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### Erratum

## Erratum to “Personal implications of functional electrical stimulation standing for older adolescents with spinal cord injuries”

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**The following is a fully correct version of the above paper**

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#### Abstract

Functional Electrical Stimulation (FES) augmented in-home standing is a life-changing and time consuming assistive technology with the significant potential for increasing the independence of persons with Spinal Cord Injury (SCI). Although positive psychological benefits are often cited as expected outcomes, little is known of the psychologically related effects of participation in FES research applications. To investigate these variables, four older adolescents/young adults with SCI who used FES to stand in their home environments were recruited. This study explores the age specific constructs of self-image, the disability specific constructs of personal independence and handicap, and the person-specific construct of device match for these older adolescents. Results are described in light of disabled adolescent's needs, and future research areas are identified. © 1997 Elsevier Science Ireland Ltd.

*Keywords:* Functional electrical stimulation; Spinal cord injury; Older adolescence; Personal independence; Handicap; Self-image; Quality of life; Assistive technology match.

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## 1. Introduction

### 1.1. *Issues of adolescents*

The period of adolescence is one of many changes — physiological, educational, emotional and social. Konopka (1973) refers to adolescence as the age of commitment, a time when an individual struggles between dependence and independence, moving into interdependence within his environment. Gaining experience in decision making, reflection of self in relation to others, and a formulation of value systems are necessary experiences for healthy development in adolescence. Erikson (1963) emphasizes autonomy, body image, and identity as the main ingredients of adolescence. This integration of previous identities of childhood, through societal and cultural influence, is seen in the autonomous struggles of the adolescent years and the synthesized goal of positive feelings of persona.

Offer et al. (1992) view the adolescent's self-image as encompassing multiple areas of life. Mastery of one area of self-image can occur while failing to adjust in another. Rosenberg (1965) defines self-image as an attitude, opinion or value toward the self, either favorable or unfavorable. Life decisions, physiological and psychological changes, and status ambiguity all account for the heightened awareness of self-image in the adolescent. In a study on life stressors in adolescence, Tolan et al. (1988) found that chronic daily stressors correlated significantly with factors relating to female adolescent's self-image, including body image satisfaction, moral clarity, psychopathology, and superior adjustment.

### 1.2. *Issues of adolescents with disabilities*

Autonomy and independence for adolescents are interpreted in many ways (Erikson, 1963; DeJong, 1979; Crittenden, 1990; Purtillo, 1991; Nosek and Fuhrer, 1992). Yet for adolescents with disabilities their issues are much different. Crittenden (1990) defines a theoretical concept of autonomy in adolescents with disabilities as encompassing two developmental processes. Accepting responsibility for one's own actions and for deci-

sion making is the first process. The second includes forming supportive relationships which consist of transforming more mutual parent-child relationships, establishing a peer support network, and developing reciprocal peer attachments to replace the primary parent-child relationship. An individual's autonomy occurs not only in the family but also in the community environment.

This conceptualization of autonomy is consistent with the Independent Living (IL) philosophy (DeJong, 1979; Nosek and Fuhrer, 1992). The IL philosophy is comprised of four components: (1) perceived control over one's life; (2) functioning at physical and cognitive levels; (3) psychological self-reliance; and (4) characteristics of the physical and social environment. The IL movement focuses on assisting the person with a disability in becoming more independent in the community by advocating for services, educating others as to one's needs and providing for the opportunity to take control over one's life (DeJong, 1979).

The normative developmental tasks of adolescence, that of body image, separation from peer group and family unit, achieving independence, sexual identity, aggression, educational and vocational development, and depression are especially challenging for the adolescent with a disability (Goldberg, 1981). Some of the psychological effects of chronic illness in adolescents include changes in relationships with peers, siblings and parents, disruption of normal life, and in particular the restriction of freedom (Zeltzer et al., 1980). Resnick and Hutton (1987) investigated self-image, happiness, anxiety and body image among adolescents with cerebral palsy. Significant relationships were found between adolescents' self-image and daily functioning, including friendships, household responsibilities, disabled peer group, and self-perception of disability.

Cook (1985) describes a 'dual trauma' in adolescents with spinal cord injuries (SCI). The typical adolescent needs of independence, decision-making, identity, sexual identity, body image, and socializing are seen as confounded by the addition of a traumatic injury and the process of returning to an increased or pre-morbid level of independence (Rutledge and Dick, 1983). The potential alterations in life following SCI are best

evaluated with an understanding of the adolescent's specific developmental needs at the time of injury. For instance, younger adolescents will likely be concerned with being 'normal', becoming injured at this time could potentially lead to social isolation from previous peer groups. Middle adolescence is marked by concern with body image. SCI occurrences at this time could lead to a lack of social skill experiences and decreased self-esteem. At the time of late adolescence, SCI could result in perceptions of isolation due to possible problems in developing intimate relationships or attaining educational and vocational goals (Rutledge and Dick, 1983).

The notion of a dual trauma as described above is also explained by Wright (1983), where the adolescent with a disability is coping with two situations that are overlapping and persistent. The situations are those experienced as a result of the disability and those occurring as a result of the transitional period of child–adult. These simultaneous situations may continue on past the typical span of years. The disability may cause the later adolescent issues of attaining autonomy to be persistent beyond expected adolescent years. Others too have supported the view that social maturation and other psychosocial milestones may be likely to extend through to the early twenties (Siegel, 1987), although individual differences may exist.

Studies have arisen that investigate the importance of change in the lives of adolescents who have sustained a spinal cord injury (Dewis, 1989; Mulcahey, 1992). Dewis (1989) found that adolescents with SCI were concerned with normalcy and being valued. Normalcy concerns centered around maintaining physical appearance and function, maintaining gains in physical and emotional independence, and maintaining social skills and interpersonal relationships. Evaluations of adolescent's perceptions about returning to previous school environments after SCI showed similar issues (Mulcahey, 1992). After interviewing adolescents with SCI concerning feelings, perceptions and experiences, the following themes emerged from their comments: people's reactions (teachers, friends, peers), role change, self-image, coping strategies, accessibility, and feelings.

### *1.3. Issues of spinal cord injury*

Research and literature on aspects of spinal cord injury abound, especially in the areas of physiological and functional changes. Persons with SCI are confronted with several psychological and physical issues that can relate to their overall adjustment to their disability. Many professionals believe that pre-disability factors relate to this adjustment process (Trieschmann, 1988). Even though there appears to be certain pre-disability commonalities among persons with SCI, Trieschmann concludes that there is no evidence of a unified SCI personality. Trieschmann theorizes that the components of the person's adjustment should be more of a focus than specific personality features. Trieschmann proposes a model that explains the behavior of persons with SCI. Behavior, health and adjustment, are a function of the interaction of psychological, organic, and environmental factors. This model is used to guide professionals in the rehabilitation process and has implications in trying to conceptualize the needs and behaviors of individuals with SCI.

In a review of spinal cord injured individuals overall independent living outcomes, living arrangements and productivity, DeJong et al. (1984) found that the significant factors of barriers to transportation, economic disincentives, education, marital status, and the severity of the disability were important in the prediction of the ability to live independently following medical rehabilitation. Self-concept, perceived independence and mobility among individuals with SCI were studied by Green et al. (1984). Respondents who believed that they were as independent as possible had more positive self-concepts, including the dimensions of personal self, moral-ethical self, social self and physical self than those who thought they were less independent.

Transportation and mobility, are other common concerns of persons with SCI (Heinemann et al., 1987; Stallard et al., 1989). Mobility can affect many aspects of life, including perceptions of increased independence in persons with SCI.

