EFFECT OF HEART RATE INTENSITY DURING PHYSICAL EXERCISE, ON AUTISTIC STEREOTYPED BEHAVIOURS

By

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September 2006

ABSTRACT

This study was designed to investigate relationships between the aerobic physical exercise and self-stimulatory behaviours in Autistic children. A study was designed featuring twenty minute observation periods, both pre and post a five minute duration of aerobic physical exercise undertaken on a cycle ergometer. The exercise intensity performed by the subjects varied between 43% and 87% of their maximal heart rate.

The data gathered indicated that five minutes of aerobic physical exercise sufficed to bring about a decrease in post-exercise self-stimulatory behaviours. The research showed a possible link between aerobic physical exercise performed at 55% and 69% of subjects' maximal heart rates, however a significant positive relationship between heart rate intensity and self-stimulatory behaviours was not evidenced.

The data also appeared to show a trend of pre-exercise self-stimulatory behaviours decreasing in frequency over the five-week duration of the study.

The research highlighted some design imperfections such as the necessity for differentiated equipment and the requirement to measure pre-observation resting heart rates.

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INTRODUCTION

Prior to commencing the MEd in Professional Studies the author had worked in secondary physical education for four years. Throughout her fourth year, the author elected to work within the special educational needs (SEN) sector, choosing to work between two secondary level schools; one catering for a variety of SENs including Autism, the other, specifically exclusively catering for secondary level children with Autism or Aspergers Syndrome.

By comparing and contrasting the two SEN schools on a regularly basis, the author began to observe patterns in disruptive behaviours and attempted variations of discipline strategies to calm behaviour and increase attention levels. Through additional teaching of non-physically active subjects, the author believed to see a difference in behaviours; calmer and more focused following certain activities and lesson structures. With varying and intermittent levels of success, the author attempted to structure lessons in such a way that children appeared to engage their attention for the whole of the lesson or activity. A visible difference was noted after routine and repetitive tasks in addition to following periods of structured physical activity.

Self-stimulatory behaviours (SSBs) became one of the author's main focus points after observing them dominating a majority of behaviourally disruptive lessons, particularly at the Autistic specialist school. Repetitive and at times extremely physical, SSBs are characteristically displayed by Autistic children and adults. It is hoped, that through analysis of this research study, senior teaching staff may realise the importance and significance of physical exercise and physical education within an Autistic environment and subsequently adapt timetables to incorporate an increased number of physical exercise sessions. This is hoped to lead, in turn, to a manipulation of SSBs and a decrease in their observed frequency within academic lessons. The author would hope that similar changes may then be incorporated into daily lifestyles exposing calmer and more relaxed existence both the Autistic person and those around them.

Chapter 1

LITERATURE REVIEW

INTRODUCTION

This chapter will consider, in detail, literature associated with three research questions central to this study:

(i) Does physical exercise of five-minute duration reduce observed post-exercise SSBs?

(ii) Does exercise intensity affect observed post-exercise SSBs? and

(iii) Does an optimal heart rate intensity exist to bring about an optimal decrease of post-exercise SSBs?

To increase awareness and understanding and to introduce the principle features of this research study, this literature review will be presented under the headings; Autism, Autism and SSBs, Autism and 'Daily Life Therapy', Autism and physical education, Autism and exercise intensity, methods of HR monitoring, duration of exercise, methods of physical activity, methods of observation, further implications and summary.

AUTISM

"Autism is a developmental disorder of a neurological origin affecting approximately one in every one thousand people" (Sainsbury, 2000, p13). The precise cause of Autism to this day is unknown: however, specific genetic links have been widely hypothesised and researched. Practitioners in this field, including Hans Asperger (1944) and Sainsbury (2000) have extensively discredited the speculation of Autism as a form of emotional disturbance.

While many Autistic children have some degree of learning difficulty, it is not rare for an Autistic person to possess an average or higher-than-average intelligence. To assist in clarifying types and degrees of severity, the *Autistic Spectrum* (Kanner, 1943) is used to express the extremity of the condition; ranging from the most severely disabled person, who may never develop speech and have major problems with communication, to the most highly-functioning person. With many shared features of Autism, "Aspergers Syndrome, is a condition at the more able end of the spectrum" Clarke (2002, p11). The fourth edition of the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders (1994)* (DSM-IV) is an accepted diagnostic criteria used to distinguish Aspergers Syndrome (Sainsbury, 2000). Throughout this study, the author shall use the term 'Autism' to refer to all subjects and related literature. "According to Kanner (1943), the main features of this condition (Autism) include severe social impairment, communication, rigidity of thought processes and ritualistic patterns of behaviour" (Clarke, 2002, p12).

Autistic children often possess an inability to understand social rules. "They are characteristically inflexible and have a great need for personal routines" (Sainsbury, 2000, p21). To alleviate pressures caused by presentation of new situations and decrease opportunity for disturbances, many researchers, including Celberti et al (1997) and Lochbaum and Crews (2003), have documented individual test pre-experiment familiarisation (see 'Methods of Physical Activity') opportunities for subjects with Autism in an effort to alleviate pressure/stressors and decrease opportunity for disturbances caused by novel situations.

AUTISM AND SELF-STIMULATORY BEHAVIOURS

Autistic children often display an individual form of body language. Sometimes repetitive actions can be quite subtle and other times more visible, such as rocking. Such stereotypic behaviours are also commonly referred to as self-stimulatory behaviours (SSBs). SSBs are components of normal behaviour, “Autistic children displaying abnormal, higher rates” (Willemsen-Swinkels et al, p547). SSBs are often described negatively and as being problematic, due to “observation of SSBs interfering with on-task responding and inhibiting performance of socially accepted behaviours” (Kern et al, 1982, p399). Consequently, numerous researchers have undertaken efforts to observe occasions where such behaviours are less evident and encourage the reduction of SSBs exhibited by the individual.

A variety of methods have been documented as having been regularly used in academic institutions to counteract and/or decrease SSBs. Such methods have included physical punishment, over-correction, physical restraint and sensory extinction (Watters and Watters, 1980; Kern et al, 1982). Watters and Watters (1980), amongst others, have recorded a decrease in SSBs following gym periods, field trips and outside excursions. Watters and Watters (1980) and Lochbaum and Crews (2003) recorded eighteen studies and Celiberti et al (1997), eleven studies, to specifically support beneficial effects of exercise “appearing to show a reduction in Autistic stereotyped behaviours in concurrence with an apparent increase in learning and social responding” (Lochbaum and Crews, 2003, p225). “Exercise has not been shown to be effective in raising IQ scores” (Tkachuk and Martin 1999, p276), nor in decreasing academic levels, Rosenthal-Malek and Mitchell (1997). Tkachuk and Martin (1999, p275) further elaborated regular exercise to be “a viable, cost-effective, but underused treatment for mild to moderate depression." Furthermore, the review analysed exercise therapy effects for individuals with developmental disorders. Similar studies as documented by Kern et al (1982) have been conducted in populations of certified mentally retarded children, reporting a decrease of aggressive and hyperactive behaviour following periods of physical exercise. It should be noted, that effects of exercise, in all recorded instances, have appeared short-lived with pre-exercise behaviours recurring within a two-hour period, Kern et al (1982) observed this after 75-90 minutes with two subjects.

AUTISM AND 'DAILY LIFE THERAPY'

Kiyo Kitahara (1983) predominantly highlighted the relationship between Autistic children and physical exercise in the early 1980s, dedicating over two decades to teaching Autistic children in Japanese educational institutes. Based on her experiences, Kitahara developed an educational method specifically tailored to the needs of Autistic children, which she named 'Daily Life Therapy'. Kitahara (1983), defined Daily Life Therapy (DLT) as,

> establishing a 'rhythm of life' and stabilizing the child's weak emotions through a programme of physical training; removal of the child's 'spirit of dependence' through group education and fostering the child's intellectual development through continuous repetitions of the same actions (Kitahara, 1983, cited by Quill et al, p626, speechmarks in the original).

DLT was formulated around five fundamental principles; group orientated instruction, highly structured routine activities, learning through imitation, rigorous physical exercise and a curriculum focused around movement, music and art (Quill et al, 1989).

AUTISM AND PHYSICAL EDUCATION

The sixth book published by the Musashino Higashi Gauken, home school of Kitahara (1984), concentrated solely on physical training guidance of Autistic children; detailing the ethos, practicalities and evidence of physical activity as a fundamental part of DLT in practice. Kitahara (1984) incorporated ’rigorous physical exercise’, as a central feature of the curriculum, believing the exercise resulted in the body releasing beta endorphins, thus facilitating a person’s ability to learn through the decrease of an apparent physical state of chronic hyper-arousal. As part of the DLT physical exercise programme, Autistic children ran outside for a twenty minute period, 2-3 times a day; guided by an adult where required. Children participated in a daily gym period of gymnastics, aerobic exercises or martial arts, with an additional hour of outside play including football, basketball, cycling or utilising playground equipment.

AUTISM AND EXERCISE INTENSITY

Kitahara (1984) described her programme of physical exercise as rigorous. Lochbaum and Crews (2003) observed that the intensity of exercise used in some studies was difficult to determine due to a predominant lack of precise physiological measurement of exercise intensity. Lochbaum and Crews (2003) observed a ‘moderate intensity’ of 10-15 minutes of jogging to be beneficial for behaviour change and later defined moderate intensity to be 65-70% of maximum heart rate (MHR). Other definitions used to describe exercise intensities included ‘faster than a walk’ (McGimsey and Favell, 1988), ‘mild’ (Celiberti et al, 1997), ‘mildly strenuous’ (Kern et al, 1982; 1984), ‘antecedent’ (Allison et al, 1991; Elliott et al, 1994; Celiberti et al, 1997), ‘exercise’ (Allison et al, 1991), ‘aerobic’

(Rosenthal-Malek and Mitchell, 1997; Lochbaum and Crews, 2003), ‘flushed’ (Rosenthal and Malek, 1997) and ‘vigorous’ (Kern et al, 1984; Elliott et al, 1994; Celiberti et al, 1997). ‘Vigorous’, defined by the Penguin dictionary (2002) to mean “carried out forcefully and energetically”, was numerically defined in only one study (Elliott et al, 1994), recording a mean 76% of MHR. ‘Exercise’ as recorded by Allison et al (1991), maintained a mean of 75.8% of MHR throughout testing, continually targeting 60-80% of MHR. Such descriptions impact greatly on the understanding of the intensity of the exercise performed and may have further implications in study replication. ‘Antecedent’, defined by the Penguin dictionary (2002) as ‘preceding thing, event or circumstance’, appeared to be a common labelling to methods and intensities of exercise across a range of studies.
In a review compiled from twenty-five related studies, Tkachuk and Martin (1999) failed to record any HRs. Descriptors of ‘exercise’ included only the words: ‘aerobic’, ‘walking’, ‘running’. It should be noted, however, that this review was compiled from a psychiatric and not physiological viewpoint. The same review (Tkachuk and Martin, p278), acknowledged “a direct and positive relationship may exist between intensity of exercise and reduction in inappropriate behaviours”.

