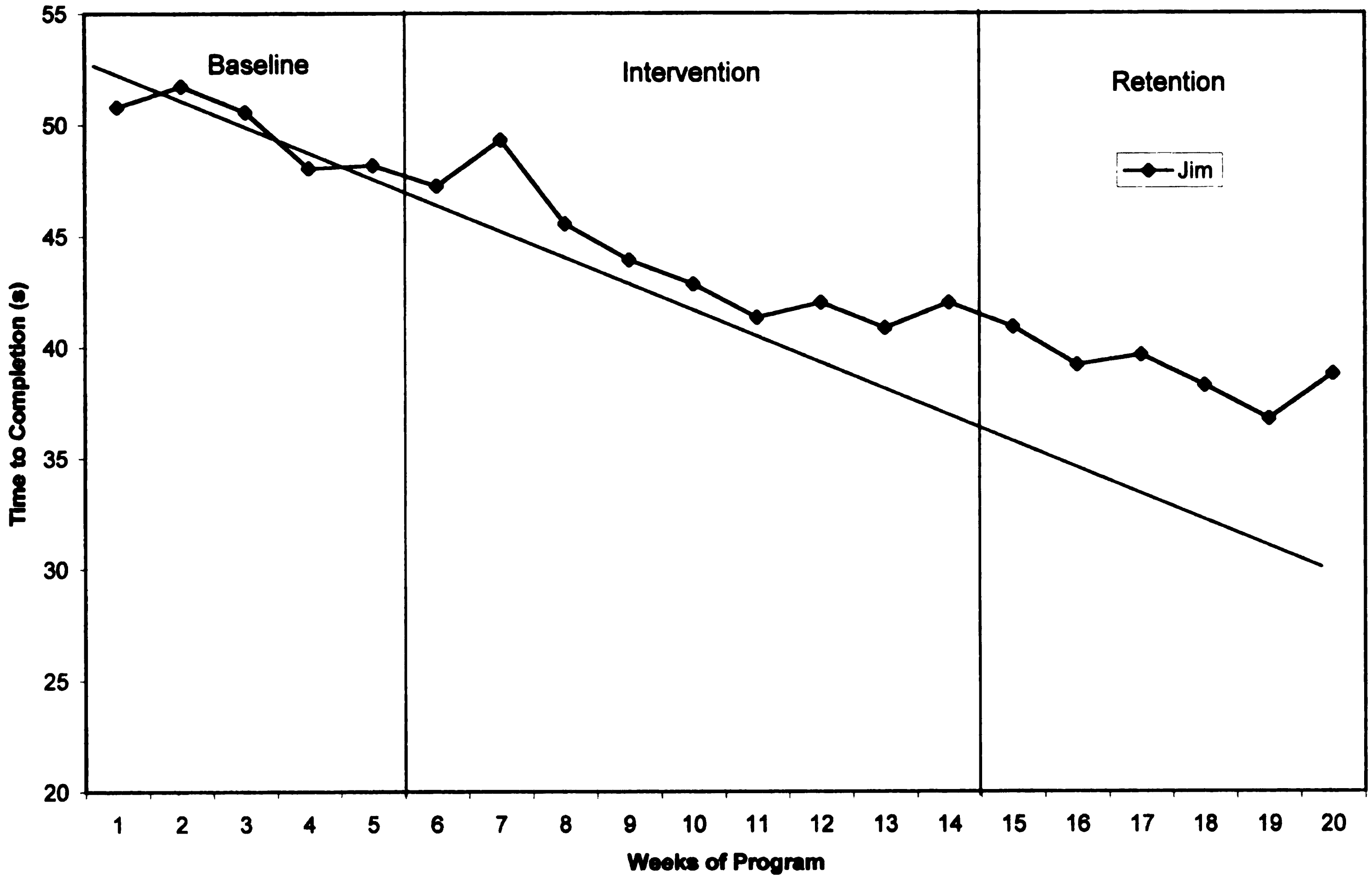

Figure 17. Celeration line for Jim's hand truck push scores.

36.8 s that was completed during week 19 of the study.

Bob. Figure 18 shows that all of the data points during the intervention phase are below the celeration line. This is an indication that the scores during the intervention phase were significant. The actual rate of improvement is better than predicted by the celeration line. That is, not all the scores are close to the extended celeration line for the intervention phase. The last 3 weeks of the intervention show drastic improvements with scores of 36.1, 34.6, and 32.4 s respectively. There was an improvement of approximately 9 s during the 9-week intervention period. The split middle line calculation for the retention phase shows an increase in the amount of time to complete the hand truck push after the treatment is stopped. The scores within the retention phase were also below the celeration line of trend estimation extended from baseline. Scores in the retention phase start to move closer to the celeration line at about week 4. This pattern gave some confidence that that treatment was effective for Bob. When the intervention was removed the participant's performance started to decrease.

The celeration line data basically indicates non-significant results. However, the level and trend data for the hand truck push suggest that the intervention had a small positive effect. Shane and Jacob had better overall scores than Jim and Bob. The mixed results did not provide conclusive evidence for complete support of work productivity for the hand truck push task.

Comparison of Participants' Box Stacking Scores

Mean scores showed improvements across all phases of the study for all participants (see Table 12). Jacob was the only participant that had a drastic treatment effect with level and trend changes, celeration, and improved time to completion by more than 5 s.

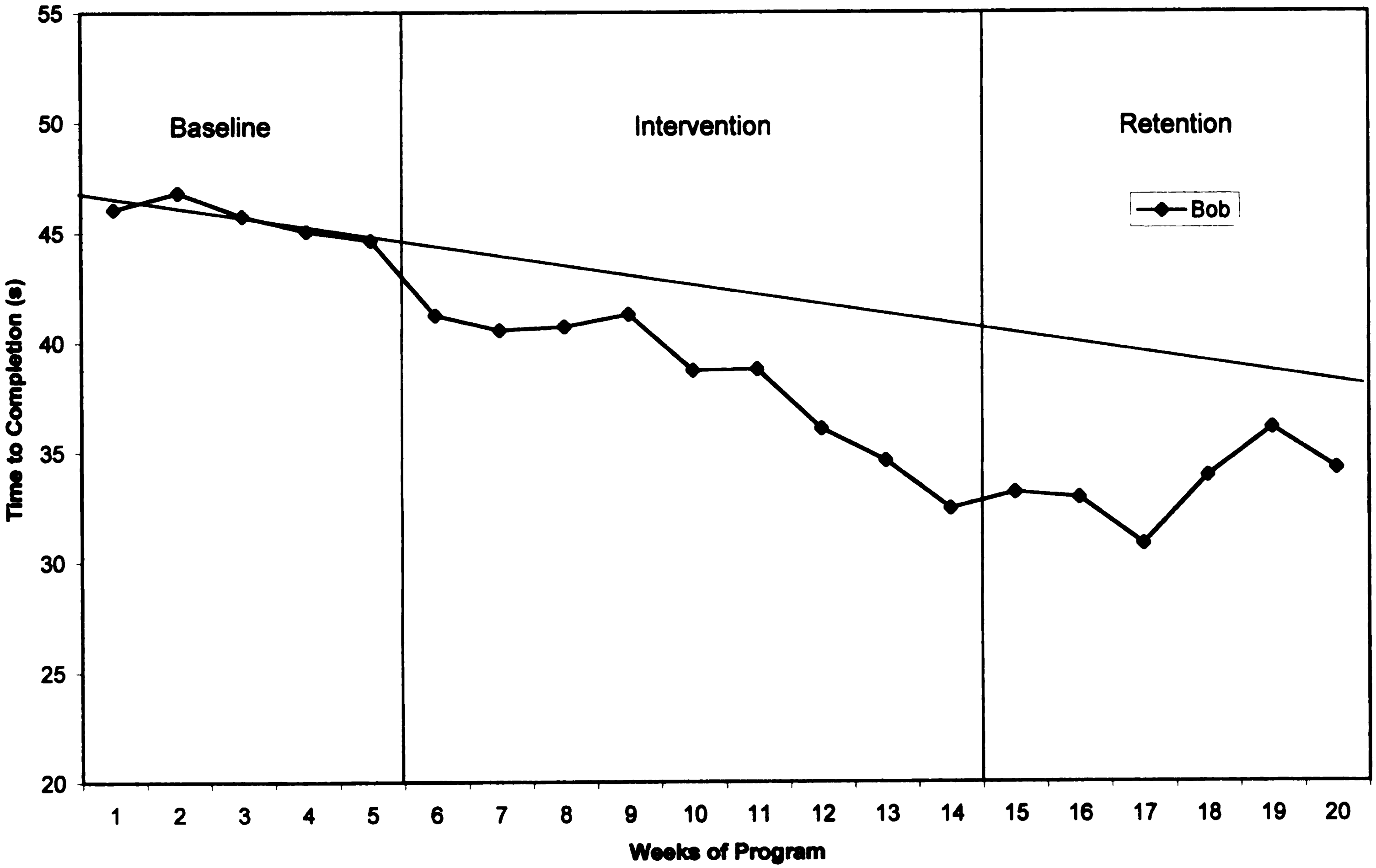

Figure 18. Celeration line for Bob's hand truck push scores.

Table 12

Mean Time to Completion of Box Stacking Task

Participants	Time to Completion (s)		
	Baseline	Intervention	Retention
Shane	39.78	37.93	35.22
Jacob	41.73	35.30	34.44
Jim	42.06	38.49	37.31
Bob	40.90	35.21	36.44

Note. Scores are listed in s and represent the participants' mean productivity scores measured by time to completion.

As with the hand truck push score, the comparison shows varying levels of significance among the participants. The mean time to completion varied for each participant, with Jacob and Bob having the lowest (fastest) box stacking mean scores during the intervention. These two participants also demonstrated the best improvements in completion times.

Initial visual inspection of baseline data shows variability throughout all phases of the study for some of the participants (see Figure 19). Comparison of the trend of the data points indicates that all participants showed improved times from baseline to intervention; however, the level of significance varied. Shane and Jim recorded the most stable baseline scores for the box stacking tasks. Bob showed the most extreme variation during baseline of all the participants.

Level and Trend Changes for Box Stacking Task

Changes in level and trend of the data series varied for each of the four participants on the box stacking tasks. Only one of the four participants had significant level and trend changes in completion times. More detailed descriptions of change for all participants are provided below.

Shane. Figure 20 illustrates that there was no change in the level of the data pattern from baseline to intervention. Shane's scores on the last week of the baseline and the first week of intervention were 38.5 and 39.5 s respectively. Intervention scores show some variability with extreme scores recorded on weeks 3, 7, and 9 of that phase. Shane's peak intervention score was 33.2 s and was not reached until the final week of intervention. In addition, the trend of the data series is relatively level, indicating not much overall improvement in box stacking scores. On the other hand, there is a noticeable level and

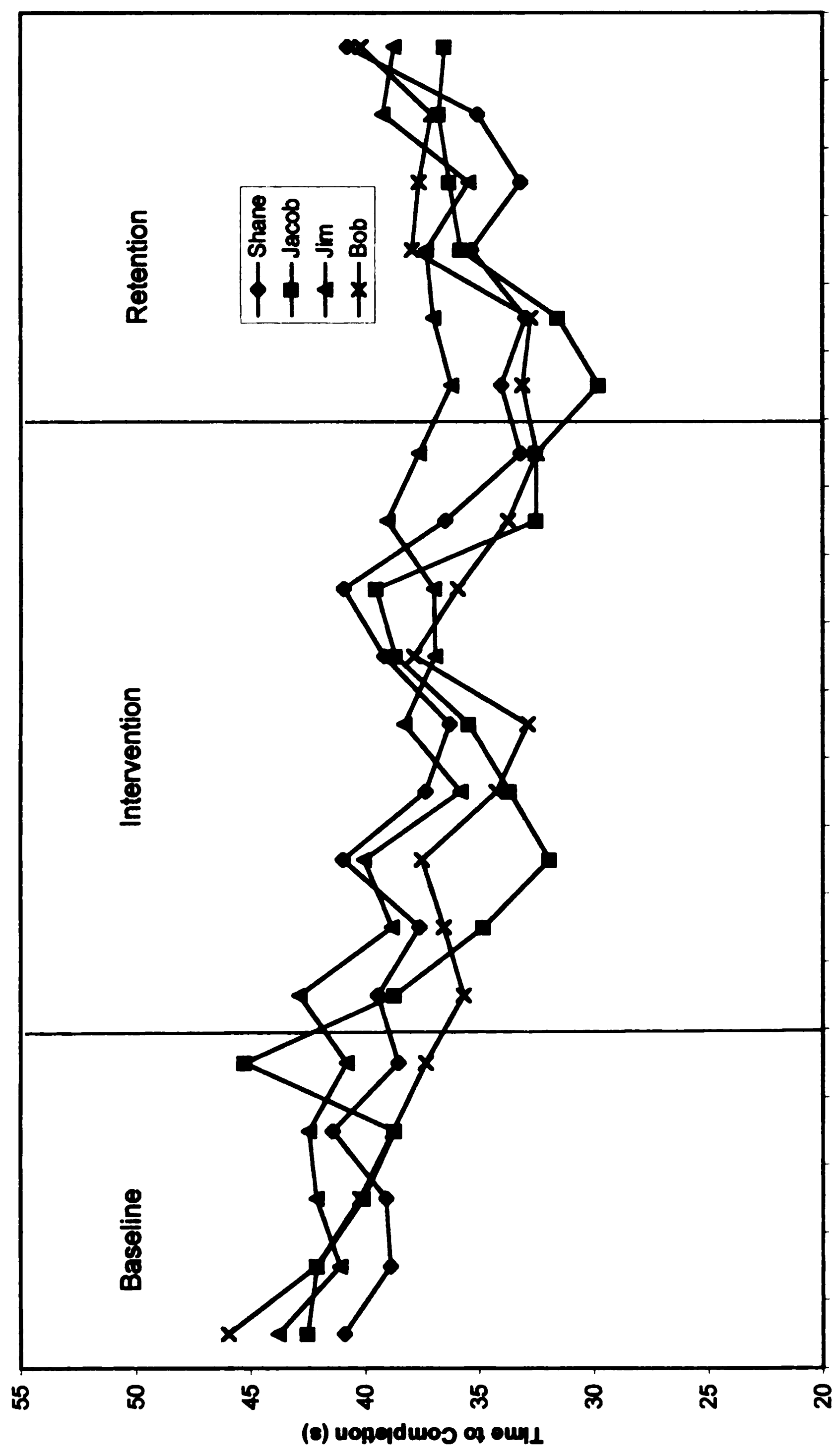

Figure 19. Comparison of box stacking scores for all participants.