Most of the above studies concern factors that are attributed to disability and SCI and are investigations of these issues on the levels of disability

and bodily impairment. Inherent in the lives of persons with disabilities and those with SCI is the effect of disability and impairment at the societal level. The World Health Organization's (WHO) (1980) model of disablement consists of three components, impairment, disability and handicap. Impairment deals with loss or abnormality at the anatomical and physiological level. Disability occurs at the person level and is measured by the ability to perform various activities. Handicap occurs at a societal level and is defined as the degree of advantage or disadvantage one encounters due to disability or impairment. These advantages or disadvantages are specific to performing and fulfilling normal roles based on age, sex, and social and cultural factors (World Health Organization, 1980).

#### *1.4. Assistive technology devices*

Increases in technology have afforded persons with disabilities greater independence in the community and in daily life. An assistive technology device (ATD), as defined in the Technology-Related Assistance of Individuals with Disabilities Act of 1988 (PL 100-407, p. 3), is 'any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities'. Assistive device use and abandonment have been thoroughly documented in the literature (Garber and Gregorio, 1990; Brooks, 1991; Phillips and Zhao, 1993). Phillips and Zhao (1993) reported an abandonment rate of 29.3% for assistive devices and found four factors that significantly related to non-use. The factors of change in user needs, i.e. easy attainment of the device, poor performance of the device and lack of consideration of the user's opinion during selection were related to abandonment among 227 users of assistive devices with various disabilities. Garber and Gregorio (1990) investigated the assistive devices used by persons with cervical level SCI. An abandonment rate of 46% was found for the first year after acute rehabilitation. Most frequently cited reasons for discarding devices for these participants included improvements in phys-

ical functioning and finding alternative solutions to their assistance needs.

A few studies have investigated assistive technology device use by pediatric populations (Caudrey and Seeger, 1983; McGrath et al. 1985; Parette and VanBiervliet, 1991). McGrath et al. (1985) reported on the device use and satisfaction of 502 families in Canada. Utilization rates ranged from 77 to 100%, devices kept 8.3% of the respondents from performing important and very important activities, and 70% of the respondents felt their devices were somewhat or very attractive. Parette and VanBiervliet (1991) report that children respond best to technology when they have peer support and the technology can act as social support to families by decreasing performance of certain stressful tasks. Further, the authors recommend that when matching assistive devices with children with disabilities the child's characteristics, the home environment, the family needs and the characteristics of the technology need to be considered. High usage rates of newly prescribed equipment among children with disabilities was determined to be attributable to a forced compliance by parents, teachers and therapists in one study (Caudrey and Seeger, 1983).

Infrequently, assistive device literature goes beyond mere use and abandonment, percentages and reasons, and seeks to determine causal factors and person-centered aspects of technology use (Scherer, 1988, 1990). In a qualitative study of individuals with SCI and cerebral palsy, 10 assistive device users and non-users were compared based on functional measures, personal capacities, temperament and observations and interviews. Scherer (1988) found a dynamic relationship between technology use, temperament, personal characteristics and quality of life. Successful ATD use was linked to a belief that technology will benefit the user, and technology use was found to be influenced by the characteristics and nature of the purpose of use; to characteristics of the technology; to cognitive, personality and temperament characteristics of the user; and psychosocial characteristics of the users environment. In a follow-up study of the same ATD users plus two more, Scherer (1990) found longitudinal support for the findings of the first study. In both

of these studies, persons with SCI judged assistive devices on how well they replaced their pre-injury functioning, and SCI users of ATDs viewed their assistive devices as tools that enabled them to complete activities and attain independence.

### *1.5. Functional electrical stimulation*

Functional Electrical Stimulation (FES) is the application of low levels of electrical stimulation to paralyzed nerves and muscles, which allows for functional movement and increased daily living skills (Peckham, 1988). FES results in the restoration of functional movements and some applications are reported to lead to the prevention of secondary medical complications (Yarkony et al., 1992). Some of the functional applications of FES include restoration of hand grasp, and standing and walking under controlled situations (Heetderks and Hambrecht, 1988). The main goal of this technology is increased function at the disability level and subsequent independence.

The possible psychological effects of applications of FES have received little attention in refereed journals. In a review of the literature, Harvey et al. (1992), found nine articles that directly and indirectly addressed the psychological effects of functional and therapeutic uses of FES. Some of the cited effects of FES therapeutic applications have been an increase in self-esteem, mood factors and self-image, and improvements in depression and anxiety (Robinson et al., 1988; Sipski et al., 1989; Alexander and Sipski, 1990). Staff perceptions of the psychological benefits of FES exercise graduates included increases in mood, independence, self-esteem, future planning, and positive healthcare behaviors (Harvey and Bradley, 1992). Relatedly, participants perceived increases in psychosocial adjustment (Bradley and Harvey, 1993). These perceived changes included psychological changes in self-esteem, sense of independence and self-confidence, and positive effects.

The psychological aspects of FES augmented standing and walking were investigated by Heinemann et al. (1985). Results suggest an individualized psychological evaluation to better determine

the specific needs of participants, especially those with unrealistic expectations of FES technologies. Personal, environmental and social characteristics of the SCI participant should be evaluated to assist in coping with the changes afforded by this technology (Baker et al., 1989). Bradley (1994) found similar concerns in affect, especially depression and hostility, particularly among FES exercise participants with unrealistic expectations of the exercise program (expectations to stand and walk unassisted). Implications of these studies show a need to more closely evaluate the psychological effects of this ATD.

### *1.6. Purposes of the study*

The most basic issue in considering an assistive technology is the overall effect it has on the user. Assessment of standing and mobility technologies are predominately related to physiological and functional improvements and development of devices (Kantor et al., 1993). Ironically in view of their importance qualitative evaluations of technology and related implications of changes in Quality of Life (QOL) are rare. However, studies suggest that individuals with disabilities who use assistive devices have higher rates of adjustment, a sense of positive well-being and increased independence in activities (Scherer, 1990). In determining the QOL of adolescents and children with disabilities Rosenbaum et al. (1990) recommend that evaluators recognize the unique characteristics and developmental needs of this population. In addition to developmental change, the evaluation perspective (child, parent or professional) needs to be determined (Pantell and Lewis, 1987). Starfield (1987) advocates the use of QOL measures that evaluate areas of importance to children, not to adults. In order to fully ensure that adolescent QOL is evaluated, Rosenbaum et al. (1990) suggest the use of multiple or additional sources of QOL areas for pediatric populations.

The current study assesses psychological perceptions related to disability, subjective responses concerning ATD use, and constructs reflecting adolescent issues in four older adolescents with traumatic spinal cord injuries. These persons have

been research participants who were using or had previously used an FES standing system in their home. They have undergone an extensive program for muscle conditioning and training via percutaneous intramuscular electrical stimulation, including laboratory standing in a research setting in a small pediatric orthopedic rehabilitation facility (Hunt et al., 1994).

Because of the nature of spinal cord injury, the developmental needs of older adolescents, and the implications of changes due to FES application, this study investigates participant's feelings about personal independence, handicap and self-image. As the FES system is a promising assistive device and time consuming application, aspects of ATD match are also determined. The purpose of this investigation is to uncover and verify qualities of older adolescent users of FES standing systems and aspects that have the potential to add to successful use. Using a post-hoc investigational design, the results are presented on a case-by-case basis to glean a more detailed view of individual needs and feelings. When applicable, results between subjects are compared.

The hypotheses are: participants who regularly use their FES systems will have positive perceptions of self-image; frequent FES users will perceive an increased personal independence compared to those who do not use their standing systems; participants with high levels of personal independence will also show decreased perceptions of handicap; and participants with low levels of use will show problems in the area of the device in the person/technology match.

