

# CHAPTER 1

## Introduction

### 1.1 INTRODUCTION TO THE RESEARCH

This research addressed the question: *“What is the impact of Neuro-Developmental Treatment on the functional outcomes of children with cerebral palsy as measured by their performance in selected daily living tasks?”*

Three pilot studies were used during the course of the research. The first two pilot studies were constructed to develop and trial methodology that was able to measure change in children’s motor participation in daily tasks, and resulted in an ‘NDT Measurement Model’ which could be used in the final phase of this research and in future studies. The third pilot study described the changes that twelve children with cerebral palsy made during performance of everyday tasks over the course of intensive NDT intervention, and the degree to which the changes were maintained when NDT intervention was withdrawn. Daily tasks included self-care, mobility, hands skills, communication, educational and vocational skills, leisure pursuits and play (Howle, 2002; World Health Organisation, 2001)

### 1.2 NEED FOR THE STUDY

Evidence of intervention effectiveness is important for families, colleagues and public funding bodies when considering the inclusion of Neuro-Developmental Treatment (NDT) in intervention programs for people with cerebral palsy (Barry,

2001; Campbell, 1989). However, the literature offers little empirical evidence to support anecdotal claims of positive functional outcomes from NDT (Fettters & Kluzik, 1996; Siebes, Wijnroks & Vermeer, 2002). Despite the NDT framework being used internationally, and most commonly for children with CP, only a relatively small number of studies have investigated the efficacy of NDT. The general consensus is that evidence of benefit has not been established (Anttila, Suoranta, Malmivaara, Makela, & Autti-Ramo, 2008; Bar-Haim, Harries, Belokopytov, Frank, Copeliovitch, Kaplanski, & Lahat, 2006; Berry & Ryan 2002; Fettters & Kluzik, 1996; Jeanson, 2005; King, 1997; Siebes, et al., 2002). One consistent feature of these studies is their use of outcomes that are based solely on ‘quality of movement’ rather than achievement of functional goals. While past NDT perspectives emphasised *quality of movement*, contemporary NDT practice frameworks have shifted their focus towards achievement of *functional outcomes* (Howle, 2002, 2005). There is now a need for the efficacy of this contemporary NDT practice to be evaluated (Butler & Darrah, 2001; Sharkey, Banaitis, Giuffrida & Mullens, 2002). This study reflects the revised theoretical base and practice model of the Neuro-Developmental Treatment Association of North America (NDTA<sup>TM</sup>; Howle, 2002), which is outlined in Chapter Two of this thesis.

The study was prompted by my clinical observation as an occupational therapist, and also an NDT instructor and practitioner, that children appear to achieve functional goals that are targeted during NDT intervention. This observation has related to both clinical situations, and the apparent changes that children make during the intervention practicums in NDT training courses. In addition, positive

feedback from parents in these settings over a long period of time has prompted me to undertake a more formal approach to evaluating outcomes of NDT intervention.

### **1.3 BACKGROUND**

Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation that is attributed to non-progressive disturbances in the foetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behaviour, by epilepsy and by secondary musculoskeletal problems (Rosenbaum, Paneth, Leviton, Goldstein, & Bax, 2007).

Cerebral palsy is identified as the most common cause of severe physical disability in children. Its prevalence is approximately 2.5/1000 live births (Steenbergen & Gordon, 2006). There are between 500 and 600 new cases of cerebral palsy each year in Australia and 10,000 in the United States. Despite advances in obstetric medicine in recent decades, the incidence of CP has continued in relation to the improved survival rates of preterm neonates (Blair & Watson, 2006; Boyd, 2006; Eskew & Dawson, 2001; Koman, Smith, & Shilt, 2004; Lin, 2003; Stanley, 2002).

CP comprises a wide range of functional problems, resulting in children and their parents having many different needs at different stages across the child's lifespan. The main aim of intervention is to optimise children's functional performance

relative to their and their family's specific needs at each stage. There is increasing evidence that a child's development may be positively affected and changed by regular therapy of a 'high standard', with research supporting the concept of neuroplasticity in the potential to change (Bauder, Miltner, Taub, & Weiller, 2000; Eskew & Dawson, 2001; Liepert, 2000; Nudo & Milliken, 1996; Odman & Oberg, 2005; Olliff, Reddihough, & Reynolds, 2008; Weindling, 2000).