Allison et al (1991) documented no significant correlation between heart rate during exercise and subsequent behaviours. Allison et al (1991, p84) remarked, “there may be a possible threshold of intensity above which further increases have diminishing returns.” This statement was made following an observation that after less intense exercise sessions, heart rate was recorded to reach a minimum of 59% of MHR, which the researchers believed to still be ‘fairly intense’. Opportunities are therefore provided for other researchers, to investigate an optimum rather than minimum exercise HR intensity to bring about desired behavioural effects.

Goodwin et al (2006), reported no significant cardiovascular response within Autistic subjects in reaction to being presented with stressful situations; ‘stressors’. Goodwin et al (2006) cited Kootz and Cohen (1981), whose Autistic subjects had “elevated HR responses during an entire session that included rest, social interaction and a reaction time test” (Goodwin et al, 2006, p101). In another study, documented by Goodwin et al (2006), higher functioning Autistic children displayed normal patterns of cardiovascular responses whilst lower functioning Autistic children showed increased cardiovascular levels. If theories that cardiovascular changes are stirred when organisms are aroused by stressors (Goodwin et al, 2006) are to be believed, then Goodwin et al’s (2006) findings indicate that perhaps resting arousal levels of Autistic children, are innately higher than those of non-Autistic counterparts. In their own study investigating cardiovascular reactivity to environmental stressors, Goodwin et al (2006) observed variable HR changes within a group. On average, Autistic subjects showed mean HR responses 20 beats per minute higher during the benchmark and test situation. Such observations may affect future prospective experimental designs when considering target HRs, but was not explored by the author for this research study.

Willemson-Swinkels et al (1998), when analysing correlations between cardiovascular measurements (HRs) and stereotypic behaviours, observed SSBs to lead to an increase in HR, likewise HR increases leading to an increase of SSBs (at presentation of new tasks and/or situations). Willemsen-Swinkels at al (1998) noted HR to decrease following episodes of SSBs, rhythmical SSBs to produce a decrease in HR and HR to increase variability in correlation with SSBs. All observations note a significant correlation between HR and SSBs.

METHODS OF HEART RATE MONITORING

Methods of HR assessment varied where recorded, between experimental designs. Of the five studies detailing methods of HR analysis, two used a detachable chest strap with a compatible beat-to-beat HR recording device worn on the wrist (Willemson-Swinkels, 1998; Lochbaum and Crews, 2003). Refusal to wear the chest strap and displacement of the chest strap by some subjects resulted in failure to provide conclusive data in the study performed by Willemson-Swinkels (1998). However, this method did, allow HR to be continually and readily monitored and the equipment, following calibration, was deemed reliable. Goodwin et al (2006) operated a similar, telemetric recording device enabling beat-to-beat data to be stored and downloaded to personal computer. Allison et al (1991) alternatively used an electrocardiogram to record subject pre-test normalities and sustained a radial artery HR measurement every ten minutes of the exercise condition. Conversely, Elliott et al (1994) used a stethoscope handled by a licensed physician to record resting heart rate. No details were provided for the methods used for HR monitoring throughout the twenty-minute exercise periods.

DURATION OF EXERCISE

Rosenthal-Malek and Mitchell (1997) discussed the optimum amount of time that may be required to bring about an effective reduction in SSBs. Duration of observed physical exercise periods appear to vary immensely between experimental designs. Wattles (2001) suggested 20-60 minutes of aerobic exercise three times a week at 50% MHR to be effective; however, it was not clear if any other combinations had been attempted. In contrast, Celiberti et al (1997), maintained exercise for periods of six-minutes, despite recording no change in behavioural problems after 15 minutes of antecedent exercise in Larsen and Miltenberger's (1992) cited study. Although inexplicable, it may be possible that six-minute periods were to assist with the subject's difficulties in maintaining attention. Kern et al (1982) detailed initial exercise periods, which lasted between 5-10 minutes, gradually lengthened to twenty minutes over the course of the study. It was unclear how this information correlated to the specific recorded results. Results conclusively supported a marked decrease in SSBs following exercise, which infers that five minutes of exercise may be suffice in reducing SSBs in Autistic children. Allison et al (1991) cited Gordon et al (1986), stating this study did not obtain positive effects after three-minute exercise periods.

Watters and Watters (1980, p385) made reference that "periods of exercise in excess of 8-10 minutes may bring about differing effects after observing a decrease in SSBs following exercise of the same duration." Numerous studies opted in their design to maintain exercise duration of twenty minutes (Kern et al, 1982; Allison et al, 1991; Elliott et al, 1994; Rosenthal-Malek and Mitchell, 1997; Lochbaum and Crews, 2003). In addition, Lochbaum and Crews (2003, p225) observed “a minimum period of 10-15 minutes in duration appears to be beneficial for behaviour change”.

METHODS OF PHYSICAL ACTIVITY

Methods of physical activity used to research effect of physical exercise on SSBs appear limited. Kern et al (1982, p414) commented on suggestions that “certain types of exercise do not have a favourable effect on learning… the exact type and duration of exercise may be important.” Wattles (2001, p3) recognized “aerobic activity is more effective in reducing short-term stereotypic responding, than is participation in ball-playing or leisure activities.” Independent jogging featured as the dominant form of aerobic exercise in many studies of similar design (Kern et al, 1982; Kern et al, 1984; Celiberti et al, 1997; Rosenthal-Malek and Mitchell, 1997; McGimsey and Favell, 1998; Allison et al, 1991; Watters, 2001)**.** Only one of the referenced studies recorded use of a motorised treadmill (Elliott et al, 1994). In the same study by Elliott et al (1994) a choice of cycle ergometer, aerobic step machine or weights was provided for general motor training activities. Two studies (Lochbaum and Crews, 2003; Goodwin et al, 2006) utilized a cycle ergometer, the latter primarily to instigate a rapid HR increase. In contrast, Celiberti et al (1997, p140) highlighted “similar effects with roller-skating. Positive behavioural changes have also been achieved with light callisthenics, aerobic exercise and unstructured exercise.” Lochbaum and Crews (2003, p225) designed their study in attempt to “demonstrate the beneficial effects of exercise in reducing stereotypic behaviours through participation in both aerobic exercise and muscle strength training (MST) programmes.” Training 2-3 times per week, the MST programme lasted less than one hour, subjects performed each exercise with a ‘full range of motion’, using six upper and lower body exercises. Both the aerobic and MST exercise programmes produced positive fitness gains, however, the study was unclear whether this referred also to SSB reductions. Where researchers have included aerobic exercise as part of their design, some studies elected adults to jog by the side of their subject (Kern et al, 1982; Kern et al, 1984; Allison et al, 1991; Elliott et al, 1994). Allison et al (1991) and Elliott et al (1994) additionally permitting adults to hold subject’s hands if they appeared about to stray from the designated area. Celiberti et al (1997) conducted pre-experimental jogging trials prior to commencement of an exercise study and a similar study timetabled jogging sessions into daily curriculum one month prior to testing (Rosenthal-Malek and Mitchell, 1997).

Age, sex or group size of subjects observed in any consulted studies appeared insignificant. Allison et al (1991) observed a twenty-four year old man, in contrast to Willemson-Swinkels et al (1998) observing twenty-six children between the ages of 33-84 months. Watters and Watters, 1980; Kern et al, 1982,1984; McGimsey and Favell, 1988; Elliott et al, 1994; Celiberti et al, 1997; Rosenthal and Malek, 1997; all recorded both actual age (4.9-41.3) and IQ scores (1.5-80) of subjects. Three studies (Kern et al, 1982; McGimsey and Favell, 1988; Elliott et al, 1994) specifically recorded the participation of female subjects.

METHODS OF OBSERVATION

Observation methods and techniques appeared varied, whilst sharing similar features. All studies featured in this literature review thus far opted to formulate a tabularised list of known subject specific SSBs prior to experimental observations. Studies generally recorded SSB occurrence within strict time constraints, non-recording time built in to the overall observation period. Kern et al (1984) observed post-exercise for ninety minutes in total. Of the ninety minutes, SSBs were recorded for the first five minutes of a fifteen-minute period. Each five-minute observation period was split into fifteen-second intervals; the first five seconds used to observe SSBs and the following ten seconds to record. The sum of individual subject SSB observation equalled one hundred seconds. In a similar design, Rosenthal-Malek and Mitchell (1997) observed a total of five subjects, post exercise, for five seconds consecutively until each subject had been observed ten times. This totalled an individual observation time of fifty seconds. Again individual subject SSBs were elicited prior to testing and recorded in tabular form. ‘Frequency of correct academic responses’ and ‘amount of work completed’ were additionally recorded by Rosenthal and Malek (1997). Kern et al (1982) tallied occurring pre-selected SSBs per five-second intervals over fifteen minute periods both pre and post the experimental conditions, a sum of seven-and-a-half minutes. Celiberti et al (1997) recorded SSBs forty minutes post the experimental condition each ten-second interval, a sum of twenty minutes.

Specific individual subject SSBs were analysed during observation periods in the study conducted by Elliot et al (1994). During initial assessments, researchers recorded maladaptive and stereotypic behaviours and selected the three most frequently occurring for each subject. Observations took place for thirty minutes pre and post experimental conditions. In an attempt to counteract difficulties in obtaining frequencies of relatively low rates of occurring behaviours in subjects McGimsey and Favell (1998, p169) devised a “5-point rating scale to assess intensity of behaviours”. Staff recorded behaviour occurrences and their ratings accordingly. Duration and times of observation are unclear. Allison et al (1991, p81) when referring to observation and recording protocol, did not elaborate further than “episodes of physical aggression per evening shift”.

FURTHER IMPLICATIONS

Tkachuk and Martin (1999) in conclusion to their analytical review, listed specific implications for consideration by clinicians wishing to apply exercise therapy for children with a psychiatric disorder. In addition to recommending ethical, health and safety protocols, Tkachuk and Martin (1999) offered practical advice based on guidelines provided by Sime (1996), as to how best make exercise a functional part of a daily lifestyle, “take advantage of the client’s environment (e.g. *(sic)* parks, lakes …), in facilitating exercise activity” Tkachuk and Martin (1999, p280, () in the original), in manageable and understandable prose. Such intelligence and clear presentation of information, may serve to enhance exercise prescription and safe participation within curriculums, residential settings and home environments enabling Autistic children, amongst others, to benefit physically, emotionally and psychologically.

SUMMARY

This literature review began with an introduction to Autism and typical behaviours associated with the condition. Autism was then linked, sequentially, with SSBs, ‘Daily Life Therapy’ and physical education. A review of sixteen identified studies followed, giving particular detail to study exercise intensities, durations of exercise, methods of physical activity and methods of observation. Finally, Autism and physical exercise recommendations and daily life implications were presented.