Results of this study have potential significance in the practice of FES research and the application of expensive and time-consuming assistive technologies to older adolescents with spinal cord injuries. Psychological benefits and needs can be identified during the early stages of research participation. Areas of mismatch between these young adults and ATDs can be determined and clinical intervention or device adaptations can be made to ensure optimal ATD use. This type of QOL assessment can help to guide interventions and research designs meant to create positive changes that can be realized by FES or similar technologies.

## 2. Methodology

### 2.1. Participants

As of 1994 the four adolescents of this study were the only research participants who had taken part in both laboratory based and in-home standing in a research project involving FES. Three are female and one is male, all had acquired traumatic spinal cord injuries resulting in paraplegia. Participant number 1 is an 18-year-old male, number 2 is a 21-year-old female, number 3 is a 21-year-old female, and participant number 4 is a 20-year-old female.

All successfully completed the laboratory based phase of an in-home standing program, including practical experiences in standing during different home and community scenarios. The participants were then discharged to their homes with a standing system and encouraged to stand using FES as needed and to exercise daily to maintain strength and endurance. Periodic returns to the hospital for follow-up services included evaluations of strength and endurance testing, functional standing, compliance, testing of hardware, and re-implantation of electrodes and reprogramming if needed (Triolo et al., 1996).

### 2.2. Instruments

#### 2.2.1. *The Offer self-image questionnaire, revised*

The Offer Self-Image Questionnaire, Revised (OSIQ-R) is a self-report inventory used to measure adjustment and self-image of adolescence (Offer et al., 1992). The test is composed of 129 questions and uses a six-point Likert response scale. Self-Image is defined in terms of 12 areas:

- Impulse control
- Family functioning
- Self-reliance
- Emotional tone
- Self-confidence
- Mental health
- Body image
- Vocational attitudes
- Sexuality
- Social functioning

- Ethical values
- Idealism

The OSIQ-R provides a profile of an adolescent's feelings based on the above 12 areas. Raw scores are translated into standard scores with a mean of 50 and S.D. = 10. Scoring includes validity and reliability checks to determine if the responses reflect inconsistencies or the adolescent's true feelings. Score summaries are provided with comparisons of the individual's results to a norm reference group with similar demographics (low standard scores below 40, and high standard scores above 60). Although designed for adolescents aged from 13 to 18, Offer et al. (1992) state that the OSIQ-R can have significant value when applied to young adults dealing with the issues of adolescence. Because of the potential for continuation of psychosocial needs when adolescence is paired with disability, the OSIQ-R is a valid measure of self-image for this group (Siegel, 1987). For those adolescents over 18 years, standard scores are compared to the closest available normative group of 16–18-year-old females. Reliability and validity are acceptable for this questionnaire for the intended adolescent population (Offer et al., 1992).

#### 2.2.2. *The personal independence profile*

The Personal Independence Profile (PIP) (Nosek et al., 1991) is an instrument developed to test the psychosocial constructs of independence in persons with physical disabilities as proposed by the IL philosophy (Nosek et al., 1992). The PIP includes four components of independence: (1) perceived control over one's life; (2) psychological self-reliance; (3) physical functioning; and (4) environmental resources (Nosek and Fuhrer, 1992). Part I consists of 10 questions, using a five-point Likert scale, to measure perceived control over 10 areas of life. Part II consists of 34 items, using a five-point Likert scale, measuring psychological self-reliance. Part III has 25 items assessing the users degree of independence from others in physical activities of daily living performance. Part IV includes 16 nominally scaled questions that look at environmental resources of housing, education, income, employment, and transportation and are meant to be used as comparisons to the

first three sections. The items of importance to this study which were identified from Part IV include residence accessibility and transportation to reflect mobility related areas and needs. Participation in organizations and leisure time inside and outside the home is included in the analysis because it is reflective of social and peer integration. Items reflecting the adolescent's perception of health and level of independence are also evaluated due to their importance in further determining perceived self-image and personal independence (Possible scores for Part I range from 10 to 50; Part II range from 34 to 170; and Part III range from 5 to 10). The PIP is an assessment in the process of normalization. Raw data is assigned to a scoring algorithm procedure to determine independence clusters. Scoring algorithm procedures and resulting assignment to the three independence profile clusters were not available from the PIP authors at the time of data analysis. Preliminary reliability and validity testing supports the PIP and its sub-scales show acceptable internal consistency (Nosek et al., 1992).

#### 2.2.3. *The Craig handicap reporting technique*

The Craig Handicap Reporting Technique (CHART) is a measurement tool used to determine the construct of handicap as suggested in the model of disablement proposed by the WHO. The CHART is a 27-item objective measure of the degree to which disabilities and impairments result in handicap at the societal level, compared to norms for persons without disabilities. Results produce an overall index of handicap and the dimensions of handicap of physical independence, mobility, occupation, social integration and economic self-sufficiency (Whiteneck et al., 1992a). Psychometric properties of reliability and validity have been established through test-retest, proxies and independent raters, as well as Rasch analysis to verify scoring procedures (Whiteneck et al., 1992b). As certain items in the CHART have been determined to be questionable in administering to an adolescent population, these items have been adapted to meet adolescent societal roles and status as recommended by Whiteneck (personal communication, July 27, 1993).

#### 2.2.4. *The assistive technology device pre-disposition assessment*

The Assistive Technology Device Pre-disposition Assessment (ATD-PA) is based on the Matching Persons with Technology model (MPT) (Scherer Associates, 1991). The MPT model states that the characteristics of the person, the milieu, and the technology need to be considered when using a given technology (Scherer Associates, 1991; Scherer and McGee, 1991). The ATD-PA consists of Likert scored items and checklists divided into sub-scales, assessing the given technology, the individual's temperament, the environment within which the technology will be used, and the influence of disability on technology usage and quality of life (Scherer, 1993). The degree of consumer and technology match is evaluated through the comparison of sub-scores in the areas of Assistive Device, Temperament, Disability and Psychosocial Arena. As this type of FES system is still a research technology and thus fully funded for participants, some scores were changed to reflect funding availability at the time for these adolescents. The device funding question is included in both the Psychosocial Arena and Assistive Device sub-scale areas. For the subjects who responded to the funding question as if it were not a fully funded piece of assistive technology, responses were given a value of 4.5, reflecting that most expenses incurred as a result of using this device had been met with the consumer's available resources (i.e. research funds). These changes were necessary to allow for comparison to other subject's responses. Inter-rater reliability

and content and criterion-related validity have been established for this instrument (Scherer, 1993; Scherer Associates, 1991; Scherer and McGee, 1992).

#### 2.3. *Procedure*

Participants were sent the four questionnaires and a demographic survey to record aspects of their disability, years since injury, level of injury, and FES compliance and usage patterns. They were instructed on matters of informed consent, explained of their rights of participation, and encouraged to contact the researcher with problems or questions. A self-addressed stamped envelope was provided for returning data. The study was approved by the Illinois Institute of Technology's University Human Subjects Institutional Review Board.

### 3. Results

Results of this investigation are described below for each individual by test area.