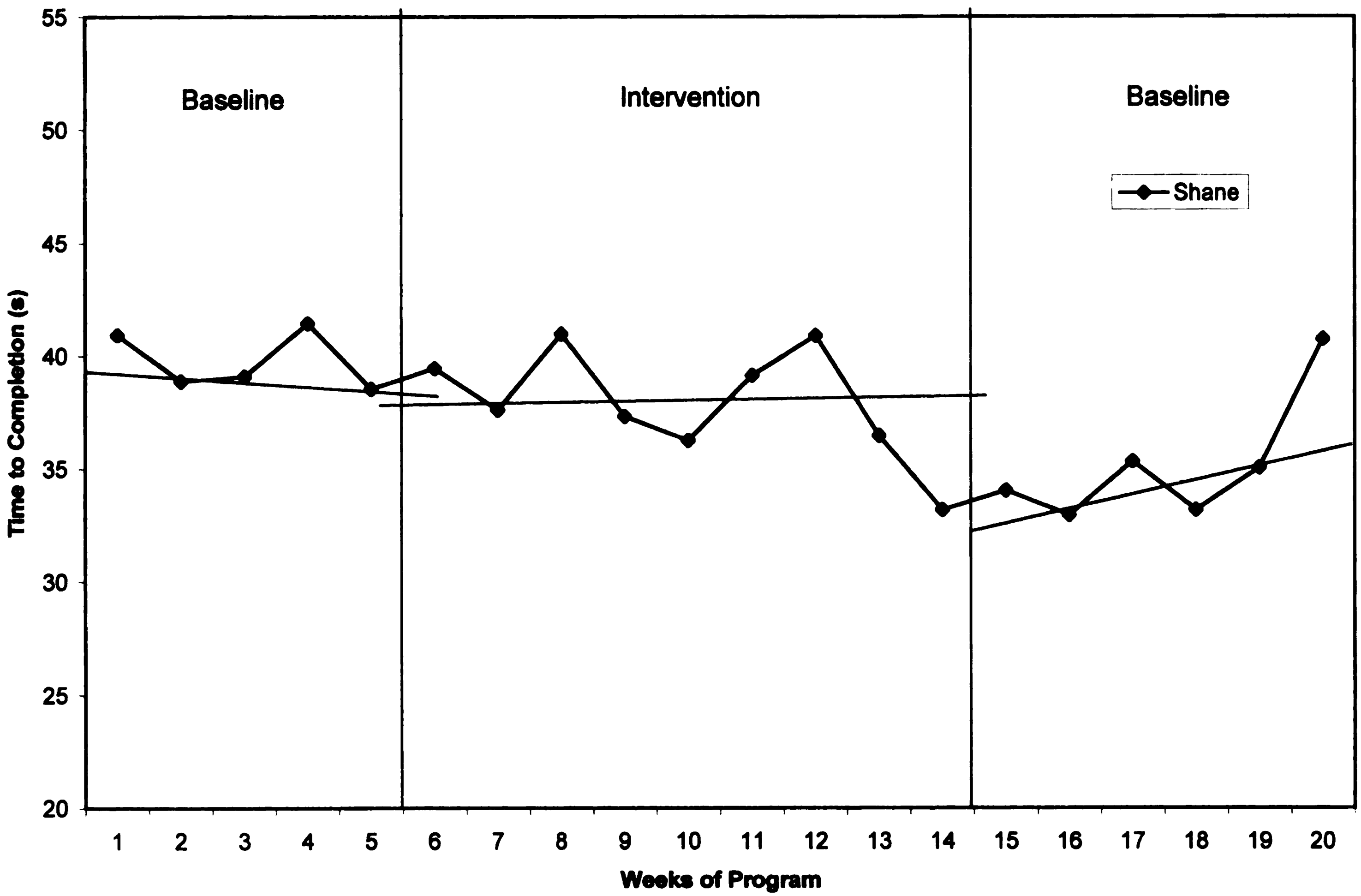

Figure 20. Shane's level and trend changes for box stacking scores.

trend change between the intervention and retention phase. The trend line for the retention phase shows increasing scores. A more stable retention and scores returning back close to baseline measures would have been the desired effect.

Jacob. There is an extreme change in the level between the baseline and intervention phase (see Figure 21). The trend of the data within the intervention phase is different from that in baseline. That is the data pattern for the intervention shows a slight upward trend. Jacob's box stacking scores are variable throughout the intervention phase. However, there were improvements from the baseline phase to the intervention phase. There seemed to be an immediate effect during the first few weeks of the weight-training program. The first three weeks of the intervention phase produced decreases in scores from the final week of baseline. The scores recorded for those 3 weeks were 38.7, 34.8, and 31.9 s respectively. There are not consistent improvements after week 3 of intervention. That is, scores started to increase from week 4 through week 7 of the intervention phase. Lastly, there was a change in level between the intervention phase and the retention phase.

Jim. No major changes in level or trend were observed for Jim between the baseline phase and intervention phase (see Figure 22). In fact, there was a 2.1 s increase in scores from the final week of baseline (40.8 s) to the first week of the intervention phase (42.9 s). Data in the intervention phase were relatively stable. The trend of the data series for the intervention phase shows a slight descending pattern with scores showing little variability. There is a minor change in level of the data trend between the intervention and retention phase. The difference from the final week of intervention and the first week of retention is only 1.4 s. The trend of retention scores shows an upward pattern, indicating increasing scores when the intervention is stopped.

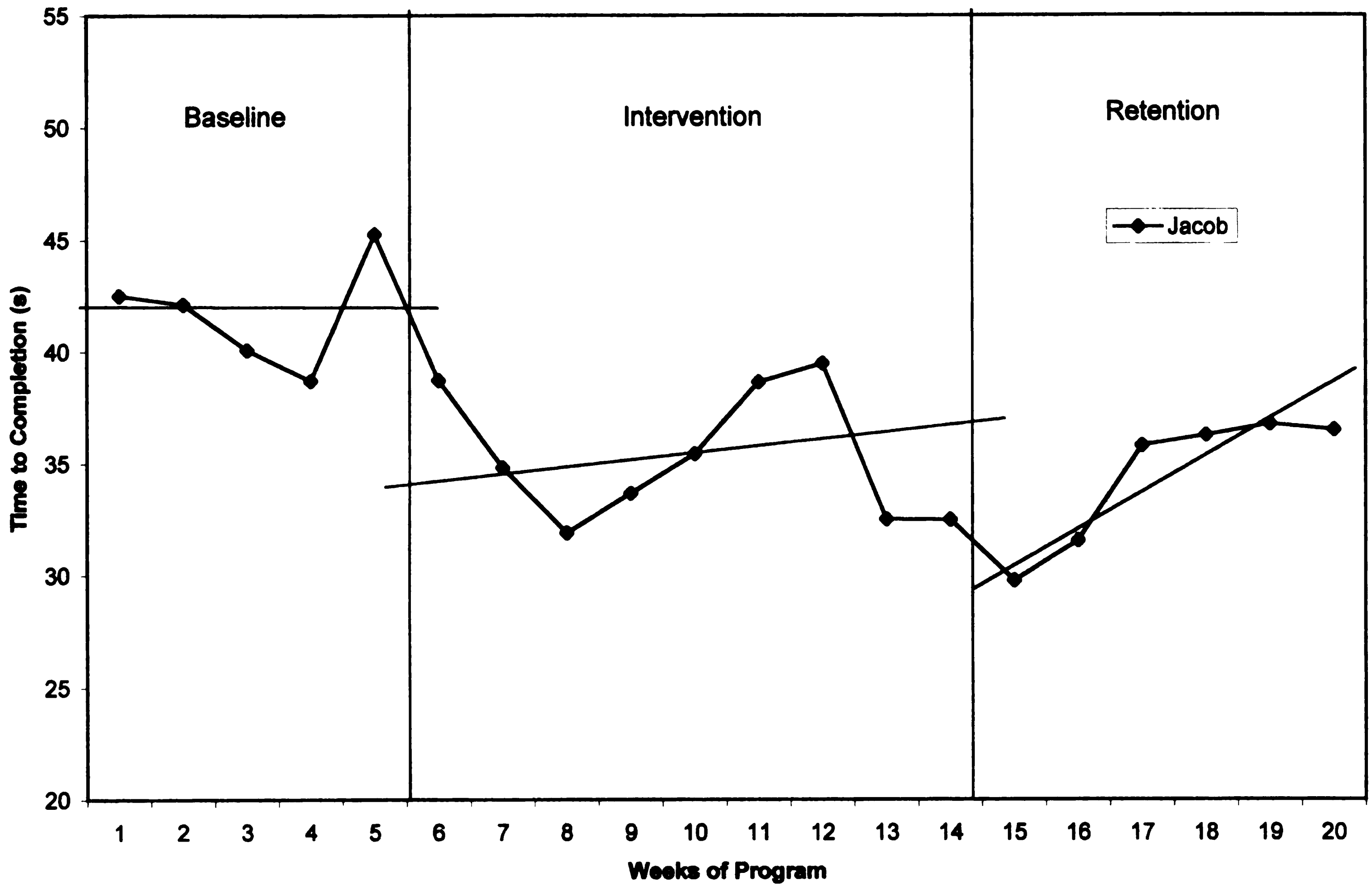

Figure 21. Jacob's level and trend changes for box stacking scores.

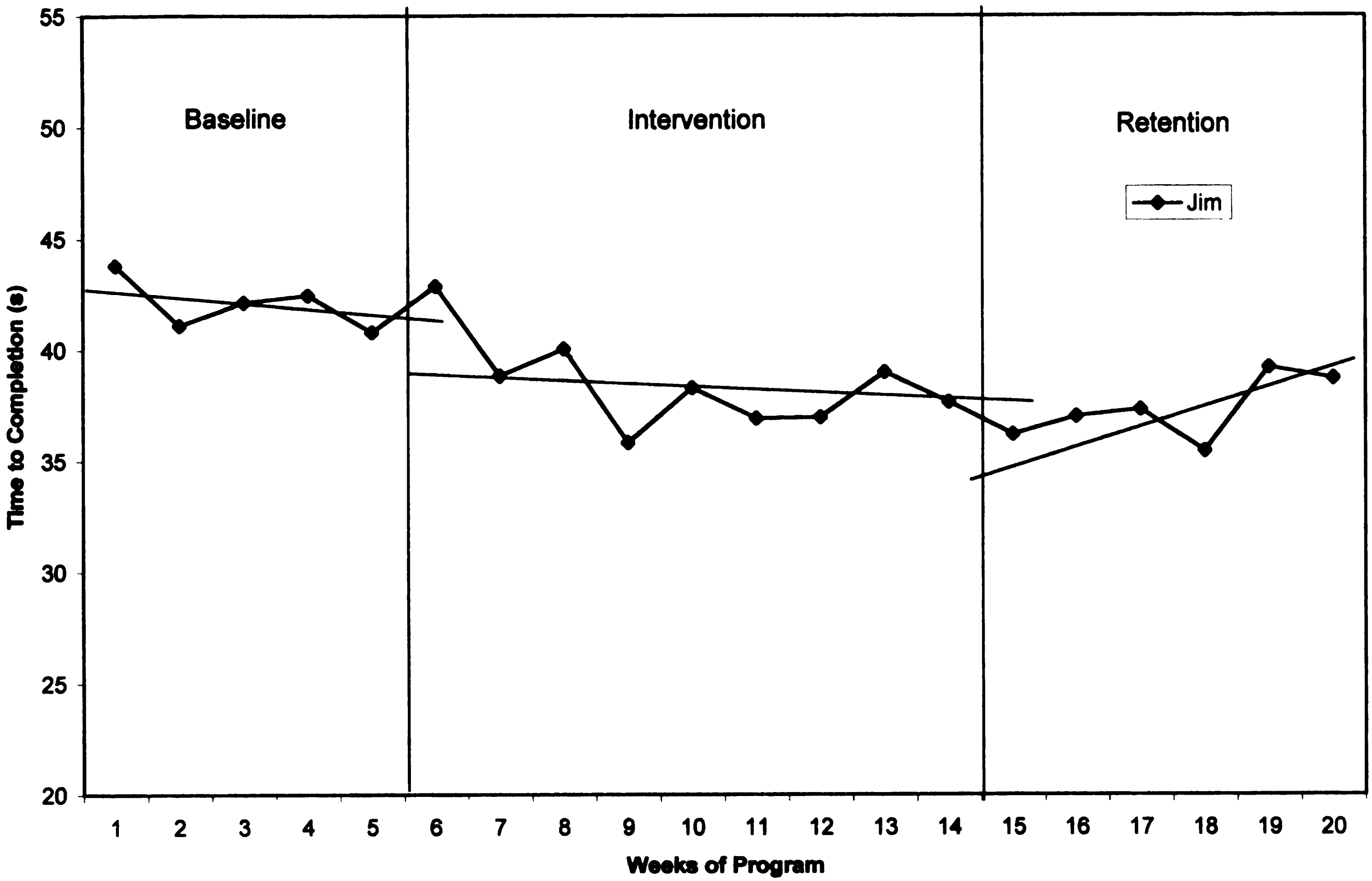

Figure 22. Jim's level and trend changes for box stacking scores.

Bob. There were no significant level changes between baseline phase and the intervention phase or for the intervention and retention phase. Bob's level and trend changes for all phases are pictured in Figure 23. There were changes in the trend of data for both the intervention and the retention phases of the study. Scores during the intervention phase showed a downward trend indicating improvement in Bob's box stacking scores. The trend of the data pattern for the retention phase showed scores on the increase.

Celeration Line for Box Stacking Task

Table 13 outlines the number of data points that fall at or below the celeration line for the intervention and retention phases of the box stacking scores of all participants. As with the hand truck push, visual inspection of the celeration line is a way of determining the effectiveness of the progressive resistance-training program. Results are significant if the majority of the data points fall below the celeration line. Three of the participants had the majority of their intervention scores fall below the celeration line.

Shane. The celeration trend line derived from baseline measures predicted a slight decrease in scores throughout the intervention and retention (see Figure 24). Shane has the majority of his intervention scores below the celeration line. One can interpret by looking at the celeration line across intervention and retention that changes seemed to be minor, therefore, leading one to conclude that the significance of the treatment may be minimal.