Chapter 2

METHODOLOGY

INTRODUCTION

The aim of this research study was to ascertain whether periods of exercise, at varying levels of heart rate, affected observed SSBs in Autistic children of varying severity. Severity, as documented on individual's statements of educational needs. On establishing an optimum heart rate, exercise programmes could be tailored to "successfully reduce aggression, out-of-seat behaviour, self-stimulation and self-injury among disturbed children" (Allison et al, 1991, p80), more specifically to increase attention span to tasks. This aim is consolidated into three research questions:

(i) Does physical exercise of five-minute duration reduce observed post-exercise SSBs?

(ii) Does exercise intensity affect observed post-exercise SSBs? and

(iii) Does an optimal heart rate intensity exist to bring about an optimal decrease of post-exercise SSBs?

These research questions will be resolved through the application of a logically and rationally designed experimental study. This will be presented under the headings; design, reliability, sampling, ethics, measurements and procedure.

DESIGN

- Method of Design

"Qualitative methods of design are used in research designed to provide an in-depth description of a specific topic" (Merten, 1998, p159), as opposed to quantitative methods, which are intended to; "obtain answers to research questions, isolating variables for study" (Sapsford and Jupp, 1996, p336). Correlational research, where "the researcher is interested in using one or more variables to predict performance" (Mertens, 1998, p93) is an approach appropriate for studying nonmanipulable variables; as both variables are able to be manipulated. Correlational research as a design method was rejected for this study.

- Case Studies

Case studies, comprising of observations and interviews, can only feature a small number of cases, which suited this research study of five subjects in total. The intense and detailed study of a small number of subjects could, however, prove time consuming and bring about non-specific conclusions and would not provide physiological evidence for this study.

- Interviews

Interviews; structured, semi-structured, unstructured or as part of a focus group, may allow a larger subject sample to be researched and require a smaller time commitment than case studies. Ferguson (1992) cited by Mertens (1998, p323), observed, "interviewing people with disabilities could present challenges because of the capabilities or communication need of the respondents". This method would prove particularly challenging for those diagnosed on the Autistic Spectrum who have (as part of the diagnostic criteria) an impairment in communication skills.

- Questionnaires

Self-completion questionnaires "offer a relatively cheap method of data collection over the personal interview" (May, 1997, p89) in addition to offering anonymity and the perception of being less threatening to subjects. Questionnaires, however, rely on ensuring questions are unambiguous, non-threatening and not answered using a 'given response' (May, 1991) as opposed to an honest opinion and that enough data is produced to answer key research questions. Subjects may have had great difficulty responding to questions related to their SSBs.

- Observation

The author rejected compiling case studies, conducting interviews, issuing questionnaires or making videos as methods of experimental design. All methods were qualitative and considered to generate general data, non-specific to the research questions. The author felt that none of the aforementioned methods were suited to subject's social or communication abilities. Observation, defined in detail under the sub-heading 'measurements'; where "the researcher is interested in observing people's behaviours as they naturally occur in terms that appear to be meaningful to the people involved" (Adler and Adler, 1994, cited by Mertens, 1998, p317) was deemed most appropriate. Observational design, producing quantifiable data was envisaged to represent behaviours at their most authentic, compliment physiological data and be least distressing to the subjects.

- <u>Summary</u>

The research study was conducted within the postpositivism paradigm due to the research being theory laden (Mertens, 1998). The observational research was qualitative and the physiological research quantitative, therefore quantitative data was used to substantiate a qualitative approach. Data was examined through quasi-experimental design; “almost a true experimental design attempting to establish cause and effect relationships, treatment, however, studied on an intact group” (Mertens, 1998, p79). The design was a non-equivalent control group design, where performance was measured pre and post-test. The experimental design did not have a control group per-se, due to the nature of the task paired with the subject’s ability to understand and carry out the procedure at the required standards. Each subject’s resting heart rate (RHR) was recorded and used as a baseline value. The independent variable within the study was heart rate (HR) and dependant variable SSBs.

RELIABILITY

> Reliability is one aspect of validity; the extent to which observations accurately record the behaviour of which the researcher is interested … reliability refers to the consistency of the same observer on different occasions, to come away with the same data (Sapsford and Jupp, 1996, p88).

The author was the sole observer for each of the testing periods to eradicate inter-observer variation and observer bias. Personal and procedural reactivity existed as threats to validity throughout the study. Intra-observer variation was minimised by ensuring each of the following conditions remained the same and repeated for each individual test period:

- *Subjects;* identity, order and weekly time of observation;
- *Cycle ergometer;* placement, load, handles and seat positioning per subject;

- *Heart rate monitor;* positioning and tautness per subject; and

- *Testing;* procedure instructions, pictorial cue cards, verbal encouragement.

The cycle ergometer was not calibrated prior to testing, therefore the heart rate displayed on the ergometer screen throughout testing was recorded as an addition to the heart rate measured and displayed on the calibrated heart rate monitor. This would also be used in the case of malfunction.

SAMPLING

Sampling refers to "the method used to select a given number of people from a population" (Mertens, 1998, p253). Subjects in this research study were not randomly selected. All subjects were selected from a small population of sixty-four pupils attending a Midlands based specialist secondary school for children diagnosed with Autism and/or Aspergers Syndrome. Subjects were selected according to the following criteria:

- The subject was familiar with the author as a teacher who had taught him in physical education lessons. Autistic individuals stereotypically avert from new situations and people; preferring routine (Sainsbury, 2000). A familiar person conducting the study was anticipated to reduce stress within the subjects; an important ethical consideration;

- The subject was physically capable of completing the exercises included in the study on the equipment provided;

- The subject commonly displayed SSBs which could be readily recorded in observation periods; and

- The subject had returned his signed parental consent form and physical activity readiness questionnaire.

The sample size of five subjects was smaller than desired. Factors that affected the number included the time and resources available to the author to complete the testing and the time available within the subjects' school timetable.

ETHICS

The principle of 'Ethics' is to ensure that subjects of research studies are not harmed by their participation. The Helsinki agreement (1964) was developed to protect the life, health, privacy and dignity of the subjects involved in studies "It is the duty of the physician to promote and safeguard the health of the people. The physician's knowledge and conscience are dedicated to the fulfilment of this duty" (Helsinki Agreement, 1964, p1). In-line with ethical guidelines, prior to commencement of the study, parents/carers (addressed herein as parents) were given written information outlining the intentions, protocol and measurements of the study (see Appendix 1). As each subject was under the age of sixteen, informed written consent was gathered from each subject's parent prior to testing and emphasis given that each subject was free to withdraw at any time. (see Appendix 2). This 'exit clause' was reinforced verbally, pictorially and in written form to each subject prior to each exercise period. Approval was also sought from the Head Teacher of the identified school.

MEASUREMENTS

This research study incorporated numerous methods of data provision, collection and interpretation. Each method will be defined and its use within the study explored under subheading ‘measurements’.

- Physical Activity Readiness Questionnaire (PAR-Q)

Prior to testing to assess subject’s ‘physical readiness’ and ‘safeness’ to perform physical activity for the five-minute cycle ergometer period the researcher used an adapted PAR-Q. The PAR-Q was originally developed by the British Columbia Ministry of Health and was revised by an expert Advisory Committee of the Canadian Society for Exercise Physiology in 2002 (Canadian Society for Exercise Physiology, 2002). The PAR-Q was specifically designed for children aged 15-69, to be used as a self-assessment checklist and as a protective checklist for public and professional bodies before commencing physical activity. Comprising of a yes/no question and answer list, the PAR-Q states that for any questions answered as yes, the individual should refer to a Doctor before commencing physical activity. Individual and professional bodies may at this point state they wish for physical evidence of the completed PAR-Q before physical activity is commenced at their establishment. Post PAR-Q, a declaration of understanding and conformation is required. The PAR-Q formulated by the Canadian Society for Exercise Physiology states that no changes are permitted to the form. It is for this reason that the researcher adapted a PAR-Q form. Parental consent was required for each subject as they were under 16 years of age and all had learning disability according to their statement of special educational needs. Questions were adapted to be answered on each individual’s behalf by a responsible parent. The question relating specifically to pregnancy was omitted and a legal disclaimer and declaration added (see Appendix 4). The author required entire forms to be accurately completed prior to subject testing and observation.

- Borg's Rating of Perceived Exertion Scale (B-RPE)

Borg (1998) devised an ordinal scale with values between six and twenty with emotion statements against nine of the numerical values. Borg (1998) devised the scale in an attempt to standardise comparisons of physical exertion across individuals and tasks. The scale was designed to increase linearly with physiological measures such as HR and Vital Capacity measures as intensity of exercise is increased. Borg (1998) acknowledged that not all children could be expected to give reliable or valid ratings on any form of scale method. Due to the communication limitations of the subjects in question, the author adapted Borg's (1998) RPE (see Appendix 5) to include pictures designed to reflect the statement at given levels on the scale. The original Borg (1998) statements were vaguely adapted to maintain the use of simple and understood words in a progressive format. Words were also chosen to correspond with pictures from the picture exchange communication system database.

- Picture Exchange Communication System (PECS)

The PECS was developed in 1985 as a unique augmentative/alternative training package to teach children with Autism and other communication deficits to initiate communication (Pyramid Educational Consultants, 2006). Using photographs of familiar items or icons created by computer software similar to a word processor, individuals learn to write and/or communicate using symbols instead of alphabet letters. The author chose to give instructions in the PECS form. The rationale behind this decision was based on the following:

(i) The subjects were familiar with PECS in the classroom on a day to day basis;

(ii) Using PECS should enhance the subjects' understanding of the given situation and the instructions; and

(iii) Preparing the subjects in advance by letting them know what to expect should help reduce stress within the subject as those on the Autistic Spectrum can often feel distress when they are faced with the 'unknown' (Sainsbury, 2000).

- <u>Social Story</u>

The term 'social story' originated from Carol Gray (1995) and detailed a brief description of a social situation to assist with any difficulties arising in social situations experienced by autistic children and others sharing a deficit in social thinking and understanding skills. "By preparing answers to questions that the person may need to know; such as the 'who, what, where, why and how' of a situation, it is hoped that such a person may feel at ease and in a position to be able to interact appropriately with others" (Gray, 1995, p1, speechmarks in the original). Social stories in their design are shaped by a combination of descriptive, perspective, directive and control sentences (Buckinghamshire Educational Psychology Service, 2006), and are designed to ensure the pupil gains enough information about the social situation, without overloading. For the purpose of the study, the researcher formulated two adapted social stories consisting of a maximum of five sentences. Both the pictorial instructions and specific method used basic language composition and efforts were made to ensure they were kept simple and informative.