#### 3.1. *Demographic information*

Specific participant demographics are represented in Table 1. The age range is from 18 to 21 years, and the range of years injured was from 2.25 to 11.6. Participant #1 (P#1) had been using FES to stand at home for 3 months. He stood approximately 1.4 times a week for physical (to stretch) and leisure/recreational (enjoy the

Table 1  
Demographic summary

Subject	Variables			
	No. 1	No. 2	No. 3	No. 4
Gender	Male	Female	Female	Female
Age	18	21	21	20
Years injured	11.6	2.25	5.5	3.8
Age at injury	6	18	15	16
Injury level	T8–T10	T12	T4–T5	T5–T6
Injury cause	Motor vehicle	Gun shot wound	Motor vehicle	Motor vehicle
Occupation	Full-time student	Full-time student	Full-time student, part-time receptionist	Part-time receptionist



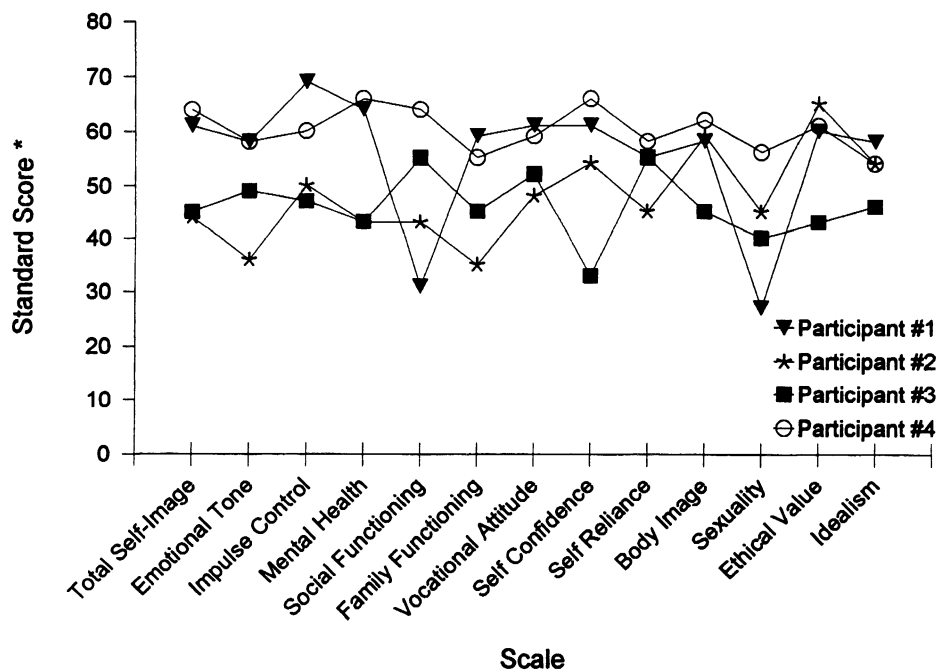
weather) activities. He did not use FES in any other environments. Other activities performed with FES were exercising about 3.5 times per week. When deciding not to use the system when opportunities existed, he cited environmental reasons (cold outside, no room inside), school-related reasons (homework), physical reasons (sickness), motivational (laziness) and device-related reasons (rare electrode malfunction).

Participant #2 (P#2) had been home using the FES system to stand for 12 months. She reported not using her system for standing for the 2 months prior to data collection. FES activities performed included reaching (to get to dishes) and house-keeping (do the laundry). She did not use her system in other environments, although she did use the system for exercise about two times per week. At the time of data collection, P#2 had withdrawn from the research program and was no longer using FES. The device-related reason for not using the system when available was ‘taking too much time to hook up’.

Participant #3 (P#3) had been using the FES

standing system at home for 24 months. In the 2 months prior to data collection she used her system approximately 2 times per week to stand and perform mobility related (perform swing to’s), physical/appearance related (look in the mirror) and personal related (to stand for the sake of standing) activities. P#3 reported using the system at friend’s homes as well as her own, and had exercised about two times per week in the past 2 months. Reasons for not using the system included physical (feeling tired or sick), and device related (not enough time and not charged).

Participant #4 (P#4) had been using the FES system for 6 months at home and reported using it approximately two time per week. She used the system for reaching activities (getting things from high places) and accessibility (getting in and out of places too crowded or small for her wheelchair). This participant used FES in other areas besides her home environment, including friends vehicles and inaccessible public areas. She reported exercising about 3.5 times per week for the 2 months prior to data collection. P#4 reported the



\* standard scores:  $M = 50$ ,  $SD = 10$

Fig. 1. Summary: Offer Self-Image Questionnaire — Revised (OSIQ-R).

device-related reason of taking too much time to hook up for not using the system when she might have been able.

### 3.2. Offer self-image questionnaire — revised

Fig. 1 depicts results of the participants' standard scores related to self-image. P#1's Total Self-Image score falls within the 86th percentile which is considered high. Lower sub-scales include Social Functioning and Sexuality. Higher areas include Impulse Control, and Mental Health. A poor response consistency was found in social functioning questions, which might have weakened the scale's validity for P#1. The second participant's Total Self-Image score falls within the 27th percentile, this is considered to be an average self-image. Weaknesses are evident in Emotional Tone and Family Functioning, while strengths are found in Ethical Values. The Emotional Tone sub-scale contained inconsistent responses for P#2, possibly reducing the reliability of this scale. This one area did not reduce the reliability of any other scale or Total Self-Image. Intra-individual differences, which is a comparison of performance on individual scales and

overall Self-Image, were evident for P#2 in Self-Confidence and Body Image. There is indication of possible symptomatology to clinical group profiles through the comparison of her Total Self-Image score. For the OSIQ-R, scores over +0.30 suggest the possibility of a match with clinically diagnosable groups. P#2's similarity coefficients were +0.51 for single episode depression, and +0.47 for suicide attempt or at risk. The third participant scored within the average range in Total Self-Image, at the 31st percentile. Her lower area is in the Self-Confidence sub-scale, the remainder of her sub-scores are in the average range. P#4's Total Self-Image was at the 92nd percentile, representing a high self-image. Strengths exist in Mental Health, Social Functioning, Self-Confidence and Body Image. Other sub-scales for her were in the average range. An intra-individual discrepancy was evident in the Family Functioning sub-score.

### 3.3. Craig handicap reporting technique

Fig. 2 shows results of the participant's percentile ranks related to handicap. Overall, CHART Combined scores placed participants in

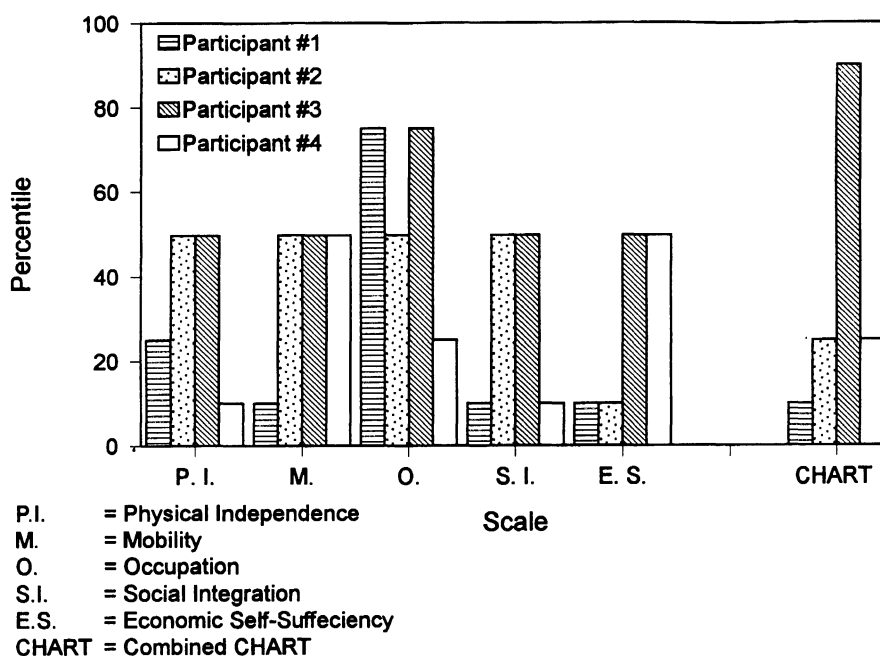


Fig. 2. Summary: Craig Handicap Reporting Technique (CHART).

percentile ranks of 10th, 25th, 90th, and 25th, respectively. Higher percentile ranks are seen in the area of Occupation for P#1 and P#3 (75th percentiles). Lower rankings (less than or at the 10th percentile) were experienced by P#1 in Mobility, Social Integration and Economic Self-Sufficiency; by P#2 in Economic Self-Sufficiency; and for P#4 in Physical Independence, and Social Integration. The third participant had no handicap indicators that were below the 50th percentile.