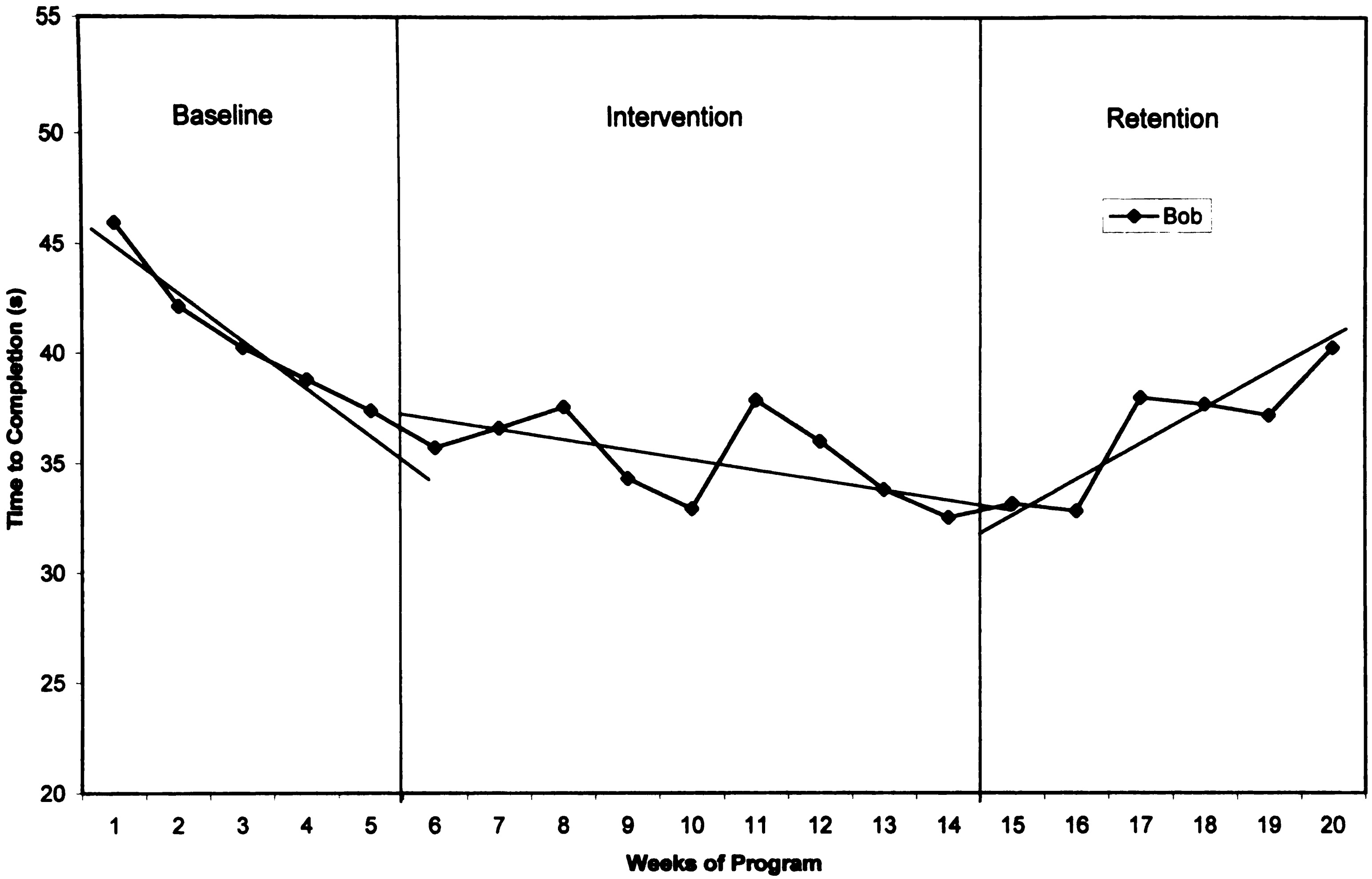

Figure 23. Bob's level and trend changes for box stacking scores.

Table 13

Number of Points On or Below the Celeration Line for the Box Stacking Task

	Intervention (Maximum 9 data points)	Retention (Maximum 6 data points)
Shane	5	5
Jacob	9	6
Jim	5	2
Bob	0	0

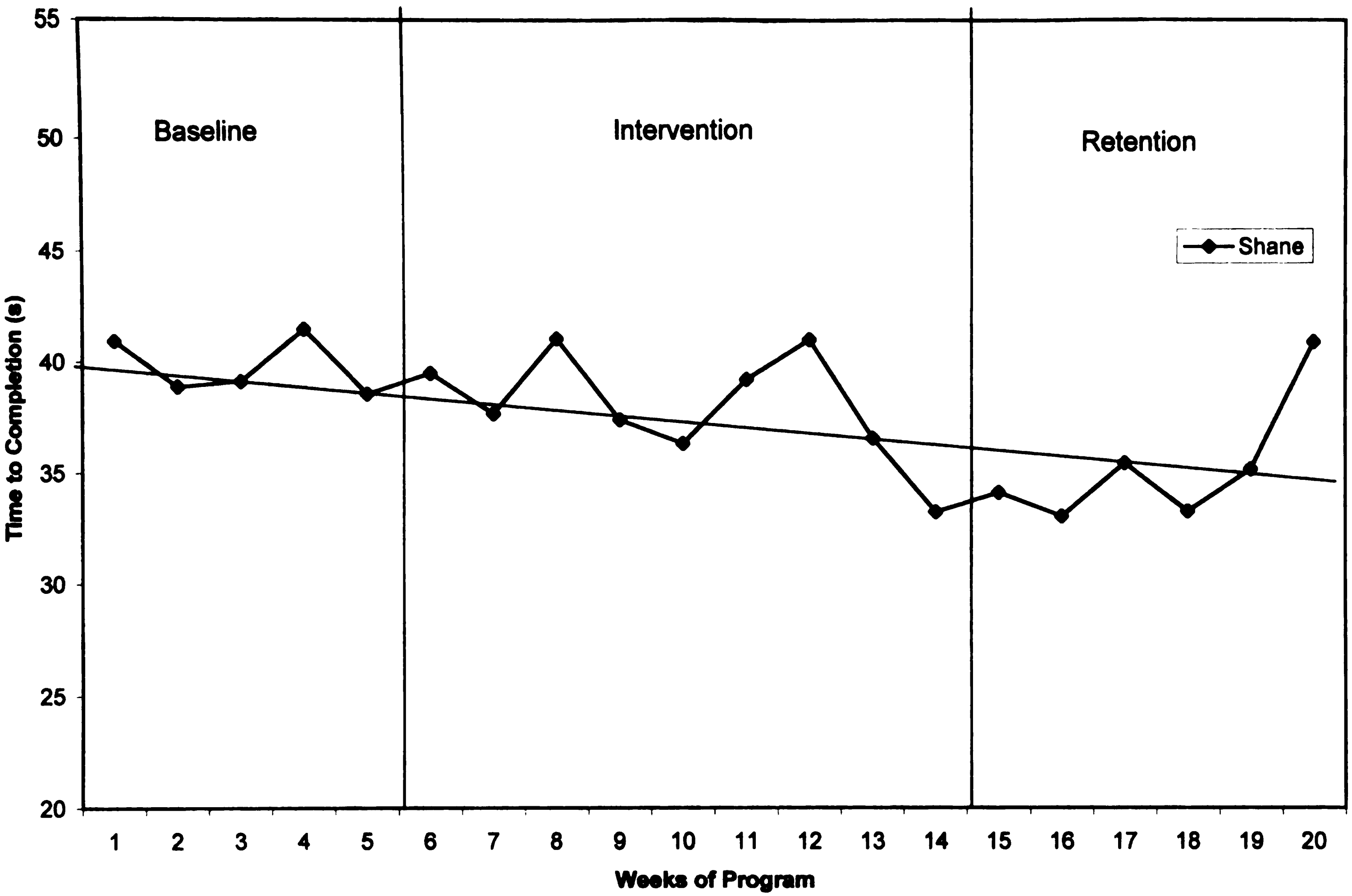

Figure 24. Celeration line for Shane's box stacking scores.

Jacob. As illustrated in Figure 25, all data points during the intervention phase fell below the celeration line. This was a good indicator that there was an overall improvement in Jacob's scores from the baseline to retention. Score variability was a concern during the intervention phase. Extreme score increases occurred during week 6 and 7 of the intervention and started to decline again by the week 8 of the phase. The aforementioned scores moved closer to the celeration indicating a rise in scores. The treatment effect for Jacob was significant from baseline to intervention and subsequently from baseline to retention.

Jim. The majority of the data points in the intervention were on or below the celeration trend line (Figure 26). This was a good indication the treatment effect was significant. The scores in the intervention phase were quite stable. Improvements in productivity did not occur until week 2 of the intervention. The low score for Jim during intervention was 35.8 s, which was attained during the fourth week of the phase. Jim's results were evidence that participation in the weight-training program can improve work productivity for the box-stacking task. Data points in the retention phase do not show significant increases in scores when the intervention is stopped.

Bob. All data points in the intervention phase were above the celeration line (see Figure 27). This indicates that there was no significant treatment effect. Box stacking scores for Bob showed continued increase throughout the intervention phase. Data points within the intervention phase continued to move away from the celeration line as the phase progressed. The high scores for Bob during the intervention phase were 37.5 and 37.8 s recorded during weeks 3 and 6. These scores were about a 5-s difference from his

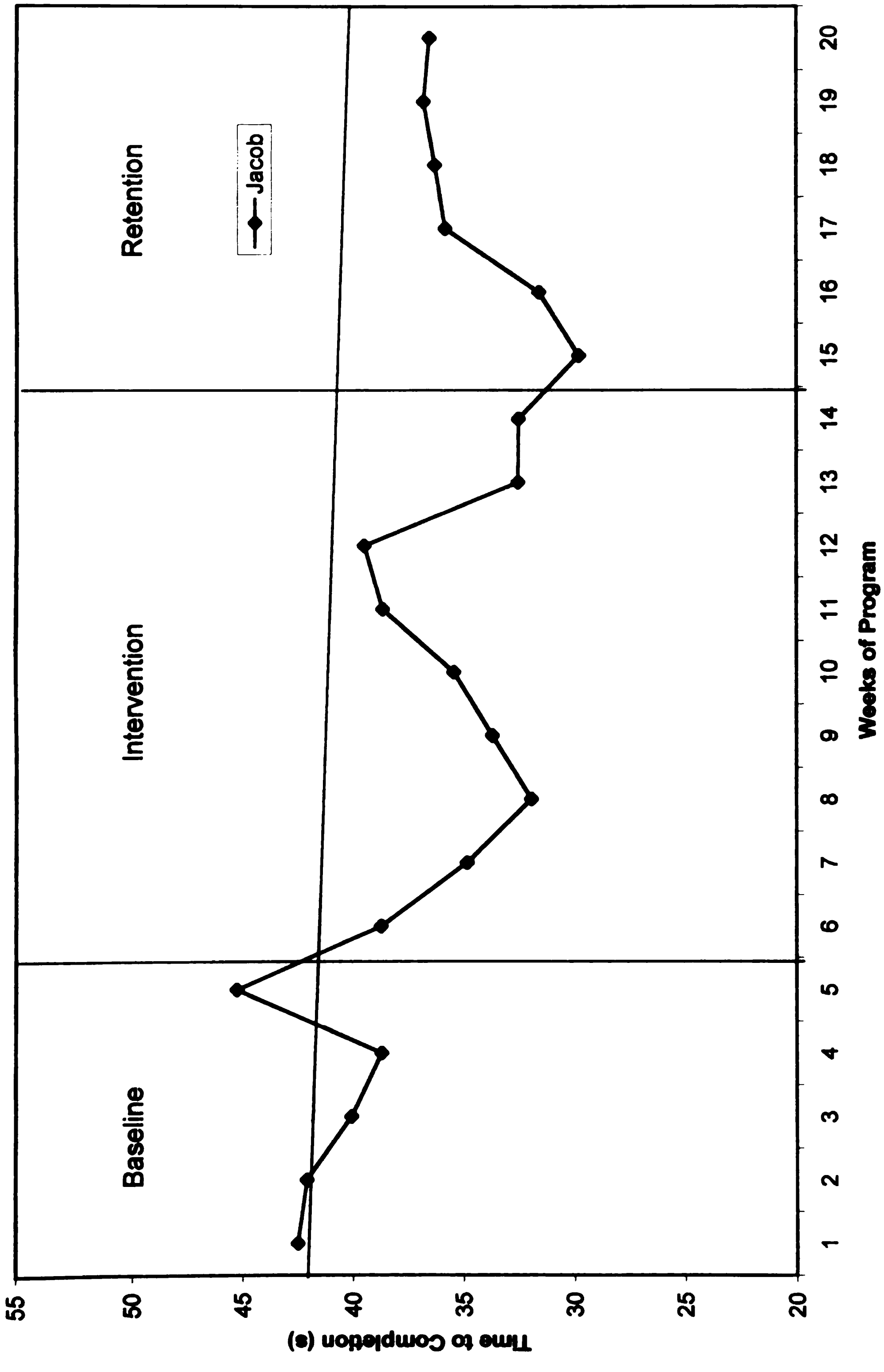

Figure 25. Celeration line for Jacob's box stacking scores.