- Observation

Observation is a process of “systematically recording, interpreting and analysing, using systemic and planned procedures” (Sapsford and Jupp, 1996, p58). Structured observation was elected for this study, for accurate and objective measurement of observable human behaviour. Observations lead to the production of quantitative data based on pre-specific observable behaviours and patterns of interaction. Spradley (1980) defined five types of participation by the observer attempting to collect information without intention of guiding any behaviours. Of the five types, the author primarily adopted the passive participation method; the author was present, but did not interact with the subjects. Due to the nature of the observation environment, at some phases of observation, the researcher reluctantly adopted moderate participation, attempting to balance observing and participation in some but not all activities (Mertens, 1998). Continuous recording was used throughout observation. Time/point sampling procedures, used to estimate proportions of time behaviours are performed, were not used. Observation bias was limited by having only one observer. Limitations of observational data collection included the possibility that subjects may have consciously or unconsciously adapted their behaviours due to the knowledge they were being observed, observations may have been filtered or skewed by the observer, observations were time consuming and some difficulties may have been encountered accurately recording pre-selected SSBs.

- Self-Stimulatory Behaviours (SSBs)

SSBs, referring to "repetitive body movements or repetitive movement of objects" (Edelson, 1999, p1) appear to be most common in Autistic children although also observed in children with other developmental disabilities. SSBs are often listed and associated with each of the five senses. Several theories attempt to explain the reasoning behind SSBs, one such suggesting they are exhibited to calm a person where an environment is independently deemed too stimulating. SSBs can take the form of many guises and therefore the researcher devised a list of numerous SSBs that might be observed in any subject. To enable ease of marking, the researcher developed an extended list divided into eight categories referring to specific parts of the body and/or types of actions. The list was complied directly from accumulation of eight researched and referenced Journal studies that each recorded types of Autistic observed SSBs. The list was designed to enable tally-markings to be made on the sheet as the behaviours were observed (see Appendix 9). As weeks progressed, the observation sheet was modified as additional behaviours were included as observed in particular subjects, thus developing more tailored, individual SSB recording sheets (see Appendix 10-14).

- Heart Rate (HR) and Heart Rate Monitors (HRM)

"Over the last 20 years, HRMs have become a widely used training aid for a variety of sports. The development of new HRMs has evolved rapidly during the last two decades" (Achten and Jeukendrup, 2003, p517). HRMs monitor bodily reaction to physical activity and provide a convenient method for measuring and recording HR during exercise. Heart rate levels are believed to "alter according to numerous factors including due to stress, illness, over training, medication, time of day, food and drink, attitude, temperature and activity level" (Londeree and Moeschberger, 1982, p297). The use of a HRM to set exercise intensity is based on physiological principles; as work increases, vital capacity and heart rate increase in a linear relationship until near maximal intensities. Heart rate is easier to measure than vital capacity, as the rate at which oxygen is consumed, can be measured at a pulse on the body or with a HRM. The first portable HRM was introduced in 1983 and was the first to establish a maximum heart rate. Results from pilot studies indicated the monitors as valid alternatives for measuring heart rate in field and laboratory settings (Londeree and Moeschberger, 1982). In order to assess the working rate of the heart, a maximum quantity must be known. Londeree and Moeschberger (1982) used the formula *220-age* understanding that maximum HR varied mostly with age, however not in a linear relationship. Miller et al (1993), proposed a formula *217-(0.85-age)*. Neither sex nor race appeared to alter conclusions found in the study, however, activity type and level of fitness were found to be varying factors. Specifically for the purpose of the study, the author used Londeree and Moeschberger's (1982) formula to devise target HRs for subjects to aspire to work on the cycle ergometer. Progressive target HRs of 55-70% of maximum HR in increments of five beats per minute (bpm) were originally planned for testing. At week two of testing, progressive HRs were changed to between 55 and 80% of maximum HR at five bpm increments.

- Cycle Ergometer

The Wingate Anaerobic 30 cycle Test was developed during the 1970s at the Wingate Institute in Israel (Sports Coach UK, 1997). The Wingate test considers the cycle ergometer to be both a reliable and valid method of physiological testing (Inbar et al, 1996); Extensive use of cycle ergometers in research studies evidenced in local universities and exercise laboratories (Sport England, 2006) support this claim. An ergometer has an ability to be calibrated providing valid and reliable results and can measure according to a specific model; output on Watts and HR through the use of telemetry. Additional features on ergometers can include number of pedal turns per minute, cycling time in minutes and seconds, cycling speed in kilometres per hour and distance covered in kilometres or miles. Braking power has the ability to be set on some models allowing a further reading of calorie consumption. In addition to cycles, ergometers may take the form of a row machine or treadmill. For the purpose of this specific study, the author opted to use a cycle ergometer for ease of testing and to aid subjects in familiarity, clarification, understanding and completion of their physical task.

PROCEDURE

Initial study information and invitation letters were posted to eight potential subjects' parents. On receipt of an initial permission and interest form (see Appendices 1, 2), parents were sent a specific study letter (see Appendix 3) and PAR-Q, which included a declaration to complete, sign and return. Parents were sent, for information only, a specifically adapted version of B-RPE.

Prior to the selected test day, in order to maintain a near-normal routine, the researcher briefed the staff hosting the lesson of each child to be observed, verbally, via school intranet and in written form (see Appendix 6). In order to prepare and brief the five selected pupils, the author devised an adapted form of social story (see Appendix 7) with pictorial symbols and read through the pictorial instructions aid with the subjects on the day previous to testing, the morning of the test and at the beginning of the test period.

One week prior to the test day, at the time equivalent to the beginning of their first observation period, the subjects' RHRs were measured and recorded. On the test day, the author prepared the cycle ergometer with new batteries for the heart rate monitor, the saddle at height in accordance with the hip height of the observed subject, presence of a large display screen countdown stopwatch, collaborated heart rate monitor with compatible chest strap, B-RPE visual aid and combined SSB and heart rate monitoring recording sheet.

At the beginning of each lesson period in which the observation was to take place, the author approached the identified subject with the pictorial instructions, in anticipation that they would recognise they were about to be observed and about to participate in a period of time on a cycle ergometer. The author proceeded to observe the subject from a mutually convenient position in the classroom (mutually convenient for teacher, subject and author), after starting a twenty-minute count down timer. Throughout both observation periods, the author recorded tally marks in the most closely fitting behavioural descriptive boxes on the formulated SSB recording sheet. On conclusion of the twenty-minute observation period, the author showed the pictorial method sheet to the subject, highlighting the picture of the bike specifically. On presentation of the method stimulus, the subject followed the author to the ergometer area. On arrival to the ergometer, the subject took off any surplus clothing such as jumpers and lifted their t-shirt to allow the Heart Rate Monitor (HRM) chest strap to be securely and comfortably fitted. The HRM watch accompaniment was then firmly fitted on the left wrist to allow the author comfortable reading access.

To commence testing, the subject cycled freely whilst the visible stopwatch counted down one minute. After one minute, the timer was reset to a five-minute countdown, the first HR reading was recorded on the HR recording sheet as ‘minute 00’ and the subject was encouraged verbally to cycle continually in a forward momentum for a further five minutes; complemented by the presentation of the pictorial method sheet. On week one of testing, the subject was encouraged to go faster or slower according to their predetermined target rate (50% of maximum heart rate). This was written onto the pictorial method sheet in bold red writing. On weeks two and three of testing, the ergometer was marked with a large printed, red target HR number (see Appendix 16) (55 and 60% of maximum HR successively) next to the ergometer screen displaying their actual HR. On week four, the subject was verbally encouraged to cycle as fast as they could for the five-minute duration. On week five, the subject was encouraged to cycle as fast as they could for the five minute duration and was additionally shown pictorial descriptors (see Appendix 17) comprising of the words ‘fast’, ‘slow’ or ‘no stopping’. Subjects were shown these as when deemed individually appropriate by the researcher throughout the test period and will be discussed in the analysis of results.

On conclusion of the five minute cycle period, the subject was asked their B-RPE, indicated by pointing to the most appropriate facial picture on the adapted B-RPE ‘How Do You Feel’ (see Appendix 5) sheet. Subjects were offered water to drink before being disarmed from both HRM attachments and returning to their previous lesson. The second observation period was conducted in the exact same manner as the first.

On completion of both observation periods and practical testing, the author discreetly left the subject’s timetabled lesson. In the following weeks, the author replicated the exact procedure from the showing and understanding of the pictorial instruction sheet at the beginning of the school day through to the leaving of the lesson.

Chapter 3

RESULTS

INITIAL RESPONSES

Eight initial information letters with attached consent forms were sent to parents prior to the study. Five completed consent forms were returned. Out of the three remaining, one did not give permission and two were not received. The five subjects with completed consent forms were elected to complete the study, to maintain confidentiality, they assumed the identities A, B, C, D, E respectively throughout.

DATA ANALYSIS

Table 1 (p37), shows raw data of all five subjects participating in weeks one through to five, as labelled in the topmost row. Resting HRs are recorded between 35% and 39% and exercise HRs between 43% and 87%.

HRs are shown recorded in beats per minute, with percentages adjacent. The underlined and bold figure indicates the heart rate used for data collection. Non-registered HR readings are indicated by '-'. No readings were recorded for Subject **D** in weeks four and five, due to voluntary non-participation.

Frequencies of observed SSBs are shown in the bottom three rows, the third row indicating the difference in observed behaviours, calculated by (SSB pre-exercise – SSB post-exercise). For the purpose of reading the data, a +/- figure was added to indicate a decrease or increase of observed SSBs, it should *not* be read as a numerical value.