### 3.4. Personal independence profile

Because norming procedures were not available for the PIP sub-scales results are given in raw scores and referenced by the possible range, and specific answers to the last section on Environmental Resources are discussed. For all areas of the PIP, higher scores are considered to be indicative of increased feelings of independence. Scores for Perceived Control (range = 10–50) were 39, 41, 37, and 42 for the participants, respectively. Psychological Self-Sufficiency raw scores (range = 34–170) were 140 for P#1, 118 for P#2, 124 for P#3, and 120 for P#4. In the area of Physical Autonomy, the mean of the raw scores (range = 5–10) for participants were 6.1, 6, 6.1 and 6.4, respectively. For the first adolescent, the Environmental Resources questions revealed ready access to his residence, dependency on rides for transportation needs and lack of participation in any organizations. He was not involved in any leisure activities outside his home, spent approximately 1–2 h per day engaged in in-home leisure activities, perceived his health as excellent, and rated his independence as high. The second participant reported ready access to her home, was independent in transportation needs and participated in outside organizations now and again. She spent 15 or more hours per week in leisure activities outside the home and 1–2 h in leisure activities inside her home, perceived her health as excellent, and felt a very high level of independence. P#3 reported her residence as readily accessible, used transportation independently, and participated in organizations many times per month. She was engaged in leisure activities out-

side the home 6–14 h per week, spent 1–2 h per week in leisure activities in the home, perceived her health as good and expressed a high level of independence. For the identified PIP variables in Environmental Resources, P#4 reported ready access to her residence, was independent in transportation needs and participated in organizations now and again. She participated in leisure activities 6–14 h per week outside the home, and 4–6 h of in-home leisure activities per week. This older adolescent perceived her health as excellent and her level of independence as very high.

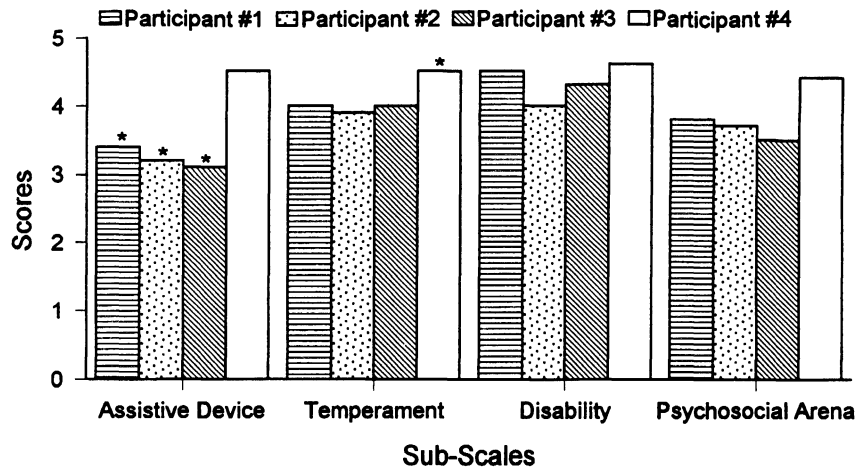
### 3.5. Assistive technology device pre-disposition assessment

Fig. 3 is a summary of scores for the participants in the ATD-PA. Problematic areas were indicated in the Assistive Device area for P#1, 2, and 3, and in Temperament for P#4. The first participant's scores ranged from 3.4 to 4.5 (4.5 = Disability sub-scale). The range for P#2 was from 3.3 to 4.0 (4.0 = Disability sub-scale). P#3 had a low score of 3.3 and a high score of 4.0 in Temperament. The lowest score for P#4 was 4.5 and her highest was a 4.7 in the Assistive Device area.

## 4. Interpretation

### 4.1. Participant #1

P#1's OSIQ-R scores present a mix of strengths and weaknesses compared to normative data. His scores indicate an older adolescent with an ability to delay gratification. He is oriented towards traditional educational attainment with a focus on the future. His strong Self-Image is a reflection of his confidence in his abilities and seems to be attributable to great skill in dealing with frustration. Ethically, P#1 has a well-cultivated sense of responsibility and concern for others. Lower self-image areas for this young man includes poor object relations and feelings of discomfort in social situations. This is further reinforced by his placing in the 10th percentile in the CHART sub-scale of Social Integration. It seems that P#1 does not choose to be integrated in customary social relationships with peers at the time. In



\* Lowest score and potential problematic area for this participant

Fig. 3. Summary: Assistive Technology Predisposition Assessment (ATD-PA).

addition, his placement in the less than 10th percentile in the CHART sub-scale of Mobility supports a lower self-image. Lack of social integration might also reflect his dependence on transportation or his low CHART Economic Self-Sufficiency scores. It seems that he has neither the opportunity nor the economic resources to partake in social interactions.

In regards to Personal Independence and indications of Handicap, P#1's scores present an individual who is feeling the societal implications of his disability yet able to overcome these and feel a fairly strong sense of Personal Independence. Although he has limited economic resources, limited ability to control his mobility and transportation needs, and limited participation in social activities, P#1 perceives himself to be psychologically self-sufficient. The overall CHART score, an indication of a disadvantage in fulfilling societal roles, should be interpreted with his individual differences in mind. P#1 might not fit into the expected role of an 18-year-old adolescent, but his other scores indicated that this disadvantage is not a problem for him.

P#1's scores related to assistive technology match indicate that the ATD-PA sub-scale area of the Assistive Device reveals a potential deficit in the match between himself and the FES system. In reasoning why he did not use the system

when he could have, P#1 listed more personal and device-related situations compared to others. However, he is the only one to reveal a social/role-related reason for not using the system, that associated to school work. Vocational and personal achievement appear to be important to P#1, as is reflected in certain high Self-Image sub-scores. He does not appear to utilize creativity in other areas to stand other than his home environment. This might be due to only having 3 months of in-home use of FES. He does, however, express originality in activities that he does when standing, such as stretching and leisure activities. It seems that he has started to incorporate the standing system in other areas of his life.

#### 4.2. Participant #2

According to OSIQ-R data, P#2 shows an overall Self-Image on the lower end of average of the normative distribution. Her combination of significant strengths and weakness suggests an unusual mix in her evaluation of Self-Image. She has a well-cultivated sense of responsibility and the capacity to take the viewpoint of others. Other scales indicate feelings of poor affective control, frequent depression and tension and a focus on the negative. Some tension was evident in experi-

ences at home. It seems that P#2 gets along rather poorly with her parents, whom she perceives as being non-supportive of each other and other family members. Overall, her Self-Confidence is an area that engenders a Self-Image that is closer to average, in that she is able to deal with frustration and feels relatively confident of ultimate success. Her Body Image score is also an aid in elevating her overall Self-Image. This older adolescent possesses strength in her confidence about her body, feeling relatively healthy and attractive. What is of concern for this participant is the indication of symptomatology compared to clinical groups. Her Self-Image profile is similar to clinically diagnosable group profiles of low affect. Because her Total Self-Image and profile sub-scores are not sufficiently below average, these coefficients are likely to be lower than expressed. It is unclear from the OSIQ-R and the other assessments whether she actually is similar to peers with single episode depression or those who have attempted suicide/are at risk for suicide.

Her ATD-PA sub-scores reveal that the Assistive Device poses a potential problem in the technology/person match. Her only reason for not using the system is device related. As well this young adult reports not using the system during the 2 months prior to data collection. The use responses and the decision to no longer have the FES system reflects the mismatch between P#2 and the standing system.