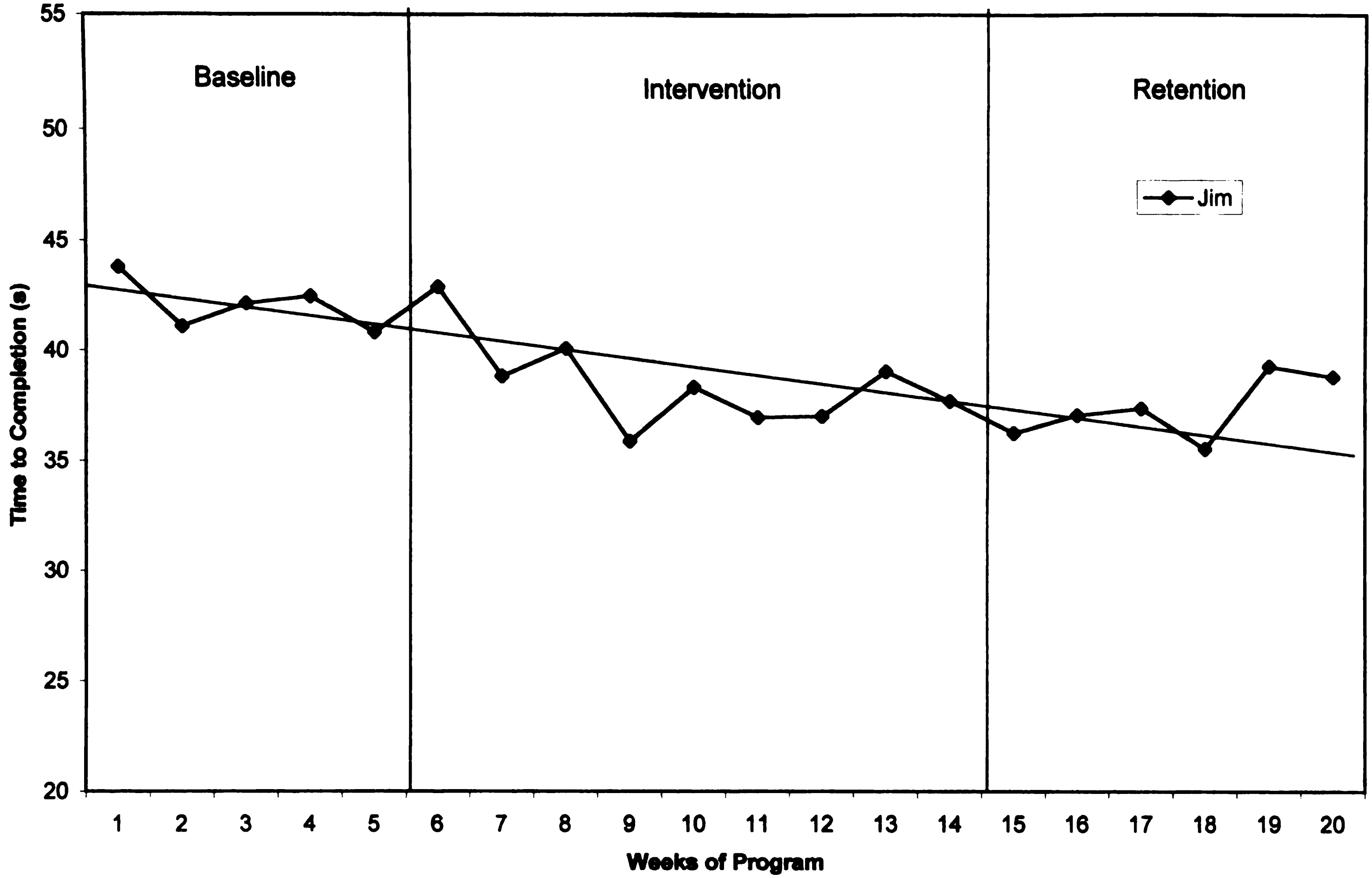

Figure 26. Celeration line for Jim's box stacking scores.

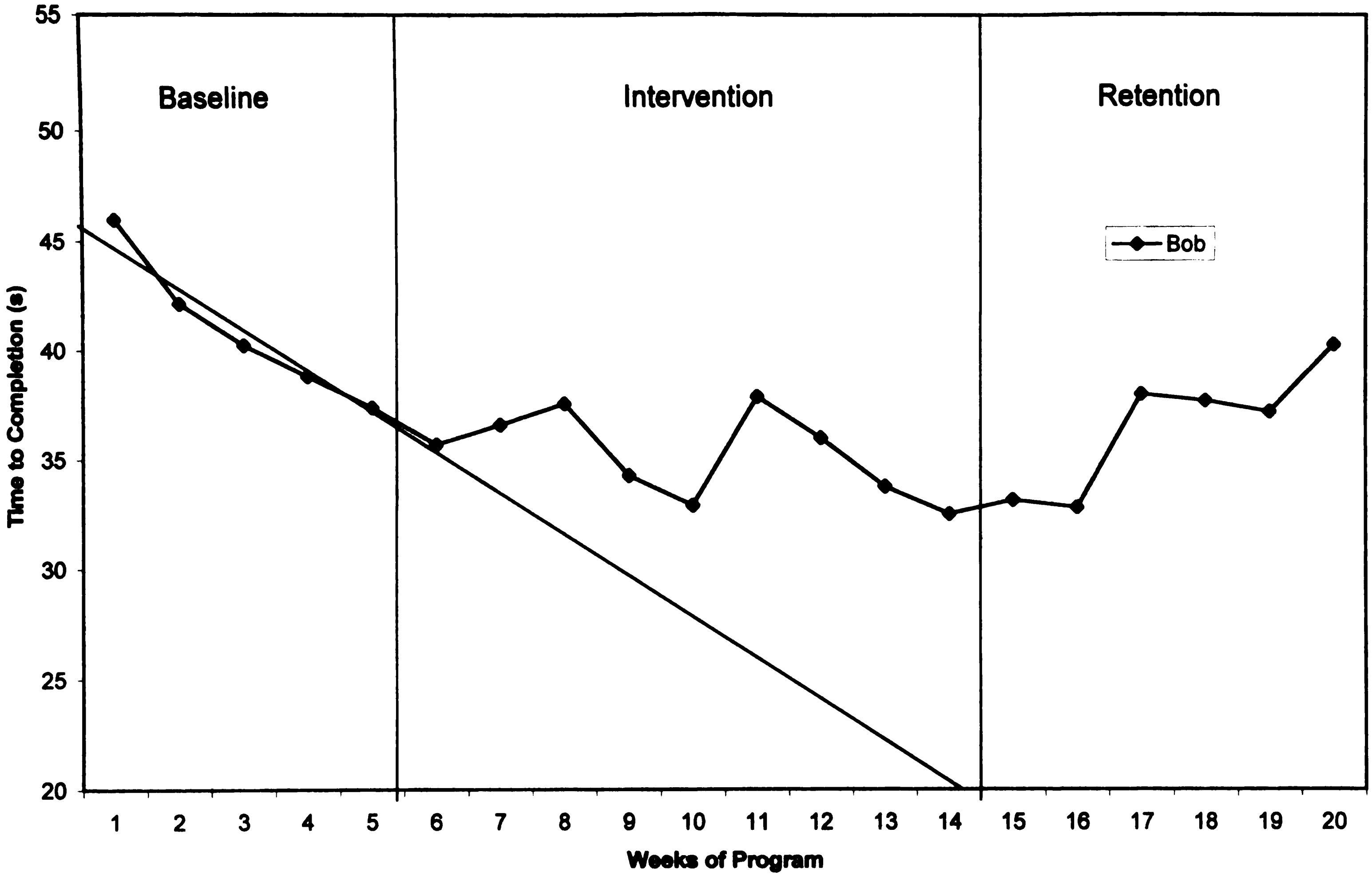

Figure 27. Celeration line for Bob's box stacking scores.

best score of 32.9 s recorded on week 5 of intervention. In addition, the retention scores were also a distance away from the celeration line. This increase during the retention phase was somewhat anticipated with the removal of the treatment.

Percent Performance Changes for Simulated Work Tasks

The improvements in completion times for the hand truck push task were modest and less robust than for the strength data. Percent changes for the simulated work tasks are outlined in Table 14. The percent changes for the hand truck push ranged from 12% to 19.1% baseline to intervention and 18.3% to 26.6% baseline to intervention. Jacob and Bob experienced the greatest percent change between baseline and intervention for the hand truck push. Jim and Bob demonstrated the greatest percent change from baseline to the retention phase with decreases in time of 22% and 26.6% respectively.

The percent changes for the box-stacking task were not as prominent as for the hand truck push. The lowest percent change of 4.7% was by Shane in the baseline to intervention phase. Jacob had the greatest percent change in scores between baseline and retention for the box-stacking task.

Hypothesis 3

This hypothesis postulated that participation in a progressive resistance-training program would improve work productivity of on-site job tasks. It was expected that there would be increases in work productivity, however, the researcher was unable to get any substantial quantitative data regarding the participants' actual job performance. The qualitative data provided for this section were derived from supervisors' ratings using a 4-point Likert scale (poor, average, good, great) and comments. Examples of the work data

Table 14

Percent Change in Mean Scores for Simulated Work Tasks

	Shane	Jacob	Jim	Bob
Hand Truck Push				
Baseline (B)	37.01	38.68	49.87	45.66
Intervention (I)	31.94	31.29	43.89	38.26
Retention (R)	30.22	30.34	38.92	33.53
% Change B-I	13.7	19.1	12	16.2
% Change B-R	18.3	21.6	22	26.6
Box Stacking				
Baseline (B)	39.78	41.73	42.06	40.90
Intervention (I)	37.93	35.30	38.49	35.21
Retention (R)	35.22	34.44	37.31	36.44
% Change BL-I	4.7	15.4	8.5	13.9
% Change BL-R	11.5	17.5	11.3	10.9

Note. Percentages are expressed as a decrease in time to completion between the designated phases of baseline to intervention and baseline to retention.

forms may be found in Appendix K. Job supervisors recorded the participants' work productivity data, and the investigator had no control over the data. Comments and ratings for all participants should have been recorded on a weekly basis; however, supervisors did not provide consistent data. The investigator was able to get quantitative data on two of the participants, as well as qualitative data on all participants.

The supervisor's comments from the workshop ratings for Shane and Jacob did not correspond to the amount of hours worked or the amount that they were paid. That is, on weeks when the participants worked more hours at a high pay rate their performance ratings may have been only "average" or "good". The lack of correspondence between objective and subjective indicators of performance made it virtually impossible for the investigator to draw conclusions regarding the effect of the progressive resistance-training program on work productivity for the on-site job tasks. Jim and Bob had only one job during the course of the study.

Shane

Shane worked at a sheltered workshop performing light assembly, packing, and materials handling tasks. Table 15 provides a summary of work performance results for Shane's workshop job task. He was paid for the number of assemblies he completed. The job supervisors reported the data in two-week intervals, according to the workshop pay schedule. No data were given on the number of specific assemblies performed by Shane. There was no data recorded for the last two weeks of the study. He took time off the job at the workshop to work only at the high school. The supervisor at the workshop indicated that he would return to the workshop after the summer.

Table 15

Productivity Data for Shane's Workshop Job

	Hours x Rate = Pay	Ratings/Comments
Week 1 & 2	30.25 x $2.78 = $84.10	Average
Week 3 & 4	07.50 x $3.79 = $28.43	Average
Week 5 & 6	28.25 x $1.60 = $42.30	Average
Week 7 & 8	28.50 x $1.73 = $49.31	Average
Week 9 & 10	28.50 x $1.70 = $48.45	Average
Week 11 & 12	No Data	Average
Week 13 & 14	11.50 x $1.30 = $14.95	Average/Good
Week 15 & 16	10.50 x $2.09 = $21.95	Good
Week 17 & 18	09.50 x $0.80 = $07.06	Good
Week 19 & 20	No Data	No Rating

Note. Productivity recorded according to pay schedule of workshop contract.

Supervisor comments for Shane's high school job were provided a total of 11 weeks and can be found in Table 16. He transferred to another school for a period of 3 weeks in weeks 13, 14, and 15 of the study. There were no comments made during this time. The investigator contacted the new job supervisor and explained the form; however, only ratings and job task information were provided.

<u>Jacob</u>

Jacob also held a job at a workshop setting performing light assembly, packing, and material handling tasks. Data were recorded in two-week intervals, according to the workshop pay schedule (see Table 17). No data were given on the number of specific assemblies performed by Jacob. Jacob had no data recorded for weeks 15 and 16 of the study for his workshop job because he was sick on those days. A summary of the comments from Jacob's supervisor at the restaurant can be found in Table 18. Jacob received comments for only eight weeks of the study. The comments provided for Jacob gave general descriptions of his work performance and not the amount of work completed. One of the major concerns for supervisors at the restaurant was the speed at which Jacob worked. Due to the nature of the business, completing work in a timely manner was important. Jacob's co-workers and supervisors were generally pleased with his performance.

<u>Jim</u>

A summary of comments from Jim's supervisor may be found in Table 19. It was difficult to get consistent comments from Jim's supervisors. The mailroom supervisors did provide ratings; however, comments were scarce. Jim received comments on 7 of the 20 weeks. Comments were generally descriptive indicating what Jim had done and how

Table 16

Shane's Weekly Job Performance Rating/Comments for High School Job

	Ratings	Comments
Baseline		
Week 1	Good	None
Week 2	Good	None
Week 3	Average	"Shane staying on task and doing less wandering out of work area."
Week 4	Average	"Continue to remind Shane to stay in his work area. Does a great job when he remains focus."
Week 5	Good	"Improved attention to tasks. Very pleasant to work with."
Intervention		
Week 6	No Rating	None
Week 7	Good	"Shane is expressing his need to improve. He wants to transfer to the new kitchen so he has a goal."
Week 8	Good	"Garbage disposal down so a lot less work this week. Shane did other cleaning duties. He was overly excited about his transfer this week! Is showing signs of displaying too much affection with employees. We're working on this."
Week 9	Good	"Shows signs of improvement with appropriate contact with fellow employees. He worked closer with Sheri (not real name) to share work load, particularly pots, pans, and rotating sprayer/catcher."
Week 10	Great	"Staying in work area-assisting with other duties not expected of him."

Table 16 (cont'd).

	Ratings	Comments
Intervention		
Week 11	Good	"In absence of co-worker Shane displayed enthusiasm for being capable of performing on his own. We did use disposable trays which saved a lot of labor."
Week 12	Good	"You can see when Shane is putting away dishes that he wants to come and visit, but refrains from doing so most of the time. Continue working on less wandering and visiting the office! He expressed concern of not knowing anyone at Elmer School (not actual name)-We stress he will need to stay in the kitchen area!"
Retention		
Week 13	Average	None
Week 14	Average	None
Week 15	Good	None
Week 16	Good	"Shane is doing well after coming back from the other school"
Week 17	Good	None
Week 18	Average	Week 18: "He had trouble with staying in his work area this week. We had a talk with his job coach this week."
Week 19	Great	None
Week 20	Average	None

Table 17

Productivity Data for Jacob's Workshop Job

	Hours x Rate = Total Pay	Rating/Comments
Week 1 & 2	24.00 x $1.31 = $31.44	Average
Week 3 & 4	22.50 x $1.04 = $23.40	Average
Week 5 & 6	43.00 x $0.81 = $34.83	Average
Week 7 & 8	35.50 x $0.56 = $19.88	Average
Week 9 & 10	42.50 x $0.56 = $23.80	Average
Week 11 & 12	41.00 x $0.46 = $18.86	Average
Week 13 & 14	43.00 x $0.46 = $17.78	Great
Week 15 & 16	No Data	No Rating
Week 17 & 18	27.00 x $0.80 = $21.60	Good
Week 19 & 20	47.00 x $0.94 = $44.18	Good

Note. Productivity recorded according to pay schedule of workshop contract.