TABLE 1

Raw data of observed SSBs and mearsured HRs for subjects A-E

A (RHR: 80bpm/39%)		**Week 1**		**Week 2**		**Week 3**		**Week 4**		**Week 5**	
Average Ergometer	Av %	113.8	55.2	138.7	**67.3**	147.9	71.8	158.5	76.9	162.4	78.8
Average Monitor	Av %	114.4	**55.5**	-	-	153.1	**74.3**	162.7	**79.0**	174.1	**85.0**
SSB pre exercise		65		54		33		32		35	
SSB post exercise		55		42		34		16		7	
SSB difference		-10		-12		+1		-17		-28	

B (RHR: 80bpm/39%)		**Week 1**		**Week 2**		**Week 3**		**Week 4**		**Week 5**	
Average Ergometer	Av %	111.6	54.2	144.1	**70.0**	129.3	62.8	147.0	71.4	149.2	72.4
Average Monitor	Av %	113	**54.8**	-	-	178.3	**86.6**	155	**75.3**	154.4	**75.0**
SSB pre exercise		82		66		70		35		35	
SSB post exercise		70		36		58		11		20	
SSB difference		-12		-30		-12		-24		-15	

C (RHR: 76bpm/37%)		**Week 1**		**Week 2**		**Week 3**		**Week 4**		**Week 5**	
Average Ergometer	Av %	90.2	**43.4**	110.0	**52.8**	-	-	-	-	-	-
Average Monitor	Av %	-	-	-	-	138.2	**66.4**	127.9	**61.5**	133.6	**64.2**
SSB pre exercise		25		38		37		24		22	
SSB post exercise		23		28		33		16		11	
SSB difference		-2		-10		-4		-8		-11	

D (RHR: 76bpm/37%)		**Week 1**		**Week 2**		**Week 3**		**Week 4**		**Week 5**	
Average Ergometer	Av %	-	-	-	-	-	-	-	-	-	-
Average Monitor	Av %	134.9	**65.8**	147.1	**71.8**	141.0	**68.7**	-	-	-	-
SSB pre exercise		45		34		52		41		36	
SSB post exercise		38		29		29		-		-	
SSB difference		-7		-5		-23		-		-	

E (RHR: 72bpm/35%)		**Week 1**		**Week 2**		**Week 3**		**Week 4**		**Week 5**	
Average Ergometer	Av %	101.0	49.3	100.1	**48.8**	-	-	117.4	57.3	-	-
Average Monitor	Av %	128.3	**62.6**	-	-	138.9	**67.8**	140.3	**68.4**	145.5	**71.0**
SSB pre exercise		11		16		7		19		12	
SSB post exercise		6		10		31		14		9	
SSB difference		-5		-6		+24		-5		-3	

Charts 1-5 show raw data in pictorial form, pre-test and post-test referring to SSBs before and after physical exercise. Corresponding test week numbers are shown directly under each chart, SSB frequencies beneath.

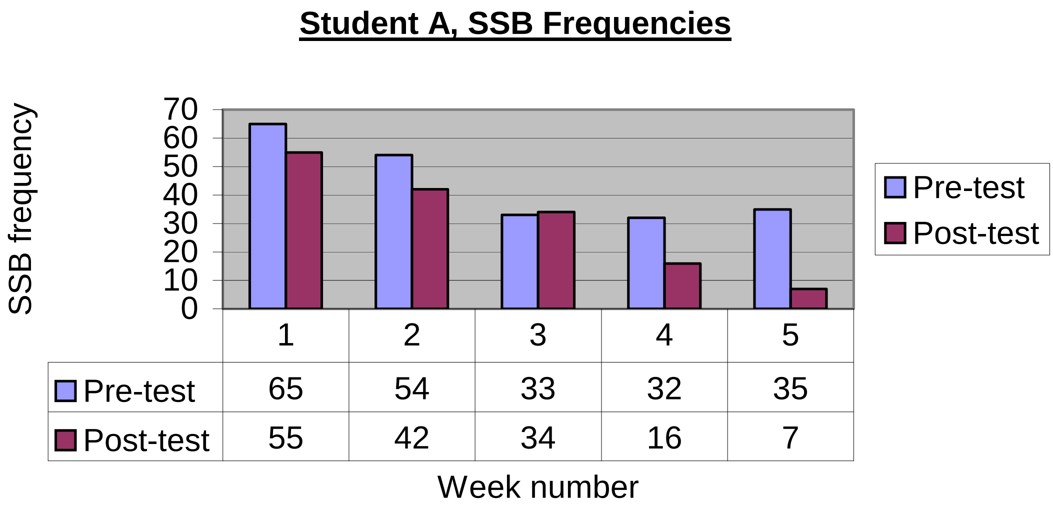
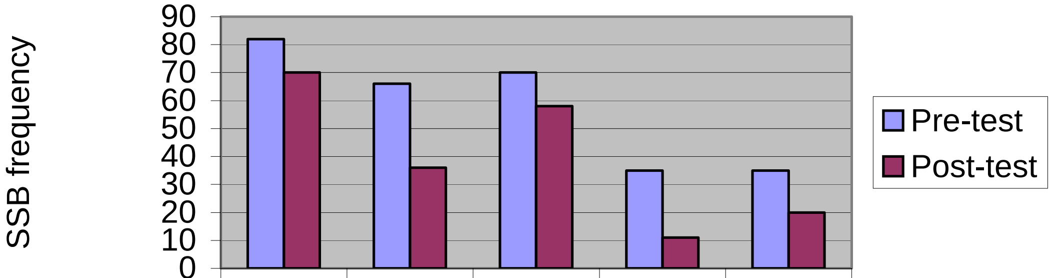


CHART 1

Subject **A** shows a decrease in SSBs post-exercise on weeks 1, 2, 4, 5. Week 3 shows a slight SSB post-exercise increase, a frequency of 1, corresponding to 3%.

<u>Student B, SSB Frequencies</u>



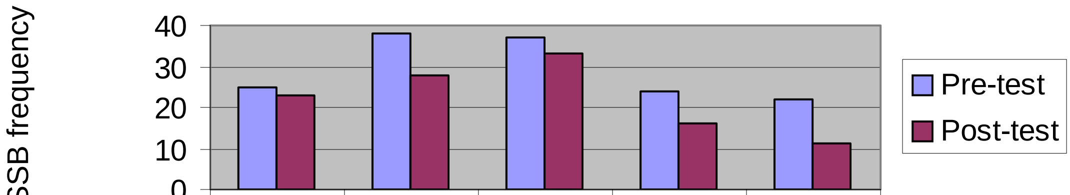
	1	2	3	4	5
Pre-test	82	66	70	35	35
Post-test	70	36	58	11	20

Week number

CHART 2

Subject **B** shows a decrease in SSBs on all weeks; 1, 2, 3, 4, 5. Week 2 showing a 45% decrease and week 4 a 68% decrease of post-exercise SSBs.

<u>Student C, SSB Frequencies</u>



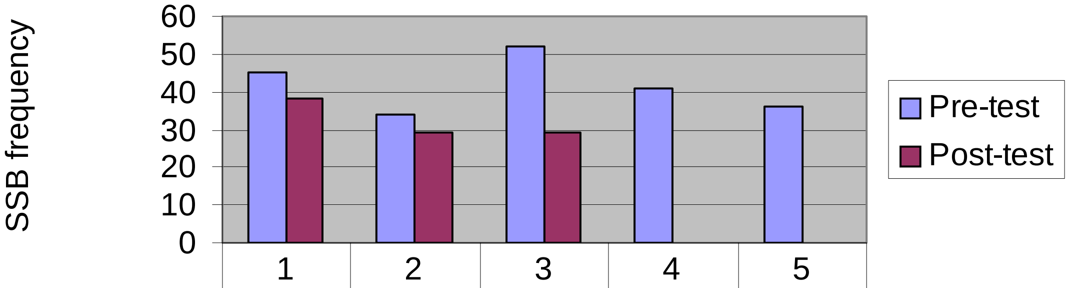
	1	2	3	4	5
Pre-test	25	38	37	24	22
Post-test	23	28	33	16	11

Week number

CHART 3

Subject **C**, again, shows a decrease on weeks 1, 2, 3, 4 and 5. In week 5 there was a 50% decrease in post-exercise SSBs. Excluding week 1, all pre-exercise SSBs show a progressive weekly decrease (corresponding with post-exercise SSBs).

Student D, SSB Frequencies



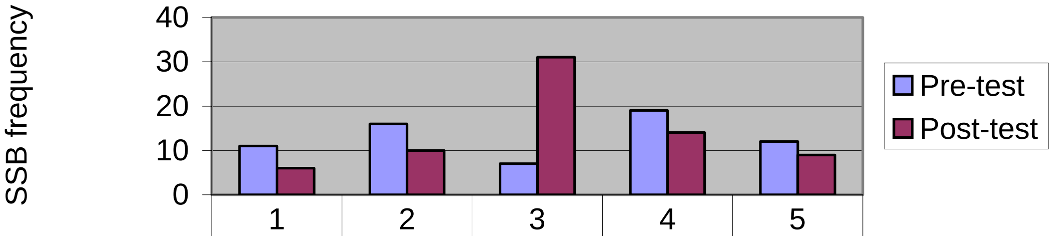
	1	2	3	4	5
Pre-test	45	34	52	41	36
Post-test	38	29	29		

Week number

CHART 4

Subject **D** shows a decrease in SSBs during the weeks he participated in the study. In week 3 a 44% decrease in post-exercise SSBs was recorded.

Student E, SSB Frequencies



	1	2	3	4	5
Pre-test	11	16	7	19	12
Post-test	6	10	31	14	9

Week number

CHART 5

Subject **E** shows a visible increase of 44% of post-exercise SSBs on week 3. Weeks 1, 2, 4 and 5, feature decreases in post-exercise SSBs, matching subsequent data patterns.

In subjects B-E (but not A) the post-exercise recordings of SSBs in the final week of participation (Subject D did not participate in weeks 4 and 5) have decreased similar to their week 1 recordings.

Charts 6-10 show subject's HR (% of MHR) against a positive or negative difference in observed post-exercise SSBs. Data is shown in ascending heart rate order as opposed to arrangement in order of weeks observed.