In regards to Personal Independence, she has a relatively high Perceived Control of her life, yet low Psychological Self-Sufficiency and Physical Autonomy. These perceptions appear to be not so much an issue for her since her parallel CHART score of Physical Independence are high in comparison to the other participants, and she views herself as having a very high level of independence. P#2 is very active, reporting the most hours of leisure activities outside the home which falls within the 50th percentile in Social Integration. As far as societal handicap, she has the second highest combined CHART score, indicating an advantage in being able to adequately fulfill expected roles for a 21-year-old.

Given the opportunity to use the FES system

for 1 year in her home environment, P#2 did not appear to utilize the system as often or as creatively as the others with both more and less FES experience. This might be a result of assistive device mismatch, low Psychological Self-Sufficiency, perceived lack of appropriate psychosocial and family support, or comparative similarities with suicidal and depressed clinical groups. It is unclear if the low system use is due to one or some combination of these factors.

#### 4.3. Participant #3

P#3's lowest OSIQ-R score is in the sub-scale of Self-Confidence suggesting a predominant attitude that achieving goals is not worthwhile. Other scores indicate a decreased ability to finish tasks and an over generalization of failure. A few sub-scales were low enough to be considered discrepancies compared to the total Self-Image scale. She shows a sound ability to interact with others, an independent orientation towards the long-term and a placement of value in individual achievements.

Although she participated in many outside organizations and leisure activities, this young adult has a low Perceived Control score reflecting power and control-related issues as hampering her overall Personal Independence. Compared to the others using FES to stand, P#3 readily meets societal expectations for role and status in all areas.

The low score of Assistive Device reflects a potential problem in the match of P#3 with the FES system. With a problematic ATD match paired with decreased ability to finish tasks and low Self-Confidence, it is hypothesized that she could potentially experience decreased device use. P#3 reports several physical and device-related reasons for not using the system when available. The former reasons were also reflected in her lower perception of health compared to other FES users. Her use of the system in non-home environments, like friend's homes, is an example of her significant ability to not allow her disability to be a handicap in social relationships. The profile produced by the assessments reveals an older adolescent with average Self-Image and Personal Independence, yet with an ability to not

allow SCI to produce a handicap in any dimension. P#3 is able to utilize the FES system for several types of activities even though the person/technology fit reflects a potential mismatch related to the Assistive Device.

#### 4.4. Participant #4

P#4's overall positive perception of herself reveals adaptive coping and mature development. She has a well developed ego, is able to delay gratification and has the ability to cope with stress and tension through the use of problem solving skills. Other scales indicate her ability to have meaningful relationships with peers and a well developed capacity for empathy. This participant's high score in Self-Confidence shows an ability to deal with frustration and an orientation towards achievement due to confidence in her abilities. She demonstrates a well-defined body concept, in which she feels confident about her body and appearance, and in which realistic assessment of deficiencies are associated with a feeling that she can confidently correct them. As well, she has a well-cultivated sense of responsibility, concern for others and a focus beyond her own interests, including the capacity to take the viewpoint of others. The intra-individual discrepancy evident in the Family Functioning sub-score, reflects a less than strong alliance with her parents. This suggests that communication between this young woman and her parents might possibly be strained.

Perceptions of excellence in health and a very high level of Perceived Independence in combination with significant feelings of Perceived Control reflect an overall high Personal Independence. In contrast, a significant degree of handicap is indicated in Occupation, Physical Independence and Social Integration dimensions. It appears that P#4 has been able to overcome the disadvantages of societal handicap through the integration of a well defined self-perception which includes elevated Personal Independence, Body-Image, Mental Health, Social Functioning and Self-Confidence.

Although she has a high overall Self-Image, the person/technology match reveals a potential

deficit in the area of Temperament. This one lower area cannot reasonably denote a mismatch for her usage since all other ATD-PA scores were well above other users' and since she maintains the highest FES usage rate. P#4 is often able to utilize her FES system in several environments and integrates this tool within personal coping constructs.

#### 5. Discussion

The above results are discussed in terms of independent relationships and areas that suggest interdependent relationships among the variables however without pre-FES data this can only be hypothesized. The demographics of the present participants are not typical of the larger SCI population. For example Trieschmann (1988) reported the incidence of paraplegia due to motor vehicle accidents as 46% while the incidence due to acts of violence is 69.5%. Also, SCI has been reported to occur at an almost 3:1 ratio of males to females in the overall SCI population (National Spinal Cord Injury Association, 1992). Because of the differences in demographics in this study compared to other available samples, it is important to not over generalize these findings to the larger population of older adolescents/young adults with SCI.

Self-Image for most of these older adolescents falls within the average range of non-disabled adolescents. Some discrepancies in areas of Self-Image are further supported in perceptions of Personal Independence and Handicap. This finding is not consistent with some studies (Rutledge and Dick, 1983; Resnick and Hutton, 1987). However, Arnold and Chapman (1992) found disabled adolescent's self-esteem, aspirations and expectations were not significantly different from their able-bodied peers. Personal Independence varied among participants in Perceived Control, Psychological Self-Sufficiency and Physical Autonomy. One participant revealed especially low scores in the Family Functioning dimension of Self-Image. She had the lowest Physical Autonomy and Psychological Self-Sufficiency scores as well. In relation to Crittenden's (1990) concept of autonomy

among adolescents with disabilities, it can be theorized that she was unable to reach a high perception of autonomy within her family.

Tolan et al. (1988) found a correlational relationship between lower self-image, including adjustment and psychopathology, to an adolescent's ability to deal with daily stressors. With the exception of one who showed indications of pathological symptomatology, these older adolescents have been able to deal with the chronic daily stressors related to their SCI. For one participant, clinical symptomatology related to lower Self-Image was evident in areas related to suicide and depression. These areas are often especially problematic among SCI populations. Increased depression has been documented in SCI participants involved in FES exercise programs (Robinson et al., 1988; Bradley, 1993). As well, Goldberg (1981) viewed the task of dealing with depression to be a normative developmental task for adolescents with disabilities. Furthermore, a study on suicide and SCI by Charlifue and Gerhart (1991) led to the development of a predictive model of suicide after SCI. It was found that the variables associated with suicide included depression, hopelessness, alcohol abuse, guilt, anger, previous suicide attempts, and pre- and post-injury family disruption. With family influences having been a factor associated in suicide among persons with SCI, P#2's low Family Functioning sub-score supports the comparison to clinical suicide attempt groups. This comparison however, must be evaluated in light of her overall Self-Image which fell within the low-average range.

Advantages and disadvantages relating to handicap at the societal level fell within a normative sample distribution. It is apparent that three of these participants have equivalent mobility and transportation resources and near equivalent scores in physical independence. The differences in overall handicap that were found can be attributed to a lack of opportunity in these areas as well as occupational and economic differences. The CHART was not able to indicate whether ATD use would be integrated into social situations. For the two who also utilized FES in non-home environments and among friends, one fell within the 50th percentile and one in the 10th

percentile in the Social Integration dimension of the CHART. It might be that advantages or disadvantages perceived as handicaps are not the only factors at work in one's decision to use ATDs in social environments. Other areas relating to Self-Image, such as Body Image or Self-Confidence, might be more predictive of integrating FES into social situations.

It seems that societal view of handicap might inversely influence one's perceived personal independence. An unusual opposite relationship exists in the area of perceived control in personal independence compared to combined CHART handicap scores. Those with higher CHART scores, indicating a limited experience of societal handicap, revealed lower feelings of perceived control and vice versa. With the limited number of participants it is impossible to determine if this phenomenon is indicative of a significant or causal relationship. The aspects of Personal Independence and dimensions of handicap, specifically expressing high Personal Independence and low perception of handicap, did not correspond to interpretations of Self-Image. It might be that high or low levels of self-image can occur without any reflection or integration into one's perceived independence or dimension of societal handicap.