Table 18

Jacob's Weekly Job Performance Rating/Comments for Restaurant Job

	Rating	Comments
Baseline		
Week 1	Average	"Jacob is getting better at completing the dishes quicker. He sometimes has a difficult time staying on task."
Week 2	No Rating	None
Week 3	Good	None
Week 4	Average	None
Week 5	Average	"Jacob is not feeling well this week and is not alert as he usually is."
Intervention		
Week 6	Average	"Doing better with completing tasks on time this week. He is coming off of a cold."
Week 7	Average	"Jacob was very distracted today. He will be going to visit his father this weekend to go to a concert. We had to keep reminding him to gather the dishes."
Week 8	Poor	"Went home sick on Tuesday complaining of stomach pains. He only worked for 2 hours."
Week 9	Average	None
Week 10	Average	None
Week 11	Average	"Got all of the dishes done, but forgot to take out all of the garbage."
Week 12	Average	None

Table 18 (cont'd).

	Rating	Comments
Intervention		
Week 13	No Rating	None
Week 14	Poor	None
Retention		
Week 15	Good	"Jacob worked very hard today we had a busy day. He washed all the dishes and took out the garbage. Still working on being faster."
Week 16	Poor	None
Week 17	No Rating	None
Week 18	Average	None
Week 19	Good	"Jacob is doing a good job. He is learning to use the new dishwasher and is getting better with putting away all of dishes"
Week 20	Average	None

Table 19

Jim's Weekly Job Performance Rating/Comments for Mail Room Job

	Rating	Comments
Baseline		
Week 1	Good	"Jim did all of his work this week. There was a lot of mail to sort. He also was a big help with stacking packages for delivery to the other buildings on campus."
Week 2	Good	None
Week 3	Good	"He sorted all of his morning packages this week. He is very happy with his job."
Week 4	Good	None
Week 5	Good	None
Week 6	Average	None
Week 7	Good	None
Intervention		
Week 8	Poor	"Jim seemed to be distracted this week. His mom said they were changing his medication this week."
Week 9	Average	None
Week 10	Great	"This week was very good for Jim. He has worked very hard and was able to help with other jobs in the mailroom. He gets excited when he does a good job."
Week 11	Great	None
Week 12	Average	None

Table 19 (cont'd).

	Rating	Comments
Week 13	Great	"Jim had an excellent week at sorting and some delivery of mail. He works very fast, but we tell him to slow down so he won't make any mistakes."
Week 14	Great	None
Retention		
Week 15	Good	"Jim wants to start delivering mailbags and packages to other buildings. We told him we will think about it and he needs to keep working hard." "Good week, He is working hard."
Week 16	No Rating	None
Week 17	Good	"Had a chance to help deliver mail to other buildings. He was told that he had to do all of his work and he may be able to go out again later."
Week 18	Average	None
Week 19	No Rating	None
Week 20	Good	None

well he was getting along. Overall Jim's ratings were positive which is an indication that his supervisors were generally satisfied with his work performance.

Bob

An overview of the ratings and comments from Bob's supervisors can be found in Table 20. The ratings and comments for Bob were obtained from several individuals due to the fact he had various supervisors throughout the course of the study. Although the ratings for Bob were relatively consistent, the supervisors provided comments for only 8 weeks of the study. The positive ratings that are offered by Bob's supervisors indicated a general satisfaction with his job performance.

Table 20

Bob's Weekly Job Performance Rating/Comments for Health Club Job

	Rating	Comments
Baseline		
Week 1	Average	None
Week 2	Average	"Bob has been working very hard. He sometimes rushes through his cleaning and spills water."
Week 3	Average	None
Week 4	Good	None
Week 5	Good	None
Intervention		
Week 6	Good	"Bob cleaned all of the machines and worked in the locker room some this week. He was really busy, because he worked during the afternoon rush."
Week 7	Average	None
Week 8	Average	None
Week 9	Average	"Bob did okay this week. We want him to be able to get his work completed without rushing and missing some machines."
Week 10	Average	"He was cleaning up after construction this week. It was difficult for him to stay on task."
Week 11	Average	"Bob was not feeling well this week, but he did okay working. Most of his cleaning was in the aerobic exercise room."
Week 12	Great	None

Table 20 (cont'd).

	Rating	Comments
Intervention		
Week 13	Great	None
Week 14	Good	"Very good week. Bob worked in the exercise room and the locker room this week. He mopped floors and cleaned counter tops in the locker room."
Retention		
Week 15	Good	None
Week 16	Average	None
Week 17	Good	"Good job this week. He had to do some cleaning in the locker room and the windows in the cardiovascular room."
Week 18	Good	None
Week 19	No Rating	None
Week 20	Good	"Bob worked hard this week. We had some remodeling done and he worked extra time."

CHAPTER FIVE

DISCUSSION

There were three hypotheses offered in this study; namely that participation in progressive resistance training by young adult men with mental retardation (MR) would result in increased muscular strength, work productivity in simulated work tasks (hand truck push and box stacking), and work productivity at the participants' on site jobs. The only hypothesis supported in this study was the one regarding strength. There was partial support for increased work productivity of simulated work tasks. Lastly, the hypothesis for increased work productivity for on-site jobs was not supported.

Strength Gains

The strength gains experienced by the four participants during the intervention in this study are comparable to other findings in the research literature for both persons with and without MR.

Non-Disabled Persons

The use of the progressive overload principle is essential for optimal muscular strength and endurance development (ACSM, 1998; Edstrom & Grimby, 1989; Fleck & Kraemer, 1997). The intervention phase of this study used progressive overload with positive results. Shane, Jacob, Jim, and Bob were subjected to gradual increases in strength as they improved and as the weeks progressed. These increased resistances were based on percentages ranging from 30 to 80% according to their weekly 1-RM lifts. Brzycki (1995) mentions that the increases in resistance for progressive training programs did not need to be in large amounts, but need to represent a challenge for the individual. Therefore, the progressions were individualized to the strength of each participant.

This study has further demonstrated that noticeable strength gains are possible by participating in a progressive resistance training program for as little as 9 weeks. In conjunction, several researchers (Brzycki, 1995; Braith, et al. 1989; ACSM, 1991, 1998) have conducted studies and reported that 8 to 14 weeks of resistance training is sufficient to produce significant gains in strength for adults. Although the aforementioned studies involved non-disabled participants, persons with MR have the potential to benefit as well. The strength gains experienced in this study were similar to those observed in past research. For example, Braith et al. (1989), Fleck and Kraemer, (1997), and Pollock et al. (1989) have reported strength gains ranging from 16% to 100% on various resistance exercises. Similar to previous studies, participants in this study had strength gains ranging from 5.3% to 65.1% baseline to intervention and 25.9% to 138.2% baseline to retention on various exercises.

Persons with Mental Retardation

The results of this study confirm other findings in the literature that persons with MR have the potential to respond to progressive resistance training similar to persons without disabilities. Although not all persons increased their 1-RM at the same rate, there were noticeable strength gains for each participant. The findings are consistent with past research indicating that there can be significant muscular strength increases among individuals who have mental retardation with the use of reinforcement-based exercise (Croce & Horvat, 1992) and progressive resistance training (Rimmer & Kelly, 1991). Participants in the previously published studies showed increases in strength ranging from about 11% to 35% (Croce & Horvat, 1992) and from 42% to 121% on upper body strength measures and from 42% to 52% on lower body strength measures (Rimmer &

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Kelly, 1991) from baseline through intervention phases. These increases are similar to the strength gains in this study where the participants lifted two days a week on non-consecutive days for 9 weeks. Young adult males with MR who decide to use a resistance training protocol similar to the one used in this study could expect 5% to 113% gains in strength in as little as 9 weeks.

Score Variability

Shane and Jacob had the least variable baselines for composite strength. Stability within baseline may have been due to the fact that Shane and Jacob are faster learners and had opportunities to practice the weight lifting exercises prior to the study. This was done to allow them to become familiar with the setting and the use of the weight machines.

Score variability experienced by participants could be due to the fact that some individuals respond better to resistance training than others do. Therefore, the rates at which participants improved varied throughout the study. Brzycki (1995) mentions that improvement in strength can be observed in as little as two weekly sessions for some individuals. In addition, participation in 1-day per week resistance training has the potential to improve muscular strength comparable to 2-days per week and 3-days per week programs. With this in mind, it is possible that the 1-RM exercises performed during the baseline phase were sufficient enough to improve the participants' strength in as little as two weeks. If this is the case, variability in scores is probably inevitable. It is also possible that the strength gains may have just occurred by chance. More research needs to be conducted to further examine the possible causes of strength gains. This is important because 3 of the 4 participants showed composite strength increases ranging from 10 to 20 lb from the first week to the second week of baseline.

The variability in week-to-week strength scores throughout the intervention and retention phases can possibly be attributed to minor illness, lack of motivation, and/or stressful events in the participant's life. Two of the four participants indicated at least one of the aforementioned factors. Changes in variability of scores for Shane during the intervention may have been due to him not feeling well. Shane became ill during Weeks 11 and 12 of the study. Lack of motivation may also been a factor affecting score variability. In addition, Shane contemplated dropping out of the study in order to play softball during Weeks 6 and 7 of the intervention. The investigator assured him that there would be no harsh feelings if he decided to drop out of the weight-training program. He later decided that the softball schedule would interfere with his work schedule and continued to participate in the weight-training program. Shane has a short attention span and had to be constantly reminded to remain on tasks while in the weight room. It should be noted that Shane was the most difficult to motivate of all the participants.

Jacob had the greatest strength gains of all participants. However, he did experience some score variability at about Weeks 5 and 6 of the intervention phase. His scores actually decreased from the previous two weeks. His erratic scores may have been due to minor complications from the medications he was taking. Jacob's mother indicated that the doctor was experimenting with the dosage of his medications to better control his seizures and stomach ailments. There were a few occasions during this time when he came to sessions complaining of being tired. On those days he was encouraged to do what he could. By the end of the exercise sessions he usually reported that he felt much better. It is important to note that Jacob experienced no adverse effects from the weight-training and simulated work tasks during his medication changes.

Jim and Bob did not reveal any major situations in their lives that may have caused concern regarding score variability. A few minor issues involved sickness and transportation. Although Bob became ill during week 2 of the intervention phase, his strength scores did not reflect any major changes for week 3. Another minor concern for Jim and Bob involved transportation to and from the weight training sessions during the retention phase. There were times when the participants were unsure of how they would get to the training sessions. Jim and Bob's attendance was not affected and they were not absent from any sessions due to transportation difficulties. The scores during the retention phase did not seem to be effected. As a matter of fact, the scores during retention were on the increase for the first few weeks of that phase.

Detraining Effects

The strength retention experienced by the participants, after completion of the intervention, may be explained by the detraining effect, which is consistent with the literature. The ACSM (1998), Graves et al. (1988), and Lemmer et al. (2000) have reported that strength can be maintained anywhere from 12 to 31 weeks detraining. However, in order for strength to be maintained, the individual must sustain the intensity of the resistance training for at least one-day a week. The participants in the present study performed were tested using the 1-RM exercises once a week after the intervention was concluded. Although not at the same intensity as the intervention, participants were still performing some type of resistance training.

As with the baseline, it is possible that the once a week testing during retention was enough to maintain the muscular strength of the participants. The trend of the data series for the retention phase showed some decrease and leveling off during the last three weeks of the retention phase. This may be an indication that more time is needed to accurately measure the detraining effect to determine if the participants' scores would regress toward baseline strength levels. Pitetti and Tan (1991) mentioned, "there are no reported studies of MR individuals that evaluated detraining effects following the conclusion of the training period" (p. 594). Pitetti and Tan (1991) further implied that by not looking at detraining effects, it would be difficult to determine if the intervention led to any positive lifestyle modifications and lead these persons to independently continue participating in an exercise program. For this study, no formal analysis was done to determine the detraining effects of the resistance-training program post intervention.

The literature (Croce & Horvat, 1992) also supports strength retention for several weeks post intervention for a person with MR. As with the study by Croce and Horvat (1992), all participants in this study had significant strength gains that were above the celeration line. In addition, the participants in the present study had scores above the celeration line for all 6 weeks of the retention phase. This is a positive sign in that persons with MR may have the potential to maintain their strength after participation in a structured resistance-training program similar to person without disabilities.

Training Protocol and Equipment

The strength training protocol used in this study seems to be quite appropriate for young adult males with MR. The type of training, muscle fiber types, and overloads are a few of the factors that come into play when setting up strength training programs. The individualized weight training programs used in the present study were determined by each participant's l-RM lifts. Participants lifted on non-consecutive days and were given ample rest periods to minimize the likelihood of fatigue. The ACSM (1991) and Braith et al.

(1989) confirm that strength training two to three times a week on non consecutive days should allow muscles to have sufficient recovery time, which would reduce fatigue and provide for optimal strength gains.

The protocol used in this study was designed for optimal strength gains across participants and to limit injury. However, it is possible that fatigue could have been a factor in regards to strength gains. Prior to the study, Jacob was the only participant who was involved in some type of regular physical activity (martial arts). The only complaints received from the participants were regarding muscle soreness during the first three weeks of baseline. None of the participants complained of soreness throughout the remainder of the study.

The personalized resistance-training program used in this study allowed for an effective progression that produced noticeable strength gains. The protocol also seemed to be acceptable to the participants in this study. In an effort to minimize the possibility of injury, the lifting program in this study did not start until participants had a chance to practice each of the strength exercises. When participants started baseline trials they should have been familiar with all aspects of the lifting exercises. This aforementioned protocol may have added to improvement in strength. It was similar to the protocol used by Combes and Jansma (1990), Rimmer and Kelly (1991), and Croce and Horvat (1992).

The participants had very positive attitudes toward the intervention. They seemed to look forward to attending the sessions. The presence of the investigator may have contributed to the positive attitudes and improvements of the participants. They seemed to enjoy the company of the investigator. This could be because each time the participants lifted, they were given verbal praise and encouragement from the investigator. The verbal statements for Shane, Jacob, Jim, and Bob varied and could have been a motivational factor. In addition, participants related well to the investigator and often talked about the happenings of their day and jobs. It was apparent by their attendance that they looked forward to the interaction. They also appeared to recognize the benefits of the progressive weight-training program. For example, Shane and Jacob often stated that the weight lifting was making them stronger and they can lift heavier objects at work and around the house.

Jacob experienced the greatest composite strength gains across all exercises. He was the largest of the four participants and in my opinion exerted the most effort during the weight training exercise. Jacob also participated in martial arts and showed more discipline and commitment when performing the lifting tasks. In addition, he often asked for increases in weight before the designated dates. It should be noted that all weight increases were based upon the percentages of 30-40%, 50-60%, and 70-80% of participants' 1-RM lifts. The progressive nature of the weight-training program allowed for safe increases in strength. Each of the increases and adjustments of the weight machines were conducted or supervised by the investigator.