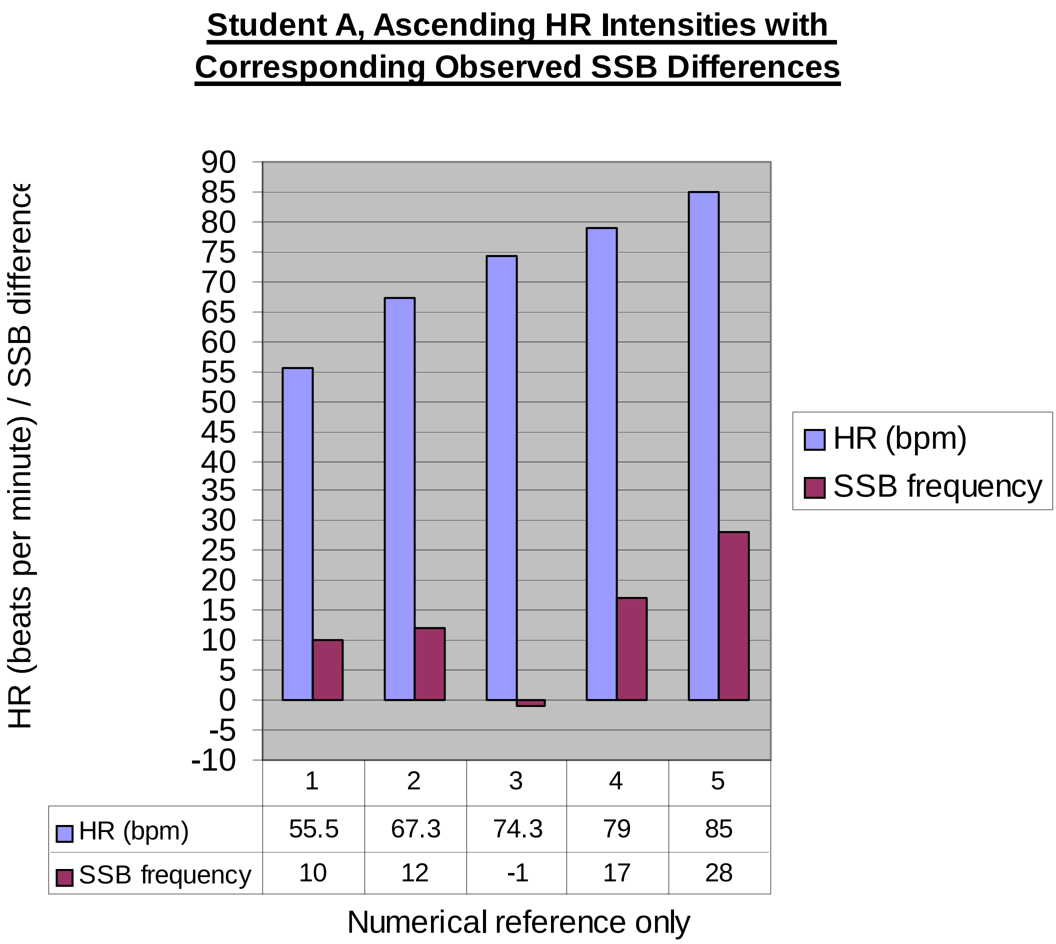
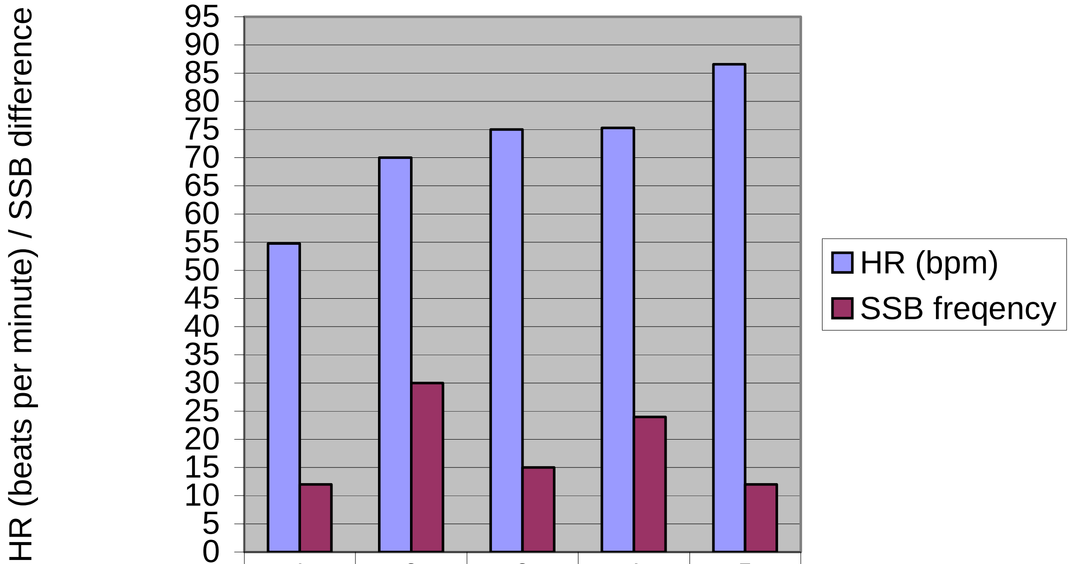


CHART 6

Subject **A**, excluding week 3, shows a positive correlation between HR intensity and reduction in SSB differences.

Student B, Ascending HR Intensities with Corresponding Observed SSB Differences

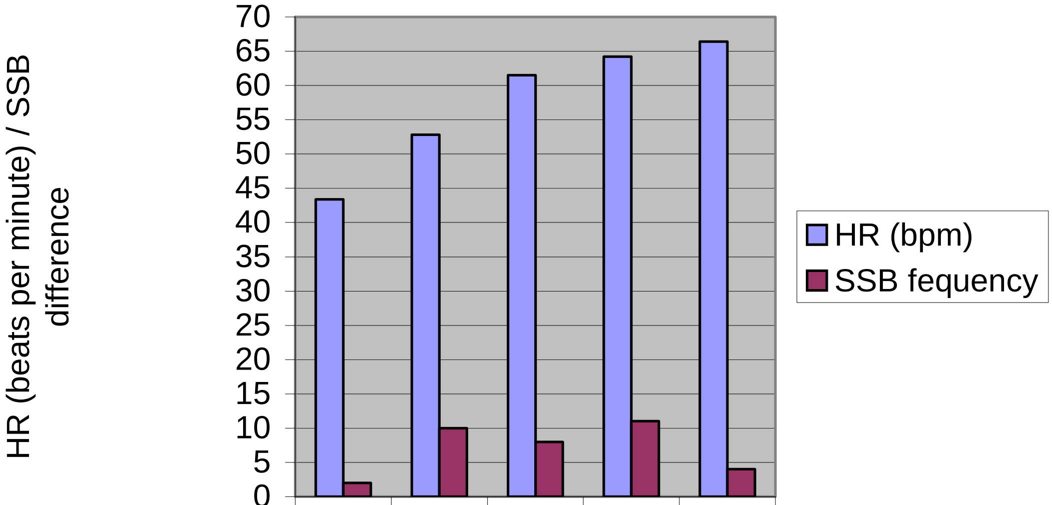


	1	2	3	4	5
HR (bpm)	54.8	70	75	75.3	86.6
SSB freqency	12	30	15	24	12

Numerical reference only

CHART 7

Student C, Ascending HR Intensities with Corresponding Observed SSB Differences



	1	2	3	4	5
HR (bpm)	43.4	52.8	61.5	64.2	66.4
SSB fequency	2	10	8	11	4

Numerical reference only

CHART 8

Student D, Ascending HR Intensities with Corresponding Observed SSB Differences

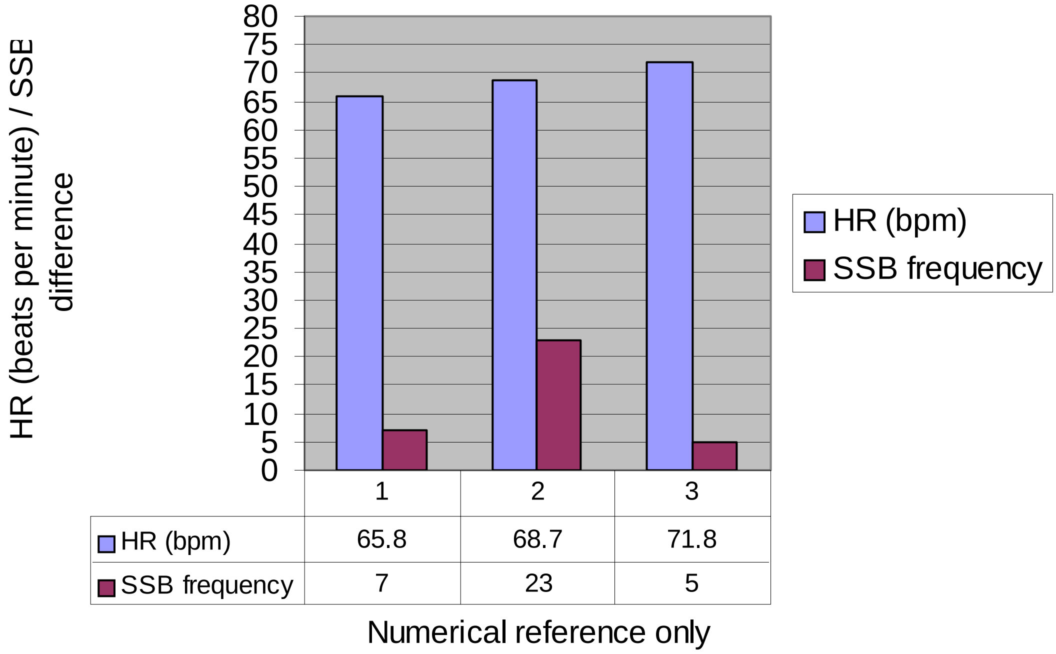
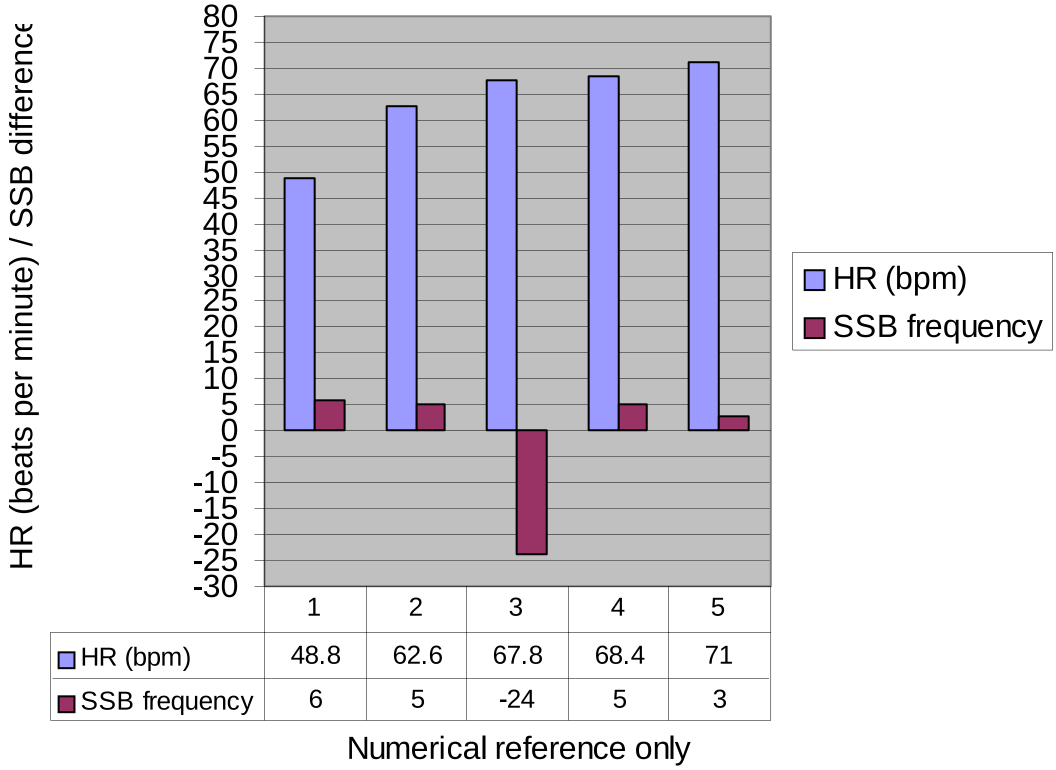


CHART 9

Subjects **B, C** and **D** (Charts 7, 8, 9) all show no observable relationship between HR intensity and reduction in SSB differences. The highest recorded HR intensity of all subjects, appear to also share one of their lowest SSB frequency differences. (Either the lowest, joint lowest or second lowest observed SSB difference).