NDT is a 'hands-on' approach used in intervention for children with central nervous system insults that result in difficulties controlling posture and movement. NDT aims for children to achieve their highest functional participation in individually chosen daily skills, using their most efficient movements (NDTA, 2006; Stamer, 2006). Contemporary NDT is viewed as an ecological approach to intervention, in that it is family centered, driven by the individual, salient goals of parents and children, built on children's functional strengths, and cognisant of the daily function related to participation needs at home and in the community. NDT attempts to engage children's motivation through playful intervention environments (Blanche, 1999; Bly, 1991; Davis, 2004; King, 2002; Palisano, Snider, & Orlin, 2004).

The child's individuality is considered the central focus of the NDT theoretical base. A relationship is assumed to exist between NDT and successful participation in life through improved functional performance (Howle, 2005). Intervention strategies include both 'hands on' physical guidance strategies, verbal cues and feedback, which are gradually changed and withdrawn according to the needs and emerging skills of the child. Parents and teachers, if they choose,

are also trained to help children apply and practise newly acquired functional skills. NDT may also provide the foundation for the prescription of environmental adaptation and adaptive equipment. Other adjunctive interventions, such as the use of casting and orthoses, may also be utilised together with ‘hands on’ NDT strategies (Barthel, 1996; Boenig, 2005; Cope, Liu, Verber, Cayo, Rao, & Tassone, 2010; Curatti, 2004; Deluca, 2002; Howle, 2002; King, 1997; Jeanson, 2005; Law, Russell, Pollock, Rosenbaum, Walter, & King, 1997; Mayo, 1991; Stamer, 2006).

Emphasis is placed on measuring change in function following NDT. This includes measuring change in the related underlying neuromuscular and musculoskeletal systems. Realistic functional outcomes in tasks important to the child are formulated for each session as well as for the longer term. Evaluation of goal achievement occurs *during* as well as *following* treatment sessions and changes are made accordingly ( Bly, 1991; Davis, 2001, 2004; Halfens, 2004; Howle, 2002, 2005; Jeanson, 2005; Lilly & Powell, 1990).

## **1.4 RESEARCH QUESTIONS**

The overall research question addressed in this research is:

*“What is the impact of Neuro-Developmental Treatment on the functional outcomes of children with cerebral palsy as measured by their performance in selected daily living tasks?”*

The following are research sub-questions that contributed to fulfilling the overall research question and addressed the additional investigation of appropriate

*methods to measure change in children's functional performance in targeted daily living tasks immediately following NDT and at a follow-up period. The sub-questions relate to each of three pilot studies that formed the research.*

#### **1.4.1 Pilot Study One:**

*How can Goal Attainment Scaling (GAS) be used to reliably evaluate change in task performance from video taped pre-test and post-test data of two children with cerebral palsy, who had each received a one hour session of NDT?*

#### **1.4.2 Pilot Study Two:**

*What components of a filming protocol could be developed to i) enable children to comfortably and optimally perform their targeted task, ii) maximise 'onscreen' clarity, and iii) increase the accuracy of GAS rating by 'blinded' expert raters?*

#### **1.4.3 Pilot Study Three:**

*i) What is the change in children's functional performance in targeted daily living tasks immediately following NDT and at a follow-up period?*

*ii) What were the parent and therapist perceptions of goal outcomes and related NDT intervention?*

## **1.5 DEFINITION OF TERMS**

### **1.5.1 Cerebral palsy**

Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation that is attributed to non-progressive disturbances in the foetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behaviour, by epilepsy and by secondary musculoskeletal problems (Rosenbaum, et al., 2007). In these three pilot studies a total of 20 children between the ages of two and seventeen years representing all classifications of CP, were studied.

### **1.5.2 Neuro-Developmental Treatment (NDT)**

NDT is a 'hands-on' approach used in intervention for children with central nervous system insults, which result in difficulties controlling posture and movement. NDT aims for children to achieve their highest functional participation in individually chosen daily skills, using their most efficient movements (NDTA, 2006; Stamer, 2006). In the final (third) pilot study in this research, NDT intervention was characterised by an intensive application of NDT during an NDT certification course held in Australia, 2009. The NDT intervention comprised two sessions per week, for two hours each session, for five weeks. The intervention was administered by course participants, who were experienced paediatric therapists, and under supervision from NDTA™ paediatric NDT instructors.

### **1.5.3. Functional outcomes**

Functional outcomes are indications of ability to perform in daily tasks or parts of tasks that are important to the child and family and contribute to improved participation in various environments: for example, self-care, mobility, hands skills, communication, educational and vocational skills, leisure pursuits and play. In this study, functional outcomes were derived from salient goals of parents and children that built on the children's functional strengths and participation needs at home and in the community. Salient goals were utilized in the form of Goal Attainment Scaling (GAS) scales that could measure differences in goal attainment over time.