There were three brand names of weight machines used in this study. Although possible, it would seem unlikely that the different types of weight machine could have affected the rates and amount of strength improvements among participants. All participants in the study used weight machines at facilities that were convenient to them. Although there were three types of machines used, they all worked the same muscle groups. For safety reasons, none of the participants performed exercises on free weights. The investigator made every effort to insure the consistency of exercises.

Lastly, two of the four participants involved in the present study continue to be involved in some type of physical activity, however, not consistently. Jacob is involved with martial arts and Bob participates in weight training once a week. As mentioned previously, the investigator did not formally evaluate participants exercise routines after completion of the study. The data about continued involvement in physical activity were obtained from the participants and their parents. Major deterrents to continued participation seemed to be transportation, lack of facilities, and/or lack of equipment. None of the four participants engage in resistance training at the same intensity and frequency as in this study. However, it is encouraging to know that participants are actively involved in some type of consistent physical activity.

Performance on Simulated Work Tasks

Only one of the four participants showed significant improvements on box stacking and one on the hand truck push. Overall they improved about 25% in hand truck and 15% on box stacking compared to a 60% gain in composite strength. However, each participant did show minor improvements in time to completion on both of the simulated work tasks. The results regarding simulated work tasks are consistent with the literature (Croce & Horvat, 1992; Zetts et al., 1995) in that participants showed improvements in completion times while engaging in a progressive resistance-training program.

Improvements on Simulated Work Tasks

There may have been several reasons why some participants were successful and others were not in the simulated work tasks. Bob was the only participant to have significant results on the hand truck push. Jacob produced significant results for the box-stacking task. That is, they met the criteria for the celeration line, level and trend changes, and score improvements.

Participant motivation and experience with the tasks may be factors offered that contributed to success for Bob and Jacob. For the most part, participants seemed to be motivated throughout the course of this study. They were enthusiastic during the training and testing sessions. Each of the participant's parents indicated that their son was enthusiastic about the workout program used in this study. It could be that participants found the investigator's attention a motivating factor that encouraged them to work hard during the study.

Muscular strength and coordination also are possible factors that may have contributed to the results of the simulated work tasks. Both the hand truck push and the box stacking required a certain level of strength. It was shown that Jacob had the highest increases in strength and improvement in box stacking scores. It is possible that muscular strength is a major factor in the improvement of box stacking scores. This is logical in that each of the boxes weighted 25 lb and a certain level of muscular strength and endurance was needed to place them onto the table

Coordination also could have been a factor in the results of the hand truck push and box stacking tasks. The investigator did not observe any noticeable problems with coordination during the hand truck push task, which required participants to be able to balance the hand truck while moving a distance of 160 ft. They had to maintain control of the hand truck while pushing it around the designated course. It is likely that the lack of coordination could have created problems for some of the participants. Participants performing the box-stacking task had to bend, pick up a box, walk a few steps, and place it on a table or platform. The bending, lifting, and walking required to perform the box stacking requires a certain level of coordination.

Other factors that may have affected the improvements include participants' experience and the complexity of the task. Zetts, Horvat, and Langone (1995) also alluded to these factors as possible reasons for participants' scores in their study. It is very likely that the hand truck push task was unfamiliar to the participants in the present study. Jim was the only participant who possibly would have had experience using a hand truck push. He worked in a mailroom and may have used a hand truck. However, Jim's results on the hand truck push and box stacking were not significant, which shows his past experience may not have helped his work productivity. The participants with possibly the most experience performing the box stacking would have been Shane, Jacob, and Jim due to the nature of their jobs. However, Jacob was the only participant with significant results for the box-stacking task.

An additional reason why some participants did not improve may be that they were still learning the skill during baseline, producing unstable data, which in turn affected the calculation of the celeration line. Participants were given an opportunity to practice prior to starting the study. It could be that more practice time was needed in order to assure the participants were comfortable with performing the simulated work tasks. The simulated work tasks required a certain level of cognition. The participants had to remember how to balance the hand truck and push it for a designated distance. The box stacking required the participants to place the boxes in a certain pattern on a table. Each participant had to be verbally reminded to stack the boxes properly during the baseline and about the first three weeks of the intervention phases of the study. This could have easily caused a distraction and impinged upon participants' completion times. No verbal prompting was needed during the retention phase for any of the participants. On the contrary, Crouch et al. (1984) reported that verbal prompting prior to performing work tasks improved work productivity. It should be noted that the Crouch et al. (1984) study was conducted using the participants' actual jobs and their improvements were required in order for them to keep their jobs. The jobs in the present study were simulated and there were no consequences if participants did not improve which could have affected the participants' motivation to work hard.

Jacob was the only participant that had all intervention data points fall below the celeration line for the box stacking tasks. Again he really worked hard when performing the box-stacking task. Additionally, all the participants seemed to enjoy the box stacking tasks more than the hand truck push. As with the hand truck push, participants had a chance to practice the box stacking prior to starting the study. They were motivated to perform the task and would periodically ask for additional attempts after their testing was done.

Score Variability of Simulated Work Tasks

Baseline measures for the hand truck push scores were not entirely stable. This variability affected the celeration line scores. Although results of the box stacking celeration line showed significance for three of the four participants, the level and trend changes were significant only for Jacob. It should be noted that the participants' unstable baselines possibly confounded the results and contributed to less reliable and valid celeration line scores. Baseline stability needs to be established prior to starting the intervention. This should lead to a more valid and reliable celeration line analysis.

The reason for the variability early in baseline may be due to participants' difficulty in understanding the concept of pushing the hand truck around the designated course. There were occasions during baseline and intervention when participants had trouble completing the course. It may have been difficult for the participants to comprehend the concept of pushing and lifting as quickly as they could. As with participants in the Zetts et al. (1995) study, the men in the present study sometimes stopped or slowed down before completing the course. They hesitated at times and had to be verbally prompted to complete the course. The investigator in this study used only verbal prompting to get participants to complete the course. No physical prompting was permitted during any of the simulated work tasks.

Limitations

A major limitation of the present study involved baseline instability. None of the four participants achieved a stable baseline for the hand truck push task. On the other hand relatively stable baselines were achieved for three of the four participants (Shane, Jacob, and Jim) for the box stacking tasks. The unstable baselines may possibly have affected the celeration lines, which in turn may have compromised the validity and the reliability of the results. The trend of the celeration baseline scores for each of the participants had a drastic downward slope and did not start to stabilize until the intervention. The participants could have been experiencing a learning effect into the intervention phase. Therefore, more time needs to allow to establishing baseline stability.

Recommendations for future research on solving the problem of baseline instability includes establishing stable baselines before starting the intervention, allowing more practice time, and using more visual cues to assist with completion of the simulated work tasks. Participants may have benefited from more practice sessions to increase familiarity with the task. It may have been also possible to allow participants to have more practice trials prior to starting the study. As for the visual cues, the course for the hand truck push was rectangular and the perimeter was marked with colorful cones. It may have helped to include some type of taped and colored line and arrows to show the direction of the course. Although the investigator demonstrated the hand truck push weekly, it may not have been sufficient for optimal learning.

Baseline instability for the simulated work tasks may be attributed to several factors. Baseline scores for the box-stacking task were stable for Shane, Jim, and Bob. This was an indication that they understood the tasks and were performing as predicted. Jacob on the other hand demonstrated some variability near the end of baseline. As previously mentioned, Jacob was experiencing some minor illness during various times during the study. Bob had stable scores but the trend of his baseline data showed a drastic downward slope that suggest the scores he experienced were not as prominent as the celeration line predicted. The results of the box stacking tasks were more stable than the hand-truck push. This was consistent with results from Zetts et al. (1995).

<u>Nature of the Simulated Work Tasks</u>

The simulated jobs used were typical of those performed by persons with mental retardation (ARC 1994, Wehman et al. 1985a). The hand truck push and box stacking tasks used in this study were modifications of those used by Zetts et al. (1995). Although the simulated jobs may have been novel tasks for some the participants, they are appropriate for this and future studies designed to test work productivity in adult males with MR. In addition, the investigator contacted several professionals who have several years of experiences working with adult with MR and they agreed the task are appropriate for person with MR.

The box-stacking task appeared to be the most difficult and strenuous of the simulated jobs. This particular task could potentially have caused the most injury to participants because the boxes were weighted and they had to travel a short distance to put them on the table or platform. Fortunately no one was injured. Participants viewed a training video and received demonstrations from the investigator that detailed proper box lifting techniques. However, they still had to be consistently reminded to maintain proper posture by using the legs to lift and keeping the back straight and head up. The verbal cues seemed to distract participants from the lifting task. For example, when the verbal cues were given, the participants would either stop momentarily or put the box back down on the floor and lift again. Because the cues seemed distracting, they were kept to a minimum and mostly given at the start and end of each trial whenever safety was not compromised.

Improvements at On-site Work Tasks

The results for the on site work tasks were non-significant, probably for two reasons. There was inadequate instrumentation, and the some of the on site jobs did not require the same level of muscular strength as others.

Instrumentation Concerns

The instrumentation used in this study was not sufficiently sensitive to determine the effects of the progressive resistance-training program on the work productivity at participants' actual jobs. Results regarding work productivity of on site job tasks were inconclusive due to insufficient data from job supervisors. This finding is not consistent with the literature. Previous studies have been able to successfully measure work productivity using participants' onsite jobs of bench assembly tasks in a workshop setting (Serr et al. 1994; Beasley, 1982) and general cleaning task of sweeping and mopping in a food service setting (Crouch et al. 1984). For the present study, supervisor's comments were not provided with enough frequency or detail to be helpful. It was a challenge to determine the extent of the participants' improvement at their on-site job tasks. Many of the tasks did not allow for consistent data collection to track improvement. In addition, there were several different supervisors who recorded participants' work data. Having more than one person recording the data may have caused some inconsistencies. The job supervisors were responsible for recording work productivity data. The investigator's role was to communicate with the job supervisors and request that work productivity data be recorded and submitted on a regular basis.

The use of objective methods of assessing productivity such as amount paid and pieces of work completed did not work in this study. The recording instruments used did not allow the investigator to get accurate measures of the participant's productivity levels in relation to the intervention. This could be due to a lack of understanding about the research project by the job supervisors and/or to the nature of the jobs held by the participants. For example, the workshop productivity data were recorded for Shane and Jacob involved their supervisors listing the hours and pay rates and conducting performance ratings with comments at 2-week intervals. The total pay does not provide an accurate prediction of the amount of work completed for Shane and Jacob. The supervisors indicated that the amount received depended on the job contract held by the workshop. That is, participants may work long hours but the pay may be minimal. In addition, the hours and pay rates were not consistent. Attempting to use total pay to determine productivity in relation to participation in the resistance-training program would not provide a reliable measure.

Some of the participants' on-site jobs may not have required as much strength as others did. Each participant performed various tasks at their respective jobs, which made accurate data recording difficult. Shane performed various assemblies and packaging tasks as well as general maintenance and cleaning. Jacob also performed assembly and packaging tasks, was employed as a dishwasher, and performed general cleaning at a local restaurant. Jim sorted mail and assisted with the delivery of packages at a local university. Lastly, Bob performed general cleaning duties at a health club. The various tasks made data analyses and comparisons difficult. Logically, the intervention is likely to be effective only if the jobs required a higher level of strength. The investigator did not obtain adequate data here because of instrumentation problems.

Performance Ratings

The majority of the comments provided by the supervisors were relatively positive or neutral. Although not directly stated, one can determine from the supervisors' comments that they were generally satisfied with the participant's performances on the job. This is consistent with the past literature (Wehman, 1993).

Data regarding job ratings of work performance for all participants ranged from "poor" to "great." The rating of "poor" was only recorded three times during the study, twice by Jacob's supervisors at the restaurant and once by Jim's supervisors in the mailroom. Jacob's rating was followed by comments of "Went home sick on Tuesday complaining of stomach pains, he only worked 2 hours." The other rating had no comment. The "poor" rating for Jim was supported by the comment that he seemed to be distracted and was having a medication change that week. The comments from supervisors generally revealed legitimate reasons for poor job performance.

Attempting to retrieve data on the amount of work participants performed was not practical for the jobs they held. Although encouraged to do so, job supervisors did not provide many open-ended comments. The only supervisors that were forthcoming with this type of information were for Shane (high school) and Jim (mailroom). The investigator contacted all the job supervisors at least twice a month throughout the study. He also encouraged the supervisors to contact him if they had any further questions or concern. None of the job supervisors communicated with the investigator outside of the scheduled contact times. It can be concluded that for this dependent variable, the data have questionable validity and reliability and therefore do not serve as a good basis for statistical analysis. A more feasible method of data collection needs to be developed

Conclusion and Recommendations

This study provides strong support that a 9-week progressive resistance-training program resulted in increased strength for adults with mental retardation. This information confirms earlier findings in the literature. The results in this study are useful to service providers who design exercise programs for this population, employers, parents/guardians, and for the individuals themselves, especially those who are responsible for making their own employment decisions.

The results of this study provide partial support for the hypothesis that increased strength can lead to better performance on simulated work tasks that involve strength. However this study needs to be replicated using a longer and more stable baseline period prior to intervention. Nevertheless, it seems reasonable to conclude that strength gains can be generalized to "real world" tasks for persons with mental retardation. This study did not provide support for the hypothesis that increased strength would lead to increase work productivity at the participants' on-site jobs. The failure to find significant results does not mean that the hypothesis is necessarily untrue. Limitations in research methods made it impossible to fairly evaluate all the hypotheses. This research should be repeated with more valid and reliable ways of assessing productivity.

The practical significance of this study is that there were improvements in muscular strength, partial improvements on work productivity, and positive comments from employers. In addition, participant motivation was high. Although not formally assessed, participants in the study showed great motivation. As previously mentioned, past studies have reported lack of motivation for person with mental retardation. Motivation was not lacking in this study. They attended all sessions and had good weight training sessions. That is, they seemed to make very effort to complete the necessary exercises and simulated work tasks. The investigator made every effort to create a good rapport with the participants. This was done by encouraging and listening to participants when they arrived at their respective exercise and testing sessions. The special attention given to the participants could have further encouraged their participation.

Past researchers have also reported that exercise adherence for this population is difficult. Reasons for this include problems with understanding the task and attention deficits. The participants in the present study attended all weight training and test sessions. The investigator made every effort to make the weight training protocol easy to use. The investigator was always cordial to each of the participants. This may have added to their desire to continue to partake in the investigation. The environment was conducive to a safe and fun weight-training program.