Student E, Ascending HR Intensities with Corresponding Observed SSB Differences



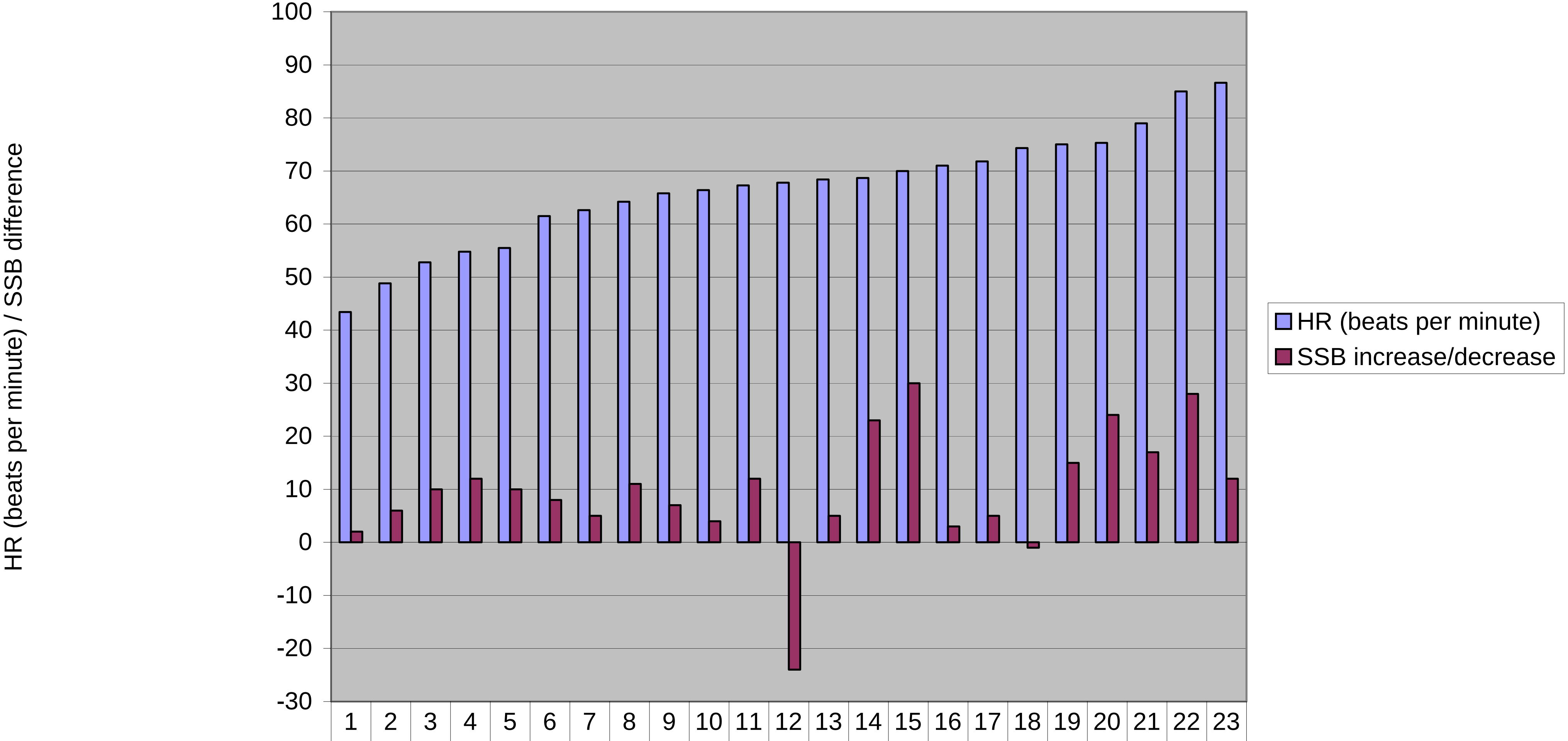
	1	2	3	4	5
HR (bpm)	48.8	62.6	67.8	68.4	71
SSB frequency	6	5	-24	5	3

CHART 10

Subject **E**, excluding week 3, shows a similar difference of observed SSBs, with no correlating relationship to heart rate intensity. Subject E also shows the lowest difference in observed SSBs when exercising at his highest recorded heart rate intensity.

Chart 11 (p43), shows an accumulation of all subject's SSB differences against HRs in ascending order. The chart appears to show no correlation between HR intensity and observed SSB differences. SSB differences of 20+, however, were only recorded at HRs of 69% of MHR and over. SSB differences of 10+ were recorded at HRs of 53% of MHR and over and SSB differences of 2+ were recorded throughout. Two negative SSB differences (subjects increased observed SSBs post-exercise) were recorded at HRs 68% of MHR and 74% of MHR.

Ascending HR Intensities with Corresponding Observed SSB Differences



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
HR (beats per minute)	43	49	53	55	56	62	63	64	66	66	67	68	68	69	70	71	72	74	75	75	79	85	87
SSB increase/decrease	2	6	10	12	10	8	5	11	7	4	12	-24	5	23	30	3	5	-1	15	24	17	28	12

Numerical reference only

CHART 11

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

RESEARCH QUESTION I

- Does physical exercise of five-minute duration reduce observed post-exercise SSBs?

Within the five weeks of the study, the original subjects (A-E) remained constant throughout; leaving no reason to suppose collated data produced any irregularities. Future studies may prove more conclusive if a larger sample was used.

Within this study there were issues regarding the accuracy of the displayed ergometer HR readings. The overriding use of calibrated HRM suggests that the subjects' calculated HR intensities were accurate throughout physical exercise testing. Calibrated ergometers are therefore recommended for use in future studies.

91% of the conducted tests revealed a decrease in frequency of SSBs following five minutes of aerobic physical exercise. It is therefore proposed that five minutes of aerobic physical exercise is sufficient in reducing SSBs and recommended for use in further extensions of this study.

It was of concern that subjects appeared to lack motivation to complete five minutes of aerobic physical exercise. It is therefore recommended that subjects are familiarised and integrated into exercise regimes prior to study commencement.

The introduction of a 'reward system' might also be considered as a means of increasing motivation levels.

RESEARCH QUESTION II

- Does exercise intensity affect observed post-exercise SSBs?

The majority of data did not show a relationship between HR intensity and decrease in observed post-exercise SSBs. It was noted that Subject A did appear to show a positive correlation between increased HR intensity through aerobic physical exercise and a decrease in observed post-exercise SSBs. Within this study gender differences were not explored but future studies might explore this variable by using a mixed gender sample.

The collected data recorded randomly performed HR intensities. Designs researching relationships between behaviours and HR intensities may find it useful to repeat physical exercise tests at pre-determined HR intensities.

RESEARCH QUESTION III

- Does optimal heart rate intensity exist to bring about an optimal decrease of post-exercise SSBs?

The research highlighted a possible relationship between HR intensity and decrease in post-exercise SSBs occurring at 55% of MHR intensity and 69% of MHR intensity. Observed post-exercise SSBs were decreased by a frequency of ten or more only at HR intensities of 55% or more and a decreased frequency of twenty or more only at HR intensities of 69% or more. This data indicates to possibilities that HR intensity thresholds may exist and warrants further research. Focus may be directed towards investigating whether an optimal HR intensity of between 55 and 69% exists in bringing about a significant decrease in SSBs.

LIMITATIONS OF THIS RESEARCH AND SUGGESTIONS FOR FURTHER RESEARCH

Many of the points identified below have already been mentioned within the paper but are summarised at this juncture.

- Attention has been drawn to design faults in the failure to record a weekly RHR. The obtrusive nature of attaching the HRM chest strap to the subject and subsequent subjects' comfort over prolonged periods, were concerns that should be addressed in future studies.

- This piece of research was conducted specifically with male Autistic children within in a four-year age bracket. Expanding the population sample by age, sex and regional location of subjects might lead to different, varying results.

- The nature of the observation protocol used within this study might have had a bearing on the findings of this study being as variance with the findings of previous published studies. Multiple observers, spilt observation time combinations or separate observations location may have brought about a difference in recorded SSBs.

- The limitations of the ergometer specific to size and comfort of the subjects was a concern throughout the study. Differentiated equipment, specifically saddle height, pedal and handle bar distances, should be considered for further research.

- Further limitations regarding the ergometer included inaccurate HR intensity recordings. All featured equipment should be calibrated, within the facility prior to each test period.

- The study provided data reflecting aerobic exercise conducted on a cycle ergometer. Future studies may seek to repeat the experimental design using others methods such as jogging or a rowing ergometer.

- Within the literature and research design chapters, concern was expressed by the author with regard to the subjects' lack of familiarity with the equipment and participation in periods of aerobic physical exercise. More valid results might be attained if subjects had opportunities to engage in the chosen physical exercise prior to testing. Pre-test integrated physical exercise of the chosen method of physical exercise for the study may lead more true results.

The author expressed her appreciation to the subjects and their host school for their high level of co-operation and enthusiastic participation. The author believes completion of the study to have been truly worthwhile in raising awareness and in increasing understanding surrounding the link between physical education and learning within an Autistic educational environment. It is hoped that in addition to further research, practitioners use the information supplied in this study to aid teaching and learning of Autistic children. Schools may choose to integrate physical education throughout the school day with supplementary physical exercise periods as deemed beneficial. Implementation of adapted school timetables to allow increased physical exercise, could lead in turn, to a revolutionary new style of learning evidencing increased attention to learning and increased learning.

Chapter 4

DISCUSSION

METHODOLOGICAL ISSUES

- Adapted Borg Scale

The adapted BORG RPE scale (see Appendix 5) used within this study appeared to have little impact. No studies thus so far, documented the use of such a scale or anything similar. As an Exercise Physiologist, the author felt the scale to be important in assessing a subjects' well being; particularly in light of some of the subjects having impaired communication skills. The author was unsure whether the subjects participating in the study understood the adapted Borg scale increments. The scale could possibly have been introduced prior to the study, such as in physical education lessons within the curriculum. This would have provided opportunities to familiarise and teach the subjects how to identify their own ratings of perceived exertion.

- Social Story

The adapted social story (see Appendix 7) produced for this study proved significantly useful to the author in preparing the subjects for the physical exercise sessions; wearing the HRM and in helping them understand that the author would be present in their lesson on the identified weekday. The 'adapted method' social story (see Appendix 8) of the physical exercise test provided to the pupils on the day of testing also appeared useful as a prompt. On showing the subjects a PECS bicycle picture, the subjects often repeated the word 'bike' to which the author responded with the question 'will you help me on the bike today?' The subjects consistently replied that they would. On week two using the same aid and following the same question ritual, subject B had to be walked to and shown the ergometer before he would settle in lesson of which he was to be observed. This followed subject B repeating, 'bike' and 'now' in a raised voice. In the case of Subject D, who did not participate in the last two physical exercise tests, the subject did respond positively with the same aids and questions and went voluntarily to the ergometer, but stopped mid test, indicating for the HRM to be removed. Due to the observed success of the adapted social stories, on week five, the author introduced PECS words of 'fast', 'slow', 'forward' and 'no stopping' (see Appendix 17). These additions were made to aid motivation within the physical exercise test as they could be shown to the subject when and if required.