## **1.6 SCOPE AND SIGNIFICANCE OF THE STUDY**

This research tested the proposition that NDT improves the functional abilities of children with CP through pilot studies aimed to investigate and measure the immediate short-term impact of NDT on a small group of children with cerebral palsy. In particular, it aimed to investigate the use of sufficiently sensitive outcome measures that were developed to measure functional change. These measures formed the basis of the development of an 'NDT Measurement Model'.

The research is viewed as preliminary to a line of research that aims to study larger numbers of children and the impact of NDT on extended aspects of daily life of children and their families. This research used descriptive methodology to demonstrate the outcomes and carry over of functional gains made by children who received NDT. There was no attempt to compare NDT with other

interventions, or no intervention. Further experimental research is needed to measure the impact of NDT in comparison to other forms of intervention.

The significance of the study lies in its capacity to: document the functional ability of children with cerebral palsy following NDT; provide a basis for further research using the methods developed for this research; and contribute to evidence about the outcomes of NDT intervention.

## **1.7 OUTLINE OF THE STUDY**

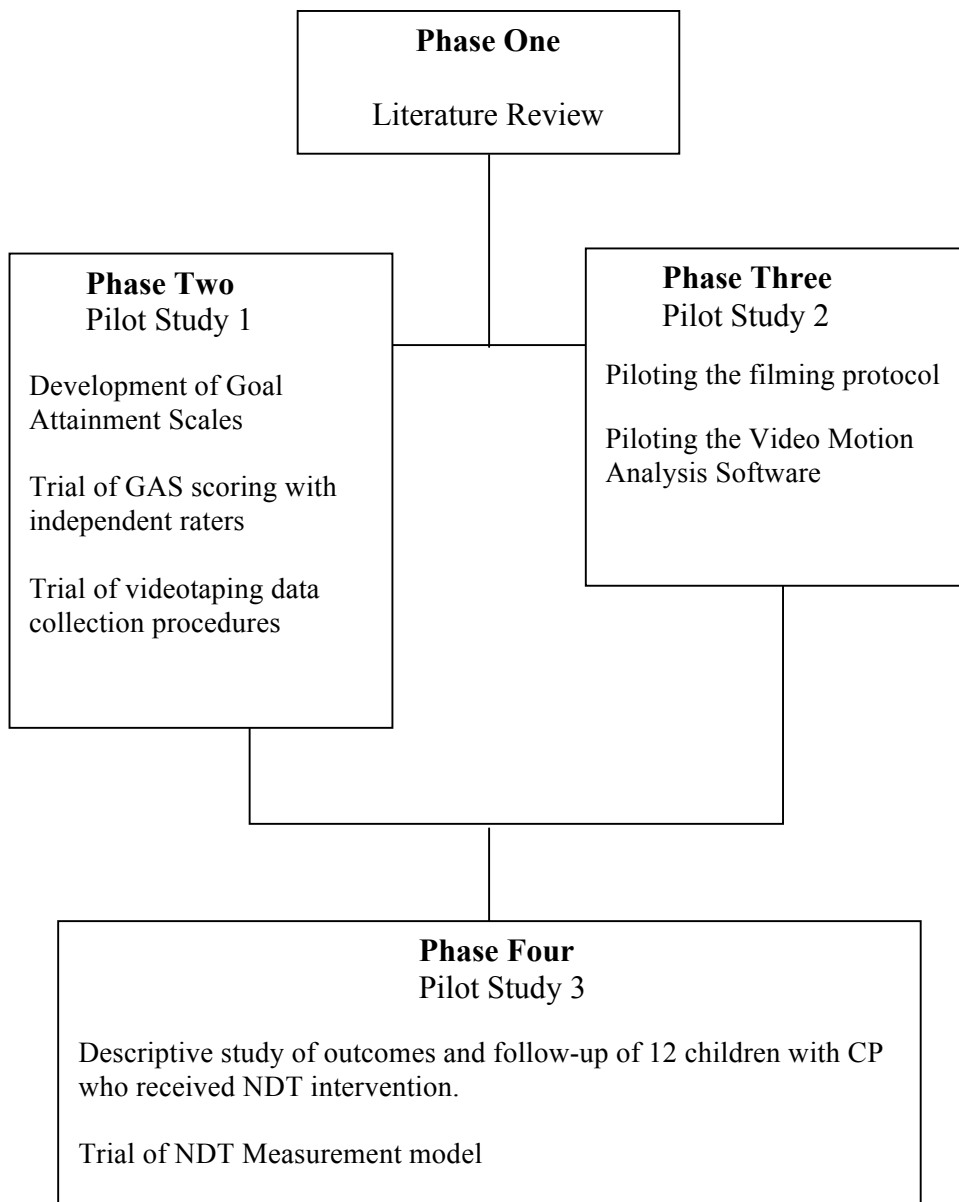
The study design took into account the difficulties encountered in past empirical studies on NDT, and the difficulties encountered in this current research that related to obtaining consent to carry out experimental designs that involved withholding and comparing interventions.