All cited the device-related reason of taking too much time to don the system for not using the system when opportunities existed. Device-related factors, including ease of use and fit within an individual's lifestyle, were found to be part of the interrelated factors attributable to device use (Gitlin et al, 1993; Phillips and Zhao, 1993). Other factors reported that are related to not using the device, that of personal/physical, device performance, environment and roles were consistent with the literature (Scherer, 1988, 1990; Brooks, 1991; Parette and VanBiervliet, 1991; Gitlin et al. 1993; Phillips and Zhao, 1993). Two of the three assistive device users reported standing within the 2 months prior to data collection and the one non-user revealed problems with characteristics of the device in the technology/person match. One device user showed temperament related difficulties in the person/technology match. Results of the users and the non-user correspond to those found by Scherer (1988, 1990) and the MPT

model in many personal and utilization factors. The non-user indicated problems in family functioning, related that the system would not be beneficial in attaining goals, felt lower psychological self-sufficiency and physical autonomy, expressed that she was not satisfied with her life, and revealed feelings of depression. The users showed higher levels of psychological self-sufficiency and physical autonomy, cited creative activities for device use reflecting the enabling power of the device in the attainment of increased independence, and felt they could benefit from the use of the device. Wright (1988) includes the ability to manage limitations in social and physical environments through the use of prostheses and assistive devices as a characteristic of those coping with their disability. The participant with the highest usage rates showed the highest satisfaction in several life areas and expressed that the device would change her overall quality of life to a great extent.

The small number of subjects supports only limited comparisons, yet allows for more in-depth evaluation of variables. This small number is restricting and makes generalizing the findings to the larger population of adolescents and young adults with SCI difficult. Although these results relating to use, independence, quality of life and personality are intriguing, it is difficult to determine where factors that might relate to FES participation start and where they end. However, these results have potential implications in the settings where FES is utilized. Changes in psychosocial adjustment and psychological status throughout participation was found in studies of FES exercise participation and FES standing participants (Heinemann, et al., 1985; Robinson, et al., 1988; Sipski, et al., 1989; Harvey and Bradley, 1992; Bradley and Harvey, 1993). Similar changes can be imagined based on this investigation, but caution must be used in making concrete inferences. In addition to limitations of the research design, an additional limitation exists when using evaluations which are not normed nor designed for the disabled population, such as the OSIQ-R, or tools not consistent with the adolescent transition to young adult, like the CHART where age specific normative groups are not available.

Future research that would incorporate pre-participation as well as post-participation scores may give a clearer illustration of the effects of the application of this type of assistive technology with disabled adolescents/young adults. Additional investigations of other possible environments or occurrences that might change FES participant's independence behaviors, such as clinical rehabilitation setting, school, or home factors, might shed light on specific variables that would lead to successful FES participation. An understanding of these constructs is not enough to ensure successful participation, however. Because an individual does not change without influence and experience, a thorough investigation and evaluation of treatment options at the research level and the psychological and social effects of research participation would also add to the success of FES research and clinical technology applications that propose increases in levels of independence.

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#### **References**

- Alexander, C.J., Sipski, M.L., 1990. Electrical stimulation bicycle ergometry with spinal cord injured patients: potential medical and psychological benefits. *SCI Psychosoc. Process* 3, 18–20.



- Arnold, P., Chapman, M., 1992. Self-esteem, aspirations and expectations of adolescents with physical disability. *Dev. Med. Child Neurol.* 34, 97–102.
- Baker, R.C., Heinemann, A.W., Yarkony, G.M., Jaeger, R., 1985. Functional neuromuscular stimulation for stance and ambulation: six month evaluation of psychological effects. Proceedings of the 12th Annual RESNA Conference. Resna, New Orleans, LA, pp. 401–402.
- Bradley, M.B., 1994. The effect of participating in a functional electrical stimulation exercise program on affect in people with spinal cord injuries. *Arch. Phys. Med. Rehabil.* 75, 676–679.
- Bradley, M.B., Harvey, J.R., 1993. Perceptions of the graduates of an FES exercise program. *SCI Psychosoc. Process* 6, 99–105.
- Brooks, N.A., 1991. Users' responses to assistive devices for physical disability. *Soc. Sci. Med.* 32, 1417–1424.
- Caudrey, D.J., Seeger, B.R., 1983. Rehabilitation engineering service evaluation: a follow-up survey of device effectiveness and patient acceptance. *Rehabil. Lit.* 44, 80–85.
- Charlifue, S.W., Gerhart, K.A., 1991. Behavioral and demographic predictors of suicide after traumatic spinal cord injury. *Arch. Phys. Med. Rehabil.* 72, 488–492.
- Cook, E.A., 1985. Dual trauma of spinal cord injury in adolescence. *Rehabil. Nursing*, Sep./Oct., 18–19.
- Crittenden, P.M., 1990. Toward a concept of autonomy in adolescents with a disability. *Child. Health Care* 19, 162–168.
- DeJong, G., 1979. Independent living: from social movement to analytic paradigm. *Arch. Phys. Med. Rehabil.* 60, 435–446.
- DeJong G., Branch, L.G., Corcoran, P.J., 1984. Independent living outcomes in spinal cord injury: multivariate analyses. *Arch. Phys. Med. Rehabil.* 65, 66–73.
- Dewis, M.E., 1989. Spinal cord injured adolescents and young adults: the meaning of body changes. *J. Advanced Nursing* 14, 389–396.
- Erikson, E.H., 1963. *Childhood and Society*, 2nd ed. W.W. Norton, New York.
- Garber, S.L., Gregorio, T.L., 1990. Upper extremity assistive devices: assessment of use by spinal cord-injured patients with quadriplegia. *Am. J. Occup. Ther.* 44, 126–131.
- Gitlin, L.N., Levine, R., Geiger, C., 1993. Adaptive device use by older adults with mixed disabilities. *Arch. Phys. Med. Rehabil.* 74, 149–152.
- Goldberg, R.T., 1981. Toward an understanding of the rehabilitation of the disabled adolescent. *Rehabil. Lit.* 42 (3–4), 66–74.
- Green, B.C., Pratt, C.C., Grigsby, T.E., 1984. Self-concept among persons with long-term spinal cord injury. *Arch. Phys. Med. Rehabil.* 65, 751–754.
- Harvey, J.R., Bradley, M.B., 1992. Staff perceptions of the psychological benefits of FES training: a grounded theory approach. *SCI Psychosoc. Process* 5, 92–98.
- Harvey, J.R., Bradley, M.B., Aronica, M.J., 1992. Psychological effects of functional electrical stimulation: a review of the literature. *J. Neurol. Rehabil.* 6, 203–208.
- Heetderks, W.J., Hambrecht, F.T., 1988. Applied neural control in the 1990's. Proceedings of the IEEE, 76, pp. 1115–1121.
- Heinemann, A.W., Magiera-Planey, R., Gimines, M.G., Schiro-Geist, C., 1985. Evaluating the special needs of functional neuromuscular stimulation research candidates. *Arch. Phys. Med. Rehabil.* 9, 167–173.
- Heinemann, A.W., Magiera-Planey, R., Schiro-Geist, C., Gimines, G., 1987. Mobility for persons with spinal cord injury: an evaluation of two systems. *Arch. Phys. Med. Rehabil.* 68, 90–93.
- Hunt, M., Mullin, C.M., Moynahan, M., 1994. A pilot study of functional neuromuscular stimulation for standing by adolescents with paraplegia. *J. Am. Paraplegia Soc.* 17, 122.
- Kantor, C., Andrews, B.J., Marsolais, E.B. et al., 1993. Report on a conference on motor prostheses for workplace mobility of paraplegic patients in North America. *Paraplegia* 31, 439–456.
- Konopka, G., 1973. Requirements for healthy development of adolescent youth. *Adolescence* 8, 291–316.
- McGrath, P.J., Goodman, J.T., Cunningham, J., MacDonald, B.J., Nichols, T.A., Unruh, A., 1985. Assistive devices: utilization by children. *Arch. Phys. Med. Rehabil.* 66, 430–432.
- Mulcahey, M.J., 1992. Returning to school after a spinal cord injury: perspectives from four adolescents. *Am. J. Occup. Ther.* 46, 305–312.
- National Spinal Cord Injury Association, 1992. Factsheet No. 2: Spinal Cord Injury Statistical Information. authors, Woburn, MA.
- Nosek, M.A., Fuhrer, M.J., 1992. Independence among people with disabilities: I. A heuristic model. *Rehabil. Couns. Bull.* 36, 6–20.
- Nosek, M.A., Fuhrer, M.J., Howland, C.A., 1991. Measuring the independence in people with disabilities: the personal independence profile. ILRU Research and Training Center on Independent Living, Houston.
- Nosek, M.A., Fuhrer, M.J., Howland, C.A., 1992. Independence among people with disabilities: II. Personal independence profile. *Rehabil. Couns. Bull.* 36, 21–36.
- Offer, D., Ostrov, E., Howard, K.I., Dolan, S., 1992. Offer self-image questionnaire, revised (OSIQ-R) manual. Western Psychological Services, Los Angeles.
- Parette, H.P., VanBiervliet, A., 1991. School-age children with disabilities: technology implications for counselors. *Elem. Sch. Guid. Couns.* 25, 182–193.
- Pantell, R.H., Lewis, C.C., 1987. Measuring the impact of medical care on children. *J. Chron. Disabil.* 40, 99S–108S.
- Peckham, P.H., 1988. Functional electrical stimulation. In: Webster, J.G. (Ed.), *Encyclopedia of Medical Devices and Instrumentation*, vol. 2. Wiley, New York, pp. 1331–1352.
- Phillips, B., Zhao, H., 1993. Predictors of assistive technology abandonment. *Assistive Technol.* 5, 36–45.
- Public Law 100-407, August 19, 1988. Technology-Related Assistance of Individuals with Disabilities Act of 1988.
- Purtillo, R.B., 1991. Ethical issues in teamwork: the context of rehabilitation. In: Marinelli, R.P., Dell Orto, A.E. (Eds.),