- Observation of Self-Stimulatory Behaviours

Throughout observation, SSBs were recorded by tally mark on a pre-designed recording sheet (see Appendices 10-14). Quill et al's (1989) method of using a five-point rating scale was rejected as complicated and irrelevant to the current study. Elliott et al's (1994) method of recording the three most frequently recording SSBs was considered as not having enough detail and therefore also rejected. Editing the generic SSB recording sheet (see Appendix 9) to insert individual commonly occurring SSBs within a top section, proved easier for the author to record SSBs within the tight time period. A total of twenty minutes, in line with the study completed by Celiberti et al (1997), to record subject SSBs seemed realistic and adequate to collate constructive data, as well as fitting well with subjects' lesson timings and time required for exercise testing. The author held reservations regarding the utilisation of spilt observations times as seen in studies conducted by Rosenthal-Malek and Mitchell (1997), Kern et al (1984) and Kern et al (1982), whose total observed SSB recording times equalled fifty seconds, one-hundred seconds and seven-and-a-half minutes respectively. Observing the subjects and their commonly occurring SSBs previous to the study may have been advantageous for the author to aid recording. Particularly as the author, at commencement of the study, had limited experience within this field. The limited experience of the author may in turn, have led to bias in interpretations; however this was minimised by only having one observer. Having only one observer also meant there was consistency categorising SSB and interpreting any behaviours seen across subjects and time frames.

Observing the five subjects within one day may have given opportunity for bias due to onset of author fatigue throughout the day. The author also found it difficult to solely concentrate on observing within classroom lessons. Due to the specialized nature of the school classes, it was found that at times other class pupils attempted to demand attention. Similarly, health and safety considerations meant attention, was diverted away from the subject being observed.

- Heart Rate Intensity

At the onset of the study, the physical exercise HR intensity target was 50% of MHR, increasing by 5% increments weekly. 50% of MHR was selected in attempt to take into account of Elliott et al's (1994) observation of no SSB differences at 53% of MHR. On completion and examination of week one performances, the author recognized the difficulty of maintaining a specific target heart rate with the elected subjects. 50% of MHR was also perceived to be too low as a starting HR, as only a maximum 70% of MHR would be achieved in week five. 50-70% of MHR was a range felt too small for significant comparisons in respect of studies completed by Lochbaum and Crews (2003), Elliott et al (1994) and Allison et al (1991), who observed post-exercise positive SSB differences after performances at 65-70%, mean 76% and 75.8% of MHR respectively. The author therefore amended target HRs to 65, 70, 75 and 80% of MHR respectively, from week two onwards. These figures were suspended on week four, in favour of the subjects' being encouraged to 'cycle as fast as they can' in order to encourage consistent HRs above 70% of MHR, which were previously not forthcoming. A pre-study ergometer familiarisation timetable may have encouraged increased exercise intensities as the subjects became more relaxed and possibly tried to exert themselves beyond their physical comfort zone.

Week three appeared to generate increased HRs when compared with the previous two performances. Goodwin et al (2006) commented on cardiovascular increases when aroused by stressors, similar to Willemson-Swinkels et al (1998) who described HRs and SSBs to increase on presentation of new tasks or situations. Although the author cannot recall any changes in test conditions throughout the day, external factors; such as absence of a regular teacher or a difference in weather conditions, may have influenced week three results. The same external factors may also account for the week three increase of post-exercise SSBs observed in Subjects A and E. In addition to the post study RHRs, which all appeared similar, weekly RHRs would have been useful to explore this hypothesis further.

- Heart Rate Monitoring

The formula (220-age) was adopted to calculate subjects' MHRs; similar to the study Londeree and Moeschberger (1982). Miller et al's (1993) formula of (217-(0.85-age)) was rejected as least preferred, as was using a stethoscope to measure HRs featured in the study by Elliott et al (1994); subjects not anticipated to remain still and quiet enough for accurate readings to be obtained. HR monitoring pre and post-exercise were decided against as the author felt that HRM attachments may be uncomfortable over long periods of time which, in turn may have led to alterations in observed SSBs. For this reason, non-attaching or discreet HRMs should be considered in future studies.

The adopted style of HRM was not compatible for all of the subjects. The HRM equipment required adjustment for some of the subjects, for instance the adjustable chest strap was shortened, tied in a knot and had to be placed above the nipple line in order for the HRM watch to be activated for one of the subjects who was of smaller stature. Willemson-Swinkels et al (1998) and Lochbaum and Crews (2003) made reference to subjects refusing to wear HRM attachments during their tests. This is a possible factor in Subject D terminating their exercise test; however this is only speculation by the author.

In retrospect, the subjects might have benefited from being instructed to complete a warm up of longer than one-minute. As it was in the first of the thirty-second HR recording intervals, the HRM chest strap and watch were not always completely synchronised, the watch not displaying the HR data.

- Ergometer

In addition to subjects being familiar with the cycle ergometer (an important consideration for these subjects who can feel anxious when faced with novel situations) and it being easy to use, the cycle ergometer was specifically chosen for use in testing due to its ability to record and display each subjects' performance through HR. Data (see Table 1) repeatedly showed ergometer HRs below the calculated HR displayed by the calibrated HRM, suggesting that ergometer HRs were inaccurate and unreliable. At week two, the author displayed target HRs in number form next to the ergometer HR reading display, however, in an effort to counteract the problem of the subjects not aiming for the correct HR (as the display HR was likely to be undervalued), at week four, the author displayed a lower red number next to the ergometer HR reading display. The featured number was lower than the subjects' desired HR in the hope that the subject would feel the target attainable.

The size of the ergometer had a direct impact on the subjects. Three subjects were tall in stature (170cm+) and comfortable on the ergometer. One slightly smaller subject appeared uncomfortable in reaching the handlebar HR sensors. The smallest subject, even with the seat at its lowest and handlebars turned over to a lower and closer position, struggled to pedal comfortably throughout the exercise session.

- <u>Subjects</u>

Throughout the five-minute exercise duration, the author found it difficult to keep the subjects motivated and on task. One subject performed the test on two occasions without shoes and three subjects expressed desires to cycle backwards on more than one occasion! Unfortunately, cycling backwards as fast as possible, as was observed over two-minute duration in one subject, did not bring about a desired increase in HR.

Showing a visible countdown timer during exercise periods appeared useful in keeping the subjects on task. All subjects were male and between twelve and sixteen years old due to the selection criteria and population of the host school.

CONDUCT OF RESEARCH

- <u>Timetabling</u>

Observations were timetabled throughout one whole day over a five-week period due to study time and money constraints (no funding was available). Observations were delayed until the last possible time, as the author had only commenced employment within the school five months previously. In line with observations shared by Celiberti et al (1997) and Lochbaum and Crews (2003), the author wished to become familiar with persons of an Autistic population whilst simultaneously becoming familiar to the pupils in the school. Routines (Sainsbury, 2000) were previously established through weekly curriculum physical education lessons, which the author considered helpful for conducting the physical exercise test phases. In addition, the author attempted to add to subjects' routines; rather than change them when scheduling observations and tests. In retrospect, it may have been beneficial to timetable cycle sessions up to one month previous to testing as seen in the study by Celiberti et al (1997) who ran pre-test jogging trials and Rosenthal-Malek and Mitchell (1997) who timetabled jogging into the curriculum one month prior to testing.

Although the subjects' observation and tests were timetabled in the same lessons at the same time each week, there were occasions throughout the study that lesson content and locations varied. These differences may have accounted for changes in observed behaviours and/or performances.

- Duration of Exercise

Five-minutes of exercise was determined, in-part, due to research question one; 'determining effects of exercise on SSBs after a five minute duration'. However the time constraints associated with combining two-times twenty-minute observation periods and one-times five-minute exercise period into a sixty-minute lesson was an important factor to be considered in the decision making. In view of the results indicating five-minutes of exercise as adequate to decrease post-exercise SSBs (Table 1), five-minutes of exercise appeared justified.

In addition to time constraints, the author did not feel the subjects would be willing to exercise for periods longer than five minutes. In their curriculum physical education lessons over the previous five months, the subjects had gradually increased continuous running for a period of three-and-a-half minutes. The author (and also the physical education teacher) did not perceive the subjects increasing this time without the onset of fatigue and monotony. Therefore five minutes on a cycle ergometer appeared more fitting than running or cycling for a longer period.

OBSERVATIONS

- Research Question I:

Does physical exercise of five-minute duration reduce observed post-exercise SSBs?

Twenty-one out of a total twenty-three (91%) recorded post-exercise SSB observations showed a decrease in frequencies (Charts1-5), indicating that physical exercise of a five-minute duration did reduce post-exercise SSBs in this study.

- Research Question II:

Does exercise intensity affect observed post-exercise SSBs?

Subject A (Chart 6), showed a positive correlation between increased exercise intensity and a decrease in observed post-exercise SSBs. This was not, however, observed in the same data provided for subjects B-E who showed no correlation between exercise intensity and observed post-exercise SSBs (Charts 7-10). The lowest HR recorded for all subjects A-E showed a low decrease of observed post-exercise SSBs, but was only the lowest occurring on one occasion. Unpredictably, the highest HR recorded for all subjects A-E also featured low decreases of observed post-exercise SSBs; the lowest or second lowest occurring frequency for four out of the total five subjects.

- Research Question III:

Does an optimal heart rate intensity exist to bring about an optimal decrease of post-exercise SSBs?

Chart 11 showed no significant correlation between HR intensity and decrease in observed post-exercise SSBs. This statement is further evidenced by previously discussed data showing HRs of a high intensity recording low decreases of observed post-exercise SSBs.

Interestingly, observed post-exercise SSBs which decreased by ten or more in frequency, only featured where HR intensity was a minimum of 55%. Observed post-exercise SSBs decreasing with by twenty or more only occurred where HR intensity was 69% or more. These observations offer possibilities that there may be a positive relationship between increased HR intensity and decreased post-exercise SSBs.

Finally, a general observation. Observed pre-exercise SSBs appeared to decrease universally throughout the weeks. In subjects A and B, this can be seen from weeks one through to five and in subjects C-E from week three onwards. One possible explanation for this could be the Hawthorne Effect (Huczynki and Buchanan, 1991); the selected subjects felt special and were pleased to receive attention from the observer/author; as a consequence their behaviour changed. The change of behaviour could have led to subjects being more relaxed, therefore displaying decreased frequencies of observed pre-test SSBs.