The research design incorporated four phases (Figure 1.1).

### **1.7.1 Phase One**

Phase One of the research consisted of a literature search of prior NDT studies to determine suitable methodology and potentially effective outcome measures.

During the search, a number of methodological issues and difficulties in conducting NDT research were found. These have made past research findings difficult to interpret (Barry, 2001), and resulted in the need to develop methodology that would suit the needs of this particular research. The results of the literature search are documented in Chapter Two of the thesis.



**Figure 1.1:** Visual representation of the four phases of the study.

### 1.7.2 Phase Two

Phase Two of the research consisted of Pilot Study One, involving the recruitment of ten expert NDT practitioners (NDTA™ Coordinator Instructors [CIs]) to pilot the use of Goal Attainment Scaling (GAS) to reliably evaluate change in performance from video taped pre-test and post-test data of two children with cerebral palsy, who had each received a one hour session of NDT. In this GAS

pilot study, the CIs, 'blinded' to the condition of intervention, were randomly assigned DVDs of pre- or post-intervention performances of the two children and the associated GAS scales. They rated the performances against the GAS scales provided, and agreement was calculated. The methods and results of Phase Two of the study are found in Chapter Three of this thesis.

### **1.7.3 Phase Three**

Phase Three comprised a pilot study which developed a filming protocol aimed to further maximise 'onscreen' clarity and increase the accuracy of the GAS rating when capturing the functional performance of children with cerebral palsy. Using three regular video cameras, suitable for easy use in the clinic, three views were simultaneously filmed of task performance in each of six children with CP. Final Cut Pro™ (Final Cut Pro, 2007) software was used to edit and convert footage to DVDs so that each DVD simultaneously played three views of the performance: front, side and overhead. Each DVD was randomly assigned and posted to expert NDT practitioners, accompanied by the associated GAS scale for rating.

Onscreen measures of motion during occupational performance were developed for use by raters observing the DVDs in Phase Four of the research: for example, the time taken to perform parts of a task, or the amount of active motion at particular joints during task performance. First, Videopoint™ was chosen for use in this Phase of the research and piloted with one child, as it is simple and inexpensive motion analysis software that is portable to community & clinical environments. Second, Logger Pro 3 for Mac (Vernier, 2010) and Excel (Excel, 2004) were used to collect and analyse movement data such as timing of

performance and position of body segments from the Quicktime movies created through Final Cut Pro. After trialing VideoPoint™ software (Videopoint™, 2005) in Pilot Study two, Logger Pro was found to be more versatile and easier to use, though many features of VideoPoint™ were included in Logger Pro 3.

A description of the methods and finding of Phase Three are contained in Chapter Four of this thesis.

#### **1.7.4 Phase Four**

Phase Four of the study investigated the immediate changes in performance of daily living activities of 12 children with cerebral palsy who had received NDT intervention, and the extent to which any change was maintained upon withdrawal of intervention. The research hypothesis guiding this part of the research was that children with CP will significantly improve in their performance of daily living tasks following an intensive course of NDT and that the functional outcomes obtained would be maintained. The intervention comprised bi-weekly NDT intervention which totaled two hours per session for each of 12 children with CP, administered by paediatric therapists (an occupational therapist, physiotherapists, and speech pathologists) who were undertaking a full-time postgraduate NDT course and who were under supervision from NDTA™ (Neuro-Developmental Treatment Association) paediatric NDT instructors.

Goal related task performances were videotaped before and after intervention and at one month follow-up. Videotaped data were converted to DVD and subjected to scoring by independent raters as well as the researcher, using GAS and video

motion analysis equipment and procedures that were piloted in previous phases in the research (Final Cut Pro, 2007; Kiresuk, Smith et al., 1994). The Measures of Processes of Care (MPOC - 'modified') were scored by parents at the end of the course of intervention. This aimed to measure perceptions of the effect of NDT on families & children (King, et al., 1995, p.55). In addition, parents and therapists filled out further qualitative surveys, which particularly addressed their perceptions of goals obtained.

The MPOC resulted in summarized calculations of frequencies of parents responses related to their perceptions of the NDT intervention. Similarly the surveys allowed analysis of themes for various questions such as therapists' and parents' perceptions of goal outcomes and their relevance.

The results of these analyses are described in Chapter Five.

All findings from each of the phases are discussed in Chapter Six of the thesis in the light of literature and future research recommendations.