All sessions were conducted in facilities that allowed accessible to the public. This may have made the participants feel as if they were important. They were closely supervised throughout the study and they seemed to become quite familiar with the workout and testing routine by the end of baseline. That is they were able to move to the next exercise on their own and at times verbalized the amount of weight the needed to complete their lifts. Participants also showed etiquette in that they had to remain aware of others who may have been using the equipment ahead of them.

Participants were made aware of their results during all weight training exercises and testing sessions. They often wanted to do better than their previous performance and were excited to come back each week. This is important in that allowing participants with mental retardation to view their scores and results on a consistent basis may encourage them to want to improve each performance. Persons who coordinate exercise programs for these individuals should allow for viewing of data. However, the data given should be understandable to the participants. The investigator in the present study also verbally communicated participants' scores weekly.

Recommendations

Several suggestions/recommendations are offered for future research on strength training and work productivity for adults with MR. These recommendations include the following:

1. Improved instrumentation is needed especially for on-site work tasks. Research needs to be completed that uses valid and reliable methods of determining the effects of

progressive resistance training on work productivity. It may be necessary to have the investigator collect work productivity data or to compensate the job supervisors. If the investigator were to collect the data he would have been able to control for erratic recording. In addition, the investigator would have been able to get the exact data he/she required.

2. There is a need for longer baselines and use a multiple baseline approach where participants must show stability on all measures before proceeding to the intervention. A 5-week baseline period was set prior to the study and the investigator continued with the intervention regardless of baseline stability. Although Barlow and Hersen (1984) mentioned that a minimum of three data points is needed to establish baseline data, more time was needed in the present investigation. Extending the baseline until scores are stable would allow for more valid and reliable results from the trend, level and celeration line data. In addition, the use of multiple baselines would allow the investigator to be more confident that the intervention had an effect on the variables. On the other hand, longer baselines and multiple baselines may be difficult because the variable being tested is strength. There is likely to be improvements just by the nature of the testing. Lastly, motivation and fatigue may be additional factors that make extending the length of the study a difficult task.

3. To promote more efficient strength gains, future investigations should use a protocol that has participants perform 1 set of resistance exercise instead of multiple sets for each lifting exercise for the 9-week period. This may also assist in preventing fatigue and to minimize the risk of injury. To help increase strength efficiency, Brzycki (1995) emphasized that completing 1 set of resistance at capacity at a high level of intensity has

the capacity to increase strength. This type of protocol may be warranted for because persons with MR are known to have limited attention span and adherence in participating in strength training exercises.

4. This study should be repeated with participants of different ages and gender to expand the generalization of the results. If further studies are conducted using other age groups and females, the results can be generalized to assist a larger population of persons with MR.

5. More attention needs to be given to assessing the dependent variables during the retention phase. Extending the retention phase until scores become stable will help to determine the detraining effect and better explain the continued strength gains.

6. Future studies should be done to examine employer attitudes, which may provide additional explanations of participants' productivity levels and overall perceptions of their jobs. It would be beneficial to know how the employers perceive the worker with mental retardation. Results from this data have the potential to provide insight into the hiring and retention practices of employers who have employees with mental retardation.

The results of the present study provide some valuable information for those who work with persons who have MR. It is imperative that we seek ways to better prepare persons with MR for the work force and come to the realization the majority of the jobs they have require some type of physical labor. If persons with mental retardation can benefit from increased strength it would seem imperative that they be given the opportunity to do so. If properly supervised and motivated these persons can become involved in a program that has implications for employment, physical health, self esteem, socialization. The present study has contributed to the research literature by providing a rationale for the use of progressive resistance training to improve the muscular strength and work productivity of young adult males with MR. Much research is still needed to understand the factors that enhance strength and work productivity of working persons with mental retardation.

APPENDIX A

Informed Consent

CONSENT TO PARTICIPATE IN A WEIGHT TRAINING AND WORK TASK STUDY

Dear Parent/Guardian,

My name is Lorenzo Parker. I am a doctoral student at Michigan State University in the Department of Physical Education and Exercise Science. I currently hold the position of Assistant Professor at Chicago State University in the Department of Health, Physical Education, and Recreation. I am writing to ask your permission for your son (NAME: ______________________________________) to participate in my dissertation research.

The purpose of my study is to examine the effects of weight training on the work productivity of adult males with mental retardation. Although no beneficial effects of the weight training program are guaranteed, I expect that the weight-training program will have a positive effect on the participant's health and work productivity. Other benefits may include the following:

1. Your son may learn how to lift weights using Nautilus equipment and be able to improve his muscular strength and endurance.
2. The results of this study may allow your son to learn effective strength training tips.
3. Lifting weights may help your son's health and make him feel and look better.
4. Lifting weights may help your son do his job better.

Participants in this research will be tested once a week during a 5-week baseline period, a 9-week treatment period, and a 6-week retention period (a total of 20 weeks) on the following measures:

- Records will be maintained of his maximum lifts on seven weight-lifting exercise using Nautilus equipment.
- He will be timed as he lifts eight 25-pound boxes from the floor to a table.
- He will be timed as he pushes a hand truck weighted with 85-pounds of boxes around a 160-foot course in a gymnasium.
- I will consult with his job supervisor to obtain records of his work productivity (e.g., number of items produced).

During the 9-week treatment period, participants will attend a twice-a-week weight-lifting class. Each session will begin with light cardiovascular exercise and stretching, continue with weight-lifting exercises, and end with cool-down exercises. Participants will be instructed and reminded as needed about correct posture and lifting technique.

The duration of each testing session (maximal lifts, box stacking, and hand truck push) and each weight training class will be approximately 90 minutes. All testing sessions and classes will be conducted in a weight room and gymnasium at a local facility. I will supervise all testing sessions and weight-training classes. I am an experienced weight-training instructor and am a certified instructor of first aid and CPR. Transportation to and from the weight training facility will be the responsibility of the family or group home.

The risk of injury (e.g., muscle soreness or strain) during this project is no greater than the risk when participating in a weight-training program offered by a health club or gym. The risk may be lower because of the supervision and instruction that is provided. *****If your son is injured as a result of his participation in this research project, the following steps will be taken. If any minor injuries occur, I will administer first aid and will notify you or the group home supervisor.*** If the injury is serious, I will request emergency medical services. The family will be responsible for the costs of any emergency medical services.

I will respect your son's privacy by treating all information with strict confidence. The data obtained during this study will be kept in a locked file cabinet in my office and will be seen only by me, the students who assist with data collection, and my dissertation committee. I will not use participants' names in presentations or publications related to this research. In addition, please note that your son's results will only be shared with you if he agrees to this on the assent form.

I will obtain written consent from the parent/guardian (you) and written assent from your son before beginning this research. Before asking for your son's assent, I will explain the purpose of the study to him and will show a videotape of an adult male performing the weight-lifting exercises and testing tasks involved in this study. Your son will also have an opportunity to ask questions. You may request to see the videotape and you should feel welcome to ask questions before signing this consent form.

Participation in this study is voluntary. Your son may choose not to participate in certain exercises or tasks or may discontinue his participation at any time. Similarly, you may withdraw your permission for your son to participate at any time. There are no penalties for choosing not to participate or for withdrawing from the research.

If you have any questions about this research, you may contact me, my dissertation director, research supervisor or UCRIHS Chair.

Lorenzo Parker (Investigator)
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David E. Wright (UCRIHS Chair)
Office of Research and Graduate Studies
Michigan State University
246 Administration Building
East Lansing, MI 48824-1046
Phone: (517) 355-2180

Please sign and return the form below to Lorenzo Parker at the address listed above. You may keep the description of the study for your records.

I have received a copy of the consent form for Lorenzo Parker's dissertation study on the Effects of a Weight-Training Program on the Job Productivity of Adult Males with Mental Retardation. By signing this form, I voluntarily agree to the provisions of this consent form for my son's participation in this study.

Signature of Parent/Guardian________________________________ Date________________

Name of Participant__________________________________ Date___________________

Check the box below if you would like a copy of the results upon completion of this research

☐ I **Do** want a copy of the individual/study results. *****Please note that results will only be shared with you if your son has given me permission to do so by checking the "Yes" box on his assent form.***

Assent Form

Participant's Name____________________________Date of Birth ______/_____/_____
month day year

This assent form will be read aloud to potential participants. They will also be provided with a written copy of the form and will be given an opportunity to ask questions before they are requested to assent to participation..

Lorenzo Parker told me about this research study and he showed me a videotape about the study. He wants to know if I will get stronger from lifting weights. He also wants to know if lifting weights will help me do more work at my job.

I agree to go to weight-training classes two times a week.

I agree to do the box-lifting test every week.

I agree to do the cart-pushing test every week.

I agree to do the weight-lifting tests every week.

I give permission to Lorenzo Parker to talk to my boss every week. I know that Lorenzo will ask my boss about how much work I did that week.

I can decide if I want to participate in this weight-training study. I know that I can quit at any time. I can say no to doing any of the tests. No one will get mad at me if I say no or quit the study.

Signature of Participant____________________________________ Date________

Name of Participant_________________________________ Date________
(Please Print)

By checking the "YES" box, I give permission to Lorenzo Parker to show or tell my parents/guardians how I did on the lifting and working tasks during the study
[ ]YES

MICHIGAN STATE
UNIVERSITY

September 10, 1997

TO: Gail M. Dummer
132 IM Sports Circle

RE: IRB#: 97-601
TITLE: EFFECTIVENESS OF A PROGRESSIVE RESISTANCE TRANING PROGRAM ON WORK PRODUCTIVITY AND MUSCULAR STRENGTH AMONG ADULT MALES WITH MENTAL RETARDATION
REVISION REQUESTED: N/A
CATEGORY: FULL REVIEW
APPROVAL DATE: 09/08/97

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project and any revisions listed above.
PLEASE ADD DR. DAVID WRIGHT'S NAME, ADDRESS, AND PHONE NUMBER TO THE CONSENT FORM AS A CONTACT PERSON FOR SUBJECTS WHO HAVE QUESTIONS ABOUT THEIR PARTICIPATION IN THIS STUDY.

RENEWAL: UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB # and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/ CHANGES: Should either of the following arise during the course of the work, investigators must notify UCRIHS promptly: (1) problems (unexpected side effects, complaints, etc.) involving human subjects or (2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of any future help, please do not hesitate to contact us at (517)355-2180 or FAX (517)432-1171.

Sincerely,

David E. Wright, Ph.D
UCRIHS Chair

DEW:bed

cc: Lorenzo Parker

OFFICE OF
RESEARCH
AND
GRADUATE
STUDIES

University Committee on Research Involving Human Subjects (UCRIHS)

Michigan State University
246 Administration Building
East Lansing, Michigan
48824-1046

517/355-2180
FAX: 517/432-1171

APPENDIX B

Data Collection Forms

Employment Observation Form

Subject #_____

Name:___________________________________ Date___________

Date of Birth:_____________________ Gender: Male_________ Female_____

Living Environment: Group Home___ Community Living_____ Other______
If Other Please Explain____

Job Site:____

Job Supervisor/Job Coach:____
Telephone: ____________________________

Participants Employment Background Information.

How long have you been at your current job?

How did you hear about this job?

Did you have to have a job interview?

What do you do at your job?

How do you get back and forth to work?

Do you or have you used public transportation to get back and forth to work?

On average how many days of the week do you work?

How many hours per week do you work at your job?

Do you like your job?

What type of job training program were you involved in?

Comment regarding work performance and environment (attitude of participant, attitude of supervisors, work environment, etc).

HEALTH HISTORY/BACKGROUND INFORMATION FORM

Participant #______

Participant Name ______________________________ Date______

Date of Birth:____________________ Date of Verbal Assent______________

Living Environment: Group Home______ Community Living_____ Other______
If other, please explain____

Data to be collected from the participant's parent/guardian or group home supervisor.

Do you have or have you had in the past:

		Yes	No
1.	Any health condition that would be harmful if you lift weights in this study?	____	____
2.	High blood pressure?	____	____
3.	Difficulty with physical activity or exercise?	____	____
4.	History of breathing or lung problems?	____	____
5.	Muscle, joint, or back problems, or any physical injury still bothering you?	____	____
6.	Hernia, or any condition that may be aggravated by lifting weights?	____	____

Please explain any YES answers below:

Please answer the following questions:

Do you like to exercise?

Are you currently taking any medications that could be harmful to you if you lift weights?

How often do you exercise per week?

What type of exercises do you do?

Work Task Data Performance Sheet

Date	Box Stacking 8 boxes, 25 lb each Seconds	Hand Truck Push (160 ft, 85lb) Seconds	Comments
	1. 2.	1. 2.	
	1. 2.	1. 2.	
	1. 2.	1. 2.	
	1. 2.	1. 2.	
	1. 2.	1. 2.	
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	1. 2.	1. 2.	
	1. 2.	1. 2.	
	1. 2.	1. 2.	
	1. 2.	1. 2.	

Participant's Name:______________________________________

Workout Schedule

Participants Name:____________________________________

DATE: Intensity	Leg Extension	Leg Curl	Chest Press	Bicep Curl	Triceps Curl	Back Extension	Abs Curl
Once Wk. Baseline							
1-RM							
1-RM							
1-RM							
1-RM							
1-RM							
Twice/Wk							
30-40%							
30-40%							
30-40%							
30-40%							
50-60%							
50-60%							
50-60%							
50-60%							
50-60%							
50-60%							

Workout Schedule (cont'd)

70-80%							
70-80%							
70-80%							
70-80%							
70-80%							
70-80%							
70-80%							
70-80%							
Once/Wk Retention							
1-RM							
1-RM							
1-RM							
1-RM							
1-RM							
1-RM							

Comments:

Work Performance Forms for Onsite Job Tasks

Name:________________________Job Location: ________________________

Week of:	Job Task	Amount of work completed	Job performance ratings (Check one)			
			Poor	Average	Good	Great

Weekly Comments Regarding Job Performance

Week of:	Job Task	Amount of work completed	Job performance ratings (Check one)			
			Poor	Average	Good	Great

Weekly Comments Regarding Job Performance

Week of:	Job Task	Amount of work completed	Job performance ratings (Check one)			
			Poor	Average	Good	Great

Weekly Comments Regarding Job Performance

Week of:	Job Task	Amount of work completed	Job performance ratings (Check one)			
			Poor	Average	Good	Great

Weekly Comments Regarding Job Performance

Week of:	Job Task	Amount of work completed	Job performance ratings (Check one)			
			Poor	Average	Good	Great

Weekly Comments Regarding Job Performance

APPENDIX C

The Abilities Index

THE A B I L I T I E S INDEX

Rune J. Simeonsson
Donald B. Bailey

Frank Porter Graham Child Development Center
University of North Carolina at Chapel Hill

The ABILITIES Index provides a profile of a child's abilities across 9 major areas. Individuals completing the Index should be familiar with the child and may base their ratings on knowledge of the child, as well as assessment results or available records.