- The Psychological and Social Impact of Disability. Springer, New York, pp. 23–31.
- Resnick, M.D., Hutton, L., 1987. Resiliency among physically disabled adolescents. *Psychiatr. Ann.* 17, 797–800.
- Robinson, C.J., Bolam, J.M., Ketty, N.A., Johnson, P.B., Chino, M.J., Nemchausky, B.A., 1988. Electrical stimulation of paralyzed muscle after spinal cord injury: influence of surface electrical stimulation on muscle strength, endurance, spasticity, cross-sectional area and x-ray density and on urodynamic and psychological factors. *Rehabil. R D Prog. Rep.* 25, 164–165.
- Rosenbaum, P., Cadman, D., Kirpalani, H., 1990. Pediatrics: assessing quality of life. In: Spilker, B. (Ed.), *Quality of Life Assessments in Clinical Trials*. Raven, New York, pp. 205–215.
- Rosenberg, M., 1965. *Society and the Adolescent Self-image*. Princeton University Press, Princeton.
- Rutledge, D.N., Dick, G., 1983. Spinal cord injury in adolescence. *Rehabil. Nursing* Nov./Dec., 18–21.
- Scherer Associates, 1991. *The Scherer MPT Model: Matching People with Technologies*. Webster, New York: Authors.
- Scherer, M.J., 1988. Assistive device utilization and quality-of-life in adults with spinal cord injuries or cerebral palsy. *J. Appl. Rehabil. Couns.* 19, 21–30.
- Scherer, M.J., 1990. Assistive device utilization and quality of life in adults with spinal cord injuries or cerebral palsy two years later. *J. Appl. Rehabil. Couns.* 21, 36–44.
- Scherer, M.J., 1993. The Assistive Technology Device Predisposition Assessment: How Does it Measure Up as a Measure? Paper presented at the 70th Annual meeting of the American Congress of Rehabilitation Medicine, Denver, CO.
- Scherer, M.J., McGee, B.G., 1991. The Development of Two Instruments Assessing the Predispositions People Have Toward Technology Use: The Value of Integrating Quantitative and Qualitative Methods. Paper presented at the Annual Meeting of the American Educational Research Association (ERIC Document Reproduction Service No. TM016608). Chicago, IL.
- Scherer, M.J., McGee, B.G., 1992. Early Validity and Reliability Data for Two Instruments Assessing the Predispositions People Have Towards Technology Use: Continued Integration of Qualitative and Quantitative Methods. Paper presented at the Annual Meeting of the American Educational Research Association (ERIC Document Reproduction Service No. TM018385). San Francisco, CA.
- Siegel, D.M., 1987. Adolescents and chronic illness. *J. Am. Med. Assoc.* 257 (24), 3396–3399.
- Sipski, M.L., Delisa, J.A., Schweer, S., 1989. Functional electrical stimulation bicycle ergometry: patient perceptions. *Am. J. Phys. Med. Rehabil.* 68, 147–149.
- Stallard, J., Major, R.E., Patrick, J.H., 1989. A review of the fundamental design problems of providing ambulation for paraplegic patients. *Paraplegia* 27, 70–75.
- Starfield, B., 1987. Child health status and outcome of care: a commentary on measuring the impact of medical care on children. *J. Chron. Disabil.* 40, 109S–115S.
- Tolan, P., Miller, L., Thomas, P., 1988. Perception and experience of types of social stress and self-image among adolescents. *J. Youth Adolesc.* 17, 147–163.
- Trieschmann, R.B., 1988. *Spinal Cord Injuries: Psychological Social and Vocational Rehabilitation*, 2nd ed. Demos, New York.
- Triolo, R.J., Kobetic, R., Betz, R.R., 1996. Standing and walking with FES: technical and clinical challenges. In: Harris, G. (Ed.), *Human Motion Analysis*. IEEE Press, New York, NY.
- Whiteneck, G.G., Charlifue, S.W., Gerhart, K.A., Overholser, J.D., Richardson, G.N., 1992. *Guide for the Use of the CHART: Craig Handicap and Reporting Technique*. Craig Hospital, Englewood, CO.
- Whiteneck, G.G., Charlifue, S.W., Gerhart, K.A., Overholser, J.D., Richardson, G.N., 1992. Quantifying handicap: a new measure of long-term rehabilitation outcomes. *Arch. Phys. Med. Rehabil.* 73, 519–526.
- World Health Organization, 1980. *International Classification of Impairments, Disabilities and Handicaps: a Manual of Classification Relating to the Consequences of Disease*. World Health Organization, Geneva, Switzerland.
- Wright, B.A., 1982. *Physical disability — a Psychosocial Approach*. HarperCollins, New York.
- Yarkony, G.M., Roth, E.J., Cybulski, G., Jaeger, R.J., 1992. Neuromuscular stimulation in spinal cord injury: I: restoration of functional movement of the extremities. *Arch. Phys. Med. Rehabil.* 73, 78–86.
- Zeltzer, L., Kellerman, J., Ellenberg, L., Dash, J., Rigler, D., 1980. Psychologic effects of illness in adolescence. II. Impact of illness in adolescents — crucial issues and coping styles. *J. Pediatr.* 97, 132–138.