The ABILITIES Index
Rune J. Simeonsson
Donald B. Bailey

Participant's Name:____________________
Date of Birth: ____________________
Program:____________ Date:____________

Instructions: In each column, place an X in the space that best describes the child. Please not that multiple Xs should be recorded under A (Audition), B (Behavior), L (Limbs), I (Intentional Communication), T (Tonicity), & E (Eyes).

	A		B		I	L						I		T		I	E		S
	Audition (Hearing)		Behavior & Social Skills		Intellectual Functioning	Limbs (Use of hands, arms, legs)						Intentional Communication		Tonicity (Muscle Tone)		Integrity of Physical Health	Eyes (Vision)		Structural Status
	Left Ear	Right Ear	Social Skills	Inappropriate Behavior	Thinking & Reasoning	Left Hand	Left Arm	Left Leg	Right hand	Right Arm	Right Leg	Under-stands others	Commu-nicating with others	Degree of tightness	Degree of looseness	Overall Health	Left Eye	Right Eye	Shape, Body Form & Structure
1	Normal		All behaviors typical & appropriate for age		Normal for age	Complete normal use						Normal for age verbal & non-verbal (includes signs, gestures or symbol systems)		Normal		General good health	Normal		Normal
2	Suspected hearing loss		Suspected disability	Suspected inappropriate behaviors	Suspected disability	Suspected difficulty						Suspected disability		Suspected		Suspected health problems	Suspected vision loss		Suspected difference or interference
3	Mild hearing loss		Mild disability	Mildly inappropriate behaviors	Mild disability	Mild difficulty						Mild disability		Mild		Minor ongoing health problems	Mild vision loss		Mild difference or interference
4	Moderate hearing loss		Moderate disability	Moderately inappropriate behaviors	Moderate disability	Moderate difficulty						Moderate disability		Moderate		Ongoing but medically controlled health problems	Moderate vision loss		Moderate difference or interference

The ABILITIES Index (cont'd)

	A		B		I	L						I		T		I	E		S
	Audition (Hearing)		Behavior & Social Skills		Intellectual Functioning	Limbs (Use of hands, arms, legs)						Intentional Communication		Tonicity (Muscle Tone)		Integrity of Physical Health	Eyes (Vision)		Structural Status
	Left Ear	Right Ear	Social Skills	Inappropriate Behavior	Thinking & Reasoning	Left Hand	Left Arm	Left Leg	Right hand	Right Arm	Right Leg	Under-stands others	Commu-nicating with others	Degree of tightness	Degree of looseness	Overall Health	Left Eye	Right Eye	Shape, Body Form & Structure
5	Severe hearing loss		Severe disability	Severely inappropriate behavior	Severe disability	Severe difficulty						Severe disability		Severe		Ongoing poorly-controlled health problems	Severe vision loss		Severe difference or interference
6	Profound hearing loss		Extreme disability	Extremely Inappropriate behaviors	Profound disability	Profound difficulty						Profound disability		Totally tight	Totally loose	Extreme health problems, near total restriction of activities	Profound vision loss		Profound difference or interference

Ratings in each area are made on a scale of 1 to 6, with 1 indicating normal ability, 2 (suspected) indicating some questions about the child's ability, and 6 indicating extreme or profound lack of ability. In making each rating, think about the child compared to other children the same age. Guidelines follow to assist you in making each rating. You may use the space on the back of this form to provide additional information about ratings.

Audition (Hearing) Think about the child's ability to hear in everyday activities. Score hearing for each ear separately. A score of 6 (Profound loss) means that the child has no hearing. Rate the child's hearing without a hearing aid. If the child uses a hearing aid, indicate this on the back of the form.	Behavior & Social Skills Two ratings are make in this area, one for social skills and one for inappropriate or unusual behavior. Social skills refer to the child's ability to relate to others in a meaningful manner. Inappropriate & unusual behavior may include fighting, hitting, screaming, rocking, hand flapping, biting self, etc.	Intellectual Function (Thinking & Reasoning) This rating reflects the child's abilities to think and reason. Thing about the way the child solves problems and plays with toys and compare this to other children of the same age.
Limbs (Use of Hands, Arms, & Legs) Think about the child's ability to use his or her hands, arms, and legs in daily activities. Score left and right limbs separately. A score of 6 (Profound difficulty) means that the child has no use of a limb.	Intentional Communication (Understanding & Communicating with others) Two ratings are made, one for the child's ability to understand others and one for the child's ability to communicate with others. This rating includes attempts to communicate in ways other than talking (signs, gestures, picture boards). Think about the child's ability to understand and communicate with others and compare this to other children of the same age.	Tonicity (Muscle Tone) Think about the child's muscles are neither tight nor loose. If the child's muscle tone is not in the normal range, place an "X" in each box that indicates the degree of tightness or looseness or both. Two rating should be made since, in some children, tightness or looseness can vary in different parts of the body or from one time to the next.

ABILITIES Index (cont'd)

Integrity of Physical Health (Overall Health)	Eyes (Vision)	Structural Status (Shape, Body Form & Structure)
Think about the child's general health. Normal means the usual health problems & illnesses typical for a child this age. If there is a health, problem, ratings should be made indicating the degree to which health problems limit activities. Ongoing health problems may include seizures, diabetes, muscular dystrophy, cancer, etc.	Think about the child's ability to see in everyday activities. Score both the left & right eye. A score of 6 (Profound loss) means that the child has no vision. Rate the child's vision without glasses. If the child uses glasses, indicate this on the back of the form.	This rating reflects the form and structure of the child's body. Normal means that there are no differences associated with form, shape or structures of the body parts. Differences in form include conditions like cleft palate or clubfoot; differences in structure include conditions like curved spine and arm or leg deformity. Ratings should indicate how much these differences interfere with how the child moves, plays, or looks.

You may use this space to clarify ratings or provide additional information.

THE
ABILITIES
INDEX

Individuals interested in using the ABILITIES Index for purposes of research, program planning or evaluation may copy and distribute this instrument as long as the source is recognized. Address all correspondence to: The ABILITIES Project, Frank Porter Graham Child Development Center, University of North Carolina at Chapel Hill, Campus Box #8180, Chapel Hill, NC 27599-8180.

APPENDIX D

Data Files

Table 21

Strength Data Files for Shane's 1-RM Lifts for Baseline, Intervention, and Retention

	Leg Extension	Leg Curl	Chest Press	Biceps Curl	Triceps Extension	Abs Curl
Baseline						
February 25	70	50	80	37.5	35	20
March 4	70	40	80	37.5	30	30
March 11	80	40	80	40	30	30
March 18	80	30	80	40	30	30
March 25	80	30	80	40	30	30
Intervention						
30-40%-1RM						
March 30	80	30	90	40	35	30
April 6	90	30	90	40	40	30
50-60%-1RM						
April 13	90	30	90	40	35	50
April 22	100	50	90	40	35	50
April 29	90	50	90	45	40	50
70-80%-1RM						
May 6	80	30	80	40	35	40
May 13	90	40	60	45	35	60
May 18	120	50	100	50	50	50
May 27	130	50	100	50	45	50
Retention						
June 3	150	50	100	40	50	70
June 10	150	50	110	45	55	70
June 15	160	50	110	55	55	60
June 24	170	60	100	45	55	70
July 1	160	50	110	55	55	60
July 8	160	50	110	50	50	70

Note. Scores are listed in pounds represent the 1-RM lifts for each testing session.

Table 22

Strength Data Files for Jacob's 1-RM Lifts for Baseline, Intervention, and Retention

	Leg Extension	Leg Curl	Chest Press	Biceps Curl	Triceps Extension	Abs Curl
Baseline						
February 25	120	60	70	47.5	37.5	50
March 4	120	70	70	47.5	40	50
March 11	125	70	70	47.5	45	50
March 18	130	60	80	47.5	47.5	50
March 25	125	60	80	45	45	55
Intervention						
30-40%-1RM						
March 30	130	60	80	45	45	50
April 6	140	50	80	45	45	50
50-60%-1RM						
April 13	170	60	100	52.5	67.5	60
April 22	190	60	110	52.5	67.5	70
April 29	210	70	80	57.5	55	60
70-80%-RM						
May 6	210	70	80	57.5	55	60
May 13	210	70	110	60	60	80
May 18	230	80	130	60	60	70
May 27	230	90	140	65	65	80
Retention						
June 3	245	90	140	70	70	80
June 10	260	100	150	80	75	90
June 15	275	110	150	80	75	100
June 24	270	80	140	80	75	90
July 1	270	100	150	85	85	80
July 8	270	90	140	85	75	90

Note. Scores are listed in pounds represent the 1-RM lifts for each testing session.

Table 23

Strength Data Files for Jim's 1-RM Lifts for Baseline, Intervention, and Retention

Abs	Leg Extension	Leg Curl	Chest Press	Biceps Curl	Triceps Extension	Curl
Baseline						
May 19	90	50	90	40	30	30
May 26	90	50	100	45	35	30
June 02	100	55	90	45	35	30
June 09	100	50	90	45	35	35
June 14	100	50	110	40	40	35
Intervention						
30-40%-1RM						
June 23	105	55	110	45	45	35
June 30	105	50	100	50	50	35
50-60%-1RM						
July 05	120	55	110	50	55	40
July 14	120	55	110	55	60	45
July 21	110	50	110	60	65	45
70-80%-1RM						
July 28	130	55	120	50	60	45
August 02	120	50	120	55	60	50
August 11	130	50	120	60	60	60
August 18	150	65	120	65	65	60
Retention						
August 25	155	65	125	60	70	60
September 01	165	65	125	65	65	60
September 08	170	65	130	65	65	65
September 15	165	65	120	65	65	70
September 22	170	60	130	65	65	70
September 27	170	65	120	70	60	65

Note. Scores are listed in pounds represent the 1-RM lifts for each testing session.

Table 24

Strength Data Files for Bob's 1-RM Lifts for Baseline, Intervention, and Retention

Abs	Leg Extension	Leg Curl	Chest Press	Biceps Curl	Triceps Extension	Curl
Baseline						
May 19	80	40	75	35	35	30
May 26	80	40	75	35	40	35
June 02	70	35	80	30	35	35
June 09	85	35	80	35	35	35
June 14	85	35	85	35	40	40
Intervention						
30-40%-1RM						
June 23	85	45	90	40	40	40
June 30	85	45	90	40	45	40
50-60%-1RM						
July 05	90	45	90	40	40	40
July 14	90	45	100	45	35	45
July 21	100	50	90	45	35	45
70-80%-1RM						
July 28	95	50	100	45	40	40
August 02	100	40	100	45	40	50
August 11	130	40	100	50	45	55
August 18	140	45	110	50	45	55
Retention						
August 25	150	45	110	55	50	60
September 01	155	45	110	55	50	60
September 08	155	50	110	55	50	55
September 15	160	50	110	55	50	55
September 22	160	50	115	60	55	55
September 27	170	45	110	50	60	50

Note. Scores are listed in pounds and represent the 1-RM lifts for each testing session.

Table 25

Data Files for Shane's Average Time for Completion of Simulated Work Tasks

	Box Stacking	Hand Truck
Baseline Dates		
February 25	40.92	40.93
March 4	38.89	37.37
March 11	39.10	38.92
March 18	41.44	36.59
March 25	38.54	31.23
Intervention Dates		
March 30	39.45	33.98
April 6	37.62	32.61
April 13	40.98	29.98
April 22	37.34	31.68
April 29	36.28	35.00
May 6	39.14	32.23
May 13	40.90	31.95
May 18	36.48	30.24
May 27	33.18	29.78
Retention Dates		
June 3	34.04	28.15
June 10	32.97	31.65
June 15	35.35	31.40
June 24	33.18	29.00
July 1	35.06	28.09
July 8	40.74	33.03

Note. Scores are listed in seconds and represent the mean of two trials for each testing session.

Table 26

Data Files for Jacob's Average Time for Completion of Simulated Work Tasks

	Box Stacking	Hand Truck
Baseline Dates		
February 25	42.51	43.07
March 4	42.11	39.18
March 11	40.07	38.93
March 18	38.70	38.69
March 25	45.26	33.53
Intervention Dates		
March 30	38.72	33.26
April 6	34.83	31.03
April 13	31.93	29.73
April 22	33.69	31.89
April 29	35.44	30.25
May 6	38.65	33.65
May 13	39.49	32.26
May 18	32.52	30.98
May 27	32.50	28.52
Retention Dates		
June 3	29.78	27.39
June 10	31.56	30.86
June 15	35.81	29.65
June 24	36.28	32.56
July 1	36.75	29.73
July 8	36.50	31.88

Note. Scores are listed in seconds and represent the mean of two trials for each testing session.

Table 27

Data Files for Jim's Average Time for Completion of Simulated Work Tasks

	Box Stacking	Hand Truck
Baseline Dates		
May 19	43.80	50.82
May 26	41.10	51.74
June 02	42.14	50.58
June 09	42.46	48.04
June 14	40.81	48.17
Intervention Dates		
June 23	42.86	47.23
June 30	38.82	49.31
July 05	40.05	45.54
July 14	35.84	43.91
July 21	38.28	42.81
July 28	36.91	41.31
August 02	36.97	42.01
August 11	39.04	40.86
August 18	37.63	42.00
Retention Dates		
August 25	36.20	40.91
September 01	36.99	39.19
September 08	37.30	39.64
September 15	35.45	38.27
September 22	39.20	36.75
September 27	38.71	38.78

Note. Scores are listed in seconds and represent the mean of two trials for each testing session.

Table 28

Data Files for Bob's Average Time for Completion of Simulated Work Tasks

	Box Stacking	Hand Truck
Baseline Dates		
May 19	45.97	46.06
May 26	42.13	46.82
June 02	40.24	45.75
June 09	38.80	45.04
June 14	37.36	44.62
Intervention Dates		
June 23	35.68	41.23
June 30	36.56	40.54
July 05	37.52	40.71
July 14	34.26	41.27
July 21	32.90	38.73
July 28	37.83	38.78
August 02	35.94	36.06
August 11	33.74	34.61
August 18	32.48	32.43
Retention Dates		
August 25	33.11	33.16
September 01	32.76	32.93
September 08	37.91	30.81
September 15	37.61	33.91
September 22	37.09	36.09
September 27	40.16	34.26

Note. Scores are listed in seconds and represent the mean of two trials for each testing session.

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